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GENERAL DEVELOPMENTS

EIGHTH 5-YEAR PLAN, 863 PLAN, TORCH PLAN

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Qian Xuesen on Solving National Problems

91FE0308A Beijing RENMIN RIBAO in Chinese 31 Dec 90 p 3

[Text] Qian Xuesen believes Marxism, Leninism, and Mao Zedong's thought are exhortations to regard and resolve issues in their totality. The following four issues are addressed from this approach.

The first issue concerns S&T as the primal power of production. The General Secretary of the Chinese Communist Party Central Committee, Jiang Zemin, on 19 December last year, addressed the National S&T Awards Conference on the issue of S&T as the primal power of production. Qian Xuesen believes that S&T does not spontaneously become production power. There must be an environment that stimulates S&T to become the primal power of production, or expressing it in Marxist terms, a social formation, and that is now spoken of as a national environment. The present social formation in China is far from ideal. This is not to say that everything, item by item, is less than ideal; item by item, achievements have been great, but speaking from the totality of the issue, there is severe waste, and too little efficiency. This is cause for worry. China must carry out adjustments, deepen reforms, and in these efforts, it is most imperative that there be a total accounting, and no turning away to other issues.

Again, there is a related matter following on this issue, and that is the matter of S&T mastery which was raised by Zhao Hongzhou [6392 4767 1558], and Jiang Guohua [5592 0948 5478] in the S&T Review (1990:1). Qian Xuesen believes there should be around 200 S&T masters. An S&T master is not just a specialist in one aspect, but he should have a total concept of modern S&T development, and be able to consider its economic, political, and social aspects altogether. S&T masters will be needed to master the next three issues.

The second issue is to learn how to use man-made earth-satellite technology to build a 21st century socialist China. China wants to build on the advantages of its satellite technology, but it is an issue that must be examined at a high level, and not just from consultations with industrial experts. Industrial experts have a profound understanding of their own affairs; they know about the advanced countries' situations past and present, their experiences and achievements, and they know about China's shortcomings, they are able to lay out plans for catching up. However, that is not the whole picture. The views of the leaders of capitalist countries are not correct either; they are short-sighted; and they have committed many errors in making major decisions relevant to S&T because they haven't looked at the whole picture. In facing this issue, China must first look at the world of the 21st Century, how well China should be into the third step of the first stage of socialist construction by the mid 21st Century, and what China has to do by the last half-century must also be considered. This way, the issue can be discussed clearly, and the most effective strategy and plans can be laid out. Although these matters are from decades to 100 years away, they must be considered now. For example, from now to beyond mid century, if China wants to have competitive strength in the world, every Chinese should have the cultural level of a master's degree. It is now said that the 9-year compulsory education system is not enough. In view of China's history, it is certainly possible to raise the efficiency of education. Starting school at age four, after 14 years, by age 18, a master's degree level could be attained. For example, in mathematics, some years ago Ms. Liu Jinghe [0491 7234 0735] at the Institute of Psychology of the Chinese Academy of Sciences conducted over 1,000 test cases. She started to use new methods in teaching mathematics in elementary school, and was very successful at it. One must not look down on children; they are very smart, and only want to be taught correctly; and they will make rapid progress. Therefore, starting school at age four, and getting a master's degree by age 18 is possible. Of course, something must be done in the teaching ranks. Here is where satellite technology can be of help through electronic teaching methods. Vice Minister Zhu Kaixuan of the State Education Commission has studied electronic teaching methods, and believes it has great potential; and if China adopts advanced technologies, such as applied communications-satellite technology, many things that are now thought to be impossible, could be done.

The application of man-made satellite technology in building a 21st Century socialist China must be studied. The opinions of experts should be digested and considered, but they must not be the only object of study. Combined qualitative and quantitative methods must be used, and finally, quantitatively, in one sweep, the issue should be considered in its totality. The essence of the second issue is this: there must be a concept of comprehensive design.

The 3rd issue: after the experience of proceeding in the manner above, several major issues can be examined, such issues as Chinese S&T facing the 21st Century and strategy for China's modernization. There are several examples: The first is the consolidated development of energy resources, the chemical industry, metallurgy, and building materials. These should be combined and looked at as a whole, and the S&T aspects of consolidated production should be studied. There are many suggestions. For example, a former Vice Minister of the Ministry of Metallurgical Industries, Chief Engineer Comrade Lu Da [7120 6671], recently suggested that the practice of smelting iron in a blast furnace, then switching to an open-hearth furnace to smelt steel was a method of too low efficiency. He proposed not using coke, and devised a new technology called the fused-reduction iron smelting technology. And, when Jiang Zemin went to Taiyuan to see what Li Xuanglian [2621 7175 5328] had made of steel slag, it was remarkable indeed, for he had integrated them with building materials, and opened up multiple effective uses. China can take her experiences, and combine them with things that are already tested abroad. China must take the high ground, and look at energy resources, the chemical industry, metallurgy, and building materials in their totality. That is the direction of development for the 21st Century.

As a second example, in developing underground mines, at present most require men to work down in the mines; but for considerations of safety and efficiency, it is perhaps not the most advanced approach. There are those who say that robots should be used instead of men, but, in fact, that is not the best method. Studies done at Daqing in former years have been a good start. Oil extraction technology at Daqing can be expanded. Combining the past with the past is a very simple approach, as in mining underground salt, pumping water down to get the salt up is a very simple process. Americans also have gotten sulphur from down in the earth by pumping hot water down to melt the sulphur and bring it up. Like the technology developed at Daqing oil fields, after clearly modeling the subterranean conditions, physics and chemical methods were used to bring up the oil without the need for men going down. Oil can be handled this way, and other mining can be done this way too. In the fifties the Soviet Union did a lot of underground gassification of coal. This should be looked into. These technologies must be studied, and they should be studied now. These things are not just said and then done. They require a lot of work, a little searching, and testing. Once these things are done, they will change China's appearance of production technology.

Another example is the issue of geographical science. Actually this question was addressed early on by the venerable elder Zhu Kezhen [4555 0668 2823]. Geography is not entirely a natural science. It is natural science and social science combined. It is the mission of geographic science to consider the environment of social construction. What in his time was called geography, has today become geographic science. How is China's construction to improve the environment for production and livelihood? That is the mission of geographic science. Qian Xuesen raised this question, and sought the advice of China's geography experts. Comrade Huang Bingwei [7806 4426 4850], formerly president of the State Planning Commission and the CAS Institute of Geography agreed. The world of the 21st Century will be a collectivized world, and therefore the question of building a land bridge from East Asia of the western Pacific to the European mainland came up, because this land bridge should pass through China. China must consider how to build such a land bridge, that is, the ports, railroads etc. This is a question of geographic science, and a question of China's geographic construction.

The fourth issue, is highly theoretical, and that is the issue of scientific method. It is a fundamental issue. The S&T issues discussed above that must be studied, it can be said, are very complex issues. Those who study systematics call it an open system of huge complexity. Here, there is a special point, that is, these systems can't be dealt with by the customary methods of recent science, that of returning to original theories, namely Bacon's philosophy of scientific research. This method is to take an issue and divide it up, and if it still seems too large, carve it up some more into smaller and smaller bits until the issue is solved. Some issues can be solved this way. To understand the many layers of the objective world, this is the method to use. But questions like those just addressed, which are so complex, if they are divided up, what is important will disperse and vanish. Many countries of the world are gradually becoming aware of this. They raise so-called complex questions, but it can be seen that their theories are not clever, because they don't have Marxist wisdom. As soon as they say it, then they ask: how does one understand the complexity? Then they get someone to come and understand it, and they proceed to do it inside and out, that is, they emphasize the subjective approach; they emphasize and they emphasize, and they lose the substance of the objective reality that does not yield to the will of man. There are those in China who speak of pragmatic materialism, but dialectical materialism is correct. Of course, there is also another extreme; to believe that what is complex can be analyzed! Systems can be worked out by using analytic methods! Once this is believed, then they exert themselves, and believe the complexity of the whole world has been grasped, and the so-called universal holographic theory is in hand. So what does this mean? Once the principle of the complexity of the whole world is grasped, the theory then needs only to be applied, and voila! This is also wrong. This is like Hegel's absolute spirit becoming an objective idealism. Man's understanding of the objective world is an infinite and inexhaustible process. The objective world is an objective reality independent of man's will. Man gradually comes to understand the objective world through practice, and the complexity of questions at that point become very obvious. The understanding that any man gains through practice is incomplete; the understanding of many men must be combined, and formed into a totality. This step is what Mao Zedong spoke of: rational knowledge springs up from perceptual knowledge. But, the process of knowledge does not end with rational knowledge. There must be more practice, and further revision again of the original knowledge. It is an unending process. Therefore China must take the viewpoint of opening up systems of huge complexity by employing comprehensive integrated qualitative and quantitative methods to research the totality of issues. The systematic theory just mentioned is like that. The geographic system is not the ecological system that is now so fashionable. It is more complex. The ecological system is only about the natural environment. In fact, the presence of man has already influenced the ecological system, and has changed the natural environment. What must be considered is how to change the natural environment to make it more suitable to the existence of mankind. Therefore, the geographic system is an extremely complex system. Society is also extremely complex, and the social system is, of course, an extremely complex system.

Within S&T there some very complex questions: the human body is very complex. Why some people have idiosyncrasiesis inexplicable, but it has! This is one simple question that must be studied! And further, Qian Xuesen has recently been doing research with physicist Comrade Chen Nengkuan [7115 5174 1401] on normal temperature nuclear fusion, now called "cold fusion", which has been causing quite a fuss. For comparison, this was tested in China also, and it was there, sure enough. It is a strange thing. It need only occur once, twice, or several times, and then it should be researched. "Remain calm before strange things, and the strangeness will pass." It is something that must be researched, and should not be dismissed and disregarded as merely strange. Theoretically speaking, because these things are complex, they exceed our simple understanding of the realm of comprehension.

So, attention should be given to questions of complexity, because China's construction, and social construction are questions of complexity. Besides, if questions of human beings aren't to be solved, how can medical and health questions be solved? So questions of complexity must be faced, and China must look to their solutions, and then S&T will be greatly developed. China must leave behind the limitations of the S&T methods of past centuries. China must reject idealism, and mechanical materialism. China must practice dialectical materialism. This way, China will have the advantage, and will by no means have to humble itself. Actually, the crux of Mao Zedong's thought is to have a totality of understanding of issues, and get hold of the vital points. It is true that this is the cumulative experience of so many years of leading the Chinese people in revolution, and the huge achievements of the Chinese revolution are indeed astounding. The experiences gained through a generation of revolutionaries, collected in Mao Zedong's thought, are China's most precious gift. And this way, this sort of philosophical thought, is just what is needed to lead Chinese research into issues of complexity.

Zhou Guangzhao on CAS Tasks in the 1990's

91FE0266C Beijing GUANGMING RIBAO in Chinese 17 Dec 90 p 1

[Article by Zhou Guangzhao [0719 0342 0664], President of the Chinese Academy of Sciences]

[Text] Raising and training excellent scientists and technicians will be the major task for the 1990's. Every country in the world today that is competing to increase its overall national strength, regards S&T as crucial to the effort. The development of S&T, in the final analysis, always depends on excellent talent. This is the basic strategy for future development, and for the very existence of society.

The Chinese Academy of Sciences (CAS) is the center of consolidated S&T research which has always cultivated and cherished talent. Established 41 years ago, carefully nurtured by right-minded party leaders and older generation scientists, it became a well trained S&T contingent, who deeply loved their socialist homeland, and bravely engaged in the bitter struggle. It organized the administrative and technical services units that made great contributions to S&T development, economic vitalization, and social advancement. Today the total number of S&T personnel at CAS is 50,000, among whom are 13,000 middle and high level scientists and technicians. However, they are facing serious attrition. For historical reasons, half of the core S&T personnel are about 50 years old. By the end of this century, up to 40,000 staff will be leaving CAS, among whom two-thirds will be S&T personnel. For this reason, the most pressing and most important task for the CAS in the 1990's will be to concurrently bring along its middle aged personnel, to take every possible means to nurture the qualified scientists and technicians of the younger generation, and to ensure that the major scientific research undertakings be smoothly and gradually turned over to the younger generation. Therefore, reforms must be pushed ahead, exhaustive efforts must be made to find ways for creating diversified working environments conducive to challenging and fostering talent in the younger generation, systems for evaluating fair competition, and selecting excellence. Attention must be devoted to creating opportunities for S&T, social, and economic development, and to giving them proper respect and support. In general, what must be created for the younger generation are new organizational systems, and favorable environments suitable to national conditions for the nature of S&T, administrative, political, and service talents, and to enable them to make great contributions to the development of S&T, and economic vigor.

To nurture and foster talent, there must be resolute and thorough reform and open policies. The speed at which S&T developments are crashing ahead into the unknown, the exchange, the cooperation and competition in the international realm, is an irreversible trend in S&T development. Young scientists must develop within this context. To close the door to international intercourse is contrary to the nature of S&T development. Since the onset of reforms, CAS has supported the policy of "Let go, circulate, and link up the entire country", and has worked to increase international cooperation, urged on the growth of talent, and S&T advancement. During this period, the CAS has dispatched more than 7,000 exchange students, more than half of whom have already returned. Many of the outstanding ones have become academic leaders in numerous fields, have taken up major research responsibilities, and are making intelligent and powerful contributions. Some have already demonstrated their brilliance in the international science theater, shining the light for their socialist homeland.

At the same time, there must be more fostering of qualified S&T personnel within the country. The young generation must lay a foundation within the country. Since the 3d Plenary Session of the 11th CPC Central Committee adjourned at the end of 1989, CAS has granted 800 PhDs and 10,000 Master's Degrees, and since early 1985, 270 post-doctorate research personnel have joined CAS. There are now 7,000 research students. Many of the individuals of exceptional talent who have earned academic degrees within the country have been sent abroad to work, and upon returning home, have gained the attention of Chinese academic circles through their notable achievements. Some "home grown" standouts have broken new ground, and achieved new results, and have become the mainstay of scientific research units.

Whether talent is grown at home or abroad is only a matter of objective requirements being vested in dissimilar environments and conditions. What is important in the exceptionally talented is their creative ability, independent opinion, their patriotism, collective cooperative spirit, and their character and ability to become academic leaders. Ph.Ds are not separable into foreign and domestic, and they should all be treated equally without discrimination. There should be support and dedication to the growth of science in the country, and for those of exceptional talent who work so hard to that end. The conditions for, and treatment of scientists working in the country should be improved. In accordance with the idea of "old people old methods, new people new methods", new opportunities and new conditions should be created for young talent, and where there is limited capital and materials, the best should be chosen to support the best, and the degree of support should be raised to enable the truly gifted to more quickly and more surely to reach their goals.

In the last year CAS set up a special incentive award fund for scientific research by young scientists that clearly stipulates that each level of research organization will assign, by age group, young candidates to attend leadership positions, will set aside 10 percent of the area of newly constructed dorms for gifted youth, will dispatch them abroad for fixed periods for training, will ensure a rational circulation of support personnel, and in particular, will convene academic conferences for them to attend. Programs of this sort should be expanded in future.

Nurturing and fostering the gifted S&T talent still needs the understanding and support of the whole society. With everyone working together to create a supportive public environment, and good working conditions for gifted youth, they will be induced to grow. Zhou Guangzhao firmly believes the younger generation will prove themselves worthy of this call of the times, and they will make an even greater contribution to their socialist homeland.

Song Jian on Problems in S&T Development, Reform

91FE0189A Beijing ZHONGGUO KEJI LUNTAN [FORUM ON SCIENCE AND TECHNOLOGY IN CHINA] in Chinese No 6, 18 Nov 90 pp 1-4

[Article by Song Jian [1345 0256]: "On Some Questions in Current S&T Development and Intensive Reform"]

[Text] China's S&T battlefront is now conforming to the spirit of the 5th and 6th Plenums of the CPC Central Committee and is going further to adhere to and implement the basic principles of economic construction relying on S&T and S&T work being oriented toward economic construction. We are striving to complete the various tasks involved in improvement and rectification and intensive reform set forth by the CPC Central Committee, deploying development on the basis of three levels, overcoming difficulties, continually advancing, and pushing forward with the cause of S&T.

I. The Question of Intensifying Reform of the S&T System

Substantial progress and obvious achievements have been made in reform of China's S&T system. Reform has brought new life and vitality to S&T work and become a powerful motive force in promoting S&T progress. Practice has proven that the policy decisions and deployments made by the CPC Central Committee in its March 1983 "Decision on Reform of the S&T System" are correct and that reform of China's S&T system basically is successful. On the other hand, practice has also told us that reform of the S&T system involves systems engineering on an enormous scale. Establishing a new system that is truly adapted to integration of the planned economy with market regulation and achieving integration of S&T with the economy will still require a rather long time and will require pushing forward with both economic system reform and S&T system reform before they can be completed. The key goal in reform of the S&T system is to begin with actual conditions in China, swiftly and broadly apply S&T achievements in production, make full use of the skills and intelligence of S&T personnel, greatly liberate S&T forces of production, and promote economic and social development. For the past 5 years, comrades involved in this line of work have conscientiously done a great deal of work and gained understanding and support of all fields in S&T and society. However, the basic tasks set forth in the CPC Central Committee's "Decision on Reform of the S&T System" have still not been accomplished and the problem of the detachment of S&T from the economy has not been completely resolved. Much work remains to be done in coordination and matching of policies in related realms and new problems and new contradictions that appear during reform require conscientious research and careful guidance and solution. At present, we must combine mobilization of society to promote S&T progress with reinforcement of the administrative functions and regulation and control measures for S&T departments at all levels, and we must combine consolidation and development of achievements in reform of the S&T system with guidance of scientific research organs to focus on long-term R&D projects. While adhering to making S&T work orient toward the main battlefronts in economic construction, we must further reinforce support and policy guidance of basic research work and increase the strength of investments and guarantee their sustained and stable development. Moreover, on the basis of summarizing experiences, we must further perfect the scientific fund system and technical contract system and perfect the contractual managerial responsibility system, the scientific research organ director responsibility system, the senior engineer technical responsibility system in large and medium-sized enterprises, and all other administrative systems.

Like reform of the economic system, reform of China's S&T system is an integral part of perfection and development of the socialist system. With a prerequisite of the four basic principles, we should continue to promote reform and opening up and ensure that the cause of S&T is able to develop quickly. This profound social transformation concerns development of S&T and invigoration of the economy. In the final analysis, it concerns whether or not socialism will be able to achieve a final victory in China.

Today, S&T work in China has attained an unprecedented scale. By 1989, the number of natural science research organs at the county level and above throughout China had grown to more than 6,700 and the number of research organs in large and medium-sized enterprises and institutions of higher education had surpassed 10,000. China now has 10.4 million S&T personnel in the natural sciences, 2.4 times the number in 1978, and they include about 1 million S&T personnel who are involved in R&D work, 2.6 times the number in 1978. Projections indicate that this number will continue to grow at an annual rate of about 10 percent during the 1990's. This is China's big advantage. Still, such a huge scale of S&T work cannot be supported entirely by state finances in the future. Whether we are speaking of the development of S&T themselves or further solution of the problem of detachment of S&T from the economy, intensive reform is essential for their achievement. We must adhere to the basic lines, principles, and policies set forth in the 3d Plenum of the 11th CPC Central Committee and further adhere to and implement the CPC Central Committee's "Decision on Reform of the S&T System". This direction of reform fits China's national conditions and conforms to the current of economic and S&T development in the world at the present time. We must have a sufficient understanding of the hardship and complexity involved in reform and avoid being overanxious for quick results. On the other hand, there is an even greater need for innovative pioneering and bold exploration. This is essential for promoting the continual development forward of reform of the S&T system and accelerating the pace of socialist modernization and construction.

II. The Question of Increasing S&T Investments

S&T investments are an important condition for S&T development. The historical experience of world economic development shows that when a nation is in the process of an economic take-off, it must substantially increase its direct and indirect investments in S&T. Some countries have used legislative or even constitutional stipulations to set the proportion of S&T investments. The CPC Central Committee "Decision on Reform of the S&T System" clearly proposes that growth in China's S&T expenditure allocations should be higher than the rate of growth in regular financial income. Still, because of various factors and difficulties, this decision has not been fully implemented. At present, S&T investments in large and medium-sized enterprises in many nations have reached 5 to 10 percent of their gross sales volume to maintain enterprise S&T progress and competitiveness. In some countries, enterprise S&T investments account for more than half of total investments in S&T. However, China's enterprises have very small S&T investments, less than 1 percent of their volume of sales. Investments by local governments and society as a whole are even smaller. Moreover, the structure of S&T investments is irrational, especially the lack of investment in the area of converting S&T achievements into forces of production.

This situation has attracted the attention of S&T circles and all fields of society. Members of the National People's Congress Standing Committee and Chinese People's Political Consultative Conference also have offered many opinions and views. The CPC Central Committee and State Council have been very concerned with this. Growth in S&T inputs from state finances, enterprises, and society must be higher than the rate of growth in the national economy. This should be a principle that we adhere to for a long time. S&T investments should include state financial allocations, bank credit, enterprise and social investments, absorbing foreign capital, and other aspects. Besides the need to increase investments from central finances and local finances, the People's Bank of China and special banks should establish S&T credit accounts and create risk capital. In particular, enterprises and enterprise groups should invest a substantial portion of their sales volume in research and development. Only in this way will it be possible to ensure continual improvements in S&T levels in traditional industries and achieve a rather good solution to the problem of S&T investments.

Here, I would like to return to a discussion of the issue of major academies and institutes. At present, there are over 1,000 key scientific research academies and institutes under the various departments of the central authorities. They are the state's main scientific research base areas. These major academies and institutes have made enormous contributions to S&T development and they are the main army in promoting S&T progress. Because of limited state investments in S&T over the past several years, there are severe shortages of administrative expenditures on equipment renewal in scientific research academies and institutes. Added to the effects of the state's financial situation, major academies and institutes face many problems. In adapting to the needs of reform, many academies and institutes have exerted considerable effort in the area of service to the primary battlefronts in economic construction. In 1989, income from technology contracts in major academies and institutes reached 3.56 billion yuan, which was equivalent to 2.2 times the expenditures on scientific research activities during that year. This created enormous benefits for society and has alleviated the shortage of S&T investments and promoted their own development to a definite extent. However, because many large and medium-sized enterprises have still not shifted onto the track of relying on S&T progress and there is still no process of developing technology markets, there has still been no basic solution to the problem of S&T investments in major academies and institutes, while problems like outdated equipment, aging of personnel, insufficient key state projects, and so on persist. With a prerequisite of adhering to the direction of S&T reform, we should gradually readjust economic policies and increase S&T investments as appropriate to allow major academies and institutes to play a greater role in accelerating S&T progress in China. This is a major problem that remains to be solved during the process of intensive reform.

III. The Question of Taking Full Advantage of the Role of S&T Personnel

In the final analysis, world economic and S&T competition are competition between skilled personnel. S&T personnel are living carriers of scientific and technical knowledge, so taking full advantage of the role of S&T personnel is the key to S&T development, economic invigoration, and making the nation stronger. Striving to create an environment for skilled personnel to come forth in large numbers and for each to make use of their talents, motivate the initiative of S&T personnel, and foster their intelligence and wisdom is one of the basic goals of reform in the S&T system.

For the past few years, China has adopted several measures in the areas of relaxing S&T personnel policies and freeing up S&T personnel administration. Recently, the CPC Central Committee and State Council decided to adopt additional measures to improve the living and working conditions of scientists and middle-aged and young S&T workers. Many problems persist, however, and they are rather difficult ones, so we must continue to work on this during the Eighth 5-Year Plan. All areas of society are extremely concerned with the appearance of a flow of skilled personnel to foreign countries, personnel faults [duan ceng 2451 1461 geological fault] in certain fields, improvement in the treatment of S&T personnel, and other questions that have appeared in recent years. Delegates to several sessions of the National People's Congress have offered many important motions and critical views in this regard. State Council S&T, education, personnel, labor, and other departments have adopted several measures and will continue to study ways to solve them. The problem of training and bringing up millions of S&T personnel and alloying them to play their roles fully should be a major order of the day for intensive reform. Overall, dealing with the question of the treatment of S&T personnel depends on increasing the strengths of our national economy and raising social labor productivity. However, the things that urgently require solution now and that can be done with effort should be implemented as quickly as possible.

China's 10 million-plus S&T personnel are new pioneers for S&T forces of production and an important part of the working class. Many scientists of the older generation gave up their comfortable material lives in foreign countries and returned to China shortly after our nation was founded to lead and create New China's S&T system and made creative contributions. After today's S&T personnel in China took over from their forbearers, they also made significant contributions to S&T development in China. Young S&T personnel who have grown up during the 10 years of reform and opening up are the source of hope for developing modern S&T in China in the future. The older generation, middle-aged, and the younger generation of S&T workers are valuable riches of the party and state and they are the key forces for S&T modernization. During the political disturbance that occurred as we moved from spring to summer in 1989, vast numbers of S&T personnel remained steadfast at their posts under the leadership of the older generation of scientists and took a clear-cut stand. They displayed a very high political consciousness and made active contributions to the struggle to protect the basic lines of the party and the socialist republic. Through being tested by this struggle and through extensive undertaking of self-education activities in Marxism-Leninism, socialism, and patriotism, our entire S&T staff is even stronger politically than before and is an important force that the party and people can completely trust and rely upon.

In the future, we must continue striving to intensively reform and further transform systems within the existing system that are not conducive to fostering fully the initiative and creativity of our vast numbers of S&T personnel. The greatest hope of S&T personnel is to contribute their own strengths to making the motherland strong and powerful and invigorating our nationality, and they hope that their own labor will be acknowledged and respected by society. We must continue to advocate the social practice of respecting knowledge and respecting talented people, create a better environment for S&T personnel, formulate policies that will benefit rational circulation of skilled personnel and help top-notch talented young personnel reveal themselves, encourage middle-aged and young personnel to enter all battlefronts of economic construction, and foster their own talents in integration with the working people. We should create the conditions to push Chinese S&T personnel onto the world stage, participate in world competition, and create even greater outstanding achievements.

IV. The Question of Reinforcing S&T Legislation

In Chinese history, reform has always been accompanied by "political reform". The reason is that in the final analysis reform involves transforming a superstructure that is not adapted to the economic foundation to further liberate forces of production. Law is the most important part of the superstructure. The use of law to establish social rules and regulations that are conducive to development of the forces of production is an important part of intensive reform. Reform requires legislation and legislation promotes reform. This is an historical law.

To achieve the historic tasks of S&T development and intensive reform, party and state principles and policies for the development of S&T and successful experiences of the masses created during reform must be fixed in a legal form to create a legal environment and social order that are conducive to S&T progress and apply the authority and regulation and control measures of the socialist legal system to consolidate and develop achievements in reform of the S&T system, promote a shift to scientific and democratic decision making, and ensure the coordinated development of S&T with the economy and society. Perfecting construction of an S&T legal system is the most important condition for ensuring flourishing and developing S&T activities in China.

A solid step has already been taken in S&T legislation in China in the past few years. The National People's Congress Standing Committee has formulated several important S&T laws including the Patent Law, Technology Contract Law, Standardization Law, and so on. The "General Rules of Civil Law" and several important economic laws also included many articles concerning promoting the development of S&T. In areas related to S&T development, the State Council has also formulated and promulgated over 30 S&T administrative regulations. These S&T laws and regulations have created basic rules and regulations for S&T work and have become a powerful weapon for promoting reform and development in S&T work, and they have become an important framework for material civilization and spiritual civilization on the S&T battlefront. However, existing laws and regulations are far from adapted to the requirements of reform and development. S&T legislation requires further reinforcement and we especially need to formulate basic laws to guide China's S&T progress in a new historical era.

The legislative plan of the 7th National People's Congress has already included the S&T Progress Law, S&T Awards Law, S&T Research Institute Law, Atomic Energy Law, and other legislative items. At the 3d Session of the 7th National People's Congress in 1990, 172 congressional delegates proposed to the chairmanship group that they focus on studying and formulating the S&T Progress Law. This motion received active support from S&T circles, legal circles, and social circles. General Secretary Jiang Zemin recently stressed that we "must reinforce construction of the S&T legal system and focus on formulating the S&T Progress Law". The State Science and Technology Commission has already joined with the relevant departments to organize and draft this basic S&T law. Formulation of the S&T Progress Law will determine the strategic status of S&T in vanguard development of socialist modernization and construction, clarify the goals and tasks for state development of S&T, formulate basic principles for promoting S&T progress, determine the state's S&T management system, planning system, and R&D system, establish scientific and democratic procedures for major S&T decisions, and determine the mechanisms and strength of S&T investments, and measures for promoting enterprise S&T progress and rural S&T progress. Formulation and promulgation of this law will certainly promote flourishing development of S&T in China in the orbit of the socialist legal system and eventually achieve the magnificent rejuvenation of the Chinese nationality.

We have already entered the 1990's and are approaching the next century. In the next few decades, S&T will develop forward at an unprecedented pace and scale. World economic competition and competition of overall national strengths are increasingly manifested as competition in the depth, breadth, and speed of the transfer of S&T achievements into the realm of production and are expressed as the measure of S&T strength. S&T are no longer merely forces of production in the general sense. They are also factors which play a decisive role in the forces of production. Just as comrade Deng Xiaoping has summarized, "S&T are the first force of production". To achieve the goal of again doubling our GNP by the end of this century and complete the second step of our economic development strategy, and thereby reach the level of a moderately-developed nation during the mid-21st Century and achieve our third strategic goal, we must rely to a greater extent, that is to say primarily, on S&T progress. Looking at S&T strengths, China is among the world's leaders in R&D in the fields of aviation, nuclear energy technology, and so on and we were not late starters in bioengineering and laser technology. Since 1985, 807 inventions, 237 natural science achievements, and 3,586 S&T progress projects have received national-level awards and patent rights have been granted to nearly 46,000 inventions and innovations. However, in the overall picture, China's S&T levels and management levels still lag far behind the developed nations and behind certain emerging industrial nations and regions. In economic and social development during the 1990's, we are facing restrictions from factors like population, resources, environment, and others. These problems can only be solved by relying on S&T progress.

In 1988, Premier Li Peng pointed out at the 1st Session of the 7th National People's Congress that: "based on the opinions of the 13th CPC National Congress, the State Council has already made the State Science and Technology Commission and relevant departments responsible for formulating a medium and long-term S&T development program as quickly as possible to clarify the strategic goals, foci, and measures of S&T development so as to facilitate the mobilization and organization of forces in all areas in China to truly and effectively promote technical progress in the entire national economy". Now, the draft program has undergone full discussion by all departments and regions and repeated debate by experts on all battlefronts, and is now gradually maturing. It has now been submitted to the CPC

Central Committee and State Council for examination. This program will set forth the basic strategies and the principles and policies for medium and long-term S&T development in China, specify key development realms and major S&T projects, and so on. Promulgation and implementation of the state's medium and long-term S&T development program will guide and promote the coordinated development of S&T, the economy, and society to the end of this century and into the middle of the next century and raise China's S&T strengths up to new heights.

The 5th Plenum of the 13th CPC Central Committee again pointed out that promotion of S&T progress must be placed in an extremely important strategic position. Promoting S&T progress has already become an historical task of the Chinese nationality. In the past several years, a situation in which all of society supports and relies on S&T progress has taken shape in an initial fashion. During the several meetings of the 7th National People Congress, all members and delegates gave extremely close attention and guidance to S&T work in China, which played an important role in the development of S&T work in China. Faced with the favorable situation at present, China's S&T battlefront will work hard under the leadership of the Chinese Communist Party to develop the cause of S&T in China, raise scientific and cultural standards among our entire nationality, increase economic strengths and overall national strength, and raise our people's living standards, and it will make new contributions to invigorating all of China's intelligence and strength during the 1990's.

CAS Approves More Departmental Committee Members

91FE0226C Shanghai JIEFANG RIBAO in Chinese 2 Dec 90 p 3

[Article by Xinhua News Agency reporter: "Approved by the State Council, the Chinese Academy of Sciences Will Select More Committee Members"]

[Text] The State Council recently issued two directives to CAS: the 'Regarding the request to select more committee members to the CAS' and the 'Procedures to select more CAS committee members' of the State Science Commission. Two increases have been implemented since the establishment of CAS in 1955; the most recent increase occurred in 1980. At present, there are 318 committee members. Among them, approximately one-third are from the CAS. Different industrial departments, education, health, and military divisions comprise approximately two-thirds. The average age of the members is 74. In the last few decades, they have embraced patriotic ideals, and used their profound knowledge and superior learning styles to participate fully in the modernization of science and technology of the New China socialist reconstruction. They have dedicated themselves to training personnel, and have made great contributions.

The directive said that this increase in number of committee members should be around 200. The selection process includes the following four steps: submission of names by recommendation, preliminary selection, critical deliberations and voting. The new department committee member name list will then be submitted by the CAS to the State Council for deliberation and approval. After this increase, some of the older department committee members will soon consider changing their status to honorary members. In the future, the selection process will take place every 2 years.

The directive pointed out that CAS department committee member is the highest title in the field of science and technology in China. The title holds high honors and scholastic authority. It also represents the knowledge level and prestige of scientists. Therefore in selecting department committee members, care must be taken to uphold high standards, requirements, and quality.

With current department members in their advanced age, the selection of new committee members should emphasize selecting outstanding young and middle-aged science experts so that the department committee membership can represent a definite proportion in age.

S&T System Reform Studied

91FE0428D Beijing ZHONGGUO KEJI LUNTAN [FORUM ON SCIENCE AND TECHNOLOGY IN CHINA] in Chinese No 1, Jan 91 pp 36-38

[Article by Li Xinnan [2621 2450 3948] and Liu Zhong [0491 0112]; editor: Ge Yaoliang [5514 5069 5328]]

[Text] **I. Progress and Problems in Combining S&T and the Economy Through S&T System Reform**

1. Macroscopic Level

A macroscopic manifestation of the combination of S&T and the economy is a continuous optimization and rationalization of the industrial structure. Since the beginning of the reform, changes in the operating system and adjustment of the S&T deployment have greatly promoted the formation and progress of high-tech industries and accelerated the technological improvement of traditional enterprises. These changes have played an active role in the optimization of the industrial structure. However, the adjustment of the industrial structure hinges on the direction of the state's economic policy and the investment mechanism; the overseeing departments should effectively coordinate the national economy toward a course that relies on the progress of science and technology. Today the macroscopic developmental mechanism of China's economy is still in the process of making the transition from outward expansion to inward development. The total scope of the national economy kept expanding but the rate of decrease of energy and material consumption per 10,000 yuan of output value was very slow. The degree of processing, the increase of added value, and the promotion of quality of the products are less than satisfactory.

According to statistical data in some industries, such as metallurgy, the nominal rate for meeting the two standards (international and national) may be 40 percent but the actual rate for meeting the two standards is actually only 10 percent. In terms of macroscopic projects, the state has the "Breakthrough Plan," the "Technological Reform Plan," the "Technological Results Promotion Plan," the "Spark Plan," the "Torch Plan," the "863 Plan," the "Prairie Plan," and the "Harvest Plan." It can be said that the various S&T development plans on the national level have covered the entire S&T innovation process of the whole society. However, these plans belong to different management organizations and there have not been adequate coordination and interaction among the different plans. In any case, the national economy has not been placed on a track propelled by S&T advancement.

2. Intermediate Level

The effective combination of S&T and the economy at the intermediate level will manifest itself in the formulation and implementation of industrial technological advancement policies and in the efficient management of the enterprises. Since the beginning of the reform, the State Council has drafted and issued technology policies in 14 areas and promoted the active combination of production development and technology advancement. However, since the macroscopic management model is still under exploration, the function of the intermediate level management cannot be unaffected. After the management of the enterprises is delegated downward, there would still be a number of problems to be investigated and solved. These include the guidance and technical monitoring of the enterprises by the intermediate level departments, and how to adjust and deploy the S&T resources within the enterprises.

3. Microscopic Level

On the microscopic level, the combination of the economy and S&T mainly involves in investment and production structure of research units and the reliance of the enterprises and the rural development on S&T.

At the end of 1989, the research units in China got involved with the economy and social issues and generated 5.03 billion yuan of income, which is 1.7 times the financial operating costs allocated by the state. The S&T results trade amounted to 8.14 billion yuan, or 11.3 times of that in 1985. According to sampling data, less than half of the topics worked on at the research institutes in 1988 were assigned within the various plans, whereas 56.6 percent of the research topics came from the production units through the market. At the same time, research institutes entered the economy by various means and, by the end of 1989, more than 2,000 technology development organizations entered enterprises and business groups and became the technology development organizations of these enterprises and business groups. More than 10,000 research-production consortia were formed and thousands of technology contracting groups were working on the front line of industry and agriculture. More than 400,000 S&T personnel have moved from units intensive in S&T to the front line of industry and agriculture through assignment, drafting, resignation, or taking leave; these people were active in a host of technological and economic endeavors. Some 800,000 S&T workers, while fulfilling their original job requirements, were engaged also in S&T development, technology transfer, technological consulting and services. Research institutes and universities have created some 3,500 technology-economy entities that worked on the whole gamut of research, production, management, and business. Science and technology workers have created more than 10,000 consortia of technology-industry-trade and technology-agriculture-trade, and independent organizations pursuing the same activities. These entities and organizations have forcefully promoted the industrialization of research results, the reform of traditional industries, and the formation of high-tech enterprises.

Enterprises and villages have begun moving in a direction that relies on advances in science and technology and the improvement of economic and social benefits. Today, 67 percent of the large and medium enterprises have established their technology development organizations; that was 1.6 times of 1988 figure. More than 2,000 enterprises have established the chief engineer responsibility system. Most of the enterprises have established their technology development funds; in 1989 more than 13.1 billion yuan were spent by the enterprises on technology development. In the villages, the concept of reviving the agriculture with science and technology has reached into the masses. In 1989 more than 6,000 technological contracting groups were established in the villages and farmed 350 million mu of crops. Farmers' technology associations for raising tea, fruit, and fish have been formed in many regions. Technical staff and grass-root workers in the villages have worked with the farmers in establishing a host of technical services for every step of the production. A dual track system that combines centralized and distributed management and a technical service system have gradually taken form. The obvious benefits of S&T in agriculture production have motivated the farmers to learn science and use science.

Judging from the situation described above, the combination of S&T and the economy has already taken place on the microscopic scale. However, the problem of disjointedness between S&T and the economy is still not totally resolved. Adjustments of the S&T organizations for meeting the needs in the national economic development are still in the stage of exploration. The new problem of simultaneously "facing the economy" and developing the technology also needs to be solved. In the enterprises, S&T is yet to become an internal need of the enterprise and the combination of S&T and the economy has been stagnant. A prerequisite for a rational deployment of S&T resources and the establishment of a technological advancement mechanism for societal development is the effective coordination by the management departments. Therefore, if we recognize that microscopic reform has led the way in the combination of S&T and the economy, then more attention should be given to macroscopic and intermediate level issues in continued reform.

II. Planning and Marketing Issues in the Reform of the S&T System

A unique feature, and the troubling point, of China's reform is the practice of both planning and market principles. The trend of the economic system reform in dealing with this conflict has been to maintain the stability and continued development of the macroscopic economy with planning and to promote the benefits of the microscopic economy by market mechanism and planning system.

In terms of S&T system reform, this implies that, via the effective combination of the planning and market approach, new systems and mechanism will be formed at various levels to closely combine S&T and the economy, and the conflict that exists in the research institutes between macroscopic and microscopic benefits, direct and indirect benefits, short-term and long-term benefits, local and overall benefits, and economic and social benefits will be properly treated. Whether it is the guiding function of the planning or the modulating function of the market, the final goal is to have the research institutes produce high quality research results that can be applied to the first line of production as soon as possible, and to apply the results to new research cycle for the integrated and overall benefits.

The mode of operation of S&T relies mainly on administrative measures and not on the law of economics. Excessive control has been widely recognized as one of the shortcomings of the original S&T system. This shortcoming essentially led only to planned management and no market function. This has thwarted the motivation and initiativeness of the research institutes and caused the misuse of a large number of S&T workers. To solve this problem we need to introduce the market function and the effects of economic leverage and competition. This conclusion was based on 30 years of experience in national economic development and understanding of the situation in China. Therefore, the practice of S&T system reform in the last decade cannot be unilaterally interpreted as "purely market oriented." The policy to introduce the market mechanism may have had one kind of problem or another, but it was an exploration to combine planning and the market in a system based purely on planning. This exploration should be continued; otherwise, we will be back to square one.

Science and technology are different from economy. There are general nature and special nature in combining the planning principle and the market principle. The general nature is that, in the overall operation of the system, S&T needs to combine the national plans and the market modulation. The special nature is that the make-up of planning and market at the different stages and levels should be different. For example, the function of planning should not be weakened in the area of basic research, in research projects with long-term effects on the national interest, and in public service. In the industrialization of research results and in product development, the role of market adjustment should be increased. It may be easy in theory, but in practice it is very difficult to balance the roles of planning and market in the projects. Moreover, the S&T system reform to a large degree is affected and constrained by the economic system reform. Therefore, the problem of planning and market in S&T system reform is not something that can be solved in one stroke.

III. The Short-Term and Long-Term Problems in S&T System Reform

The outstanding question in the reform policy decision is how to meet the short-term needs of the national economy and maintain a steady development of the S&T effort so that the long-term needs of the national economy can also be satisfied.

Science and technology is the first force in productivity, but is different from economic endeavors. First, research results do not have direct economic benefits; some require an industrialization transformation process and others become the basis for further research. Therefore, the entire process of research and development requires investments without return, which takes sustained economic support. The level of support is unavoidably affected by the national economy reserve. Second, the application of technological results is largely passive. It on the one hand depends on people's understanding (of its benefits and the principle), and on the other hand depends on the internal needs of the economic development, that is, whether adopting a certain technological result has become a necessary condition for the survival and development of the microscopic economic organization. Third, the entire process of S&T has an exploratory nature. No matter whether it is basic research or technological development, there is an exploratory nature that does not exist in the economy. The exploratory nature of basic research, as the upstream work of S&T, is even stronger. This exploratory nature not only requires stability at the different stages, but also a continuity between the different stages. In terms of resources allocation, there should be a certain ratio in this continuity. Based on the international experience of development, this ratio is different for different stages of economic development, but the basic rule is that the distribution should be in the shape of a pagoda.

The above description of S&T shows that, before S&T is transformed into productivity, it is highly dependent and requires a continuous and steady prior input by the society. The scope of the support and direction depend on the particular situation and capability of a country and the actual needs in the national economic development. Needless to say, the basis for enlarging the investments in S&T is the economic power of the country. Therefore, in matching the resources for S&T, one must consider the ways in which S&T may contribute to the economic forces of the country. This is the fundamental principle in dealing with the relationship between short-term and long-term S&T development.

The old S&T system in China neglected the allocation of resources for S&T to transform toward productivity; as a result, a great many of S&T results did not timely transform into economic forces of the country. (In this sense, it also affected the overall growth of investments in S&T.) Therefore, the policy in the early period of the reform stressed the need to move a part of S&T into the main theater of serving the economic development. That policy was motivated primarily by the particular situation in China and the needs to develop the national economy and to adjust the deployment of S&T resources in long-term and short-term efforts. In the course of adjustments, some new problems unavoidably appeared. These problems should be solved by perfecting the policies and deepening the reform and not by going back to the old ways.

After 10 years of exploration of reform, three layers of strategy in S&T resources deployment have emerged. The first layer is to face the main theater of economic development, that is, to make direct contributions to the quadrupling of the gross value of production in agriculture and industry by the end of this century. The second layer is the development of high-tech research and high-tech enterprises. The third layer is basic research and applied research. The affirmation of the three layers has helped to lay a foundation for treating the relationship between short-term and long-term S&T. However, the proportion of the three layers in the present stage and in the various stages of the economic development has not been determined with any scientific evaluation criterion. This has caused some difficulty and some controversy in the policy for allocating S&T resources. This problem requires further exploration and solution in the reform process.

Strategy of Basic Research Should Not Exclude High-Tech

91FE0059E Beijing ZHONGGUO KEJI LUNTAN [FORUM ON SCIENCE AND TECHNOLOGY IN CHINA] in Chinese No 5, Sep 90 pp 38-39

[Article by Pan Guangyou [3382 0342 0645]: "Strategy of Basic Research"]

[Text] Basic research can be divided into three types. One, the "comprehensive" type, which means supporting the entire spectrum of basic research in order to gain an across-the-board edge in S&T. Countries with this type of basic research are primarily the U.S. and the Soviet Union. There was a time when Britain and France also followed this strategy but only intermittently since they could not afford to do so all the time. Two, "semi-comprehensive" type or high-tech type, that is, supporting all (or almost all) basic research related to high-tech development to preserve the international competitiveness of the nation's high-tech industries, while giving less attention and less financial aid to regular pure basic research. The basic research strategies of Japan and many developed capitalist nations in Western Europe fall into this category. While not as powerful as the U.S. or the Soviet Union, these countries maintain a high standard of technology in their traditional industries and are efficient and prosperous. Since their economies are largely open economies geared to the world market, the development of high-tech has life-and-death significance for their economies at a time when the modern global industrial structure is undergoing a profound shift toward high-tech. Three, the "point lattice" type, which means selecting a number of important areas in basic research and concentrate financial support on them, while delaying or conducting mere "catch-up" research in most other areas. A large number of developing nations belong to this group. It is not that these nations have no interest in developing science or that they do not need science urgently. (We can say that they need S&T even more badly than developed nations because of their backwardness.) It is just that given their very limited scientific prowess and economic resources, most developing nations even fail to fully develop their traditional production technology. They can only concentrate what limited resources they have on the major technical and economic problems facing them right now. Judging from China's national conditions at the moment, we have no choice but to follow the third type of basic research development strategy, a strategy of "achieving breakthroughs in limited targets and catching up in a broad area." Only when China's economy has developed in a major way will there be a safeguard for major investment in scientific research. Only then will we be able to essentially graduate to a new basic research strategy. The experience of many nations in the world is highly instructive in this area.

In view of the conditions in China, this writer believes that we should determine China's basic research strategic direction in the near future and for some time to come in accordance with these general principles: abide by the inherent laws of scientific development, pay close attention to the trends of S&T development in the world, make full use of what advantages we already have, and do our best to help basic research contribute to China's modernization. Specifically, we should follow the following three major principles.

First, integrate basic research with modernization. Although scientific research activities in China were somewhat divorced from economic construction in the past, this principle was still followed up to a point, thanks in no small measure to the highly planned nature of long-range scientific research management in China. For instance, of the three scientific research long-range development plans in the past, the 12-year plan between 1956 and 1967 homed in on the semiconductor, computer, automated instruments and meters, jet propulsion technology, and atomic energy technology; the 10-year plan between 1963 and 1972 emphasized the atomic bomb, hydrogen bomb, and man-made satellites; and the

8-year plan between 1978 and 1985 concentrated on eight areas, including agriculture, energy, electronics computer, laser, aerospace technology, high-energy physics, and genetic engineering. The execution of these plans (some disrupted or modified in mid-course) has contributed enormously to China's defense build-up, economic construction, and high-tech development. Today, scientific research work must continue to serve the important task of modernization. To realize the goal of quadrupling the gross value of industrial and agricultural output and raising our scientific and technical standard to that of the world in the late 1970's and early 1980's, the 13th National Party Congress of the CPC explicitly called for scientific and technical work to orient itself to he main battlefield of economic construction. This requires us to take all basic research seriously that has extensive applications potential and will help develop and improve all technology suited to China (including high-tech with considerable economic significance), fund such research as priorities to ensure their smooth progress, and do everything in our power to produce results quickly and in large quantities. Since defense modernization is also an important part of China's modernization, we must pay close attention to basic research relating to the defense industry and military technology as well. Basic research topics decided upon in accordance with this principle make up what we usually refer as applied basic research. These topics will comprise the principal component of China's basic research for some time to come.

Second, respect the intrinsic laws of scientific development and put to use our existing strengths in basic research. According to a statistical analysis of basic research achievements, basic research does not lead to technological development or production applications in every case. Some basic research serves scientific development itself, which is a precondition for the healthy, coordinated, and rapid development of science. If this particular intrinsic law of scientific development is not observed, the development of science may be hindered because of the failure to solve a number of internal problems. Alternatively, it may end up "deformed." China learned this lesson in the past when the state controlled things to death, when planning was too rigid, and when scientific research personnel were not free to choose topics on their own. As a result, while China developed a host of striking advanced technologies (such as nuclear technology and aerospace technology), little research was done in a broad range of regular academic areas. In particular, large numbers of cutting-edge disciplines, nascent disciplines, and disciplines that involved multiple fields were not developed to the extent that they should, reducing China's science and technology to a state of imbalance and incoordination, like a person with a big frame but little muscle. When we fail to operate in accordance with scientific laws, we will invariably lose more than we gain in the long haul. When we formulate basic research policies in future, we should give scientific research personnel a good measure of freedom to choose their basic research topics, and allow them to pursue a set percentage of pure basic research topics. As for the latest ideas, creative proposals, and other topics relating to new-born subjects that cannot be anticipated beforehand and incorporated into the plan, they too must be taken seriously and given strong support. Furthermore, China's basic research has its strengths, such as traditional Chinese medicine, qigong research, superconductivity, and certain biotechnology, where China is already at a relatively advanced level in the world and where it stands a chance of scoring first-rate achievements in the near future and preserve its edge. Accordingly, research in these areas too should be targeted for support.

Third, the principle of catching up. Although at present we still lack the ability to conduct large-scale research on the frontier of science, this absolutely does not mean that we should close the country to international intercourse and be content with the status quo, disregarding the trends of scientific advances. On the contrary, we should pay close attention to all new movements in scientific development in the world and master all developments on the forefront of science. We should have a firm grasp of what is going on, planting our feet firmly on China but with the whole world in view. Will the "useless" research of today remain useless a few years or a few decades down the road? That is hard to predict. The history of science and technology has proved to us time and again that many a highly abstract theory of the past that evolved from imagination and pure logical reasoning has been put to use in a wide range of scientific and technical fields. High-energy physics research can be regarded as the most "useless" and expensive research today, but already some scientists have predicted that a century from now it may well turn out to be extremely useful stuff—designing new atoms and molecules and creating materials with desired properties. This tells us that never ever can we afford to be short-sighted when it comes to the strategy of scientific research. Instead we must think as if we were armed with a telescope. As far as scientific research in areas where we cannot yet afford to spend much money is concerned, we must take pains to collect the relevant S&T information and data and take a more active part in international academic exchange, conducting more international cooperative scientific research activities and looking for opportunities to utilize more advanced laboratory equipment overseas. Sometimes it may even be necessary for us to do some research of an imitative nature based on others' achievements and data so as to catch up with the latest developments on the forefront of science in the world without spending large sums of money. If we do not track research developments, we may put ourselves in a merely reactive position with no policy to deal with any new unforeseen situation. Tracking gives us some room to maneuver and makes it easier for us to take the initiative. As soon as an urgent situation appears or a new field of scientific research looks promising, we will be able to organize people to zero in on it and try to catch up quickly. For this reason, tracking the latest S&T developments in the world extensively should also become an important principle we should follow as we select basic research topics and determine China's basic research strategy.

(Responsible editor: Zhou Li [0719 4539])

Qian Xuesen on Science and Technology R&D

91FE0142A Wuchang KEJI JINBU YU DUICE [SCIENCE AND TECHNOLOGY PROGRESS] in Chinese Vol 7, No 4, Jul-Aug 90 pp 6-7

[Article by Qian Xuesen [6929 1331 2773]: "Some Views on Scientific and Technological Work"]

[Text]

I. The 21st Century Is the Century of Science and Technology

Economic construction involves social systems engineering on an enormous scale and forces of production are the material foundation. What factors form production capacity and forces of production? Classical works and theoretical circles have offered two formulations for quite some time. One is "dual factor theory", meaning that forces of production have two aspects, one being people engaged in productive labor and the other being the tools of labor, which includes various types of machinery and equipment. The other formulation is the "triple factor theory". Besides the two aspects described above, this adds the targets of productive labor like materials, components, and so on. Actually, "dual factor theory" refers to the productive labor process itself while "triple factor theory" refers to the entire production process system, so actually they are identical.

Whether we use "dual factor theory" or "triple factor theory", what actually are the most important factors in forces of production? Comrade Jiang Zemin's speech at the National Science and Technology Award Conference on 19 Dec 89 included this paragraph: "Eleven years ago, comrade Deng Xiaoping penetratingly illustrated at the National Science Conference that S&T are the Marxist concept of forces of production. He stressed that 'the key to the four modernizations is modernization of S&T. Without modern S&T, we cannot build modern agriculture, modern industry, or modern national defense.' Comrade Xiaoping's speech laid the ideological and theoretical foundation for formulating the basic principles and policies regarding the development of S&T in the new era in China. Recently, comrade Xiaoping also pointed out in a discussion of economic development that S&T are forces of production, that science is an extraordinary thing, that we should focus on science, and that the ultimate possibility is that science can solve problems." Comrade Jiang Zemin said: "this thesis further illustrates the important status and enormous role of S&T".

In the history of mankind, man's production practice and experience are first summarized and then technology is extracted. Modern science appeared rather late, roughly during the 18th Century. Now, this relationship, from production to technology and then to science, has been reversed, meaning that we first do scientific research, begin with an understanding of the objective world, and then use our understanding of laws to find ways to transform the objective world, develop technology, and finally use it in production. Thus, S&T today are the primary forces of production. There can be no doubt about this. Even foreigners call the 21st Century the S&T Century.

II. We Must Be Concerned With Basic Research

Because we must first understand the objective world, basic research is extremely important. Looking at the development history of modern electronic technology, for example, we first had the basic science of semiconductor physics and only then could we develop electronic technology and industry which then led to the appearance of the "information society". Another example is the nuclear industry. First, there was research on atomic energy and nuclear physics, and only then did it change into nuclear technology and the nuclear industry, and now nuclear technology and the nuclear industry have become an extremely important part of modern society. In view of this type of law, modern cosmology is a very basic field of knowledge that would seem to have no connection to our daily life. However, it is possible that during a certain period in the future, research in cosmology may affect our entire world.

I feel that basic research can be divided into two aspects. One aspect is basic research, that is, understanding problems in the area of the objective world. Another aspect is what is now called "applied basic research". I suggest switching these terms and calling them "basic applied research". The idea is that to apply them better, we must clarify the reasons, so the term "basic" should come first. In view of the present situation, true basic research is often neglected because it has no directly visible benefits. This is true throughout the world. I found only one project among 60 on basic research which received awards at China's 4th State Natural Sciences Awards Conference that was truly basic research. All of the others appear to have been "basic applied research", so I want to give particular emphasis to the importance of basic research.

How is basic research done? I feel that in the realm of basic research, there may be somewhat fewer impediments to global cooperation because it has no direct applications. Thus, since China cannot invest substantial materials in this area now, greater international cooperation is one method. In work on high-energy accelerators for high-energy physics, we can be involved in international cooperation. On the other hand, because there is an "applied" side to "basic applied research", it is easier to obtain support. An example is "normal temperature nuclear fusion" which is quite the rage internationally at present. Although there is much dispute, with some confirming and some doubting and countless conferences being held, in the United States dispute is simply dispute, and the government still provides money. Why? Because it is so extremely important. If it is truly understood, the value could be inestimable. Thus, it can be said that it is easier for basic applied research to receive support, but it is hardest for basic research to obtain support.

III. S&T Applied Research and Development Depends on the Domestic Environment

In 1988, Lu Tongxiang [6424 6639 4382], vice chairman of the Science and Technology Commission and president of Zhejiang University, stated that S&T are forces of production but S&T do not naturally become forces of production. It is very important that they must depend on the operational mechanisms of the economy and society as a whole. Because S&T are the primary forces of production, in the long term improvement and rectification and intensive reform must help foster the role of S&T as primary forces of production. Making S&T primary forces of production requires conscientious study and adherence to the decisions of the 4th, 5th, and 6th Plenums of the 13th CPC Central Committee and cannot be detached from improvement and rectification and intensive reform.

"Invigorating agriculture with S&T" now resounds throughout China. Premier Li Peng gave a very important speech on the question of rural work, agricultural development, and achieving new breakthroughs in agriculture in his address to the National Comprehensive Agricultural Development Experience Exchange Conference on 1 Dec 89. Subsequently, I saw some information regarding a peasant family with six members, both young and old, in Kunshan County on the shores of Tai Hu in Jiangsu Province which had a labor equivalent of just 2 and ½ people. However, this peasant household had contractual responsibility for 60 mu of land and an additional 4 mu of ponds. How were they able to fulfill their contractual responsibility? Actually, they relied on the pre-production, production, and post-production service system to complete it, meaning they used compensated services to do their harvesting and cultivation. The results, however, were startling. Their annual income was 17,000 yuan, which was 6,800 yuan in income per laborer. Moreover, this is today's level. If they can develop another step, their income will be even larger. It is apparent that in the area of agriculture, taking the route of S&T applied research and development is now clearly understood.

What, then, is "invigorating industry with S&T"? There is now a big problem in invigorating industry with S&T which is said to be the problem of investments. Originally, we were preparing to allow enterprises to use 1 percent of their sales volume to develop S&T but this was never approved. We know that large enterprises in foreign countries, especially large enterprises, pay extremely close attention to S&T development and their investments far surpass 1 percent of their volume of sales, such as 8 percent at IBM and even as much as 10 percent in others. Why is there such a great discrepancy between our ability to "invigorate agriculture with S&T" compared to "invigorating industry with S&T"? This is precisely a question that must be solved through the state's improvement and rectification and intensive reform.

As for "invigorating forestry with S&T", as the minister of the Ministry of Forestry has said, we are still somewhat distant from our shining future. China's present forest coverage rate is only 12 percent, which is too low. Do methods exist? There are methods, such as those of Fujian's senior engineer Ji Tianyou [1323 1131 0147], who several years ago proposed the need to work on a second forestry that uses a dense planting and cutting rotation method to plant small trees that are regularly cut. This would produce more fiber for papermaking per mu of land. Many things in foreign countries that are made of wood like particle board can be made from fine material.

Engineer Ji said if we set aside 20 percent of China's forests and land suitable for forests, we will be able to satisfy our national demand for papermaking and synthetic materials and the remaining 80 percent of the area would be ecological forest that can protect the ecology, protect water resources, and so on. Several years ago, the Papermaking Society and Forestry Society issued a joint proposal that called for adoption of senior engineer Ji Tianyou's suggestions. Vice Premier Tian Jiyuan [3944 4764 0061] also held a meeting to determine four trial regions, but work has been done so far only on the trial point in Fujian Province where engineer Ji is and nothing has been done at the three other locations. The reason that nothing has been done is not that Chinese people are stupid. Instead, it is a problem with our system. Papermaking is in the Ministry of Light Industry and forests are in the Ministry of Forestry, and the two ministries have not gotten together. Thus, the basic problem remains the domestic environment.

My reason for mentioning all this is that I want to say that when we are working on these natural sciences and engineering technologies, knowledge of the natural sciences and engineering technology along is not enough. If we want to convert S&T into primary forces of production, we must also rely on the social sciences. The Science and Technology Commission has a working committee for promoting an alliance between the natural sciences and the social sciences whose chairman is Qian Sanqiang [6929 0005 1730], and I consider it to be very important because this is major S&T, not the prior concept of S&T. When comrade Xiaoping said S&T are primary forces of production, he was referring to major S&T, which includes the social sciences. Comrades in the S&T field must integrate with reality and not keep their heads always in their books. If S&T are truly to become primary forces of production, they must relying on an even larger environment.

IV. The Question of Skilled Personnel

This question is very important. People from three generations are now working on S&T. One is the older level like ourselves, another very important one is people in their 30's and 40's, and the other is those who are about 20 and are now engaged in studying. I hope that the pupil will arise from the master and surpass the master and that the next generation will be stronger than us. We should use Marxist philosophy and dialectical materialism and historical materialism to summarize successful experiences and lessons of failure in education, and truly respect Marxist educational theories. This is extremely important. Guidance without theory is not possible and there are shortcomings to old educational theories.

We will face many more problems in the 21st Century and in large S&T. For example, there is the question of organization in regard to big S&T. There is an article by Zhao Hongzhou [6392 4767 1558] and Jiang Guohua [5592 0948 5478] in issue No 1 of KEJI DAOBAO [SCIENCE AND TECHNOLOGY REPORT] for 1990 entitled "There Is an Even Greater Need for Skilled Commanders of Science During the Era of Great Science", and it is worth reading. The reason is that they set forth the question of skilled scientific commanders, the people with special skills required to organize work in great science.

V. Marxist Philosophy Guides Our Work

Fostering the role of S&T as primary forces of production is a complex question of social systems engineering. How can people engaged in scientific research work find a tool which can help them consider questions? A Chinese S&T worker who wishes to solve this complex question must establish himself on the commanding heights of Marxist philosophy to pull together the overall situation and suggest views on how to use S&T as primary forces of production for the party and state to carry out improvement and rectification and intensive reform.

VI. The Question of a Ministry of Overall Design

Social systems engineering methods must be used for complex questions. I have consistently proposed that the party and state should have a Ministry of Overall Design to serve as an advisory organ. The Ministry of Overall Design could use a combination of integrated comprehensive qualitative and quantitative methods for its work to summarize all views and experiences of everyone. This could only be achieved in our socialist nation because the Chinese people are unanimously united under the leadership of the CPC and the government and people are of one heart from top to bottom. The tool for using the method of comprehensive integration is information technology. There was some good news a few days ago: the China Information Society has been established. According to the report, over 10,000 people use computers to participate in information work and they have a great deal of computer equipment including large computers and microcomputers. With this foundation, we are taking the road of scientific decision making and scientific consulting and there is great hope for overall design.

Statistical Analysis of CAS S&T Achievements

91FE0282D Beijing KEYAN GUANLI [SCIENCE RESEARCH MANAGEMENT] No 6, in Chinese Nov 90 pp 43-46, 56

[Article by Zhang Zhikui [1728 1807 1145] of the Chinese Academy of Sciences Planning Bureau]

[Text] Abstract: This article provides statistics and analysis for achievements made by the CAS since its founding, especially those which received state-level awards between 1980 and 1988. It also discusses the relationships between achievements and fund inputs and between achievements and the structure of S&T staffs, the significance of topic self-selection, and other issues.

The basic task of scientific research is to produce achievements and skilled personnel, while the ultimate goal of producing skilled personnel is also to produce achievements. The number and levels of scientific research achievements are among the main criteria used to evaluate and judge the overall research capabilities, size of contributions, and management levels of an S&T department or scientific research unit. Scientific research achievements are also a key comprehensive index for evaluating the size of scientific research work achievements. The CAS is China's comprehensive natural science research center. The number, levels, and results of its scientific research achievements are a core issue in the continued development of the CAS. This article will analyze statistics on scientific research achievements made since the CAS was founded to study and discuss several factors which affect the making of achievements to serve as a reference for scientific research management and accelerate forecasts.

I.

A. The conditions by which the CAS received three major awards from the state

Since the founding of New China, our country has established State Natural Sciences Awards (1956), State Invention Awards (1963), and State Technical Progress Awards (1985) to commend and reward superior scientific research achievements achieved on the S&T battlefront and the researchers who made them. The scope of rewards for these three major state achievements basically includes various achievements made in scientific research and technical work in the realm of the natural sciences and the S&T achievements which receive the awards embody the highest levels of science and technology in China. Statistical analysis of certain parameters of the CAS achievements that have received these three major awards can provide us with some very useful information.

Statistical results on publicly announced awards for these three major state awards show that of the 337 superior basic and theoretical research achievements which received State Natural Sciences Awards, the CAS received 168, about half (49.85 percent) of all the projects rewarded and more than the higher education system, and even more than the number of awards in the higher education system under the direct jurisdiction of the State Education Commission. The CAS received 6.9 percent of the State Invention Awards and 5.1 percent of the State Technical Progress Awards. The CAS did not hold a superior position relative to other departments and systems and the rate at which it received awards was about the same as institutions of higher education under the direct jurisdiction of the State Education Commission.

B. Analysis of parameters of CAS achievements which received the three major state awards

By 1988, the CAS had received the three major state awards for a total of 421 projects (the CAS was the number one completion unit, and the CAS was one of the units which completed another 98 projects that received awards). This article will provide a preliminary statistical analysis of several main parameters of 339 of the achievements which received awards.

1. Achievement completion units. Of the 339 achievements which received awards, 203 were completed independently by the CAS, equal to 59.9 percent. Most of the achievements which received awards were completed by one unit. They totalled 195 projects, equal to 57.5 percent. Most of the achievements which received natural sciences awards were completed independently by a single unit, equal to 82.1 percent.

2. Achievement categories. The 339 achievements which received awards can be divided according to their properties on the basis of the categorization principle for scientific research used by UNESCO into the three categories of basic research, applied research, and development. The ratio among the three was 39.2:55.1:5.0 (the remaining 0.7 is other research achievements).

3. Research fund inputs. A total of 281.51 million yuan in research funds was invested directly in 281 achievements which received awards, an average of about 1 million yuan per project. The average investment of research funds for rewarded achievements in the natural sciences was 524,000 yuan, the average input for those achievements receiving invention awards was 251,000 yuan, and the average input for those achievements receiving S&T progress awards was 1.983 million yuan. Among the achievements which received S&T progress awards, two key development engineering projects received development funds of 71.52 million yuan and 50 million yuan, respectively. If development funds for these two projects which received strong investments are deducted, the investment of research funds for the other 279 achievements which received awards drops to 159.99 million yuan and the average investment drops to 573,000 yuan. Among them, the average investment of research funds for achievements which received S&T progress awards drops to 832,000 yuan.

4. Research schedules. The shortest research schedule to make achievements for those achievements which received awards was just a few months. There were 20 achievements with research schedules exceeding 20 years. The longest schedule was 37 years, and the average research schedule for achievements which received awards was 6.8 years.

5. The people/project index (referring to the average number of S&T personnel involved in a research project). According to statistics, the average people/project index for the 339 achievements which received awards was 22 people/project. There were 14 achievements which were completed by a single person and 17 awarded achievements that involved over 100 personnel. One achievement which received an award was completed through the cooperation of 706 S&T personnel.

6. Other parameters. Statistics on the relevant parameters for 568 project leaders (the first 1 or 2 primary completers of each achievement) involved in 339 achievements which received awards lead to the following conclusions: 1) Women accounted for 13.4 percent; 2) The average age was 50, the 46 to 55 age segment accounted for 45.1 percent, and those older than 60 accounted for 18.5 percent; 3) There were 188 people who held academic degrees, equal to 33.1 percent of the total number of people; 4) Of 562 people in the statistics, 141 had done graduate study, equal to 25.1 percent, and 393 had done undergraduate study, equal to 70 percent, so the two together totalled 95.1 percent; 5) In job titles, the ratio was relatively close for high, middle, and low levels, at 1.2:1:1; 6) There were 198 people who had studied abroad, equal to 34.9 percent of the total number of people, and half of these had studied in the United States. The period during which they studied abroad was mainly concentrated during two periods: prior to liberation and during the 1980's.

C. Analysis of parameters for S&T achievements registered at the CAS

In the 9-year period since 1980, the CAS completed and registered 12,633 S&T achievements. I will now do some statistical analysis of several parameters for these S&T achievements, especially those registered after 1984.

1. The CAS averaged 1,404 S&T achievements per year over this 9-year period and the scholarly levels of all these achievements were higher than advanced levels within China. Achievements registered at the CAS during the Sixth 5- Year Plan accounted for 7.8 percent of the total in China but the number of its achievements which attained vanguard levels internationally accounted for 28.3 percent of the national total. Its achievements which attained advanced international levels accounted for 46.6 percent of national total and its achievements which attained vanguard levels within China accounted for 24.2 percent of our national total.

Thirty percent of the achievements registered at the CAS attained vanguard and advanced international levels and the remaining 70 percent attained vanguard and advanced levels within China. The figures for achievements recorded in China as a whole, on the other hand, were just 5.3 percent and 35.5 percent, respectively.

2. The ratio among the three categories (basic, applied, and development) of achievements was 15.0:73.7:11.3 (a comprehensive ratio for the period from 1984-1988). Comparing this result with the achievements that received state awards, the proportion of basic research achievements which received state awards was higher, and was approximately the same as the ratios among the three categories of some medical research achievements in China (14:72:14) from a survey done by Zhao Tonggang [6392 0681 0474] and other comrades. Statistics indicate that the ratios for the three categories of research achievements in the CAS as a whole in 1985 were 26.1:47.7:22.4. Comparison with the ratios of the three categories of achievements mentioned previously shows that applied research achievements account for a larger proportion of the achievements.

3. On the average, 75,000 yuan in research funds was invested for each achievement and this figure tended to increase from 1984 to 1988. The average amount of funds invested in each achievement was 58,000 yuan, 72,000 yuan, 79,000 yuan, and 89,000 yuan, respectively. Statistics for the achievements which received state awards as described previously show that an average of 1 million yuan in research funds was invested per achievement. If the two key development engineering projects are deduced, the average amount of funds invested per achievement was still 573,000 yuan, which is far higher than the 75,000 yuan figure. This tells us that the amount of funds invested in achievements which received awards was far greater than for regular achievements.

4. The average research schedule per achievement was 3 years. Research schedules shorter than 1 year accounted for 33.1 percent and those lasting longer than 5 years for 14.3 percent. This result is obviously lower than the average research schedule of 6.8 years for achievements which received awards. Comrade Xu Rongcheng [1776 2837 2052] found the average research schedule to be 3.7 years per project for 2,340 major S&T achievements announced by the State Science and Technology Commission in 1983. The average research schedule found by Zhao Tonggang and others for medical research achievements was 3 years. These results are about the same as the statistical results for average research schedules for CAS achievements.

5. The people/project index for the achievements was 5.4 people/project. The people/project index rose from 4.5 people/project in 1984 to 6.3 people/project in 1988. This was an indication of the growing difficulty, higher comprehensiveness, and stronger cooperation for research achievements, but this parameter was also far lower than the people/project index of 22 people/project for achievements which received state awards.

6. The ratio among advanced, mid-level, and low-level job titles for the main completers of achievements was 2.4:3.2:1. The age distribution of the main completers was 46.7 percent between 46 and 55 years. It was 3 percent for those over 60 years of age, which is far smaller than the proportion (18.5 percent) for the same age segment for achievements which received state awards. These statistics conform to statistical results from other departments.

7. Statistics for the units which completed achievements show that 58.4 percent of the achievements were completed independently by a single unit. There were no major changes in this proportion from 1985 to 1988. This shows that having a single unit take on a project is the basic form for scientific research activities in the CAS at the present time.

II.

Statistical results for certain parameters for CAS achievements which received one of the three main state awards and S&T achievements registered at the CAS permit us to summarize some interrelationships and examine several development trends and problems.

A. The CAS has an obvious advantage in the realm of basic research, but the situation is changing

The statistics show that, for the three major state awards, most of the awards received by the CAS were natural science awards. Of the different levels of natural science awards, the award rate for high-level awards was greater than the award rate for low-level awards. For example, the CAS won all three of the first natural science awards and seven of the 11 first-place awards in the third round. Of all of the projects which received third-round natural science awards, the average award rate was 49.85 percent, but it won 65.2 percent of first place awards. Moreover, all of the S&T achievements registered with the CAS were above advanced levels within China, which was obviously higher than the level of achievements within China. These facts show that since the CAS was founded, it has had a relatively strong comprehensive research capability in the natural sciences, especially in the realm of basic research in the natural sciences, where it has an obvious advantage. It must also be understood, however, that these facts cannot represent the future. Statistical results also tell us that the rate of awards received by the CAS among State Natural Science Awards has gradually declined. Its advantages were extremely apparent during the first session, but there was opposition in the award rate from institutions of higher education during the second session and it had dropped to second place by the third round. It also should be acknowledged that the CAS rate of awards for the other two major state awards was not high. This is very unequal to the comprehensive S&T strengths of the CAS. Analysis of achievements made in recent years makes one feel that levels were not high and its share of achievements was smaller. This shows clearly that the CAS faces a serious situation in making more and better scientific research achievements and that it should have a sense of urgency and crisis and absolutely cannot be blindly optimistic or relax in its ideology.

B. The relationship between achievements and inputs

Comparison of the differences between the statistical parameters of S&T achievements which received state achievement awards and those which were recorded at the CAS shows clearly that the key factors which directly affect the output of achievements have a greater effect on the former than on the latter. For example, the research schedule for the former achievements is 2.3 times that of the latter, the average investment of research funds of the former was 13 times that of the latter, and the people/project index of the former was 2.3 times that of the latter. These facts tell us that scientific research achievements at levels which receive the three major state-level awards require good stipulations and arrangements for topic selection, investment of sufficiently powerful research funds, and a sufficient number of scholarly leaders and primary research personnel with higher academic levels and research capabilities.

C. The relationship between achievements and S&T staff organization

The relationship between S&T staff organization and output of achievements is manifested mainly in:

1. The relationship between the number and structure and S&T staff groups and output of achievements. An understanding of the number and structure of skilled personnel groups which complete achievements permits us to analyze and reveal regularities in scientific research activities in the distribution and deployment of personnel, degree of cooperation, and so on. The average people/project index for CAS achievements which received state awards was 22 people/project, whereas the average people/project index for S&T achievements registered with the CAS was 5.4 people/project. This shows that centralized utilization of S&T personnel, stronger skilled personnel inputs on key projects, and rational utilization and arrangement of S&T personnel directly determine the output of achievements and their level. Moreover, the statistically derived average people/project index of 5.4 people/project for CAS S&T achievements is identical to the average people/project index of 5.4 people/project for 2,340 key achievements announced by the State Science and Technology Commission. Extrapolating from this people/project index and calculating on the basis of a 3 year average research schedule per achievement, an S&T staff of at least 22,600 would be required on the front line of scientific research to take on scientific research topics if we wish to make 1,400 achievements a year (maintaining the average number of achievements made per year over the past 9 years).

2. The relationship between the age structure of S&T staff groups and output of achievements. Understanding the age structure of the main personnel groups who completed achievements is very important for revealing the creativity and vitality of S&T staffs and the laws of their continued development. The average age of project leaders for CAS achievements which received state awards was 50 and the optimum age segment for receiving awards was 46 to 55 (accounting for 45.1 percent). The average age of the main completers of S&T achievements registered in the CAS was 44.9 years and the 46 to 55 age segment accounted for 46.7 percent. We can use come relevant data for comparison. Comrade Zhao Hongzhou [6392 4767 3166] has pointed out that the average age of those who made major achievements worldwide was about 37 years when they made their achievement and the average age of those awarded Nobel Prizes was 39 years. The world's universally acknowledged "optimum age range" for scientific creativity is 30 to 45 years. It is obvious that the average age of the main completers of achievements in the CAS is rather high and that the "optimum age range" for producing achievements has been shifted to later ages. Nevertheless, the statistical results for the CAS are very close to the results of many statistical analyses in China. For example, according to statistics for the main completing personnel for state-level achievements registered and announced during 1984, people 46 to 55 years of age accounted for 41.7 percent. Of the main completers of achievements which received state S&T progress awards in a certain ministry in 1985, people 46 to 55 years of age accounted for 64.3 percent. These facts show fully that S&T personnel about 50 years old are still the key and hard core force in scientific research in the CAS and China at present and we should have an adequate understanding of this. Moreover, it deserves special mention that scientists over 60 years of age accounted for 18.5 percent of the leaders of achievements which received state awards in the CAS, which shows that the role of elderly scientists as academic leaders cannot easily be ignored.

3. The relationship between the energy levels of S&T staff groups and output of achievements. Records of formal schooling and job title structures are two important indices of the energy level structure of S&T personnel. The differences and combinations of the educational levels and knowledge levels of S&T staff groups can reflect the creative abilities of these groups. It should be pointed out, however, that statistical data which reflect this type of relationship are rather limited. This is a shortcoming of S&T statistics.

1) School history structures: Statistics were prepared only for the records of formal schooling for leaders of achievements which received awards. Because of limitations by conditions, statistics on the records of formal schooling of the main completers of achievements could not be prepared. Of the 568 project leaders in the statistical group, 188 had degrees, equal to 33.1 percent. Of the 188 project leaders with formal schooling, 97.8 percent had studied at the college level and 25.1 percent had graduate degrees. Of the 568 people, 198 had gone

abroad for study or training, equal to 34.9 percent. These statistics show that there is a positive relationship between one's educational background and achievement output. People with graduate degrees, who accounted for 3.9 percent of the S&T personnel in the CAS, comprised 25.1 percent of the leaders of projects which received state awards. This fact is a powerful confirmation of this positive relationship. The relatively large proportion of S&T personnel who had gone abroad for training or study among project leaders who received state awards is another confirmation.

2) Job title structure: Looking at the group of leaders in the CAS whose achievements received state awards, statistics for 568 people show that the ratio among high, mid-level, and low-level job titles was 1.2:1:1. The ratio for high, middle, and low was 2.4:3.2:1 for the main completers of S&T achievements registered in the CAS. Comparison of these two statistics with the ratio of 0.56:1.2:1 for high, middle, and low level job titles for S&T personnel in the CAS as a whole also shows a positive relationship between scholarly job titles and output of achievements. The higher the job title, the greater the possibility of them making scientific research achievements.

D. The relationship between achievements and topic selection

Statistics on the original source of tasks for CAS achievements which received state awards and S&T achievements registered with the CAS reflect a very enlightening situation, which is that among the great variety of sources of tasks, achievements in self-selected projects accounted for a very large proportion. Of the 339 achievements which received state awards, for example, achievements from self-selected topics accounted for 124 projects or 36.6 percent, which is far higher than achievements for topics which came from other sources. This is particularly true for the 134 achievements which received natural sciences awards, where achievements in self-selected topics accounted for 56 projects or 41.8 percent. In statistics on the sources of tasks for research projects for 2,229 achievements in the CAS during 1987 and 1988, self-selected topics accounted for 654 projects or 29.3 percent, so there were also the leader in the various types of sources of tasks for research topics. These data again confirm that relative independence in the selection of scientific research topics plays an important role in the development of science. We must fully acknowledge the important status of topic self-selection in S&T achievement output and show concern for and reinforce support for and management of topic self-selection.

Defense Industry To Aid Key Projects

40101004B Beijing CHINA DAILY [BUSINESS WEEKLY] in English 14 Jan 91 p 1

[Article by staff reporter Xiao Zhang]

[Text] China's national defence chemical industry will give top priority to supporting construction of key national defence projects during the Eighth Five-Year Plan Period (1991-95), a senior official with the Ministry of Chemical Industry told BUSINESS WEEKLY yesterday.

Meanwhile, the industry will also do its best to meet the demand of the country's military industry for new types of chemical materials, said the official, who declined to be identified.

The official did not specify the projects for national defence, nor list the new chemical materials for military purposes.

However, he affirmed that the national defence chemical industry would "gradually expand its international exchanges with foreign counterparts while adhering to the policy of self-reliance."

Meanwhile, he said, the industry would tap the benefits of the open door policy to contribute to the country's economic development by means of speeding up the effort to change from producing solely military products to more goods for civilian use.

He disclosed that the national defence chemical industry would go all out to research, manufacture and recycling of new compound materials, rocket fuels, plastic aviation glass and special rubber products.

To keep in close step with the national defence modernization drive, the official said, the Ministry of Chemical Industry held a working conference recently in Beijing on policy guidelines for the industry.

The conference concluded that the key to developing the national defence chemical industry lies in a strengthened leadership and an integrated system of management and production.

At the same time, the conference also considered that co-ordination and co-operation between different government departments and industries remain important conditions for the industry's development.

The official said, the conference summarised the past experience of the national defence chemical industry over the last 30 years and praised the achievements.

The official told BUSINESS WEEKLY, that over that period, China's national defence chemical industry had developed a strong and complete system from basically nothing, having manufactured abundant new chemical materials for China's atom and hydrogen bombs, rockets, man-made satellites, submarines, radars, tanks, cannons and other strategic and tactical weapons.

In that period, the industry organized, produced and provided the defence industry with heavy water, fuels for all kinds of rockets, plastic aviation glasses, paints for military use, airplane fuel containers and special military-use films.

Now, the official said, the defence chemical industry is able to manufacture a new generation fuel system for rockets, including long-distance rockets.

For instance, he said, the industry provided the long-distance rocket first launched in 1984 with more than 100 kinds of new chemical materials.

About 80 percent of the total weight of the Long March Rocket family is propellant, of which six kinds were provided by the Ministry of Chemical Industry, he added.

Five Years' Implementation of Patent System

91FE0189C Beijing ZHONGGUO KEJI LUNTAN [FORUM ON SCIENCE AND TECHNOLOGY IN CHINA] in Chinese No 6, 18 Nov 90 pp 14-17

[Excerpts from article by Gao Lulin [7559 4151 7792]: "The Patent System: An Important Guarantee of Technical Innovation"]

[Excerpts] [passage omitted]

China established a patent system just 5 years ago but China's patent practice may further confirm the enormous role of the patent system in technical innovation. Below, I will use analysis in the three areas of statistics on patent applications in China, the patent implementation situation, and enterprise patent work to further illustrate the effects of the patent system in promoting technical innovation.

A. Analysis of statistics on patent applications

From 1985 to the end of 1989, we received 125,874 patents in three categories (invention patents, patents for new types of applications, and exterior design patents). They included 32,905 applications received in 1989, nearly three times the number of patents received in 1985. Of this number of patent applications, requests from within China accounted for 80 percent and requests from foreign countries accounted for 20 percent. Looking at the structure of the three categories of patents, patents for inventions accounted for 34.9 percent, patents for new applications for 59.3 percent, and patents for external designs for 5.8 percent.

Among the patent applications for inventions and new applications from inside China, most of the invention patents were for professional patents, while most of the patents for new applications were non-professional patents. This shows that adoption of the new applications system in China has promoted the development of mass invention and innovation activities and played an active role in enriching the content of material life of vast numbers of people.

By the end of 1989, China's Patent Bureau had received 25,171 patent applications from 64 countries and regions. The United States held first place with 7,346, Japan was second with 6,612, and West Germany was third with 2,291. Having this many countries and regions submit patent applications in China shows that China's investment environment holds considerable attraction for foreign businesses and that all countries have a universally good view of our technology markets.

B. Implementation of patented technology

Implementation of patented technology in China has revealed an obvious characteristic, which is a relatively high patent implementation rate. According to statistics from a sample survey of patent applications that received authorization and were made open prior to June 1989, China's patent implementation rate was about 30 percent, which is obviously higher than the rate of about 10 percent in many other countries. The structure of patent implementation in China has the following characteristics: 1) The implementation rate for professional inventions and creations was three times that of non-professional inventions and creations. The implementation rate for professional inventions and creations was 45.2 percent, while the implementation rate for non-professional inventions and creations was 14.8 percent. 2) The patent implementation rate for plant and mine enterprises was obviously higher than scientific research units and institutions of higher education. The patent implementation rate was 75.5 percent in plant and mine enterprises and 43.4 percent in institutions of higher education and scientific research units. 3) Patented technologies implemented in units under ownership by the whole people, the main force in our national economy, occupy a primary status. Among patent projects that have already been implemented, divided according to system, units under ownership by the whole people accounted for 69.8 percent, units under collective ownership for 24.9 percent, township and town enterprises for 3.2 percent, civilian-run and individuals for 1.6 percent, and joint investment enterprises for 0.5 percent.

Implementation of patented technology in China has produced obvious economic and social benefits. Statistics for 11,900 projects already implemented show that through the end of June 1989, they produced a total of 12.93 billion yuan in new output value and 2.34 billion yuan in new profits and taxes, and earned $140 million in foreign exchange. Moreover, statistics for 10 projects which received "Chinese Patented Invention and Creation Awards" announced jointly by the Chinese Patent Bureau and World Intellectual Property Rights Organization at the end of 1989 produced 480 million yuan in new output value and 120 million yuan in new profits and taxes, and they earned $15 million in foreign exchange. Among them, after Anshan Iron and Steel Company, China's biggest iron and steel production enterprise, implemented its patent for "low-ally atmospheric corrosion-resistant steel", it produced direct earnings of 19.90 million yuan for production departments and generated 430 million yuan in secondary economic benefits because it reduced corrosion, extended lifespans, reduced repairs, and so on.

To promote implementation of patented technology, relevant departments in the Chinese government have adopted several encouragement measures and methods including establishing a patent development fund, providing loans for patent projects included in state and local economic and S&T plans, giving preferential treatment in the area of taxation, establishing and supporting patented technology development organs and patented technology transfer intermediary organs, organizing patented technology exchange conferences, exhibitions, patent announcement meetings, and so on to promote the exchange of information on patents and reduce the contradiction between technology development forces and inadequate development and implementation capital. Although these measures and methods have not been in effect for very long and their achievements are preliminary ones and require further strengthening and perfection through practice, they have revealed their active role in promoting implementation of patented technology.

C. On enterprise patent work

The role of the patent system in promoting technical innovation is manifested mainly in two areas. The first is encouraging invention and creation. The main sources of inventions and creations in China are scientific research organs, institutions of higher education, and enterprises. The second is promoting extension and utilization of inventions and creations, which mainly depends on enterprises. Enterprises are important sources of inventions and creations as well as base areas for extension and application of inventions and discoveries. Enterprise patent work occupies a prominent position in China's patent work. For the past few years, to promote the development of patent work in enterprises, we have adopted several measures and methods. First, we have done widespread propaganda concerning the Patent Law and popularized understanding of patents, which has increased the understanding of large numbers of enterprise officials and employees of the significance and role of the patent system. Second, we have trained enterprise patent workers and put in place a professional backbone staff to undertake patent work in enterprises. Third, we have reinforced policy guidance. Many enterprises have been concerned with the use of the weapon of patent protection to open up and protect markets for enterprise products, increase their rate of market dominance, and reinforce enterprise competitiveness. Before implementation of the Patent Law, the new types of liquor bottles produced by Longkou Glass Plant in Shandong Province had been copied by many parties, which severely affected the economic interests of the enterprise. After implementation of the Patent Law, this plant applied for external design patents for 21 of its unusually shaped liquor bottles and effectively blocked their copying by other plants, thereby increasing their rate of market dominance. These products are now being sold in 17 provinces and municipalities in China and they have entered the Japanese market. Henan Province's Gongxian County Decelerator Plant is a township and town enterprise. Because their original product was not competitive, the enterprise faced difficulties. Based on market information, they successfully developed a new type of coal briquet machine and obtained patent protection, opening up market sales avenues in one swoop. At this time, large-scale encroachment activity appeared in society. There were over 40 enterprises in Gongxian County alone which copied this product. In accordance with the Patent Law, the decelerator plant submitted a request to the Henan Province Patent Management Office requesting that the encroachment behavior be dealt with. In accordance with the law, the Patent Management Bureau dealt severely with 46 encroaching plants and protected the legal interests of the decelerator plant.

Many enterprises have been concerned with utilization of patent documents and are using patent documents as an important source of information for enterprise technical innovation. After examining and analyzing patent documents, they can gain a macro understanding of current situations and levels in all world S&T and certain technical realms and forecast technology development trends, and they can use them as technical references for concrete research and development activities. Moreover, the difference between patent documents and other types of technical information is that they record in detail the legal situation for the relevant technology and provide an important basis for enterprise decisions on production and management. Many of China's enterprises have begun to recognize the important role of patent documents and are using them more and are benefitting. Chengdu Electric Cable Plant is China's biggest communications cable production plant. This plant has advanced equipment and relatively strong technical forces. Its products are quite competitive in China and foreign countries. To gain a better grasp of decision making authority in market competition, the plant conducted survey analysis of relevant patent documents in 1987. Through comparative analysis and research, this plant gained a relatively clear understanding of technical levels, technology values, and development charts in the field of electrical cables in relevant plants in foreign countries, clarified their main competitors, and readjusted and perfected technical countermeasures in the plant to gain clearer goals and higher starting points in product R&D work, with extremely satisfying results. A certain plant originally planned to import technology to produce electronic displays from foreign countries. Subsequently, they decided that the prices asked by their counterpart were too high. Within a very short period of time they developed a smaller volume, higher performance, and easier to operate new electronics display and saved considerable technology import expenditures.

Many enterprises have conscientiously implemented stipulations concerning awards and compensation for professional inventors, which has motivated the enthusiasm of vast numbers of S&T personnel and employees for invention and creation and promoted a benign cycle of research-development-production. Besides receiving a one-time reward, the inventors of Anshan Iron and Steel Company's "low-alloy atmospheric corrosion-resistant steel" also received 1.5 percent of the net income from implementation of this technology, for a total of 42,000 yuan awarded to four inventors. They also convened an "inventors' reward press announcement meeting" and openly accepted the award. This drew a strong reaction from within the company and from society and further stimulated the initiative of the company's S&T personnel and employees for invention and creation.

Chinese enterprises have made important breakthroughs in patent work. In 1985, the first year in which implementation of China's Patent Law began, there were 1,126 patent applications from enterprises, just 73.2 percent as many as from institutions of higher education. The number of patent applications reached 3,725 in 1989, which was 3.05 times as many as from institutions of higher education and exceed the total number of applications from institutions of higher education and scientific research units.

These conclusions can be drawn from the preceding analysis:

1. Technical innovation holds an increasingly important status and role in the process of a nation's economic and social development and more and more countries are acknowledging this point. They are also adopting active measures to promote technical innovation in their respective nations.

2. Development of the commodity economy promotes flourishing technical innovation. After the first industrial revolution, there was flourishing development of technical innovation and it became more and more closely connected to the establishment of new technical industries. Conversion of the technologies that were applied into products and property promoted the establishment and perfection of the patent system. At the same time, the patent system served as an important legal protection for technical innovation and actively promoted technical innovation.

3. The role of a patent system in guaranteeing and promoting protection of technical innovation lies mainly in these areas: 1) Encouraging invention and creation; 2) Accelerating the extension and application of inventions and creations; 3) Aiding in the international transfer of technology; 4) Promoting the dissemination and circulation of technical information.

4. China's practice since implementation of the patent system has shown that the patent system is appropriate for western industrialized nations as well as China, a developing socialist country. The growing speed of patent applications and the flourishing development of invention and creation activities over the past 5 years shows that establishment of a patent system in China has played a significant role in promoting technical innovation in China and aided in implementation of the policy of opening up, and it has a rather strong attractive force for foreign countries.

In summary, China's progress in patent work confirms the positive role of the patent system in regard to technical innovation. We must base our work on actual conditions in China, continually perfect the patent system, link it up with and match it with the relevant policy measures for reform of China's economic system and S&T system, and gradually form a social environment in China that is conducive to technical innovation.

Court for Intellectual Rights Arbitration Established in Beijing

90FE0208C Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 4 Dec 90 p 1

[Article by Wang Daitong [3769 2071 0681]: "Court for Intellectual Rights Arbitration Established in Beijing"]

[Text] China's first arbitration court for intellectual rights, Beijing Middle Court for Intellectual Rights Arbitration, was established on December 3, 1990. This is an important step taken by the Beijing Middle Court for settling disputes concerning intellectual rights.

As a result of progress in S&T and reform of the S&T system, the number of disputes concerning intellectual rights also gradually increased. Since Beijing Middle Court began accepting intellectual rights cases in 1983, it had received 123 cases by October 1990. There are 55 patent related cases, 51 technical contract disputes, and 17 cases involving trademark infringement, copyright infringement and technical accomplishment dispute.

In the press conference held by Beijing Middle Court, Associate Chief Justice Wang Yongyuan [3769 3057 3293] pointed out that intellectual rights cases cover a wide range of areas. Each case has a different set of circumstances. It usually involves some advanced technical accomplishments which are highly specialized and representative of the present era. It is very difficult to imagine that a judge without any technical background can handle this type of case. To train a number of "technically specialized" judges with high legal standards and technical knowledge has some positive effects on protecting the legal rights of owners of intellectual properties, punishing actions that impede technological progress, and preventing lengthy delays which makes the use of advanced S&T impossible.

The intellectual property arbitration court was established to protect foreign enterprises and citizens that legally obtain patents and trademarks in China. It provides the legal environment to attract foreign capital and technology.

The intellectual rights arbitration court is under the jurisdiction of the economic court of Beijing Middle Court. There are 10 judges; seven have college degrees and two have equivalent college experience. Most of them have received training in intellectual property law. The court, depending on the situation, may have expert witnesses, hold seminars and case analysis meetings, and invite technical experts as jurors.

Major Academies, Institutes Become Vital Forces in Developing High-Tech Enterprises

91FE0232A Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 17 Dec 90 p 3

[Article by Yang Anxian [2799 1344 0103], Deputy Chief, Chinese Academy of Sciences Policy Bureau]

[Text] Through 40 years of development, China has built a vast S&T force composed of more than 10,000 research organizations and several million technical personnel. The power behind this force is the Chinese Academy of Sciences (CAS), and the research academies and institutes subordinate to the departments and commissions of the State Council. Despite the fact that these research organizations make up only one-fifth of the total S&T organizations in the country, they have one-third of all the scientists and senior engineers, and receive two-thirds of all the nation's S&T investment. During these 40 years this S&T main force has made a great contribution to the development of China's S&T, economy, and defense industries. Since the reforms began, this force undertook to reform and adjust its own organizations, and actively sought to transform scientific results into production, and not only shouldered the main effort of Chinese S&T development, but also increasingly became the vital force for building and developing China's high-tech industries.

The Chosen Strategy

As the center of the world struggle shifts from military confrontation, and economic strength shifts to a contest for comprehensive national strength, it centers around the ability to bring forth new ideas in the struggle for dominance in high technology and to gain advantage in the high-tech industrial competition.

The adjustment of the world economic structure presents opportunities and challenges for China. If the strategy that China sets down is correct, if its measures have teeth, and if it maximizes the nation's S&T advantages, China can break out of poverty and become comfortably well off, and gain its rightful place among nations for its high technology and high-tech industrial achievements.

With a population of 1.1 billion, although China's economy is quite large, [income] relative to the population is not high. Though there are some technology areas, especially certain high-tech industries, that could be fairly well developed and could gain a competitive edge internationally, the overall S&T level of the enterprises is not high. China must acknowledge this imbalance, and in the context of continuously advancing science and technology, must favor the development of certain technologies and high-tech industries. As China enters the next century, a new economic structure guided by science and technology must be built step by step.

It can be said that development of high technology and high-tech industries is China's strategy of choice for the 1990s and on into the next century. The significance of the strategy cannot be understood simply from the viewpoint of technology, but in imbuing life into the effort to repair deficiencies in China's technological crucible, to create an environment for technological creativity, and nurture China's technological genius. The development of high technology and high-tech industrial output cannot be done in a single or in a couple of plans, but requires a complete strategy. The aim of the strategy is not to follow, but to pass, and to surpass, and finally, to occupy the high ground in many leading technologies, and moreover to win technological advantage, and gain for China the place in the international competition that it should have.

Study of the Chinese Academy of Sciences Technology Development

The original S&T system corrupted by organizational ossification, S&T and production dislocation, in the wake of the reforms, puts serious pressures on the major academies and institutes. Under these pressures, the CAS, in the process of carrying out research funding reforms, had to go through many layers and channels to seek ways and means for exchanging S&T results and technological development. The result of the CAS high-tech development study can be condensed to the following points:

1. Increase lateral contact and cooperation. By the end of 1988, the CAS had signed comprehensive cooperative agreements with the petroleum and other sectors, and over ten other provinces, cities, and autonomous districts including Beijing, Tianjin, and Shandong, established various forms of cooperative relationships with several hundred cities and counties throughout the country, and more than 3,000 individual enterprises, and in 1989 alone more than 3,000 lateral technical contracts were undertaken by the various institutes of the CAS. These lateral arrangements are not only an asset to local and departmental economic development, but contribute greatly to exchange of scientific results among technicians, and to setting favorable conditions for economic construction.

2. Set up management entities charged with development of high-tech products. In 1984, a new form of enterprise, backed up by S&T, guided by the market, with products as its fountainhead, encompassing scientific R&D, production and sales, all in one body, first appeared in research institutes of the CAS, and they received the Academy's nurture and support. Accordingly, that group of high-tech enterprises that originated in the various institutes pioneered by scientific researchers provided a new experience for China's high-tech industrial development. The CAS now has 400 technology development corporations employing over 8,500 personnel, among whom are more than 4,200 high and middle-level specialists. Those corporations make over 1100 kinds of products which they themselves developed, more than 450 of which have been appraised as national-level products. In 1988 the total business

performance of these corporations totalled 970 million yuan, of which product sales was 390 million yuan, which generated 7.51 million U.S. dollars in exchange, and earned over 30.94 million yuan in national tax receipts. In addition, CAS and the Shenzhen city government cooperated in the Shenzhen S&T Industrial Park, which was set up as an incubator for high-tech industries, and it achieved good results.

3. Build high-tech industry support structures. The CAS set up a support structure suitable for development of high-tech industries composed of the Dongfang Corporation, the Information Consultative and Advisory Center, the China New Technologies Trade Corporation Ltd., the S&T Advancement and Economic Development Fund, and the S&T Finance Corporation, and is in the process of planning the reform and utilization of the existing production and processing capacity of various institutes to form a production base for technology development. The CAS has also increased the training of technical cadres, and imported advanced facilities appropriate for the financial and business administration requirements of production management, such as they are, to help lift the business management skills of those technology development corporations up a level so as to enhance their competitiveness, and for the development of economies of scale in order to be well prepared for entering world markets.

4. Carry out further reforms, implement the "One-Academy, Two-Function Mechanism". As reforms progressed, two systems of different nature, different value, at once related but independent, took form; one was the scientific research system, and the other the technology development system. It became evident that to reform the scientific research system, the closed structure must be broken up, a mechanism for competition must be introduced, and a new pattern of open, dynamic, and close cooperation with other scientific research elements must be achieved, and an elite corps of vigorous research units must be formed. The technology development system should include engineering development, product development, market development, and business management development. The main aim must be to promote technology development and advancements through the needs of the market, and develop China's commercial economy, and at the same time establish a new pattern of technology development for the CAS. This involves expanding the standardization of the many corporations, to annex and team them up, to increase their scale and strength, and advance toward the ultimate goal—an outward reaching, large-scale development.

Improve Conditions for Creativity, Give Full Play to Academies and Institutes' Function

In the course of developing high technology and high-tech industries, embodied in their new form of integration, the CAS institutes have evinced a unique life force. In the past, China's new developing industries depended on national investment and planning, but the group of high-tech industries now being developed are relying on market forces, and they are thriving. Among them are IBM and BELL of CHINA, which, If they are well supported, are capable of becoming international competitors.

Faced with such needs and possibilities, it is imperative that China lay out a program for developing high technology and high-tech industries that aims at gaining a competitive edge in certain technological areas as the new century unfolds; a program whose main drive is to take full advantage of China's S&T specialties, and unleashes the major academies and institutes as its vital force. A few suggestions for such a plan follow:

1. Select high-tech areas with specific strengths that have self development potential and occupy the high ground in their realm of technology; bolster scientific research, especially engineering R&D capability, including setting up engineering R&D centers in the relevant major academies and institutes or co-build engineering development centers with the large and medium sized enterprises and enterprise groups.

2. From among those high-tech enterprise groups run by the major academies and institutes carefully select a group with distinctive character that possess strong marketing potential and the high-tech enterprises that have excellent management environments. Seek expert opinion and organize cooperative teams with the participation of the leaders of relevant ministries and commissions, and prevail over the human resistance of administrative departments, bring forth whatever works, and thrust them into the international market and the real world of international high-tech industries.

3. To build a good environment for China's high-tech industries development, the major academies and institutes must be allowed to adopt reforms that suit their own special characteristics, including the "one-academy, two-function mechanism", or some other kind of operation mechanism, and must be given care and support in every aspect.

Ties Between Chinese S&T University, Tokyo University Strengthened

91FE0180E Beijing GUANGMING RIBAO in Chinese 5 Nov 90 p 4

[Article by reports Zhu Guanghua [2612 0342 5478] and Hu Yang [5170 5017]: Chinese S&T University and Tokyo University Erect Bridge for S&T Cooperation, Experts at Both Schools Cooperate Closely and Make Rich Achievements"]

[Text] A bridge of S&T cooperation across the sea is linking closely together China S&T University and Tokyo University. Plentiful achievements have been made during 9 years of S&T cooperation. Professor Hiroyuki Yoshikawa, chairman of the Engineering Department at Tokyo University, recently led a delegation for another visit to Chinese S&T University for new discussions on even higher-level cooperation.

Cooperation between Chinese S&T University and Tokyo University is conducted on the basis of the "Agreement Between the Government of the People's Republic of China and the Government of Japan To Promote Cultural Exchange" signed between the governments of the two countries in Beijing in 1979. Thus, this is both an academic cooperation plan as well as a part of friendship activities between the people of China and Japan. S&T cooperation between the Chinese and Japanese universities has received concern and support from the Chinese and Japanese governments as well as the Japanese Ministry of Culture and Chinese Academy of Sciences. The governments of both countries have allocated special funds for S&T cooperation projects. The two universities have 280 professors and scholars who are implementing the cooperation plan.

Cooperation between the two universities is focused on developing emerging science and technology and gratifying achievements have been made. The two parties have undertaken effective research in 15 concrete projects in five cooperative disciplines, signal detection and information processing, functional materials and structural materials, semiconductor engineering and photoelectronics, instantaneous solid and liquid engineering, and fire and high-speed chemical reaction dynamics. Of the research topics already completed or now in progress, over 60 have attained advanced international levels. Scientists at the two universities have done intensive research and provide new theoretical models in numerical analysis of non-steady current and current display and in dual-layer interference phenomena in shock waves. In research on intelligent imaging, they began with artificial intelligence and spatial databases to organize intelligent systems including graphic interpretation and behavior planning, provided a run code program, and studied several algorithms for this type of data structure. At the same time, the two universities have cooperated on both sides in developing various types of scholarly exchanges at various levels, organized scholarly reports and conferences, and published over 300 scholarly treatises. Now, twelve cooperative research achievements have passed formal examination and acceptance and six of the received academy and ministry-level S&T progress awards. The Fire Science Laboratory has been included in the Key Laboratory Construction Plan supported by the State Planning Commission.

High-Tech Products Marketing Strategy

91FE0189D Beijing ZHONGGUO KEJI LUNTAN [FORUM ON SCIENCE AND TECHNOLOGY IN CHINA] in Chinese No 6, 18 Nov 90 pp 22-23

[Article by Liu Long [0491 7893] and Huang Weiguang [7806 5898 0342]: "A Discussion of International Marketing Strategies for High-Tech Products"]

[Text] High-tech products are knowledge-intensive products that have two obvious characteristics compared to traditional industrial products. One is that R&D expenditures account for a greater proportion of the total sales volume, usually as much as 5 to 15 percent. The second is that products are replaced quickly, have high added value, and involve considerable investment risk. Thus, completely new thinking is required for international marketing strategies.

First, we must strengthen survey research and international market forecasting. As the new world technological revolution develops, high and new technology appears in a continuous stream, the period of time from invention to application becomes increasingly shorter, and the pace of conversion to commodities accelerates. As a result, marketing of high-tech products must determine market development goals based on changes in international markets and regional differences. Apparently, the primary demand in western European countries at present is for industrial products that are both technology- and labor-intensive. The United States and Canadian markets demand many high-grade consumer products with high technical requirements, precision processing, attractive exteriors, and new packaging. Many Asian countries mainly demand daily consumer products that are "new, practical, and unusual". The most effective way to understand changes in international markets is to establish modern information networks. This requires dispatching survey research organs to European markets, North American markets, and southeast Asian markets to collect and transmit information in a timely manner to help in formulation of effective high-tech product marketing strategies.

Second, we must grasp the time-effectiveness of high and new technology products. Technology work places commodities into the exchange process because they are advanced. Generally speaking, the more advanced a technology is, the greater the extent to which the forces of production are raised. As a result, trade in high and new technology products mainly occurs during the patent stage for high and new technology products because only in this way can high profits be earned by relying on technical advantages. The time-effectiveness of technology creates the question of technology trade protection. To guarantee its national security, the United States has restricted the outflow and diffusion of high technology. Japan also takes an extremely cautious attitude toward high-tech transfers. Thus, we must strictly control trade in permits for high and new technology that we alone have to protect and monopolize the production and export of competitive high-tech products and thereby earn high profits that arise from our technical advantages.

Third, we should formulate prices for high and new technology products in conjunction with technical cycles. Marx pointed out: "the appraised price of science, the product of mental labor, is always much lower than its value because reproduction of the necessary labor time for science cannot be compared with the labor time required during the initial production of science". As a result, there are obvious and large differences in the use value of technical commodities during the patented technology stage, mature technology stage, and standard technology stage. When formulating high and new technology product prices, there is no doubt that prices should be set according to the technology cycle stage. During the patented technology stage, special prices are formulated on the basis of the individual labor consumed by inventors and manufacturing enterprises. This actually involves using monopoly supply conditions to earn high profits and thereby form monopoly prices during the exchange process. When a patented technology becomes a mature technology that can be produced by other enterprises, the technology reproduction price and average socially necessary labor time to produce the product can be used as a basis for setting prices. When a mature technology becomes a standard technology, prices can be set according to supply and demand relationships to form a type of supply and demand price. Besides this, prices for high and new technology products can also be set according to circulation sequences on a world scale and different patterns of exchange.

Fourth, marketing methods that can foster advantages should be adopted.

1. Models that can selected during the near term:

1) "Foreign design—Chinese processing—international markets". The developed nations have very strong technical innovation capabilities and high processing costs. Although many of their products have advanced designs, their high prices weaken their competitiveness in international markets. By combining advanced design from foreign countries with China's low technical processing costs, the products would be more competitive in international markets and both parties could profit. The main products which can adopt this arrangement are electronics instruments, communications equipment, electronic computers and software, and so on.

2) "Foreign components—Chinese assembly—international markets". Many nations in the EEC can provide tax reductions or exemptions for assembled units imported from China, so the assembled units imported from China are inexpensive. We can take full advantage of our low processing costs to import parts and components from Japan and the United States, assemble them into completed units in China, and then sell them in western European markets. This means importing raw materials from places with the lowest prices, processing them in areas with the lowest labor costs, and then marketing them at rather high selling prices. The main products suitable for this arrangement are computers, sound recording equipment, office automation equipment, communications systems, and so on.

3) "Joint design and development, cooperative production". To open up high-tech markets, many plants and businesses in foreign countries really want to open marketing avenues by adding several special market designs and technologies to their own nation's products. China has many unique customs and aesthetic concepts and can attract the interest of foreign plants and businesses for joint investments and cooperation. This also helps us obtain advanced equipment and technology and helps the marketing networks of foreign businesses open up sales avenues.

4) "Use imports to develop exports, combine imports and exports". Concretely speaking, we can adopt two arrangements. One is to import key equipment from foreign countries, assemble it in China, and export finished sets of equipment to third world countries. The other type is to import technology from foreign countries, integrate it with China's unique resources, sell the products in international markets, and use foreign technology to promote China's high and new technology product exports.

2. Long-term methods for opening up international markets:

1) Implement system supply. There is a trend toward system supply for high-tech products in international markets, known as "turn-key projects". The reason is the high technology intensity of high-tech products which requires a complete unified control system to carry out automatic management before it can be transferred. Moreover, users also want complete sets of equipment assembled from parts and components that are produced by different plants and businesses and purchase them all at once from a single plant or business. The requirements of system supply are not only that customers provide complete sets of equipment and take full responsibility for guaranteeing product quality (including the quality of products produced by the assembled equipment), but that they also require the provision of a series of decision making programs. This arrangement is suitable for use in large enterprise groups in China which have a rather good foundation in high-tech product development and production.

2) Establish scientific research centers and engineering and technical consulting centers in foreign countries. To expand sales of high-tech products, many manufacturing businesses in foreign countries have established scientific research centers and consulting centers in other countries. Buyers can send their own experts to participate in work in these centers and experts from the buyers can independently take on development work and then transfer the research achievements to the manufacturing business for production. This special type of marketing arrangement can meet the needs of buyers to the greatest possible extent, and it can greatly reduce development times. Prices also can float up or down according to the extent to which the customer participates in development. Adoption of this method could enable Chinese enterprises to gain a better understanding of the newest trends in foreign markets, make timely readjustments to

production, and use cooperation with foreign enterprises to raise development levels.

3) Multi-country administration. Establish multi-country companies focused on high-tech management activities, adopt arrangements for purchase and resale or directly establish subsidiary companies in foreign countries, transplant out "in a bundle" high and new technology products in conjunction with technologies that have entered the mature stage and investments. An example is the continual migration of United States technology through lines in Europe, Latin America, and Asia so as to obtain protection for industrial property rights, which guarantees the vanguard status of their technology and obtains the most complete profits and income.

4) Diversified technical services. The scope of technical services in international high-tech product markets is continually expanding. Technical services now account for more than 50 percent of the price for many types of automated equipment. Technical services include equipment selection, program design, software compilation, training of management personnel, and so on. Our high-tech enterprises should truly orient toward international markets and we must begin now in collecting a group of first-rate technical service personnel to carry out systematic training in this area so that we can gain a foothold in intensely competitive markets.

Study on Technology Export Policy

91FE0428B Beijing ZHONGGUO KEJI LUNTAN [FORUM ON SCIENCE AND TECHNOLOGY IN CHINA] in Chinese No 1, Jan 91 pp 29-31

[Article by Liu Yun [0491 0061]; editor: Zhang Wanbin [1728 8001 2430]]

[Text] Since the beginning of openness and reform, China has imported a number of foreign technologies. As scientific and technological cooperation and exchange progressed, China also exported many technologies, some of them were of first-rate world standards. Due to the short history of technology trade with foreign nations and the lack of experience, we have gotten the short end of the stick a number of times. Technology trade is different from product trade even though they are intimately related. The key to product trade is foreign exchange whereas technology export provides others with new basis for productivity. Because of this, many developed nations limit the export of their first-rate technologies. Sometimes, they attach their technology (not first-rate) to their products to create high profits of foreign exchange for further development of their technology. The problem with China's technology export lies in the separation of the technology and the products. Pure technology export not only creates limited foreign exchange, but also loses the monopoly on the international market, which can mean enormous losses.

Statistics show that in 1987 China exported more than 40 technologies, many of them of the world leading standard, such as the two-step fermentation method of vitamin-C and the color dye technique of movie films. The foreign exchange created was only $150 million. If these advanced technologies were converted into high-tech products and then exported, or if these advanced technologies were used to generate equipment and product for export or combine with service and engineering contracts for export, the amount of foreign exchange created will be greater by ten-fold or even several-hundred-fold. We have learned that Japan exports only about $1 billion of technology to developing nations, but the accompanying electrical appliances and systems of equipment amounted to $100 billion. In comparison, the goals of China's technology export were unclear and the export policy required further examination even though more attention has been given to export in recent years.

In international S&T cooperation and exchange, we should not be embarrassed that we cannot produce the best products in the world and hence reveal all our research treasure. The foreigners see exchange as a means for trade; they acquire information in the exchange and then use them toward trade. Their goal is just to make money. As long as you are keen in the reputation of leading in technology, people will take advantage of you and gain cheap technology transfer. (Please note that the value of new S&T results are often hard to estimate.) Once the technologies are in other people's hands, they will be quickly turned into products. With the high technical level and strong production ability of foreign companies, new products will be rushed onto the market to compete with us and to grab enormous profits. Cases like this abound; we shall list a few for reference.

Example 1—Ten years ago, DEC Corporation of the United States introduced its minicomputer into the Chinese market. Although the machines were good buys, their sales in China were thwarted because the computer did not have a good Chinese word processing ability and the Chinese input method was less than satisfactory. Later, DEC found that a Chinese computer expert, Wang Yongmin [3769 3057 3046], had a patented "five-stroke character form"; they bought the patent license immediately. After a year of R&D, they quickly came up with a sophisticated English-Chinese terminal VT382. This powerful terminal satisfied the needs of the Chinese computer users and became a big threat to the Chinese computer industry. Multi-language computer expert Professor Li Jinkai [2621 6855 6963] has said that "Transferring patented technology to foreign companies at a low price and letting them sell their products in China to make money is not exactly patriotic" (FAZHI RIBAO, 19 December 1988).

Example 2—Refrigeration technology in China is not the best in the world, so our refrigeration technologies are mostly imported (not the most advanced, of course). While the Japanese are installing refrigerator assembly lines on Chinese soil, they have already switched to the more energy-efficient and higher performance "Lorentz system." This change made the refrigerators produced in China not competitive with the Japanese products. But Chinese have brains, and a thermodynamics expert, Gu Chujun [7357 7176 6511], quickly invented the "Gu cycle" refrigeration technology. The energy saving was 20 percent better and the refrigeration performance was excellent. One would think that the refrigerator made in China should adopt this technology as quickly as possible so that they could compete with Japan. But our responsible department was anxious to export this technology and give away our edge.

Example 3—The acousto-digital input method invented by Tong Maokuan [0781 2021 1401] requires only 1.5 keystrokes on the standard keyboard; the speed is one to two times faster than the English input method. Tong's input method is very attractive because it can be used on the Chinese 0520 series computers and on the IBM-PC and its compatibles. When the Americans learned about Tong's invention, they tried very hard to buy it but were refused by Tong. His reason was that "I am a Chinese and it is my invention. I do not want someone else to make use of my invention to develop new products to earn our money. If we develop our own products, then we are on a par with them and we can go earn their money." Tong's understanding of the situation is indeed superior and visionary. Inspired by Tong's comments, this author maintains that, since the foreigners are often unwilling to transfer their technology to China, now they need some advanced technology from us, let us be the ones to name the conditions. I think that is far better than selling the patent right as it may to some extent break the high-tech embargo imposed on China by the West.

Example 4—Sitong Company developed a Chinese-English typewriter 2401, its main hardware was purchased from Japan and its main software was developed by the company itself. The hardware and the software formed a new terminal which became a popular item in China. The value of the terminal has far exceeded the combined price of the hardware and software. It is more advantageous to export value-added items made of intermediate products than exporting just the intermediate products. Deputy Director Li Xu'e [2621 4872 6759] of the State Science and Technology Commission has cited similar examples. He said: "A numerical controller sells for 1,000 yuan, which is the value of the item under the 'Torch Plan'; a machine tool sells for 10,000 yuan, but combined, a numerically-controlled machine can sell for 30,000 yuan." The state must encourage the export of such high value-added products and strictly control the export of technologies alone.

Example 5—The model DG823 electrical solid-contact film protector invented by Associate Professor Peng Daoru [1756 6670 0320] of the Beijing College of Posts and Telecommunications is a superior organic synthetic material that lubricates and protects. Contacts coated with this material will have their service life extended from 100,000 to 2.5 million times of electrical contacts and the protector is also erosion, temperature, moisture and salt-proof. Evaluations showed that the product was of leading quality in the world. Although we may create some foreign exchange by exporting this product, we can make much more profit by exporting components coated with this protector. If we export whole machines that are assembled with components coated with DG823, then we will create more foreign exchange by exporting a high value-added item because of the much improved reliability and the much longer average service time between malfunctions. We should carefully consider what to export.

Example 6—The neodymium-iron-boron magnet is the "king of magnets" because it has the highest magnet energy density in the world. Used on electrical machines and appliances, it can greatly reduce the volume and weight of the devices; it has become an important material for electrical machinery, automobiles, aircraft and ships. For this reason, countries are actively competing for the raw material, the developed products and the final devices. China is now the third largest manufacturer and exporter of neodymium-iron-boron magnets, after the United States and Japan. In terms of raw material, China has the largest reserve of rare earth material (three-fourths of the world's reserve) and has a reserve of high quality industrial neodymium equal to five times the total reserve in all other countries. This advantage in resources is the foundation for China's development of neodymium-iron-boron magnets. In the development of the neodymium-iron-boron magnets, the United States and Japan, even though their technology may be more advanced than ours, must eventually come to us for help because of their lack of material reserve. In 1983, just before the Sumitomo Company of Japan announced its research results on neodymium-iron-boron magnets, the company hastened to sign a contract with a mine in Jiangxi to buy 50 tons of raw material a year. Later, they extended the contract to five years and increased the amount of 150 tons a year. Subsequently, the world was in a fever of high temperature superconductivity and the value of rare earth material shot up. Japan came to us again to propose to the Chinese government cooperation in the exploitation of rare earth material, Japan was prepared to transfer the associated technologies in return. In a situation like this, what should we do to remain in a no-loss position? If we only export the rare earth material we will eventually lose our superiority in material reserve. If we export intermediate products, foreign companies will sell final products to us at a high price. If we refuse or limit the export of the material, we would have difficulty in exchanging for the technology we need. Considering the pros and cons, we believe that we should do the following: First, we need to work on the technology development of the rare earth material and neodymium-iron-boron magnets and try to achieve some breakthroughs in the short term. Second, we need to control the rate and quantity these materials are being exported so that we will not lose our superiority and balance in relation to Japan and the United States. We also need to raise the price in the export to protect our profit and to exchange their technology for our materials. In addition, we must be extremely careful that a unified policy is followed on the export question. China faces similar problems in its export of tungsten. China has the largest tungsten reserves in the world but relies on others for the processing technology. A similar versatile policy should be adopted for the export of tungsten.

Example 7—A brand-new type of vortex air compressor developed by Professor Wang Disheng [3769 6611 3932] of Jiatong University in Xi'an has recently been certified by the state. This type of compressor is only one-fourth in volume and one-half in weight compared to similar compressors. It has only about one-tenth the parts and components of conventional compressors and the service life is much longer. It has been dubbed the "maintenance-free compressor" by foreign countries. This achievement has in one swoop propelled China beyond the mid-1980 standard in compressor production. After that, Italy, a country dumping compressors on the international market, proposed to buy this technology for a price of $2 million. Universities and companies in the United States also expressed an interest in collaborating with Professor Wang. We heard that the responsible Chinese department agreed to the requests without thinking. In sharp contrast and in recent memory is that when we tried to import a certain machine and technology from Japan, the answer we got was "Our Diet has decided not to negotiate or export this technology for 10 years." Our rash actions should be carefully examined.

Example 8—In 1986 the Dalian Sea Transportation College transferred an ion-bombardment technology developed by Professor Yang Lieyu [2799 3525 1342] to Wanlidu Limited, a company in Singapore. The incident was reported by a number of newspapers in China at the time and this author was against the transfer. Ion-bombardment technology is still under development in advanced nations and is in its infancy in some countries. Even in the United States, ion bombardment is only used on high-priced important components and not widely used in manufacture and maintenance. The method developed by Professor Yang, on the other hand, is capable of large area coverage and may be used in machine building with significant economic benefits. We all know that the quality and service life of an engine, the heart of automobiles, aircraft, trains, rockets, and ships, have a profound effect on the performance of the machines (final products). Professor Yang's new technology of ion bombardment and diffusion proved to be extremely effective in treating key components of engines. When applied to the piston rings of large ship engines, it may ensure a cruise time of 23,000 hours. When used to treat a marine diesel nozzle, the service life can be two to four times of famous Swiss brands. When applied to the exhaust valves of 4,000-horsepower diesel engines, the service life is 2.3 times that of similar French engines. Clearly, this precious technology can substantially upgrade performance of Chinese-made engines and is extremely important to China's ability to compete in the international engine market. The hasty transfer of technology before the technology had a chance to be established in China and to be widely used caused China to lose its technological edge and was regrettable indeed. Imagine how difficult it would be when we are the ones trying to import such a technology.

The examples cited above may not be totally accurate in factual detail, but the intention of the author is to call people's attention to the policy question of technology export. China is a developing nation; even though our intellectual resources are as good as those of other countries, our technology is still falling behind because of extended periods of backwardness. We must treasure the research results obtained by our S&T personnel through hard work under difficult conditions. We should not let unwise policies cause us to lose our hard-earned edge and economic benefits, not to mention the long history of severe restrictions and unfriendliness of foreign countries toward China when it came to technology issues. The author is not advocating a refusal policy for technology export, but there were indeed many lessons to be learned over the years. We should consolidate our experience and improve our export and import practice. I believe that China needs to establish an organization similar to the "Paris Coordination Council" so that the technology export from China may be uniformly coordinated and monitored in a systematic manner.

State Council's Strategy for Eighth 5-Year Plan

91FE0282N Beijing BEIJING KEJI BAO [BEIJING SCIENCE AND TECHNOLOGY NEWS] in Chinese 5 Jan 91 p 3

[Article: "State Science and Technology Commission Suggests Goals and Directions for Extending Scientific Research Achievements, High-Tech Research, and Basic Research During the Eighth 5-Year Plan"]

[Text] The State Science and Technology Commission recently suggested goals and directions for extending scientific research achievements, high-tech research, and basic research during the Eighth 5-Year Plan. The main ones are:

A. On extending scientific research achievements

The National S&T Achievement Extension Plan deals mainly with traditional industry. The objective is to transfer large numbers of advanced and appropriate achievements over a wide area into traditional industry to promote readjustment of the industrial structure and improvements in technical levels. Some 5,000 scientific research achievements with major roles that involve several industries and several regions will roll each year into the National Key Extension Plan. In industry, there will be a close focus on development of energy resources, communications, raw materials, basic industry, and basic facilities and on active extension of new technologies, new techniques, and new products that play a major role in readjustment of the industrial structure, conserving energy and reducing consumption, and raising productivity and product quality. Support will be provided to 200 integrated technical and economic entities which use extension of achievements as a tap and are composed of scientific research, production, and utilization units. Ten key provinces and municipalities will be selected for large-scale extension demonstrations.

B. Major objectives in high-tech research and development plans

1. Information technology. Breakthrough advances must be made in application of intelligent technology, development of optical communications technology, and other areas and we must track international developments in technical research. We should form a unique and convenient-to-use Chinese character computer system and place it on the market. We should complete the development of relatively large-scale integrated optical terminals and form a production capacity to provide a foundation and supporting conditions for the development of optical communications systems in China. We should focus on high-speed high-precision new information to make breakthroughs in real-time image processing technologies and promoting their application, and in particular we need to make major advances in satellite-carried synthetic aperture radar development and infrared focal plane technology.

2. Automation technology. Track and study key technologies in computer integrated automated manufacturing systems, build demonstration production lines, and gradually extend CIMS technology to provide integration technology for plant automation, shorten product production schedules, increase product competitiveness, and play a pulling role in technical upgrading of traditional industry. Develop principle prototypes for five different categories of intelligent robots for precision operation, operation at water depths below 300 meters, operation in terrible environments, and so on, and develop engineering prototypes, provide key technologies, and take a leap forward in tracking international developments.

3. Energy resource technology. Complete the technical design for a 10MW-grade coal-burning integrated magnetohydrodynamic-steam intermediate testing power plant and carry out laboratory design for the primary equipment. Study and develop a reactor which can greatly increase nuclear fuel utilization rates and which has good safety and economics properties.

4. New materials. Explore high-level materials for the development of information technology during the early part of the next century. Develop composite materials that are resistant to high temperatures and shock and highly ductile for power devices and develop corrosion-resistant and lightweight structural materials. Explore materials design and development under the guidance of different levels of microstructure theory and techniques and technologies for their application. Make breakthroughs in key technologies in thermoplastic resin-based composite material techniques, approach or attain levels of the mid-1980's in primary performance indices of metal-based composite materials, and reinforce research on forming techniques for ceramic-based composite materials. Develop semiconductor photoelectric materials and optical memory materials, and try to approach or attain foreign levels of the late-1980's. Strive for breakthroughs in processing, inspection, and component development for artificial crystals and continue to maintain advanced international levels.

C. On the direction of basic research

Reinforce unified leadership over basic research work, work from the macro level and divide it into different levels, have a unified focus on rational deployments of topic self-selection, key topics, and major projects, and reinforce planning for major projects. Strengthening laboratory and research organ construction is very important for creating an excellent scholarly environment for developing basic research in China, training high-quality talented S&T personnel, and participating in international cooperation and competition. Use optimization of several laboratories and research institutes to form national-level basic research base areas in an effort to move into the vanguard of international academics.

Eighth 5-Year S&T Development Plan For Beijing, Tianjin, Shanghai Outlined

91FE0149A Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 28 Oct 90 p 1

[Article by reporter Li Xigen [2621 0823 2704], and correspondent Wang Jianping [3769 0494 5493]

[Text] Shanghai—The development of high technology, and readjustment of industrial organizations and services will be the main content of the Eighth 5-Year S&T development plan for Beijing, Tianjin, and Shanghai. Chairmen of S&T Committees of the three cities attended three days of discussion in Shanghai on how best to program and establish realistic goals for the Eighth 5-Year Plan.

Beijing's Eighth 5-Year Plan will focus on development of high technology with emphasis on bringing high technology into conventional industries, and using high technology to remold conventional industries. Electric power electronics, information technology, machine-electronics, new materials, and biotechnology are five topics that will be foremost in plans and arrangements, and these together with electronics, urban development, comprehensive transportation systems, precision and chemical industries make up a 10-field high technology industry development package. Preparations are being made to build 15 high technology laboratories, and 10 to 15 intermediate testing bases.

Tianjin will emphasize implementing the S&T key task plan to reorganize the municipal industries surrounding Tianjin, select a package of ten subordinate projects, combine economic committees, planning committees, and other departments into joint organizations, organize more study of science, and mobilize a trans-industrial attack into the effort. An additional 30 promising S&T projects will be organized to accumulate a reserve of strength in order to scale up industrial growth in Tianjin Municipality. A high technology industrial park covering an area of 200 mu will be built on the shores of Cuiping lake in the suburbs of Tianjin.

The Shanghai Municipal Science Committee's goal in the Eighth 5-Year Plan is to build an out-reaching multi-functional city. It will activate spark plans to support five or six project items each year to raise the high-tech production value from a previous 2.9 percent up to 5 percent. In readjusting conventional industries it will promote a scientific approach in six aspects including model furnishings, facade, and energy-conservation facilities. Construction to further perfect the Caohejing development zone will be carried out, and in Pudong, the Beicai High-Tech Park will be increased to 5 square kilometers, 50,000 S&T personnel, and will reach a target of $500 million [U.S. dollars] of production value.

Progress in Implementation of the "863" Plan

91FE0059C Beijing ZHONGGUO KEJI LUNTAN [FORUM ON SCIENCE AND TECHNOLOGY IN CHINA] in Chinese No 5, Sep 90 pp 25-27

[Article by Ma Junru [7456 0193 1172]: "Lessons from the Implementation of the '863' Plan"]

[Text] It has been 4 years since the implementation of the "863" Plan began. Through continuous experimentation and practice, we have tentatively put together operating mechanisms characterized by a new funding system and policy-making and management by experts, making fairly good progress. Practice proves that these two major reforms in the field of operating mechanisms have been a success.

1. Support and Promote the Full Utilization of Experts in Technical Policy-Making

The management-by-experts mechanism has given the expert the principal role in implementing the "863" Plan. But this is a new mechanism and two issues have been encountered in its operation. First, the requirement that the professional standard and competence of experts taking on the tasks live up to the heavy burden of the program, and, second, members of expert committees (groups), as athlete, coach, and judge all rolled into one, handle all relations properly and be fair and detached. Given China's current conditions, it is rather difficult to select members of expert committees and expert groups using those criteria. Accordingly, we have taken pains to train, nurture and discover outstanding people in the course of practice and build up a high-caliber corps.

1) Select outstanding qualified personnel from across the nation through three steps: recommendation, strict examination, and high-level expert review.

2) Give experts a free hand in overseeing the breakdown of topics and research work, improving the technical level and professional caliber through practice to adapt to the operating mechanisms of the "863" Plan.

3) Organize the examination of strategic objectives. The leading policy-makers of the "863" Plan invite experienced and accomplished scientists to review the technical philosophy of the expert committee and expert group as well as the implementation plan and the feasibility of the strategic objectives and help them improve their macro technical policy-making ability.

4) Conduct a comprehensive evaluation of the professional quality, ideology, moral character, and managerial ability of expert committee and expert group members at regular intervals, measuring them against the spirit of the "863" Plan. Demand that as athlete, judge, and coach all rolled into one, the expert be fair and detached.

5) Strictly enforce the expert objective responsibility system and fixed-tenure hiring system. There should be a regular turnover, dynamic stability, and a continuous

infusion of fresh blood in order to keep the expert committee (group) brimming with vigor and fighting spirit.

By adopting a string of effective measures mentioned above, we have mobilized the experts' initiative, made full use of their intelligence, and brought out their sound moral character. With progress in their high-efficiency, high-standard research, the experts show that their academic opinions and practice reflect the mainstream in high-tech development in the world today, represent China's S&T standard, and ease public concern. No major dispute has occurred over all the research tasks the expert groups have put together or the allocation of funds. The new mechanism of policy-making by experts has been understood and accepted by the public and is proving to be increasingly vital by the day.

2. Study and Formulate New Rules and Regulations Through Continuous Experimentation

The implementation of the "863" Plan has reformed the funding system and policy-making management system. This, in turn, requires corresponding rules and regulations as a code of conduct so that experts and managerial organs at all levels have rules to follow, thus ensuring that things are done fairly, scientifically, and in a standardized and systematic manner. The fact of the matter is that in many areas no rules or regulations exist for us to follow in many ways when we apply the new operating mechanisms. One can only learn as one goes along, finding out what is standard through practice. In this sense, the management of the "863" Program can also be regarded as a research topic. Over the past few years, technology experts and experts engaged in the management of the "863" Program, embracing enthusiastically the spirit of reform, have formulated a host of effective management rules on the review of topics, the management of funds, the implementation of tasks, work procedures, expert evaluation, and so on, thus ensuring and expediting the steady progress of the "863" Plan.

It is worth pointing out here that the expert appraisal system has worked very well under the "863" Plan, laying a solid foundation for the establishment of an evaluation and supervision system for the program. The expert appraisal system can be summarized as follows:

1) The system of appraisal standards is fairly scientific and realistic and accurately reflects the experts' abilities, standards, and moral character. When we use these standards to sum up the evaluation of experts, everyone finds the results acceptable and convincing.

2) Invite prestigious and highly respected elderly scientists to take part in the appraisal process so that they get a full understanding of the work of the "863" Plan experts. The experts win their approval with their high-efficiency, high-standard performance and dispel the elders' doubts.

3) Moreover, the appraisal and evaluation committee makes it a point to invite experts other than those in the program who have different opinions, even competitors, to participate in appraisal, thus giving them an opportunity to understand the work of the "863" Plan expert committee (group), to reflect the opinions of all parties, and to give counsel to the "863" Plan enthusiastically, thus helping the experts improve the shortcomings in their work.

4) Leaders of the agencies concerned are also invited to participate in every round of evaluation and appraisal. Experts from different sectors and units are brought together to realize the objectives of the "863" Plan. Their spirit of unity and cooperation is so moving that comrades in all departments feel that this is a new atmosphere made possible only by the break-down of departmental ownership. It would not have come about had the program been dished out to departments to implement in the usual manner.

5) Many of the experts felt nervous before evaluation began but were very pleased afterward. This is because their labor was fully affirmed and they took pride in being truly competent "863" experts.

3. Further the Spirit of the "863" Plan and Nurture and Develop an Army of High-Tech Researchers That Is Small in Number but Highly Trained and Is Full of Vitality

The implementation of the "863" Plan has provided an excellent opportunity for China's young and middle-aged scientists to battle furiously and utilize their intelligence and abilities on the forefront of high-tech in the world under the guidance of the older generation of scientists. In effect, the "863" Plan fulfills the additional historic mission of nurturing and building up an army of high-standard experts.

1) Its range of topics and investment-intensiveness make the "863" Plan a favorable climate capable of attracting and keeping outstanding S&T personnel under China's conditions: (1) The several fields provided for by the "863" Plan are the mainstream in S&T development today, the frontier of knowledge where China must struggle to gain a spot; (2) The 7000 experts who take part in the "863" Plan are the cream of the crop in Chinese S&T; (3) Giving up good pay and other excellent terms of employment, young scientists have returned to China to throw themselves into the climate created by the "863" Plan; (4) Per capita annual investment under the "863" Plan exceeds 20,000 yuan, high enough to attract qualified personnel and ensure achievements.

2) Pay attention to the age structure of the qualified personnel to ensure that they can serve as a link between the older and younger generations.

3) The expert committee (group) strictly requires that every expert have the 863 spirit, that is, that he be fair, pragmatic, cooperative, and innovative and dedicate himself to the program. Many experts realize that taking on an 863 task is a glorious mission entrusted to them by history, not a chance to "make a buck."

4) The expert committee and the expert group follow an objective responsibility system. There is turnover involving one third of the members each time for a continuous infusion of fresh blood, fundamentally breaking the traditional habit of "only going up, no going down" and keeping the expert group full of exuberant vitality and fighting power.

5) An army of management experts suited to the characteristics of the "863" Plan is taking shape. The office of the expert committee and the office of the expert group have attracted a host of highly capable technical experts. By giving up their own research to go into management they have contributed immensely to the launching of the "863" Plan.

4. Break Down Sectoral and Regional Boundaries; Pool Intelligence to Mount an Onslaught on Science and Technology

With its strategic objectives clearly established, experts from the various fields realize that in a high-tech research program like the "863" Plan, many topics are linked to long- and medium-term objectives and are highly exploratory. Thus it is advisable to form groups to conduct research separately. In the case of major projects or projects with target products, however, there is a need to assemble resources from multiple disciplines to conduct research jointly. Given China's limited financial resources, we need to take steps that effectively concentrate human and material resources. In particular, many units have their own pet projects, which makes it even more important that we improve coordination to put what limited resources we have to the best use. Accordingly, after prolonged deliberations by the experts, eight joint R&D centers of different forms have been established in five fields.

The establishment of a center, from site selection to the implementation of a task, follows the mechanism of combining competition with the selection of the best, with the expert committee in charge inviting their peers to review the feasibility report. In the course of implementation, forces from all quarters are pooled to create conditions. Outstanding personnel in the country are brought together to concentrate their energies on the center's research tasks. The CIMS experimental project, for instance, had over 40 experts from the seven research institutes and two schools of six ministries and commissions working under one roof at Qinghua University. Within a short 6 months or so they completed the preliminary design of the experimental project. Experts not involved in the "863" Plan have commented favorably on the fact that so much was accomplished by the CIMS experimental project within such a short period of time. Many units in the country have approached the program with hopes of taking part in the research of the experimental project or offering themselves as application units.

Or take the field of materials science. In accordance with its strategic objectives, everything was done to pool forces from all quarters and make full use of key national laboratories and engineering research facilities. Three kinds of experimental centers have been tentatively established. The first kind is the nation-wide joint center of an industry, such as the National Artificial Crystal Joint R&D Center. The second kind is a joint organization charged with developing a target product or an achievement of landmark importance, such as the Multi-Layer Ceramic Capacitor R&D Joint Organization now being put together. The third kind is an experimental center that may be part of a key experimental base or along the lines of an open laboratory, such as the new high-performance solid propellant experimental base.

5. Reform the Funding System, Improve Financial Management, and Increase the Efficiency With Which Funds Are Used

Directly pegging funds to tasks and directly allocating funds to the unit or group of experts that takes on a task has reduced the levels in the funding system and tightened the requirement that "special funds be used for special purposes," improving the efficiency with which limited funds are used. To manage funds, all fields, topics, and tasks have put people in charge or relied on the finance office of dependent units to carry out the job, effectively guaranteeing the proper use of funds. At the request of the Ministry of Finance, the "863" Plan joint organization of the State Science and Technology Commission and the conditioned finance department last year jointly conducted a 7-month large-scale financial inspection of the program. The inspection covered five fields, 11 topics, and 94 special topics, with a total of 550 tasks involving over 300 dependent units and units taking on the tasks, of which 130 units, or 45 percent of all units that had taken on 863 tasks, were chosen for a random survey or examined in detail. The results of the inspection show that "863" Plan funds have been utilized highly efficiently, fund management was of a high quality, and limited funds have been put to the best use by avoiding and minimizing waste and inefficient uses.

6. Open Up Channels in All Directions and Promote International Exchange and Cooperation Diligently

The outline of the program explicitly calls for developing international cooperation and absorbing expertise from abroad. At the beginning of the "863" Plan, expert committee (group) members were anxious to have the fields and topics set R&D objectives as soon as possible, so the fields put together a number of technical study missions and sent them to Europe, the U.S., and Japan. Their observations played a very useful role at the time in determining the development direction of China's high-tech and setting tracking objectives without delay.

In recent years, research under the "863" Plan has been put on a right track and is deepening all the time. International cooperation and exchange also have been moving onto a higher plane. In 1988, 69 groups and delegations were sent overseas. At the same time, a number of foreign experts were invited to come to China to lecture and conduct exchange. These activities help our effort to closely follow related high-tech developments in the world, enhance the international influence of the "863" Plan, and open up channels, paving the way for cooperative international R&D in the future. In 1988 the five fields signed a total of 12 cooperative agreements of various forms and have begun putting them into effect. In addition, there is a desire to cooperate in many other areas.

Since April last year, changes in the domestic and international situation have vastly complicated international cooperation, forcing the delay of some use projects on which and agreement has been signed. Confronted with difficulties, the expert committees (groups) of the various fields as well as their offices comply with the guiding spirit of the leaders of the CPC Central Committee and the State Science and Technology Commission—"make the most of the situation, take the initiative to hit out, and actively but cautiously launch foreign activities"—and waste no time in analyzing the situation, drawing up policies, and adjusting their plans. The experts too have used all opportunities to take the initiative to explain the situation to the outside world in order to gain their understanding and support. The difficult situation notwithstanding, the fields last year still managed to reach eight new cooperation agreements or letters of intent on cooperation, advancing international cooperation substantively beyond what had already been achieved.

(Responsible editor: Ge Yaoliang [5514 5069 5328])

Management of "863" Plan

91FE0059D Beijing ZHONGGUO KEJI LUNTAN [FORUM ON SCIENCE AND TECHNOLOGY IN CHINA] in Chinese No 5, Sep 90 pp 28-29

[Article by Hu Haitang [5170 3189 2768]: "Management of the "863" Plan"]

[Text] The development of high-tech and high-tech industries has a special need for highly efficient and high-level organization and management. In foreign nations, equal stress is put on management, money, and man, or "3M," considered the three basic elements of high-tech development. It is often said that China's S&T level and production equipment trail that of developed nations by a dozen years and even scores of years. In fact, China's level of management is even more backward than its S&T equipment. If you are well equipped but lack highly efficient management, productivity still will not improve.

This explains why back in the early stage of the "863" Plan, Chairman Song Jian [1345 0256] and Vice Chairman Zhu Lilan [2612 7787 7061] already showed a good deal of interest in the organization and management of the program, demanding that its implementation not only produce achievements and qualified personnel, but also add to our experience in reform and management. In view of the fact that the "863" Plan is a national command strategic plan that tries to catch up with developments on the forefront of high-tech around the world, an arduous task, we must fully mobilize the initiative and enthusiasm of all sectors and all experts and scientists involved in the program. Only by treating the entire nation as a single chessboard and through vigorous cooperation can we accomplish the task. Hence we arrived at the following general principles of implementation: emphasize a high degree of centralization, unify command, break down sectoral and regional boundaries and implement an expert committee responsibility system under the guidance of government agencies. Principled regulations governing organization and leadership, planned management, funding management, securing of materials, international cooperation and exchange, qualified personnel, information security, and awards and punishments were also laid down.

Certainly, as the program is being implemented in an historic era with the old and new systems coexisting with one another, the management of the program is ridden with problems. So improving the management of the "863" Plan remains an urgent problem. As Vice Chairman Zhu Lilan told a conference, "High-tech differs fundamentally from conventional technology. More than the latter, it is more management-intensive. Not only that, but it also needs a different form of management. Whether the program is well managed or mismanaged may have a direct impact on its success or failure." She said, "We are used to the supervisory mode of management for applied technology or the executive style of management for the ordinary kind of technology. High-tech management, on the other hand, is catalytic. High-tech management demands that the manager be learned and probe the laws and characteristics of high-tech management. It is not a question of simply managing men, materials, and money. Instead, it is planning and organizing tasks in a coordinated way both in temporal and spatial terms. The manager must be able to determine the extent to which science is socialized and the extent to which management should be scientific, thereby helping to determine the appropriate management procedures." In recent years Comrade Zhu Lilan has also stressed time and again, "To improve the management of the "863" Plan, we must further improve the macro regulatory and control system, the support service system, the policy-making-and-management-by-experts system, and the expert supervisory and evaluation system." I think these ideas and opinions are very important. We need to make a huge effort to study and understand them.

Proceeding from the basic principles of modern management, I think the management of the "863" Plan requires the establishment of the following five systems:

1. Policy-making command system. Its major responsibilities are to study and determine the overall direction, strategic goals, and plan of the nation's high-tech development; to consider and determine all principles, policies, and key measures; to select candidates to sit on expert committees in all fields and evaluate them; and to

be in charge of the program's organization, coordination, and inspection at a high level.

To ensure that the decisions are correct and effective, the system should structurally consist of four parts: 1) Organs in the State Council (the high-tech coordinating and guiding group of the State Council. Alternatively, a separate high-tech office may be set up under the State Council.) 2) Leading and functional agencies in charge of high-tech under the State Science and Technology Commission and the National Defense Science, Technology, and Industry Commission. 3) An expert committee for each field. 4) Domestic and foreign information gathering and research organs.

There will be a division of labor in policy-making between the various levels. State Council offices are primarily responsible for strategic decision (direction, goals, etc) at the highest level. The State Science and Technology Commission and National Defense Science, Technology, and Industry Commission make decisions regarding the planning, laws, rules, and regulations for the field in question as well as the selection and hiring of experts under the guidance of high-level strategic decisions of the State Council. The expert committee is mainly charged with making decisions to implement the strategic goals, technical lines, technical plan, and tasks in the field under its jurisdiction. As for organs charged with the gathering and study of information, their task is to supply the above-mentioned policy-making organs with a policy-making basis expeditiously.

Policy-making is a creative form of thinking. To ensure that policy-making is scientific, we must adhere to the level-by-level principle (functional differentiation in policy-making,) the principle of information (the foundation of policy-making,) the principle of forecasting (the basis of policy-making,) feasibility studies (the prerequisite of policy-making,) the principle of system (the soul of policy-making,) the principle of the group (the guarantee of policy-making,) and the principle of examination and approval (the authoritativeness of policy-making.) Accordingly we demand that in any policy-making organ, no matter what its level, the mix of personnel and the mix of their expertise be commensurate with the policy-making tasks entrusted to it.

2. Program execution system. Its main responsibilities are to organize and implement the various tasks in the program: regulate and control funds, materials, and the importing of qualified personnel; help resolve all problems in the program and organize the evaluation, reporting, and diffusion of cooperative exchanges and achievements that emerge in the course of program implementation.

To ensure the smooth execution of the program, the system should organizationally consist of three parts: 1) Leading and functional agencies of the State Science and Technology Commission and National Defense Science, Technology, and Industry Commission that are in charge of high-tech. 2) Leading and functional organs of the relevant departments that are taking on "863" Plan tasks. 3) Expert committees and expert groups.

The State Science and Technology Commission and National Defense Science, Technology, and Industry Commission should assume overall responsibility for the macro regulation and control as well as organization and coordination between the sectors and localities in a field and between the different fields. They should mobilize the enthusiasm of all sectors and localities involved for supporting the "863" Plan and actively promote its completion. Ministries and commissions taking on "863" tasks should incorporate the plan into their own plans and, using their own administrative organization, administrative tools, and administrative methods, expedite the successful implementation of the "863" Plan. The expert committee and expert group are the principal executing body for the program. They are directly responsible for the breakdown of principal, topics and special topics, bidding, selection, evaluation, implementation, as well as appraisal of the way in which the program is being carried out and reporting.

3. Support service system. Its main responsibility is to ensure the successful organization and implementation of the "863" Plan and supply funds, materials, information, personnel exchange, international cooperation, imported technology and equipment, capital construction, transfer of achievements, publicity, authorized level of personnel, work environment, and other support services as appropriate and as necessary, and actively create a good environment favorable to the implementation of the "863" Plan.

The entire task should be the joint responsibility of pertinent functional agencies under the State Science and Technology Commission and National Defense Science, Technology, and Industry Commission the functional agencies of the relevant ministries and commissions under the State Council, and the science and technology commissions of the provinces and municipalities involved. They are required to turn on the "green light" to support the "863" Plan within their own respective jurisdictions.

4. Information transmission and feedback system. The principal responsibility of this system is to promptly transmit and feed back all kinds of information in the course of implementing the "863" Plan, provide the information for implementation and inspection without delay, and furnish a basis for policy-making command and effective control.

Information feedback requires a complex of channels. One, one can rely on the expert management system and transmit information level by level as follows: sub-topic topic special topic group expert group expert committee State Science and Technology Commission. Two, conduct in-depth investigations to dig up information directly. Three, open information exchange and transmission channels with all departments taking on "863" tasks. Four, establish special information and information research organs.

5. Supervision, examination, and evaluation system. Supervision, examination, and evaluation is an indispensable part of management. Its essential purpose is to assess how units and individuals are discharging their responsibilities and how tasks are being carried out and to examine a project in earnest before it is accepted. The idea is to inspire a sense of responsibility, initiative, and creativity and mobilize, consolidate, and utilize people's enthusiasm to the maximum, and accomplish the tasks as planned even more effectively and successfully. Through supervision, examination, and evaluation, we should be able to differentiate clearly between achievements and errors, rewarding the former and punishing the latter. On the one hand, we must foster a healthy atmosphere and encourage the commending of outstanding individuals and advanced deeds. On the other hand, we must curb evil unhealthy trends and punish improper conduct and ways. Supervision, inspection, and evaluation may take place level after level in accordance with the principle of management at separate levels. In addition, outsiders may be recruited to form special groups depending on the needs of the task. Furthermore, we need to build up ties with the departments and science and technology commissions at the provincial and municipal levels and put them under the supervision of the departments and the masses.

These five systems dovetail with one another, constituting a network of management for the "863" Plan. Some functional departments may undertake one responsibility, others may have a dual responsibility.

(Responsible editor: Ge Yaoliang [5514 5069 5328])

Zhu Lilan on Formulation, Implementation of "863" Plan

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[Article by Zhu Lilan [2612 7787 5695], vice chairman of the State Science and Technology Commission: "The Formulation and Implementation of the '863' Plan"]

[Text] An outstanding feature of the global new-tech revolution since the beginning of the 1980's has been that the competition in high-tech and new-tech industry has completely moved beyond competition between private industrial groups to become the flash point in international and inter-bloc competition on the military, political, and economy fronts. To gain a solid foothold in this era, maintain a measure of developmental momentum in a few key fields, and keep pace with the forward march of history so that new-tech and high-tech will effectively serve national economic development, four elderly scientists, Wang Daheng [3769 1129 3801], Wang Ganchang [3769 3227 2490], Yang Jiaxi [2799 1367 2898], and Chen Fangyun [7115 5364 0336] sent a letter to the CPC in March 1986 in which they proposed that we track strategic high-tech development in the world. The letter received the utmost attention and powerful support from leaders of the CPC Central Committee. Subsequently, following full deliberations and successive amendments by over 200 scholars and experts and after consideration and approval by an enlarged meeting of the politburo of the CPC Central Committee and State Council, a "High-Tech Research and Development Program" (that is, the "863" Plan) emerged across China as our response to the trend of the times and the challenge of the S&T revolution. It has become the second tier of China's S&T development strategy or the heart of our effort to catch up with high-tech.

1. The Objectives and Guiding Thought of the "863" Plan

All developed nations consider high-tech development an important part of the national strategy, pouring into it huge amounts of human, material, and financial resources. In light of the actual conditions in China, this country will remain unequipped to invest in high-tech on such a scale for a long time to come. The top priority for China's S&T work right now is to expedite the technical transformation and realize the goal of quadrupling the gross value of industrial and agricultural output by the turn of the century. Most of the forces in S&T as well as the bulk of S&T personnel must be deployed on this main battlefield. However, we must pay full attention to the enormous impact of high-tech on future economic development and take measures starting today to make a long-term high-tech development plan and create conditions for lifting the standards of China's economy by the end of this century and the beginning of the next.

High-tech R&D intended to help realize strategic objectives by the end of this century was provided for in the Seventh 5-Year Plan. The "863" Plan, on the other hand, is mainly intended to serve economic construction and national defense and security by the end of the century and especially the early part of the next century. It aims to concentrate some of our best S&T forces on a few of the most important high-tech fields to catch up with international standards and narrow the gap between China and the world in the next 15 years, at the same time struggling to make breakthroughs in areas where we have an edge. As far as selecting R&D objectives is concerned, the general principle is "integrating the military with the people, with emphasis on the latter." The principal goal is to serve national economic construction, train personnel, and build up staying power.

The "863" Plan puts forward 15 principal topics in seven fields as its development focus, namely biotechnology, aerospace technology, information technology, laser technology, automation technology, energy technology, and new materials. The program can neither embrace every high-tech field nor include all the work in any particular field. All it can do is to make plans commensurate with the nation's capabilities, setting limited goals with clear priorities. A key project is normally required to come up with a tangible product. In the case of a handful of large projects, they are also expected to develop a laboratory prototype. Subsequent equipment development or new product trial-manufacturing may be funded separately or incorporated in another national plan as needed. Moreover, selected key projects promote S&T advances in other related areas through a diffusion of technology.

2. Policies and Measures

1) Concentrate forces and centralize command. Break down sectoral and geographical boundaries. Concentrate our strengths and resources to ensure that the plan is implemented. The execution of a project follows a selective bidding system. Evaluation is performed by an expert committee and tasks are assigned to units and individuals best equipped to accomplish them. Instead of sectors and units divvying up the funds, they go where the projects go. Special funds are spent for specific purposes. The implementation of the program, inspection, the evaluation of bids, the appraisal of milestone achievements and their diffusion are carried out by the State Science and Technology Commission and National Defense Science, Technology, and Industry Commission. Major policy decisions and coordination are the responsibility of the high-tech planning and coordination guiding group under the State Council. The chairman and vice chairman of the guiding group are Comrade Song Jian [1345 0256] and Comrade Ding Henggao [0002 5899 7559], respectively.

2) Cooperate assiduously to achieve close coordination. The implementation of the program must make full use of China's existing laboratory equipment and working conditions. Cooperate horizontally in a variety of ways. Organize the units taking on tasks into soft research institutes and joint development centers, utilizing the strengths of each of them and tapping their potential. So far seven joint centers of various types have been established.

The implementation of the "863" Plan must dovetail with relevant projects in other S&T programs, such as the "Torch" Plan and the key S&T projects program. They should supplement one another and avoid unnecessary duplication. The diffusion of achievements of a milestone nature must be coordinated with other diffusion plans in order to turn them into productive forces to generate economic benefits promptly.

3) Establish a clear administrative and technical responsibility system. Technical and administrative leaders are appointed for each project, giving them duties, responsibilities, and rights in the hiring and selection of personnel, the formulation of a plan, the assignment of tasks, and the use of funds. There is an expert group for each project and an expert committee for each field to make use of experts in consulting, evaluation, guidance, and policy-making management.

4) Rely on and utilize young and middle-aged experts. The "863" Plan is to be continued to the end of the century and into the early part of the next. Pay special attention to the training of the younger generation of S&T personnel. Select outstanding young and middle-aged experts from across the country and place them in key positions to make full use of them. At present the average age of expert committee members for the five civilian fields (namely biology, information, automation, energy, and new materials) is 52, about 31 percent of them under 50 years of age, and the youngest is only 29. The average age of expert group members is 49, about 68 percent of them under 50.

5) Pursue international cooperation vigorously. The program has been pursuing international cooperation and exchange through an array of flexible diversified ways, including multilateral government-to-government relations, bilateral relations, and various private channels. Such contacts have begun to pay off. Altogether 21 cooperation projects have been proposed by the five fields and been approved.

3. A Summary of the 11 Main Topics in the Five Civilian Fields Under the "863" Plan

1) Biotechnology. The purpose of developing biotechnology is to better satisfy the people's nutritional needs and improve the standards of health in the next century. The major projects are: (1) new animal and plant varieties that are high-yield, high-quality, and disease-resistant; (2) new medicines, vaccines, and gene treatments; (3) protein engineering.

2) Information technology. Goal: concentrate on cutting-edge technology that promises major breakthroughs by the beginning of the next century and has extensive potential applications. Major topics: (4) intelligent computer systems; (5) photo-electronic device and micro-electronic and photo-electronic system integrated technology; (6) information retrieval and processing.

3) Automation technology. To meet the needs of the new generation of automated production technology that turns out a variety of highly efficient high-quality products in small batches for industries that respond quickly to the market and have a high rate of product turnover, we have been following and studying the key technology of the computer integrated automated manufacturing system and built a demonstration production line. Three different types of intelligent robots have been developed for accurate assembling, operating 300 meters under water, and operating in adverse environments. Major topics include: (7) computerized integrated automated manufacturing system (8) intelligent robots

4) Energy technology. Major topics are: (9) coal-burning magneto-fluid generating technology; (10) advanced nuclear reactor technology

5) New materials technology. Major topics are: (11) key high-tech new materials and modern materials science and technology.

4. The Implementation of the "863" Plan (The State of the Five Civilian Fields)

A development outline for the "863" Plan was worked out before October 1986. Expert committees for the fields were assembled by February 1987 and expert groups for the topics, by July. The division of tasks was completed by late 1987. The program was put into effect across the board beginning in 1988.

1) How work has been progressing

(1) Straighten out thinking; clarify strategic goals.

In each field the goals of the program by the year 2000 as well as its near- and medium-term objectives were discussed in order to straighten out thinking and set priorities clearly. If a project can come up with a target objective, that must be pursued vigorously. Also, in view of the fact that high-tech is fast-developing and ever-changing, we demand that short-term objectives be stressed and the incremental nature of the program be taken note of. Last year the strategic objectives of the fields of biology and automation were examined and approved. This year the same will be examined about the strategic objectives of other fields.

(2) Launch a joint battle involving major projects.

The implementation of research tasks in the "863" Program uses a combination of decentralized research and joint effort. In the case of an exploratory topic, individual small-group research is more appropriate, whereas for a project with a major target product, there is a need to pool resources from multiple disciplines to put limited funds to the best possible use. Hence the need to establish research bases. Three major projects in the fields of information and automation, for instance, have set up research centers, namely the photo-electron center, the CIMS experimental engineering center, and the robotics engineering center. The establishment of a center, from site selection to the performance of a task, combines competition with the selection of the best, with the expert committee inviting its peers to review the feasibility report. In the course of implementation, forces from all quarters are pooled, conditions are created, and outstanding individuals in the nation are invited to concentrate their energies on the research tasks of the center. For instance, in the case of the CIMS experimental center, over 40 experts from seven research institutes and two schools under six ministries and commissions were housed under one roof at Qinghua University where they completed the project's initial design in just a short 6 months. Many units in the nation have been approaching it in hopes of getting a share of the research of the experimental project or becoming its application units.

(3) The annual plan is being carried out satisfactorily, bearing tangible fruits.

In the course of implementation, all the fields have largely succeeded in providing for each task, complete with inspection and supervision. According to preliminary statistics on 1989, of the 101 special topics and 866 subjects subdivided from the 11 projects in the five fields, 15 percent were implemented properly, a vast majority were completed as planned, and 1.1 percent were poorly executed. Remarkable progress was made in many projects. In the field of biology, rice breeding achieved great success. In the intelligent computer project in the field of information, the creation of an inventory of hand-written Han characters has passed technical evaluation. In the robotics project in automation, research in eyesight has made rapid headway. In new materials, research on metal-base composite materials used in space flights has made significant advance. In the case of less satisfactory projects, the expert committee has either readjusted them or terminated the contract.

(4) A large-scale inspection of the financial work under "863" Plan was also conducted last year. In general, financial management has been good, with the bulk of the units strictly enforcing the program's financial management regulations. They feel that they got funds for the program only after beating out their peers through competition; the money was hard-won. They also feel that it is essential that the reputation of the program be preserved. Accordingly, all the experts calculate carefully and budget strictly, operating in ways that would get things done with the least money. Their highly responsible spirit is commendable. As a result, it has been decided to reward advanced units and individuals and circulate a notice criticizing a small number of questionable units and individuals based on the results of the inspection.

2) Further tighten and improve the management of the "863" Plan

(1) Improve the expert committee management system Practice proves that it is a correct policy to manage the "863" Plan with the expert committee system. The expert committee embodies a major piece of reform in the S&T management system and is gradually showing exuberant vitality. Last year we completed the evaluation of the expert committees and expert groups. The results of the evaluation prove that the academic opinions of the experts, which take in the whole situation, reflect high-tech development trends in the world today and embody the level of learning of the nation. They have been praised by well-known elderly scientists in the country as well as their peers. As run by the experts, both the selection process and the bidding process have been quite fair. Efficiency has also increased. A vast majority of the experts have an extremely strong sense of responsibility. They work very hard and truly realize the "863" Plan spirit: "be fair, seek truth, cooperate, and innovate," dedicating themselves and making important contributions to high-tech development in China. Because this is a new mechanism, many things must be experimented with through practice, reviewing experience constantly in order to make improvements. As the program proceeds in depth in the future, we must endlessly

explore ways of implementing management by objective and process management even more successfully.

(2) Make the work of the "863" Plan more open. To keep in touch with other sectors and coordinate the "863" Plan with other S&T plans and tasks in order to win even more support from the sectors and localities, we report to the ministries and commissions concerned the management methods and operating mechanisms of the program as well as the breakdown of topics in the various fields and how it is being implemented. Reports are also made to the CPC Central Committee at regular intervals through bulletins and annual reports, copies of which are sent to ministries and commissions involved to obtain the supervision and support of all agencies and non-"863" Plan experts. It can be said that by now the agencies involved have achieved a measure of understanding of the situation in the program, which is no longer a complete novelty to them. They are also taking effective steps to support the "863" Plan. Both the Ministry of Electronics Industry and the Chinese Academy of Sciences, for instance, have put the program on their leaders' agenda.

To expedite the commercialization of the program's achievements of a landmark nature, the State Science and Technology Commission, the National Defense Science, Technology, and Industry Commission and the Merchant Shipping Group have jointly created the China International High-Tech Company, Ltd, and set aside a small part of the "863" Plan funds as seed money to finance the company's commercialization's of the achievements of the "863" Plan. This sum of money is not a free grant; it has to be paid back by a set date.

The 1990's are full of opportunities and difficulties for us. It is also an era filled with challenges and hope, one in which we can capture a S&T strategic position. In China's undertaking of high-tech development in the future, we must increase our sense of urgency and our sense of national pride and confidence. We must rouse ourselves with enthusiasm, unite and cooperate with one another, concentrate our intellectual resources on the S&T challenge and win the active support of all parties concerned. When that happens, China's quest for a place in the worldwide high-tech race will succeed. We are "capable of coming up with a number of things in high-tech that are the most advanced in the world." (Deng Xiaoping's words.)

(Responsible editor: Ge Yaoliang [5514 5069 5328]

'Torch Plan' Still Guides High-Tech Development

91FE0180A Beijing RENMIN RIBAO in Chinese 19 Nov 90 p 3

[Article by Deng Shoupeng [6772 1108 7720] of the State Council Development Research Center: "Torch Plan Looks Toward the 90's"]

[Text] Looking at certain high-tech achievements that were made during the 1980's, whether in the area of information technology, biotechnology, space technology, marine technology, new materials technology, and new energy resource technology, most were integrated with economic construction and had obvious commercial value and economic benefits. Estimates indicate that the yearly output value of high-tech industry in China accounts for about 6 to 7 percent of our GNP at present while over the years China's total investments in the high-tech realm also account for about 6 to 7 percent of total state investments in construction, so the two items are roughly equivalent. As an industry with high added value, high-tech industry, besides making an indirect contribution to output value due to its permeation of other industries, the output value it achieves has not made a sufficient direct contribution to GNP, and there is substantial potential. We must adopt measures for further improvement of efficiency in high-tech industry and gradually increase the proportion of high-tech industry's contribution to the national economy.

The view that S&T are now primary forces of production is now being accepted by increasing numbers of people. High-tech achievements must be converted to commodities and enter the market before they can diffuse their technical functions and achieve their economic benefits, which is also being understood by greater numbers of people. To promote the circulation of high-tech toward industry, we must formulate guiding plans adapted to commodity production to provide additional guarantees. After a long period of deliberation and preparation, the Torch Plan, which is linked to attacks on key high-tech problems and high-tech tracking, was formally initiated in July 1988 after approval by the CPC Central Committee and State Council.

Since implementation of the Torch Plan to promote high-tech industrialization and increase overall economic vitality and competitiveness, in a situation of broad support and divided responsibility for investments in all regions, departments, and enterprise and business units, 283 state-level and 528 regional-level Torch Plan projects had been arranged by the end of 1989 for a total investment of 2.87 billion yuan, 2.4 percent of which was guiding capital provided by the State Science and Technology Commission. Now, most of the projects are being implemented as planned.

The Torch Plan is one of six major national and comprehensive S&T plans now being implemented in China. It is being implemented in parallel with the "863" Plan, the "Plan to Attack key S&T Problems", the "Torch Plan", the "Spark Plan", and the "Bumper Harvest Plan". Each have their own emphasis and are mutually complementary to form an S&T plan system that covers the entire range of high and new technology and traditional technology. These plans are important measures for new S&T strategy decisionmaking and implementation management during the period of reform and opening up and are effective tools for promoting S&T progress in China during the 1990's.

High technology, which is established on a foundation of modern S&T achievements, is more effective and more efficient that traditional technology. In the overall view, emerging high-tech should replace outdated traditional technology as soon as and to the greatest extent possible and. This is an irreversible law.

However, high-tech industry is a modern industry that is knowledge, technology, and capital-intensive, so developing nations cannot attack along the entire line. It can only be done by carefully selecting certain industrial strong points to concentrate inputs and make breakthroughs. At present, reinforcing the development of high-tech industry in China depends on widely absorbing inputs from "all the five senses" that come from all areas. This means absorbing knowledge inputs from scientific research academies and institutes and institutions of higher education that have the strength of high-tech achievements and development; absorbing product inputs from large and medium-sized enterprises and S&T enterprises which have productive capabilities; absorbing financial inputs from financial organs and credit organizations which have capital reserves and funding networks; absorbing policy inputs from legal, planning, administrative, taxation, insurance, foreign trade, customs, and other departments that have certain types of administrative authority and transfer and control measures; and absorbing public opinion inputs from news, cultural, artistic, and other types of consciousness departments which have propaganda forces and broadcasting intermediaries. In summary, we should gradually form an S&T environment, economic environment, policy environment, and public opinion environment that provides social understanding, support, and participation in progress in developing high-tech industry.

Practice has shown that the Torch Plan is a guidance-type plan for developing high and new technology industries in China and the results of its guidance are rather prominent. The less than 100 million yuan in guiding capital that the State Science and Technology Commission has input over the past 2 years has attracted 3 billion yuan in capital inputs from local government and enterprise and business units. In the future, we should reinforce guidance in the following areas: guide high-tech in transforming traditional industries, guide high-tech in accelerating growth, guide high and new technology product batch production, guide healthy development of high and new technology development regions, provide a catalyst for and nurture high-tech industry base areas, and guide the participation of high-tech industry in international competition and cooperation.

Syntone Group Plays Important Role in 'Torch Plan'

91FE0225D Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 11 Nov 90 p 1

[Article by Correspondent Yu Zhuoli [0205 0587 4539]]

[Text] An enterprise directly under the Chinese Academy of Sciences and a leading enterprise in the Beijing New Technology Enterprise Development Experimental Zone—the Beijing Syntone Group established for 6 years has actively engaged in the unification of technology with economics. It has promoted the implementation of the "Torch Plan", and has established a model for joining hands with large and medium enterprises in developing new technologies.

Currently, the company has already developed nearly one hundred important S&T projects. Three of them were awarded international gold medal, five got national patent rights, three received the title of best selling product by the Beijing New Technology Enterprise Development Experimental Zone, six got the Beijing S&T Achievement Award, and three made in the State-level "Torch Plan" Projects List. As of the end of September 1990, total sale amounted to 400 million yuan, taxable profit, 30 million yuan, and foreign exchange earned over U.S. $5 million.

Established in November 1984, Syntone immediately engaged in developing new technology activities using CAS's as its S&T support base. Following the results of market research, it converted many of the CAS's achievements into commercial products. With the accumulated fund and technical capability, they started "Syntone Technology Development Fund" to selectively absorb the domestic and foreign S&T achievements, convert them into products and finally market these products. Such products as the interference-resistant pressure-stabilizing electric power supply, K-NET local network, city traffic computer control system for Surface Control and traffic monitor system, Kexin Chinese/Western-Alphabet Language Processor, ST-286H Advanced Micro-computer, etc. All these are of short-term development, fast capital turn-over, "short chain" or "medium chain" new-tech items. In the second half of 1987, this company, following the market demand, beginning from research, and then development, test and production, developed a small number of "long chain" products. They are the ST-IMS 88 Model Ion Mass spectrometer which was patented by the Chinese Academy of Sciences on 21 September 1990, and the patented ST-NS/1000 mini-supercomputer now being assembled and tested.

Syntone has adopted the model of "joining hands" with large and medium enterprises to promote the implementation "Torch Plan", and established the structure of "two ends done inside and the middle done outside", which means that the research and development and sale service are done inside the Syntone company. The middle, the production process, is done outside by large or medium companies. This "joining hands" model has made the most of new-tech enterprises and large or medium enterprises' initiatives. That is how Syntone puts out its new products.

While Syntone pushes for domestic market, it also treats the competition in international market as its strategic target. In August 1990, they put out a notebook-like interpreting-talking machine. This is especially convenient for those English-speaking tourists or officials to learn Chinese and translate English into Chinese. They may use it to learn Chinese also. On 2 September, this machine along with the company's earlier product, Marco Polo Intelligent Integrated Software, received the official prize at the 1990 American Inventors Annual Conference.

National Natural Science Foundation's New Measure for 1991

91FE0282M Beijing BEIJING KEJI BAO [BEIJING SCIENCE AND TECHNOLOGY NEWS] in Chinese 5 Jan 91 p 1

[Article by Gu Yue [0657 2588]: "National Natural Science Foundation Makes New Stipulations for 1991 Natural Science Fund Applications"]

[Text] The National Natural Science Foundation recently issued a national notice that it has made new stipulations concerning applications to the Natural Science Fund in 1991. The main aspects include:

1. Applications received for projects are stipulated as being free application projects, youth science fund projects, regional science fund projects, and high technology new concepts and new ideas exploration projects.

2. All units should strengthen guidance and coordination work, make strict checks, and sift through superior project applications which have new scholarly ideas, have sufficient theoretical foundations, have major scientific significance, or have major applications prospects, and they should be concerned with protecting intersecting discipline projects and projects with uniquely creative scholarly ideas to protect the enthusiasm and creativity of scientific research personnel and the reputations of units where they are located, and conserve manpower, finances, and materials.

3. Those applying to the Natural Science Fund should be scientific workers who hold Ph.D.'s or equivalent levels and are under 35 years of age. Equivalent levels refer to mid-level and above specialized technical professionals.

4. Yunnan Province has been added to the nine provinces and autonomous regions of Inner Mongolia, Ningxia, Xinjiang, Qinghai, Tibet, Guangxi, Hainan, Guizhou, and Jiangxi originally specified for funding assistance by regional science funds. Regional science fund applications submitted to these provinces and autonomous regions should also be submitted to local province and autonomous region science and technology commissions and administrative departments and bureaus.

5. High technology new concepts and new ideas exploration projects should submit directional applications based on individually prepared project guides.

6. Acceptance will begin on 1 Jan 91 and end on 31 Mar 91.

7. All applications to these science fund projects shall use new edition general purpose application formats and make the corresponding in computer recording procedures.

8. Special stipulations will be made during the period in which applications are accepted concerning application methods for major projects and key projects to the National Natural Science Fund.

Song Jian Emphasizes High-Temperature Superconductor Research

91FE0308B Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 6 Jan 91 p 1

[Article by reporter Wang Jianmin [3768 1017 2404]]

[Text] State Council Member and concurrently State S&T Commission Chairman, Song Jian, today at the "Superconductor Target Strategy Symposium" emphasized that superconductor technology is a high-tech item of important practical value and huge developmental potential, and a breakthrough in high-temperature superconductor theoretical and applied research can start a new technological revolution. In the Eighth 5-Year Plan there will be even greater national support in this field, and R&D will be organized for a key S&T attack project. All that can be done will be done to assist the S&T world to overcome the difficulties, and to improve working conditions for scientists.

Song Jian said that in developing superconductor technology, application must be the strategic target, and at the same time that attention is given to research into superconductor theory, there should be development, and as quickly as possible, manufacturing of practical superconductor materials that can satisfy the needs for their application. Only in this way will there be a basis and possibility for application and development that can serve economic construction.

Song Jian strongly emphasized that the development of China's superconductor research and practical application must be done by steady, good quality, and well drilled research units, and it is especially important that young scientists be among them. A core of solid, high-tech- knowledgeable young scientists must be ready by the beginning of the next century. Based on our experience in the 1950s and 1960s, an organized "campaign" in the front areas of scientific research is the best way to train young scientists to get results and develop talent. Several "campaigns" on the high-tech front areas must be organized in the Eighth 5-Year Plan. Superconductors is one such area, and the best idea is to have over half of the youths participate in such "campaigns", in order to create, as much as possible, conditions better suited for cultivating young scientists.

Song Jian further pointed out that expanding international cooperation and exchange is the tide of the times, and an important trend in current scientific development; and it is the necessary road to the development of high technology. Once China's high-temperature superconductor research got started, this question was looked into, and it found to be very necessary. Hereafter, China will continue to open up to the outside, and strive to create a good international environment for front area science, and assure that scientists and technicians in the front area science "campaigns" can participate in international cooperation and exchange.

Song Jian also wants to see industrial elements involved in the field of superconductor research, and further progress of the "National Superconductor Experts Committee", and "National Superconductor Technology Joint R&D Centers", and further reliance on the successful experiences of specialist to organize and manage the S&T attack.

Song jian also represents the various experts on the State Council Superconductor Experts Committee, and he expressed his appreciation of the young Chinese scientists who are struggling on the superconductor research front, and congratulations to those who have already achieved results.

Developing High-Tech Enterprises Discussed

91FE0180C Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 12 Nov 90 p 3

[Article by the State Science and Technology Commission Information Center, State Science and Technology Commission S&T Promotion and Development Research Center, National Defense Science and Engineering Commission National Defense S&T Information Center, State Education Commission S&T Management Center, Chinese Academy of Sciences Policy Bureau and S&T Policy and Management Science Institute, and Chinese Academy of Social Sciences Technical Economics and Econometrics Institute: "Some Views on Development of High-Tech Industry in China"]

[Text] Editor's note: Beginning in 1987, the State Planning Commission, State Science and Technology Commission, National Defense Science and Engineering Commission, State Education Commission, and Chinese Academy of Sciences jointly established and organized a research collective to study the development of high-tech industry in China and to discuss strategies, routes, and models for the development of high-tech industry in China, the policy environment, the profound effects of high-tech industry on society and the economy, and many other questions. These research activities aroused widespread interest in China's theoretical circles, S&T circles, enterprise circles, financial circles, and relevant administrative departments of the government and played an active role in promoting the development of high-tech industry in China.

Not long ago, the "four commissions and one academy" held a conference in Beijing in conjunction with relevant leaders from the Chinese Academy of Social Sciences and more than 40 experts and scholars to summarize their research achievements so far, analyze the political and economic situations in China and foreign countries, study the current situation and issues in the development of high-tech industry in China, and explore routes for sustained, stable, and coordinated development of our national economy and high-tech industry during the 1990's. Comrades at the conference were unanimous in their view that the opinions and suggestions from the "four commissions and two academies" concerning the development of high-tech industry in China were very important and called for them to be embodied in the Eighth 5-Year Plan to promote further permeation of traditional industry by high-tech industry, more quickly form China's own advantages in several high-tech industries, and truly shift development of China's national economy during the 1990's onto the direction of making S&T progress the guiding force, and improve China's strategic status in international political and economic competition. This article is a publication of the opinions and suggestions made by the "four commissions and two academies" for further discussion by everyone.

I. The Urgency and Importance of Developing High-Tech Industry

China is now in a period of economic readjustment. Now, we have controlled inflation and reduced the loss of balance between supply and demand, but our achievements in the areas of labor productivity and the industrial structure are less than we had hoped for. The root of the problem lies in the fact that conventional measures are not sufficient to achieve a basic solution to quality and efficiency problems on the supply side. S&T factors must quickly and truly be converted into an important part between economic strategy and economic measures.

New technology and the corresponding new organizational forms in production, allocation, circulation, and social life and promote the increasingly effective utilization of nature and transformation of their environment by human society. The leading edge of new technology today is high-tech.

1991 is the first year of the Eighth 5-Year Plan. The ideas behind formulation of the Eighth 5-Year Plan will affect development and progress in China during the final decade of this century.

What will the last decade of the 20th Century be like? The conventional wisdom is that it will be a decade during which a new technological revolution centered on microelectronic and information technology will have widespread effects. All nations will face challenges and it will offer them opportunities. If we make mistakes during this 10-year period, China will lose in capability to complete internationally completely.

Practice and discussion over the past several years have led us to have a more profound understanding that the significance of developing high-tech does not lie simply in increasing the proportion of high-tech industry and greater competitiveness of high-tech products in international markets. An even more essential meaning that the ability of all economic activity to shift toward a new technical and economic norm. This norm develops because high-tech industry groups have already become the primary force in the world economy, which means that it concerns the question of whether an entire nation keeps pace or falls behind in facing this profound revolution.

We feel that the development of high-tech industry includes the two areas of the development of high-tech industry itself and the use of high-tech to transform the entire economy. Thus, this is a core issue in China's economic development strategy. It can be said that the economic takeoff in China during the latter part of the 20th Century is a question of industrialization against a background of the high-tech era and the development of high-tech must be the most vital promoting force.

II. The Current Situation and Problems that Exist in China's High-Tech Industry Development

Other the past 40 years, we have establish high-tech industries including the aviation, aerospace, nuclear energy, microelectronics and computer, bioengineering, photoelectric and communications engineering, maritime development, new materials, automation, precision instruments, and other industries. In 1987, the output from high-tech industry in China exceeded 70 billion yuan. We have also relied on our own efforts to make several noteworthy high-tech achievements such as the "two bombs and one satellite" [atomic and nuclear bombs, artificial satellite], nuclear submarines, synthetic insulin, huge computers, high-temperature semiconductors, and so on.

We have established and are now in the process of forming high-tech enterprises and high-tech enterprise groups, and some high-tech products have already entered international markets. The Xiongmao [Panda] Electronics Group established in 1987 is an example. This is an industry group which is led by famous-brand electronics products and includes components production enterprises and microcomputer production enterprises, and it has absorbed participation by scientific research organs, institutions of higher education, financial, commercial, and materials organs to form its own competitive advantages.

Since reform and opening up, scientific research organs and institutions of higher education have done some rather successful exploration in the area of discussing patterns and routes for the conversion of high-tech and new technology achievements into forces of production. This includes transferring S&T achievements in contractual arrangements to localities and enterprises, working with localities for jointly establishing high-tech and new technology parks, starting knowledge and technology-intensive high-tech enterprises, and so on. Practice in these successes has revealed their vitality in construction of the national economy, and they have derived considerable economic benefits.

Although China is still weak in international competition in high-tech industry, because of China's high-tech industry and scientific research staffs numbering 3 million employees including 400,000 S&T personnel, and their obviously successful exploration in the new situation, this is an indication of the potential and prospects for China in developing high-tech industry.

However, we must soberly take note that the development of high-tech industry in China still haves many problems and difficulties, the main ones being:

1. The lack of a sufficient understanding of the important strategic position of high-tech industry. We have not made it the core content of S&T progress and included it in overall deployments for construction of the national economy or allowed it play its role in the process of readjusting the industrial structure.

2. The state lacks an overall strategy and macro coordination of high-tech and other industries. Departments and localities form their own systems which lead to severe dispersion of manpower, finances, and S&T resources, which were already extremely limited, so it is hard to form overall advantages.

3. Policies are not matched up and technology imports are not integrated very well with domestic R&D, new product development, and so on. Instead, they have shocked scientific research and the development of high-tech industry.

4. Financial channels are not open and certain financial channels have single targets and short-term behavior. With the additional separation, they are unable to play the role they should.

5. There is disjointing between scientific research and development, scientific research and production, and the military industry and civilian uses, so it is very hard to form a situation with open channels for the shift of skilled personnel, achievements, information, capital, and so on between scientific research and production.

6. We lack the skilled staffs required for high-tech industry. High-tech industry is a knowledge-intensive, capital-intensive, and management-intensive industry. It require excellent training and skilled S&T personnel and it also requires all categories of personnel to face intense competition inside China and in foreign countries. Although we have a high-tech industry R&D force composed of several 100,000 S&T personnel, too few skilled personnel are truly capable of satisfying this requirement, and we especially lack skilled young people.

7. China's large and medium-sized enterprises even today still lack an urgent requirement for S&T progress. Enterprise growth relies on expansion and extension their R&D inputs and existing technical capabilities are still very low.

III. Based on China's National Conditions and a Respect for Laws, Take a High-Tech Industry Development Path with Chinese Characteristics

The development of high-tech has its own regularities. It requires a foundation of research and depends to an even greater extent on market demand. The formation of high-tech industry is process of successful technical innovation, so it requires successful technology and requires even more the conditions and environment for the commercialization of high-tech achievements.

Integrating with our national conditions and adhering the laws of high-tech industry development itself, attention should be given to the following questions in developing China's high-tech industry:

1. High-tech industry and traditional industry should be closely integrated and mutually promoting. To a substantial extent, the development of high-tech industry must rely on traditional industry and basic industry, and the formation of scale economies in high-tech industry depends on its ability to expand into and permeate other industries. In another area, the primary force in China's economy is still traditional industry. In conjunction with increasing national strengths, transformation and raising grades and replacement of traditional industry, the state must rely on high-tech. As a result, central and local scientific, technical, and economic programs and plans must be integrated at this high level. The deployment of resources must embody the guiding role of high-tech industry for overall economic development, and it must meet the need to coordinate development of high-tech industry and traditional industry.

2. Deal properly with the relationship between international and domestic markets. Internationalization is an important attribute of high-tech industry. The main sources of technology and supplies of and markets for components in high-tech industry are international in character. Practice in China in recent years has proven that for high-tech industry, there is domestic competition but international competition is still in the background. Thus, high-tech development must certainly be oriented toward international markets and strive to achieve an optimum combination of the factors of production on an international scale. Product and technology indices and performance-price ratios must make competitiveness in international markets their goal. Unlike nations in which emerging industries have developed rapidly in recent years, China has a broad domestic market and has formulated flexible unified international and domestic market strategies for different industries and products which aid in taking advantage of our large national economy to develop high-tech industry in China.

3. The mutual reliance of high-tech industry on the regional economy and society and reinforcement of bidirectional relationships. The ability of high-tech industry to develop in a healthy manner in a particular region is restricted by the local economic structure, industrial foundation, support technical and administrative conditions, quality of the labor force, and other factors. In another area, the development of high-tech industry can promote regional support processing and services and can lead to the relative concentration of skilled personnel and information to create a configuration of mutual complementarity and competition among industry groups, play a role in demonstration and stimulation of the pioneering spirit, and further stimulate new investment pioneering activities. Thus, regions should formulate economic development strategies that include high-tech industry that are adapted to their own locations to form an industry structure and optimum choices of realms suitable to their own region. In addition, the relationship between central authorities and localities, the relationship between central enterprises and the regions in which they are located, and so on must be readjusted to a new level.

4. The relationship between high-tech industry and the national defense industry. Integration of military and civilian industry, joint promotion, and coordinated development is the basic model in all worlds nations for high-tech industry development. After 40 years of construction, China' national defense industry has already formed a rather good foundation for high-tech industry development, and some technologies have already attained advanced international levels. However, the closed and separated management system that has formed over a long period severely obstructs fostering the advantages of the national defense industry and has negative effects on the diffusion and permeation of high-tech industry into other industries, and the national defense industry is still incapable of playing a larger role in development of the national economy. The question of how to take the route of military and civilian industry integration and utilize the existing technical advantages and production foundation of the national defense industry to develop high-tech industry concerns the state's selection of routes for high-tech industry development and is the source of a solution for further development of the national defense industry in a changing international and domestic situation.

IV. Be Concerned with Formulation of Industrial Strategies and Technical Policies for High-Tech Industry Development in China

The core of an industrial development strategy is the selection of priority realms and its significance is that it is the basis for the allocation of resources to all levels in the overall situation. The collect selection of priority realms is essential for making full use of limited resources and achieve rapid breakthroughs in important realms.

High-tech industry often refers to an industry group with unclear boundaries, so consideration must be given to the following factors in deciding which industry is a development priority:

1. Promote exports or aid in import substitution;

2. Have diffusion effects on other economic sectors;

3. Conform to a nation's resources, economic development levels, and traditional characteristics, and meet that nation's economic and social development needs;

4. Aid in fostering that nation's scientific research, production, labor force, and other advantages.

A high-tech industry strategy is part of an economic strategy, so the most important thing is diffusion effects and the degree of adaption to a nation's economic development situation. Priority industries are those industries which play a key role in the development of other industries and provide a common technical foundation to overcome "bottleneck" links and promote development of all industries and even the entire economy. In addition, priority industries are not the same as omnidirectional development. Instead, they require the selection of technical realms for making breakthroughs in industry levels before they can focus on breakthroughs via limited goals. Only this type of strategy has relatively high controllability.

The importance of high-tech industry and the key role of S&T in economic growth mean that they place entirely different and higher requirements on the role of government in guiding economic development. Now, central authorities and local areas should make a strong effort as quickly as possible to organize their forces and, with a guiding ideology of integrated economic development, they should formulate truly feasible high-tech industry strategies and technical policies and select the main priorities within the three levels of industry, technical realms, and key technical products, integrate them with R&D, technical importing, and technical transformation plans and with investment plans, formulate and integrate with the corresponding policy measures, and enter them into the normal operating sequence of the Eighth 5-Year Plan.

V. Establish Mechanisms and Management Systems To Aid High-Tech Development

Compared with traditional enterprises, the main attributes of high-tech enterprises are: close integration of scientific research, production, and marketing; short product lifespans, strong competition, and high risk; and a need to orient toward international markets and participate in international competition. This attributes require high-tech enterprises to have different pioneering mechanisms, operating mechanisms, and management systems than the usual ones. During 10 years of practice in reform, there are certainly several enterprises (including both large enterprises with several decades of history and several 100 million in output value as well as small high science and technology enterprises that have spring up in recent years) which have begun to make excellent achievements. However, at present the two categories of high-tech enterprises have still not established very good relationships of mutual complementarity, whereas a symbiotic relationship between large enterprises and small high-tech enterprises is essential for healthy development of high-tech industry.

High-tech enterprises must still continually carry out reform in their management system and high-tech enterprises should be provided more rights over their administrative decisions under rational regulation, control, and supervision to make these enterprises capable of carrying out pioneering, and management and develop in a healthy manner according to the characteristics of orienting toward markets, flexible response, and other characteristics that are required to develop high-tech.

The S&T development companies that were newly-established in recent years are still young and the property rights relationships are clearer and simpler. It would appear that we cannot continue to delay a normalized management system for trial implementation in them first based on the principles of shareholding. The shareholding system helps clarify the property rights relationships of this category of enterprises which depend mainly on public capital and the administrative responsibilities of enterprise management groups.

Science parks, high-tech industry development zones, and so on are one important way for high-tech industry to grow and develop. Their goal is to create an optimum local environment to promote high-tech industry development. These parks and zones have developed very quickly in China in recent years and there are now several 10 of them at various locations and levels. The State Council recently has been preparing to approve a specific number of state-level key parks and regions and some local governments and departments are also thinking of establishing them. Many of the parks and regions have truly been successful, but in looking at the development situation in existing parks and regions, their role and uniqueness are not yet apparent. This is particularly true of the rather significant differences in the new operational mechanisms and management systems that they have established. Development of the parks and regions themselves is facing many difficulties and problems. As a result, we must solemnly and conscientiously summarize experiences and do intensive research on the construction and deployment of these parks and regions to enable them to develop better and play a greater role in the national economy. This is an important task at the present time.

VI. Create the Environment, Policies, and Support Structure Required by High-Tech Industry

The development of high-tech industry requires an excellent environment as well as a series of support structures and government policy supports. The most important factors among them are markets, finances, and personnel. In the two categories of high-tech industries, the first category involves large-scale investments and greater state support and intervention. The other category may be able to achieve self-growth according to economic logic. Both categories, however, require an environment adapted to their development and all must strive to develop within competition. Creating an appropriate environment for high-tech industry is an important responsibility of government. At present, although central authorities are re-emphasizing state planned management, we also must foster the role of the market. In actual work, however, we are often "indiscriminate", with the result being that many high-tech enterprises are faced with a lack of planning channels as well as markets with incomplete competition, so they are encountering the dual obstacles of plans and markets. Thus, perfecting state plan management functions and perfecting market functions are both important.

Among supporting conditions, the most important is finance, especially in a situation of a shrinking money supply and economic readjustment, when capital is an even more important restricting factor. To promote the development of high-tech industry, there should be corresponding readjustments in the financial system, including the establishment of special financial organs to make risky investments, the establishment of long-term credit banks, the establishment of risk capital, and starting up loan insurance services to provide long-term low-interest loans in order to promote the further development of capital markets, opening up securities markets, and so on, and they should be integrated with the relevant state policies.

Skilled personnel is another important factor that restricts the development of high-tech industry. High-tech industry requires S&T entrepreneurs who understand technology, understand management, know how to manage, and have an innovative spirit. Many successful entrepreneurs have come forth in China in recent years, but it the overall picture they are unable to meet the requirements of high-tech industry both in number and quality. Thus, an urgent task is to make a firm effort at training and creating this type of skilled personnel at all levels.

Supporting conditions include the establishment of information, commercial, managerial, and other advisory service systems according to international norms. The policies associated with high-tech industry mainly concerning taxation, credit, allocation, foreign affairs, foreign exchange administration, import and export rights, and so on. Further attention must be given to ways to formulate appropriate policies and ensure the stability and continuity of policies. We also should stress quick formulation of protection policies and competition policies to benefit high-tech industry development in China to implement protection from outside, guide equal competition in China, and prevent inappropriate and blind importing.

The primary role of government lies in the following areas:

Formulation of high-tech industry strategies and state coordination, organization, and implementation by levels. At present, China already has a 5-year plan to attack "key S&T problems", the 863 Plan, the Torch Plan, the establishment of state laboratories and engineering centers, and so on. The question of how to organically integrate these plans and integrate these plans with economic plans and 5-year economic development plans urgently requires solution.

The state should intervene in those key projects and realms which have a rather strong promoting and permeating role in the entire national economy. The advantages of the socialist planned economy should be embodied and fostered in this area. The intervention here includes the usual directive-type plans as well as greater use of laws, meaning legislation to promote the development of the relevant industries.

For regular high-tech industry, besides providing preferential policies, the state also should promote the full growth of markets and permit their self-development and should not intervene excessively.

For "seed" technologies which affect or determine the development of high-tech industry, R&D on key technologies, and the application and diffusion of these technologies, the state should provide support.

VII. Fully Foster the Role of Government, Research Institutes and Academies, Institutions of Higher Education, and Enterprises in the Development of High-Tech Industry

Research academies and institutes and institutions of higher education play an important role both in establishing a national defense S&T industry foundation and establishing new types of high-tech companies. China's S&T is detached from the economy at present and relationships of scientific research organs with institutions of higher education and enterprises are impeded. There is insufficient technical progress in enterprises and they have a weak capacity for absorbing high and new technology. It is both necessary and beneficial for institutions of higher education and research organs to organize several high-tech enterprises which benefit small-scale flexible administration. This sort of pioneering activity could make historical contributions to high-tech development in China. Of course, the main role of research academies and institutes and institutions of higher education in high-tech industry development continues to be making contributions and producing talented people. Industry and scientific research and education are certainly activities with different scopes and they have different operational mechanisms and management models. We feel that the primary role of research academies and institutes and institutions of higher education in industrial development is to be incubators for high-tech industry. As soon as the enterprises begin to grow, they should release them and allow them to develop. To enable research academies and institutes to play an even greater role in development of high-tech industry and the national economy, we should reinforce the weak link of intermediate testing, accelerate construction of engineering centers and intermediate testing base areas, and provide support in capital and capital construction.

The role of enterprises in high-tech industry development is self-evident. Suitable support policies should be provided for large high-tech enterprise groups as well as medium-sized and small high-tech enterprises to allow them to foster their particular advantages and develop smoothly.

Reform and opening up has allowed high-tech industry development in China to leap up to a new stage and brought hope and confidence for China's achievement of two development phases. However, it does not have a solid and thick foundation like traditional industry and our experience in managing this type of industry is incomplete. Thus, any policy deviations can have significant effects. We hope that the party and government will treat high-tech industry as an urgent strategic issue, prepare plans and make deployments for it as a guiding factor in national economic development, and that it will formulate good policies and measure for it. Then there would be great hope for high-tech industry in China and substantial hope for economic invigoration and takeoff in China.

High-Tech Enterprises Want To Compete Internationally

91FE0226B Beijing JINGJI RIBAO in Chinese 3 Dec 90 p 3

[Article by Li Guoyou [2621 0948 0645] and Zeng Hong [2582 3163]]

[Text] The goal of the strategy of accelerating the development of China's high-tech industry is to deliver high-tech enterprises to the forefront of international competition and to establish the corresponding supporting structure and environment.

In order to achieve this goal, there must be adjustments in perception and methodology;

First, achieve the effective coordination and technology, personnel and capital. The experience obtained in China and abroad demonstrates that to advance technology to the forefront of production, the real difficulty is not with technology and the scientific community. In fact, China has somewhat of an edge in this area. The difficulty is not in capital either. Rather, it is the effective coordination of technology, personnel, and capital. This coordination comes from the state's strategic planning, supportive structure and environment, quality of entrepreneurs, and the degree of participation in international competition.

In China, the hiatus is in the economic arena. There is a lack of modern business administrative personnel or there is a lack of an environment for such personnel to effectively operate. Personnel in government, professions, education, and science find it hard to cope with the demand of development. Even when the personnel are suitable there is a problem of effective utilization. It is very difficult to circumvent economic and enterprise development strategy and still achieve the benefits from accumulative and collaborative activities.

Second, China's development and long-term benefit must coordinate with the world's framework of development. In order to make the operating system close to that of the international community, China should not give in to the departmental and regional short-term benefits. It is important to follow international protocol, including the use of international market prices to measure achievement of enterprises, and the use of international competition capacity to measure pluses and minuses. In addition, loans, capital investment, taxation, restructuring, merging, and import-export enterprises all need to be treated accordingly. As the supporting structures materialize, the ability to induce and control enterprises will increase. In so doing, enterprises may gradually be able to participate in international competition.

Third, initiating changes in governmental function following the world's competition framework. This means that the government should strengthen its guidance and service capability, expand the intermediary semi-governmental and management-type support organizations and reduce governmental direct management. Practice tells us that administrative reform does not depend on departmentalization. It is the use of induction in numerous areas that can initiate the formation of new functions. This will in turn induce old functions to gradually recede or change directions. It is also very important not to attribute the commercialization and internationalization of high-tech merely to new arenas and new trademarks of old functions. Goals, personnel, functions, structures and administration have to fit one another. Basic concepts, standards, operational systems must be unified so that related governmental agencies can galvanize on the aim of international competition and enterprise advancement.

In conclusion, strategies and organization must be established according to the competition timetables, so that the process of turning science and technology into productivity can be set in motion. Otherwise, China cannot attain a respectable level of international competition.

Healthy and complete supporting structures and environment should meet the needs for high-tech commercialization and internationalization in building roads and bridges for enterprises.

Of the science and technology loans (currently 2.5 billion yuan, to increase in the next 3-5 years to 30 billion yuan annually) that are developing, the productivity depends on whether the supporting structure is fit for internationalization, including the induction of business, reorganization, and item selection, the opening of markets, and the provision of intra-country enterprises and entry to the international market. This is also required in changing China's technological development type of research academy to scientific and technology enterprises (corporations).

The modern trans-national enterprise strategy and its implementation is the effective responding system in the rapidly changing international market and its fiercely competitive set-up. It is also a classical combination of highly centralized planning and fiercely competitive marketing.

"To deliver the entire high-tech enterprise and its supporting environment and conditions to the international market"—its strategies and procedures call for using trans-national business enterprises; this is also international protocol.

We suggest that from now on, a special task force with no special departmental interest and concerns represented should be set up. It should follow modern procedures, to research and study the work needed to be done to achieve such a strategic goal. It should also concern itself with the gradual implementation of time-honored international experience and methodology down to various levels of management and enterprises. It should establish and execute unified strategy and procedure.

Establishment of Inland High-Tech Industrial Development Zones

91FE0059A Beijing ZHONGGUO KEJI LUNTAN [FORUM ON SCIENCE AND TECHNOLOGY IN CHINA] in Chinese No 5, Sep 90 pp 18-20

[Article by Du Xiangchen [2629 4382 3819]: "Thoughts on the Institutional Setup and Development Strategy of Inland High-Tech Industrial Development Zones"]

[Text]

I.

The establishment of export-oriented high-tech development zones inland is the latest wave sweeping the nation after the opening of the four special economic zones and 14 coastal cities. The basic purpose of the development zones is to create a sectional favorable environment, attract funds and technology to develop an export-oriented economy and high-tech industries, and turn the zones into an export-oriented economic zone, high-tech industrial zone, and a test zone for system reform in order to promote the economic development in the interior and expedite its opening to the outside world. However, these development zones, which were created after 1988, have been far less lucky than their earlier counterparts; they have been confronted with a string of challenges and choices from the very beginning.

In the summer of 1988, China's macro-economy entered another period of retrenchment. Superficially, the impact of the retrenchment on the zones was a shortage of capital construction funds, directly hampering the creation of "tangible conditions" in the zones. At a deeper level, it has a ripple effect on investment by industrial and commercial enterprises, investment indispensable to the industrialization of S&T achievements. These two kinds of fund shortages have become a "bottleneck" in the operation of development zones. On the one hand, every local government has the utmost enthusiasm for the development of a zone. On the other hand, it has very limited financial resources to support it. Thus development zones find themselves in a bind.

However, even as money was tight in China and development zones were faced with a dual fund shortage, a huge flow of capital was circulating robustly overseas. Ever since the New York stock market crashed on "Black Monday," 19 October 1987, stock markets in the West have been moving up and down, quickening the outflow of international investment from stocks. This outflow necessarily created a large amount of idle international capital desperately searching for a safe haven, a favorable investment climate. According to estimates, idle funds in the international capital market amounted to about $1,000 billion in 1988. Overseas investment by West Germany alone was a high 120 billion marks that year. The oversupply of international capital has continued to gather steam since 1989.

Domestically, urban and rural residents had 576 billion yuan in bank savings as of April 1990. In addition, they had an estimated 200 billion yuan in cash on hand. This shows that absolutely speaking there is no lack of funds in society in China. It is just that social funds are not evenly distributed, that the principal investor we rely on, the government, is low on funds. Not enough research has been done on the desirable destination and conditions of idle social funds, a subject we know little about. Nor do we have any idea as to what specific policies and measures to take to channel social idle funds into the development zones, end the old investment pattern, and create a new situation featuring multi-unit major investments. The various preferential policies promulgated earlier certainly have played a useful role, but since they are widely adopted by all provinces and regions, even municipalities and counties, they have lost their special appeal and become policies of "generalized preference." Clearly it will not work to rely on them to attract idle social funds.

In this sense, although the fund shortages facing the development zones are two-fold, they remain superficial. What we really lack is a good investment climate and institutional and operating mechanisms that the creation of this kind of climate requires.

II.

The industrialization of S&T achievements requires a combination of S&T and financial investment. Whether foreign or domestic, an investor must first consider the investment climate. No doubt the "tangible conditions"—water, electricity, gas, and transportation—are crucial. Practice proves, however, that investors, particularly overseas investors, pay even closer attention to the "intangible conditions"—policies, laws, rules, regulations, style of work, efficiency, and the quality of the cadres, etc. "Intangible conditions" often are the decisive factor in an investor's decision-making.

The kind of climate relied on by international capital for its survival is the developed market economy, an integrated, efficient, and authoritative management system. To steer international capital into China's socialist economy, a commodity economy that is still undeveloped with imperfect market mechanisms, and make it grow is itself an unprecedented undertaking. Accordingly, we must integrate the improvement of the investment climate with structural reform, dovetailing one with the other, in order to establish a socialist market system with Chinese characteristics and create a sound economic climate suited to the development of foreign-funded enterprises. The extent and success of reform will ultimately decide the extent to which the investment climate can be improved and with what degree of success.

In the final analysis, if we are to attract foreign and domestic funds to development zones, we must make investors feel that we have built an outstanding investment and business environment where there is a market order that promotes fair competition, where government is efficient, honest, and trustworthy, where investors' legitimate rights and interests are fully protected under the law, and which gives the best return on investment. Only such an environment can stimulate the investors' enthusiasm to invest and operate in development zones.

Located in the central plains, the Zhengzhou Development Zone is not blessed geographically like the coastal port. If it is to attract idle funds, it must put the creation of "intangible conditions" before that of the "tangible conditions." Plagued by serious fund shortages, we should make a huge effort to improve the "intangible conditions" when the zone is founded, quickly creating "intangible conditions" compatible with international commodity economic competition and giving it legal protection. This may solve the problem of fund shortages.

If inland development zones are to become high-tech industrial zones, a "window" to the outside world, they must begin by becoming demonstration zones for reform. The objective of the overall development strategy of inland development zones should be two-fold. On the one hand, there is the construction objective, which is to turn the zone into a new high-tech export-oriented industrial zone. On the other hand, there is the structural reform objective, which is to create highly efficient operating mechanisms that will fully bring out the superiority of socialism. These two objectives are complementary and bring out the best in each other.

It was in the 1970's that the large-scale construction of high-tech parks and assorted special economic zones got under way around the world. Judging from the way successful development zones are managed, most have three characteristics. One, they are on good terms with national administrative organs and have considerable managerial power. There are relatively few layers in the institutional setup for economic activities. They have substantial authority and can make decisions on their own. Two, the principal investor is not the government. Most of the funds for building the development zone come from the selling of bonds and investment by financial institutions or industrial and commercial enterprises. The responsibility of the government is limited to creating favorable "intangible conditions." Three, institutions in the development zone are clearly stated in legal documents.

Coastal development zones in China at present mainly fall into three categories in structural terms. The first category is epitomized by a management committee that combines government administration with enterprise management and is highly centralized. The director of the management committee serves concurrently as leader of the zone's development corporation, combining administrative with economic managerial power in one person. Because of the centralization of managerial power and the uniformity of institutions, orders and prohibitions are strictly enforced, reducing the lack of coordination and disputes over trifles in economic activities. This system is rather efficient in the early days of the development zone. In the second category, management is also by a management committee, but government administration and enterprise management are separated and there is an appropriate division of power. The management committee of the development zone and the functional agencies under it exercise overall administrative, legislative, and supervisory power and provide public services. This system requires a large administrative and managerial staff and layers of organizations, which militates against managerial efficiency. In the third category, management is completely along the lines of an enterprise. The entire development zone itself is a company in the form of a corporation or a Sino-foreign joint-stock company that organizes all economic activities as a legal body. The development zone per se does not discharge government responsibilities or possess managerial authority. Instead, it is the appropriate local government and the various departments in charge that are directly responsible for administrative management, supervision, and public services.

In light of both domestic and foreign experiences, the following considerations should be borne in mind when designing an institutional setup for an inland high-tech export-oriented development zone.

First, the role of the existing administrative management system. The administrative power of a local government includes the power to own assets, deploy and allocate capital goods, manage and oversee the economy, and reform the structure. These powers are in the hands of the array of functional departments at the provincial and municipal levels. In most cases the powers and preferential policies granted by a provincial government to a development zone fall within the jurisdiction of these administrative functional departments, without whose direct participation and practical support these powers and preferential policies may easily come to nothing. In putting together an institutional structure for the development zone, therefore, one must consider its relationship to the existing administrative setup organizationally and structurally.

Second, the role of the central city. For instance, the Zhengzhou Development Zone is inseparable from the central city of Zhengzhou, on which it depends for infrastructural facilities, public services, and the allocation of resources. It also relies on the city for related services, S&T, qualified personnel, and industrial products. In the early days of a development zone, in particular, we must follow the principle of "laying equal stress on four things," giving equal attention to opening the zone to the outside world and opening it to the interior. A development zone can do without the various kinds of support and help of the locality even less.

Third, avoid duplicating the traditional system. Reduce the levels of management, improve work efficiency, be just and honest, and provide good-quality services promptly. These are the objectives of administrative and managerial structural reform. And the administrative zone must achieve them ahead of others. Duplicating a ponderous and inefficient system totally deviates from the basic idea behind the establishment of development zones.

Fourth, creating a development zone in stages in the real world. Those who design the structure must consider its workability.

In view of the above, this writer thinks that before putting together the managerial institutions for a development zone, we may first consider setting up a "development zone work and coordination committee" to be headed by the leader of the local government and with the participation of people in charge of comprehensive agencies. The committee is to meet regularly in business conferences to solve the plethora of problems and issues that the zone encounters. This transitional arrangement can avoid the conflicts between the zone and the existing administrative system, on the one hand, and conflicts between the zone and the numerous functional departments.

III.

China's interior abounds in resources and, as the strategic hinterland for economic and technical development in China in the 1950's through the 1970's, boasts a formidable strategic and economic base. We should create intangible conditions capable of attracting overseas capital extensively with a relatively sound legal system and redirect the thrust of the drive to attract foreign capital to the market-oriented direct investor, stimulating the direct introduction of "capital and technology-intensive" industries. If we make this the basis of the development strategy for inland high-tech development zones, we may be able to map out a new path to attract foreign capital and develop high-tech industries, adding new driving force to the "Torch Plan." Toward that end, we may consider working along these lines:

First, establish a "development zone investment and service center" to devote itself full-time to publicity aimed at foreign investors, negotiations, liaison, service, etc. The focus of its work will be to establish contacts with overseas financial groups with substantial technical and economic muscle, such as large banks, large trade associations, multinational firms, and banking consortia, in order to thoroughly appreciate their investment intent and needs and adjust the zone's policies correspondingly and respond flexibly and quickly. Through the "overseas investment guide," it should enter into frequent contacts with them to exchange information, further understanding, and establish a relationship of trust. From among the network of contacts, we should zero in on promising projects and concentrate our energies on them to make them turn in a profit as soon as possible and hence serve a demonstration purpose by diffusing the achievements. As we attract projects to the zone, we may also use the channels to compete for commercial loans on preferential terms.

Second, attract serial investments from overseas. As our overseas ties grow in scope and depth, we should encourage carefully targeted investors to form technical and economic "alliances" based on both sides' actual circumstances and proceeding from a shared desire to gain a new competitive edge. As partners in an "alliance," these investors will enter the development zone together to operate systematically by collectively import related industrial facilities. (For example, they may go in for the comprehensive development of coal and bauxite.) This will strengthen the investor's ability to support one another. and will also be able to fully utilize our abundant resources and import foreign technology and funds on a large scale more rapidly. Third, select a number of new- and high-tech projects that have entered the industrialization stage and are ready for commercialization and have good export prospects for overseas announcement. Use technical achievements to attract foreign investors. Marry high-tech achievements with foreign capital to form new productive forces and develop new products, which can then enter the international market. Overseas scientific research achievements may also be disseminated and imported in this manner.

Fourth, work out a fund-raising strategy within the overall plan under which the land in the zone is divided into lots and land use rights can be sold for money, allowing the overseas investor to develop his lot or transfer the title to it as well as managing it on his own. Alternatively, lots in the zone may be sold in a public auction. The ultimate purpose is this: "I do the planning and divide the land into lots. You develop them and assume the risk. You make a profit; I collect taxes."

Fifth, do a good public relations job and create a favorable and trustworthy image. Open up dialogue channels and seek out overseas investors through all sorts of foreign connections.

In addition, we may consider selling for a fee residency rights, employment rights, and tertiary industry operating rights in designated areas in a development zone in order to draw "defense industry" production and scientific research units of the "third front" in the interior into the zone. We may also use this method to attract groups of qualified township and town enterprises to come to a zone for intensive operation, thus "importing" funds, technology, and qualified personnel in one stroke.

(Responsible editor: Zhou Li [0719 4539])

Hainan High-Tech Industry Development Plan Discussed

91FE0142C Wuchang KEJI JINBU YU DUICE [SCIENCE AND TECHNOLOGY PROGRESS] in Chinese Vol 7,No 5, Sep-Oct 90 pp 11-12

[Article by Xu Weitong [4958 3555 4227] and Zhao Peizan [6392 5952 3895]: "On Tactics and Models for High-Tech Industry Development on Hainan"]

[Text] The key to making Hainan a special economic zone is whether or not it develops high-tech industry and whether or not it achieves an economic takeoff.

I. Tactics for Developing High-Tech Industry on Hainan

1. Attraction tactics

High-tech industry zones in China and foreign countries are technology-intensive regions established on the basis of knowledge-dense areas to form high-tech industry clusters. Hainan, however, has backward S&T and no universities, research academies and institutes, or other knowledge-dense regions to serve as a foundation. Its traditional industry is weak and it lacks capital. How, then, can high-tech industry be established on Hainan, which is almost a complete blank in S&T, capital, and skilled personnel? What will attract imports? It must rely on preferential policies to provide an excellent investment environment for Chinese and foreign investors to come there.

Central authorities have already provided the Hainan Special Economic Zone with preferential policies to attract foreign capital. Most scientific research academies and institutes as well as institutions of higher education in China can serve as intellectual and technological backers for Hainan, and most high-tech industries in China can serve as cooperative partners with Hainan for joint utilization of Hainan's preferential policies to integrate most of China's scientific research academies and institutes, institutions of higher education, and high-tech industries to establish high-tech industry base areas and technology import-export markets on Hainan to participate in world economic and technical competition. At the same time, we should actively compete for foreign investors to establish high-tech industries on Hainan and thereby use Chinese and foreign high-tech industry to form new product production base areas on Hainan.

We should adopt a combined principle of "enticing birds to build nests" and "building nests to entice birds" to attract investors to establish a high-tech industry base area on Hainan. The goal is not importing. We should gradually digest during the importing process, continually train technical personnel and technicians, gradually form our own technical forces, gradually use our own strengths to replace imports, and gradually create our own high-tech industry clusters.

2. Management tactics

Establishing high-tech industry zones requires adoption of management tactics suited to the characteristics of high-tech industry.

The characteristics of high-tech industry are that it uses high-tech achievements as the primary technological content and primary resource input for industries that produce products with high added value. In the industrial structure, there is a high proportion of specialized technical personnel and large R&D expenditures, and it is innovative, comprehensive, and diverse. Because Hainan is in the initial stages of building a high-tech industry zone, the importing stage, foreign investments, independent investments, joint investments, joint ventures, and government-run and civilian-run activities coexist, as do various types of ownership patterns and management forms including ownership by the whole people, collective ownership, individual ownership, and so on. Thus, it should adopt a management method which integrates black, gray, and white management tactics.

Black management (also called black-box management): Management in which enterprise management departments only concern themselves with enterprise input and output is called black management. For example, an enterprise is an export processing enterprise established by individual investments by a foreign businessman (so-called enterprises with both heads outside). The enterprise is established as a bonded plant with customs, commodity inspection, taxation, and other departments carrying out supervision and management of the enterprise's inputs and outputs, but they do not manage any of the internal management affairs of the enterprise. We call this management method black management.

Gray management—equivalent to elastic management;

White management—equivalent to rigid management.

In high-tech industry zones, besides implementing black management for export processing enterprises established through independent investments by foreign businessmen, tricolor management is basically required for other categories of enterprises.

What is tricolor management? For an enterprise, higher-level management departments do not manage the internal affairs of an enterprise, meaning that the enterprise's internal knowledge is black. Only carrying out macro management of enterprise inputs and output is called black management. However, elastic control must be done to control the start of blind enterprise development of technical projects and economic and technical indices. This is gray management. At the same time, to protect state interests and the state's planned economy, planned permit management is implemented for some enterprise exports, domestic marketing proportions for foreign investment enterprise products, and so on. This requires rigid control and thus is white management. Thus, high-tech industry zone management departments basically implement tricolor management for most enterprises.

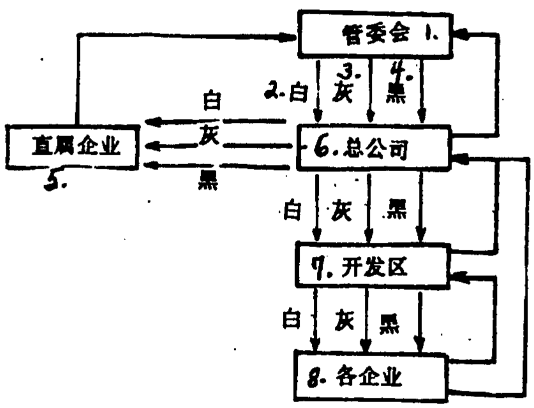


Figure 1. Tricolor Management System for High-Tech Industry Zones

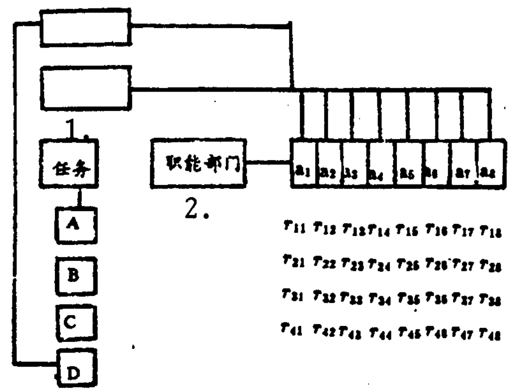
Key: 1. management committee 2. white 3. gray 4. black 5. directly-administered enterprises 6. corporation 7. development zone 8. individual enterprises

Black management is regulation of the scope of control of gray management, while gray management is regulation of white management or rigid control. Tricolor management is mutually coordinated for any particular level and tricolor management is mutually complementary for different levels. Thus, it can be said that tricolor management is a management method which liberates forces of production at systems levels. This black, gray, and white management method is abbreviated as tricolor management tactics for high-tech industry. Figure 1 illustrates the tricolor management system for high-tech industry.

The tricolor management system is a form of open system management by levels as well as a management model which pursues maximum benefits and efficiency and liberates enterprises and individuals to the greatest possible extent.

The concepts of systems theory state that systems energy comes from levels, that levels energy comes from factors, and that factors energy comes from the degree to which systems levels liberate factors. Similarly, the motive force for development in high-tech industry zone systems comes from the people involved in high S&T and the energy of people comes from the degree to which the management system liberates them. Thus, our tricolor management system must liberate systems restrictions to the greatest possible extent, foster their energy to the greatest possible extent, and also foster the energy of each level in the system to the greatest possible extent, thereby forming the motive force for overall development of the system.

High-tech industry zone systems implement an ambiguous array of relationships to organize their management structure, as shown in Figure 2.



$\underset{\sim}{R}$ is a matrix composed of a multifactor judgment, such as:

$$\underset{\sim}{R} = \begin{bmatrix} r_{11} & r_{12} & r_{13} & r_{14} & r_{15} & r_{16} & r_{17} & r_{18} \\ r_{21} & r_{22} & r_{23} & r_{24} & r_{25} & r_{26} & r_{27} & r_{28} \\ r_{31} & r_{32} & r_{33} & r_{34} & r_{35} & r_{36} & r_{37} & r_{38} \\ r_{41} & r_{42} & r_{43} & r_{44} & r_{45} & r_{46} & r_{47} & r_{48} \end{bmatrix}$$

$\underset{\sim}{A}$ is the tricolor management white, black, and gray tricolor weighted distribution array

$$\underset{\sim}{A} = |a_{ij}|$$

The fuzzy relational equation for three-shade management is: $\underset{\sim}{B} = \underset{\sim}{R} \odot \underset{\sim}{A}$

Figure 2. Array Organizational Management System for High-Tech Industry Zones

Key: 1. tasks 2. functional departments

Programs can be compiled based on the actual situation in management system levels to carry out computer ambiguity optimum management.

Professor Deng Julong [6772 5112 7893] has defined the parameters in system dynamics as gray code exclusive OR and plotted a region of indeterminate values [a,b] that has enabled the use of state spatial analysis in gray system states to solve system state equations, and he has suggested establishing the theory and methods of an indeterminate parameter state system model. We can use Professor Deng's method to establish a gray management state equation for our management system:

$$\bar{X} = Ax + Bu$$

We also can compile a program based on gray system management to carry out computer gray management.

Establishing a tricolor management system in high-tech industry zones gives each enterprise and individual complete freedom in the system and will inevitably enable the release of enormous energy. The reason is that tricolor management in the industry zone system is optimum-seeking management and optimal organizational control. As a result, there is competition in which the superior exists and the inferior is eliminated among economic units, among enterprises, among managers, and among producers, and so on. This sort of system is essential for high-tech industry zones to have development prospects.

II. High-Tech Industry Development Models

Generally speaking, there are two basic models for technological development. One is the technological development gradient model and the other is the technological development leap model. When technical levels in a country or region are very backward, but when there is an impetus from new advances or new breakthroughs in a certain technology, the main technical departments in that country or region are transformed and it takes a relatively short period of time for the process of raising overall technical levels to move to a stage that those who were originally advanced had to spend a rather long time to complete. They also can bypass certain stages and directly enter a new high-level stage.

Although Hainan now has a capital shortage, intellectual colonies (including college students and mid and high-level intellectuals) are flowing toward Hainan from inside China. They have the spirit of opening up and moving forward and excellent S&T and cultural qualities, so they are an army advancing toward high-tech. On the basis of achieving a transition to the initial stages in the high-tech gradient, this is the most important skilled personnel base area for adopting a leap strategy in Hainan's high-tech development.

Because there is mutual propulsion of Chinese and foreign technology, high-tech in Hainan must rely on forces coming from outside for "excitation" in order to be able to achieve leap development of technology. As technology develops in a leap, it inevitably will lead to leap development in Hainan's economy.

Shandong Promulgates High-Tech Development Plan

91FE0149B Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 6 Nov 90 p 1

[Article by reporters Zheng Tianfen [6774 3944 5358], Sun Shuxing [1327 2885 5281], Wang Jiannong [3769 1696 6593], and correspondent Wang Fengqi [3769 7685 6386]

[Text] **Editor's note:**

In planning and formulating the development strategy for the Eighth 5-Year Plan, the Shandong Provincial Committee and the Provincial Government took the lead in promulgating measures to accelerate the development of high technology and promote Shandong's economic vitalization. This will have a great impact on the remolding of conventional technology, on adjusting industrial output and product structure, and on building an economy that will be able to rely on local developments, and thus avoid the circumstances of market fluctuations; and it will also, thereby, serve to advance the people's economic construction. These actions will not only be a major impetus for Shandong's modernization and construction in the nineties, but will influence the course of economic development far into the future.

To advance the strategy of "Science and Education for a Prosperous Shandong", to get Shandong as quickly as possible on track toward reliance on S&T progress for economic rewards, and to ensure long term, continuous, stable, and harmonious economic development, the Shandong Provincial Committee, and the Shandong Government enacted the "Resolution to Accelerate the Development of High Technology and Promote Economic Vitalization of Shandong".

Inland and coastal development zones have been opened up in Shandong Province, and throughout the course of managing these changes the pace of reform and expansion was being stepped up gradually, and gains were made in the development of high technology and in industrial output. Now, the number of s&t personnel engaged in high-tech industrial production throughout the province is approaching 30,000, and each year more than 100 new high-tech items are being made, and the number of high-tech products now makes up 10 percent of all new items produced in the province. First to appear were electronic, biological, new material, new energy, and precision and chemical engineering high-tech enterprises. Five high-tech development zones are now under construction at Weihai, Qingdao, Yantai, Jinan, and Zaozhuang.

As the Shandong Provincial Committee and the Provincial Government see the economic development situation for the next 10 years, despite the fact that the key economic development targets for the province are ahead of those for the rest of the country, they still cannot avoid sticking to a extended and broad economic development model. The problems of high expenditures in economic construction, low efficiency, high input and low output still exist. Technology and facilities in industry are somewhat backward, products are not strong on the domestic market, and products that are exported are primarily raw materials and semi-finished products, and the exchange rate is set rather low. The problems of low levels of S&T and backward management become more evident with each passing day, and advantages that once appeared to be relatively favorable begin to fade away. In view of the above circumstances, the Provincial Committee and Provincial Government will employ the slogan "three bring alongs and one promote" as the overall guiding thought in working through the development of high technology and its production output; that is, use high technology to bring along the structural adjustment of industrial production throughout the province, to bring along the technological reform in conventional industrial production, to bring along changes in new products in the mainstay industries, and to promote a change in Shandong Province's economic strategy from an emphasis on extensive management toward an emphasis on collective management.

What the resolution says is that the development of high technology and enterprises, in basic principle, is purposeful unified planning, making complete setups, optimizing advantages, emphasizing strengths, combining initiatively developed and imported technologies, digesting, absorbing, and creating, and bringing it all into national production. The overall goal for the next five years is to speed up high-tech R&D, to create a high-tech enterprise atmosphere in key districts, to let it become the distinctive feature in key fields, and the model in key industries, and to help the reputation of key products flourish.

A particularly important target to be realized by the end of the Eighth 5-Year Plan is to attain a value of production in new, high technologies that stands above the national average. Throughout the period of the Eighth 5-Year Plan a continuum of "Spark Plan" targets will be pursued to develop high-tech products, to start new high-tech enterprises, and to increase the proportion of conventional industries undergoing high-tech reform, as well as the ratio of production value of high-tech products in the overall production value for new products, and to greatly increase the ratio of high-tech products among products exported for foreign exchange.

The resolution states that Shandong Province's main mission in developing high technology and enterprises is: 1. hasten the construction of high-tech development zones, and make them become S&T windows to the outside world and sources of diffusion within; 2. use high-tech to transform conventional industries, and in the mainstay industries, machine and chemical engineering industries, select representative large and medium backbone enterprises and graft high technology into their reform programs to raise their utility and make them take the lead in becoming prototypes for modernization and construction; 3. cultivate growth points for high technology and its production output, and give more support to what has already been accomplished, and bring along the development of secondary product development, and cultivate growth points in the conventional industries as well.

To accelerate the development of high technology there must be a support and safeguard system. For this, the Shandong Provincial Committee and Shandong Government have adopted several measures: increase investment, increase and improve construction of basic facilities, and set policy. The resolution presents a concrete plan that shows how to bring high technology and its production output out into the world, and how better to coordinate an all Shandong Province effort to organize for high technology and its production output.

Sheng Shuren on Using Electronics Technology to Reform Traditional Enterprise System

90FE0208ABeijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 4 Dec 90 p 1

[Article by Vice Commissioner Sheng Shuren [4141 2885 0088] of the State Planning Commission: "Using Electronics Technology to Reform Traditional Enterprise System"]

[Text] Editor's note: Electronic technology plays an increasingly important key role in the development of new technology in the world. Based on the need of future economic development, the State Planning Commission is planning the strategy to use electronic technology to reform the traditional enterprise system in the Eighth 5-Year Plan and tens years beyond it. This is a major campaign involving every industry in every region. It is a multi-level plan involving every orientation.

In the current global economic and technological competition, the common choice is to develop and apply electronic technology.

Since the late 1960's, a new technology revolution has swept the world due to the advent of electronic information technology which is represented by integrated circuits and computers. It opened a new avenue for productivity and allowed industry to take off producing a great deal of fortune. Industrialized nations such as the U.S., Japan and Western Europe countries are devoting their efforts to using new achievements in electronic technology to update their equipment in order to reform or reconstruct their manufacturing enterprise systems. In more than 20 years, they have fundamentally altered their traditional industries and established and developed electronics-related new industries. At the present time, developed nations and regions are leading far ahead in this aspect. They also maintain their own characteristics and competitive edges in the free enterprise system. South Korea, Singapore, Taiwan and Hong Kong are also successful examples of tremendous economic growth based on electronic technology despite a shortage of natural resources and abnormal structure.

The development and reform of productivity, and the optimization of combination of key manufacturing factors and effective modification of production process relies on progress in science and technology, especially on the degree of penetration of new technologies centered around electronics into tradition industry. We must have a clear understanding of this major trend in technological and economic growth.

However, while major progress was made in science and technology in the rest of the world and electronic technology was used in large scale, China was involved in the Cultural Revolution for a decade. Thus, the road to construction took a big detour. Since reform began 10 years ago, China has made tremendous progress in economic construction. Nevertheless, from an overall perspective, most of the huge traditional industry is still using outdated technology and equipment developed in 1950 and 1960. It consumes more, brings in less benefits, and there is a substantial gap between market demand and product quality and variety. Furthermore, it is not competitive in the world marketplace. Most of the technology and equipment imported in recent years have not been digested. We still cannot draw inferences about other cases from one instance and the coverage is limited. It even requires spending hard currency to sustain it. Although the electronics industry has made much progress in the past decade, its foundation is still weak. It has not yet established a large economic scale. It has a high dependency and low self-sufficiency. This is the bottleneck for every industry to modernize. The main objectives of technological progress in industry include quality enhancement, new product development, energy conservation, improvement of productivity and better utilization of resources. These objectives are achieved by adopting new techniques and manufacturing processes and by upgrading and modernizing equipment. Every industry has its own technology and unique characteristics. However, the common point is that technological progress in every industry depends on the development and application of electronics. The degree of penetration of electronic technology has become an indicator which is used to judge the extent of technical progress and modernization in every trade. It is imperative for us to use electronic technology to reform traditional industry in our economic development phase. If we cannot recognize this point and miss this opportunity, we will be making an error of historic proportion.

In the 1990's, it is expected that the basic form of economic and technological competition remains to be a mixture of mutual dependence and competition. Using electronics to push industry forward technologically is an urgent task for our traditional industry to face in 1990. In general, there are four areas to address.

1. Use electronics to reform traditional industry in order to raise technical level to gradually realize automatic control in production. The goal is to ensure product quality, raise productivity for large scale manufacturing, conserve energy and improve profitability. Every department and region must have a number of demonstration enterprises to upgrade the technical level and profit margin by using electronic technology.

2. Use electronic technology to upgrade product level in order to improve added value. The key is to combine new product development with electronics. This effort must address both domestic and worldwide market needs. We must mobilize every department. It will have to be a combined effort involving technical experts, workers and managers. It needs collective wisdom and creativity to achieve its goal. We have to work hard to create our own edge and develop some unique products to enter the international market.

3. Use electronic technology to improve development capability and management skill. The focal point is to develop and use computer assisted design and computer management information systems. This is a step we will have to take sooner or later in the process of management modernization.

4. Train a team of technical people in applied electronics with independent development capability. Every enterprise must try to attract talented people and train them effectively. During the Eighth 5-Year Plan, the following objectives ought to be achieved in using electronic technology to reform traditional enterprise system.

(1) Push 12,000 large and medium enterprises to develop and apply electronic technology.

(2) Make 10 percent of the manufacturing equipment in large and medium industries computer controlled. (The gauge used by the Bureau of Statistics is the total value of equipment.)

(3) Use electronic technology to conserve energy equivalent to 20,000 of coal.

(4) Develop and manufacture ten major types of integrated electromechanical products.

(5) Use computer management information system to lower production cost in large key industry by 10 percent.

(6) Train 1 million technical people in applied electronics.

This is the first time that we have used this kind of a strategy, i.e. using electronic technology to reform traditional enterprises, to push for technical progress in industry. In view of the fact that the huge and complex organization work which involves various disciplines and regions, the economic committees (economic planning or planning committees) of all departments, provinces and cities must coordinate with the relevant authorities to implement this idea. The scale, level and effectiveness of applied electronics within the system or region must first be surveyed in order to project the need for various electronic products to automate production and modernize management in the next decade. Then, based on the principle of "having a centralized plan, focussing on key issues, using joint effort, delegating responsibility at different levels," each department and region can set up its plan in the Eighth 5-Year Plan in applied electronics. This will be a special plan addressing the need for overall economic growth and social development. The plan should be drawn for each enterprise based on domestically manufactured electronic equipment. It depends on collaborated efforts of research, development and design between higher learning institutions and industries. The ultimate goal is to promote applied electronics, improve social and economic benefits, and making technological progress in industry. After formulating the plan, specific procedures required to implement such plan must be included in the economic and social development plan, especially in the industrial technology reform plan, for the Eighth 5-Year Plan in every department and region.

In addition, application of electronic technology should be regulated by technical regulations. The management of each enterprise must establish or update technical regulations such as technical standards, product standards, design guidelines and testing guidelines based on breakthroughs made in applied electronic technology in order to protect and ensure such accomplishments can remain in the technical system of a traditional enterprise.

Every department and region must link and coordinate the objectives of various plans such as key technical effort, technological development, technological reform, basic construction and employee education. When evaluating the accomplishment of technological development in electronics, the depth and breadth of its impact on converting traditional enterprise to production automation will be tracked and assessed. When technology reform plans are reviewed and evaluated, the degree of utilization of electronic technology will be determined. If electronic technology can be applied but is not included, the plan will be rejected. This step must be carefully controlled by the relevant official in each department and region. When reviewing technology import plans, we must control imports based on the availability of domestically manufactured electronic equipment in order to support our own electronic industry.

Every department and region must pay attention to new situations and problems and conduct some policy study. Within the scope of its authority, certain steps can be taken to promote such activity. Policy issues concerning the entire country will be studied by the State Planning Commission in conjunction with other relevant departments. Suggestions from various departments and regions are welcome at the State Planning Commission.

The world is a fast changing place and global competition in technology is a pressing issue. We can no longer afford to take our time to do things. We must be united and fight hard using the spirit of the Asian Games to push for the reform of tradition enterprise with electronic technology. In our struggle to meet new challenges, let us join hands to create a new phase of technological progress in industry.

Focus on Developing Electronics Industry Urged

91FE0180B Beijing RENMIN RIBAO in Chinese 21 Nov 90 p 2

[Article by Zeng Peiyan [2582 1014 3508], vice minister of the Ministry of Machine-Building and Electronics Industry; "Place Development of the Electronics Industry at a State Strategic Level"]

[Text] The world's electronics industry now has a boundless momentum is developing at a surging pace not seen in any other modern industry.

Comrade Jiang Zeming has clearly pointed out that "we certainly must strengthen our understanding of the strategic position of the electronics industry". His instruction has an extremely important practical significance and profound strategic significance.

Energy resources, materials, and information are the three main pillars of modern economic development. Information is an important resource that can play a multiplying role in the development of energy resources, materials, and the economy. A correct understanding of this issue is very important for developing China's economy from an extensive model to an intensive one.

Achieving our second strategic goal and third strategic goal in development of our national economy cannot be guaranteed by excessive consumption of materials and energy resources. Instead, we must make reducing consumption and increasing efficiency to basic principles of economic development. We should focus on raising GNP per unit consumption (energy consumption, materials, capital) and not simply by relying on expanding the scale of traditional industries to support economic growth.

The most realistic, effective, and important way to achieve this transformation is a major effort to develop the electronics industry and widely and extensively extend and apply electronics technology. Modern electronics technology which is center on microelectronics technology provides enormous potential for economic development. It can be said without any exaggeration that whenever any industry is integrated with electronics technology, an enormous leap can occur that will change the situation substantially. This cannot be compared with any other technology. Electronic information technology is the most advanced force of production in the modern world and its wide application is an indication that an extremely profound industrial revolution is imminent. Some developed nations have computers that can do the work of trillions of people. This is the equivalent to an enormous force of production!

We must have a common understanding of the importance of developing the electronics industry and place development of the electronics industry at state strategic levels. These questions now require resolution.

1. We must re-acknowledge the properties of the electronics industry. Many of our management departments even today continue to classify the electronics industry as a type of processing industry and even use the narrow concept of electromechanical integration to conceal an emerging industry with the greatest future. Now, it would seem, this sort of classification confuses the properties of the electronics industry. Most processing industries in China are relatively "long line" industries. By classifying the electronics industry as a processing industry, it is included within the scope of traditional industry, which restricts its development. The electronics industry uses a minimum of energy resources and materials consumption to carry out production with high

added value (the added value rate in output value of the electronics industry in some developed nations is more than 60 percent), so it is not a processing industry which is characterized by processing large amounts of the usual raw materials. This is particularly true for the microelectronics industry, which does its processing at the micrometer level. It uses more types of raw materials in smaller amounts that are ultra-pure and ultra-refined. These are the so-called "electronics grade" precision materials. These materials themselves are the products of high-tech. The electronics industry is a knowledge production industry which in addition to producing hardware also produces software in the form of knowledge. This is entirely different from regular processing industries. To overcome the limitations of traditional concepts, we propose listing the electronics industry as an information industry to distinguish it from regular processing industries and basic industries.

2. Raise our understanding of the electronics industry as a vanguard industry. The electronics industry is an industry which serves as an indicator of the technical levels of an era and the electronics industry must certainly be in the front ranks before it can promote and foster the development of other industries. It determines to a great extent the pace of economic development in China. The experiences and lessons of Western Europe deserve borrowing because they neglected the development of the electronics industry for a period of time, which created extreme passivity in their economies. For the past several years, Western Europe has pushed to catch up and is trying to reverse this passive situation, but because they have too many "debts" they will not be sufficiently effective in the short term. The electronics industry is an investment-intensive industry and the investment strength requirements for scientific research and capital construction are very high. Without expending national strengths, it cannot move forward, and even less will it be able to become a vanguard industry.

3. Correctly deal with the relationship between the development of traditional industries and the development of emerging industries. The relationship between traditional industries and emerging industries is one of mutual dependence, not substitution of one for the other. During the present stage of economic development in China, the development of emerging industries will become a major contradiction. If we fail to accelerate the development of emerging industries, we will achieve fewer successes despite greater efforts in traditional industries and our national economy will remain in an extensive state for a long time. In dealing with the relationship between traditional industries and emerging industries, we should begin with readjustment of the industrial structure and readjustment of investment policies and adopt appropriate slanted investments for emerging industries.

4. Deal properly with the relationship between imports and relying on our own efforts. The technology in China's electronics and information industries is backward and to avoid falling behind in national economic construction, it was necessary for us to adopt emergency import measures in the past. We feel, however, that truly high-tech people cannot be bought but instead must develop on the basis of our own forces. To achieve the four modernizations drive, China must establish its own electronics industry foundation or there is no other way out.

5. Increase our understanding of the complexity and difficulty of the electronics industry. It is a foundation of industry as well as based on the foundation of other industries. Systems and overall units of course have their own difficulty, but the difficulty of components, instruments, special devices, and materials is even greater. If we do not establish our own high precision special devices and materials foundation, talk of developing the electronics industry is meaningless. At present, the strength of capital construction inputs and scientific research inputs in China's electronics industry are all restricted within a single high-tech industry department. We must expend enormous effort to change this situation.

Editor: In the transition of China's industry from extensive management to intensive management, the electronics industry has a unique and important role. Comrade Zeng Peiyan's article offers several views with deserve attention and study. The development of the electronics industry and application of electronics technology is both an "industrial issue" and a question of a new technological revolution. Besides the suggestions in this article concerning how the electronics industry itself should develop, even more important are the questions of how all sectors and industries can absorb and apply electronics and information technology and how they can foster even better benefits in actual economic applications. In a certain sense, this is a question that is even more deserving of attention. Broad integration of electronics and information technology with all other industrial sectors is essential for truly attaining intensive management in the modern sense.

Jiang Zemin on Strategy of Developing Electronic Information Industry

91FE0428A Beijing ZHONGGUO KEJI LUNTAN [FORUM ON SCIENCE AND TECHNOLOGY IN CHINA] in Chinese No 1, Jan 91 pp 2-7

[Article by Jiang Zemin [3068 3419 3046]]

[Excerpts] Editor's note: "On the New Trend in the Development of the World's Electronic Information Industry and China's Strategy for Development" is an essay written by Comrade Jiang Zemin one year ago. In this article, Comrade Jiang put forth the idea of using electronic information technology as an enhancer for China's economy. A strategy was proposed to multiply the current level of national gross output value by improving the efficiency, reducing the consumption, and reforming the traditional industries. The article is an important guide for the formulation and implementation of China's Eighth Five-Year Plan and China's future direction for industrialization. We publish this article for further study and learning by our readers.

I. Introduction

The electronic information industry in the world enjoyed rapid development in the 1980's. In 1988, the output value of the world's electronic information industry reached a level of $587.5 billion. It is predicted that by the mid-1990's the output value of the world's electronic information industry will exceed that of traditional industries and reach a level of $1,000 billion. The enormous growth and wide application of electronic information technology have pushed the world into the so-called information economy era. Electronics has become the leading productivity indicator of developed nations in the post-industrial period.

In 1988 the output value of China's electronic information industry was 59.5 billion yuan and was growing at a rate of 39 percent. The rate of growth was very high indeed. Compared to the development of the electronic information industry in the world, however, China is falling seriously behind. The problem facing us is how to develop China's electronic information industry with limited national resources available for such effort. We must study the situation in China and in the world, especially the new trends in the development of the world's electronic information industry. By doing so, we may learn from the experience of other nations, seek opportunities to develop new strategies and meet the electronic information needs of the Four Modernizations.

The electronic information industry is an effective enhancer for China's economic development, and a prevailing new technology with high leverage. We should raise the development of electronic information technology to a strategic level and fully exploit the leveraging effect of the technology on the economy. By doing so, we would be able to improve the efficiency of our national economy, reduce consumption, make effective use of the existing steel, coal, electric power and petroleum resources and multiply our gross national production by several fold. [passage omitted]

II. Strategy for the Development of the Electronic Information Industry in China

The new trends in the world's electronic information industry development brought us inspiration and a golden opportunity. Today's international situation affords us an opportunity for peaceful construction. China will continue to implement its policy of openness and reform. All these conditions are favorable for developing China's electronic information industry although a number of difficulties remain. Faced with the problems, we should carefully contemplate our strategy.

1. Problems Faced by the Chinese Electronic Information Industry

Due to insufficient investment, the production and research of China's electronic information industry cannot meet the requirements of high-tech industry. The capital construction expenditure and the research expenditure are both about 1 percent of the annual gross output value. Compared with the investments made by foreign electronics industries, the investments made in China are below the threshold. (Some developed countries define high-tech industries as those industries with a research investment of about 10 percent of sales.) Because of the low level of investment, the development has been extremely difficult and the gap with the international standard is widening.

The Chinese electronic information industry is still basically a domestic-oriented industry. Exports account for only about 10 percent of the gross output value and the ability to compete on the international market is quite poor. The foreign exchange earned by exports is still less than the production foreign exchange provided by the state; it is an industry that still needs the support of foreign exchange.

The industrial composition of China's electronic information industry is based mainly on consumer electronics and development is still in the preliminary phase. The high-tech electronics needed in the Four Modernizations are mostly imported. In 1987 China imported about $3.5 billion worth of electronic equipment.

The rapid growth enjoyed by China's electronic information industry in the last few years was achieved using the technologies imported during the Sixth Five-Year Plan at an expense of $1.6 billion. Because of the rapid development in the electronics industry, a development policy based on import is not workable. To maintain a high rate of development, we must adhere to the policy of importing, digesting, developing, and innovating. Imports are used to promote development and innovation, and to accelerate the move toward self-reliance.

Because of problems in the economic system, the Chinese electronic information industry is highly fragmented and redundant. Organized management has not become the norm and many of the products are below the threshold of economical.

The recent phenomena of unfair distribution and short-term behavior in the society have seriously affected China's technology development and stability of the science and technology ranks.

2. Strategic Choices

In terms of strategies, we are faced with the following choices:

Import substitution versus export orientation—These are two strategies with different emphases. The two strategies differ in trade policy, investment approach, degree of openness, and in tariff and exchange-rate policy. In the international arena, countries practicing simple import substitution often encounter foreign-exchange difficulties and are forced into export orientation. The electronic information industries in Brazil and India have overemphasized import substitution in the past and were not very successful; they are now paying more attention to export orientation. The "Four Small Dragons" of Asia have quickly switched to export orientation, with good results, after practicing a period of import substitution. The situation in China favors a mixed strategy that combines import substitution and export orientation. Products of low or intermediate technology level should adhere to import substitution and be made in China. Our technology level cannot yet produce high-tech products; these products should be imported so that the national economy may move forward. If the export orientation is handled properly, the great difficulty in foreign-exchange shortage may be overcome and moreover there will be a basis for importing more technology.

Facing domestic market versus facing international market—Under the openness policy, we should combine the domestic market with the international market. The domestic market will be better maintained only by doing better on the international market. On the other hand, maintaining and developing the domestic market can form a strong base for entering the international market. For today's electronic information industry in China, the main mechanism for promoting the domestic market is developing the international market. Without growing in the international market, the development speed and technological advancement of China's electronics industry will slow down, and the gap with the international standard will gradually widen. We should not think that because the domestic market is large the strategy should be domestically oriented. The fact is that the domestic market in some respects is not that large. The capacity of the computer market in China, for example, is only about 4 billion yuan. To form a stronger market force and to realize mass production, we must rely on the international market.

High-tech versus medium- or low-tech—In terms of technology level, China's electronic information industry is mainly medium- or low-tech and that is the reality. We should emphasize developing high-tech but our financial resources and our technical and industrial standards can only obtain advances in a limited number of areas. For the short term, we should focus on the development of medium- and low-tech and use the breakthroughs to prepare for the development of high-tech; we should not pit medium- and low-tech against high-tech. There is high-tech in medium- and low-tech products, such as the magnetic drum and magnetic head and the digital recording technology in video recorders.

Indigenous R&D versus technology import—If it is real high-tech, others will not sell it to us. We must establish our own technology and adhere to self-reliance, using imports as a supplement. To this end, we must keep the long-term national interests in mind, properly treat the relationship between basic research, applied research, and R&D so that they are matched rationally. On the whole, our R&D will follow advanced foreign technology for quite some time to come. We will be combining foreign technology and the situation in China and come up with new inventions and innovations. This is the path toward success for underdeveloped nations. Under the openness condition, it is hard to imagine building a new industry by relying on our own technology only. We should be striving to create better conditions and cooperate and exchange with any developed countries on an equal and mutually beneficial basis. In the meantime, we must absorb the imported technology in order to develop our own.

Concentrated management versus distributed redundancy—The problems of departmental division are far from being solved and they have led to serious fragmentation and redundancy. Of the 30 plants that manufacture integrated circuits, only one has an annual output that exceeds 10 million units. The dispersed distribution of manufacturers of color television sets, video recorders, and subscriber program-controlled [telephone] exchanges prevents the formation of a large-scale economy. The limited funds and the dispersed application can hardly lead to a "movement." We should be determined to follow the path of concentrated management and overcome the difficulties of fragmentation and redundancy by economic, administrative and legal means.

Traditional versus emerging enterprises—Although China's traditional enterprises still need development, they have gained a certain maturity. It is not best to support economic growth by relying on the expansion of traditional enterprises. The main problems today are the low efficiency in the national economy and the high level of energy and material consumption; the energy consumption per unit of gross national product is three to five times of that in developed nations. We should make improving efficiency and reducing energy consumption the two major emphases in the strategy of China's national economy. To achieve this, we must rely on new technologies and new businesses. Although China still faces some difficulties, through adjustment of policies, it is still possible to place the electronics and information industries on a prominent position in China's development agenda.

3. A Strategy That Combines Import Substitution and Export Orientation

The guiding strategy should be a reasonable combination of import substitution and export orientation, and effective measures should be taken to expand exports and to actively promote import substitution.

Under the guidance of the new strategy and shortage of state funding, we should be determined to give up certain things and concentrate our resources to a few areas so that we may form a "movement" and enter the competitive international market.

The export of consumer electronics should be greatly expanded. We have already established a certain base on consumer electronics and the associated components. We should take the opportunity of our country's adjustment of its industrial structure to greatly expand exports and succeed in the international competition. Consumer electronics has an enormous international market; the market in developed nations alone is more than $60 billion. The "four little dragons" of Asia are all trying to take over the international market of consumer electronics; this is an opportunity and a challenge for us.

We should work on the export of systems and use that to bring along exports of hardware and software. In China, the electronic information industry is still emphasizing the manufacture of hardware and lacks an understanding of systems, software, and service as important components of the business. In the world today the price of hardware is going down but the price of software and systems is going up. This is because the design and production of systems and software relies on high-tech staff. In terms of investing in electronics for export, simply exporting hardware is very difficult on the international market and the chance for success is very small. China has a strong team of science and technology personnel and leads many countries in systems engineering, quality and scale; this is very advantageous for us. When investing in electronics for export, we may develop some conventional systems, bid on specific engineering projects, and export whole systems with software and service. When exporting systems, we should build the hardware that we can make and buy those that we cannot make. We should make use of international resources to earn greater value-added profit. To this end, we should strengthen our ability to take on systems engineering projects and software development, maintain our service and training of personnel, and gradually build China's electronics and information industries from a purely manufacturing industry to a composite business.

In our effort to develop the international market, we may work on OEM and expand our export of OEM products. Entering the international market is very difficult in the beginning. We may begin by making parts, components, subsystems and whole systems for foreign companies and use their brand name to enter their sales channels. By doing so, we may build up our strength with the help of others and gradually elevate our products to the international standards. High-tech products also contain some components that are not high-tech but may involve great variety and large volume. We could explore the possibility of contracting the manufacture of such intermediate products for foreign companies. This kind of trade could be very large but has not been sufficiently explored in the past.

We should make a great effort to develop our export of discrete components. In developed nations the profits of discrete components are gradually dropping and companies generally are not willing to manufacture such components; their manufacture is moved to other countries. We should seize the opportunity to enter the market.

China's electronics and information industry has already established a sound base. In the defense research system there is a strong team of S&T personnel; they should be able to play a greater role in the transfer of technology to the civilian sector. We should make use of our strength in our effort to expand exports and to replace imports. For products that may be manufactured in China, an effort should be made to build up such products in a systematic and planned manner. Efforts should also be made to make domestic products having the same quality and price as imported products, and to be able to deliver them on schedule.

Space Technology Impact on National Economy Assessed

91FE0208D Beijing XIANDAIHUA [MODERNIZATION] in Chinese Vol 12 No 11, 23 Nov 90 pp 6-9

[Article by Xu Ande [1776 1344 1795]: "Space Technology Impact on National Economy Assessed"]

[Excerpts] [Passage omitted] Nations and regions developing space technology are facing a huge investment. Often, the best technical people in various industries are also being used to develop space technology. China is no exception. Today, we have to answer the following question. What kind of economic benefit can space technology produce? What is the contribution of space technology to the growth of the national economy?

A Scientific Model to Study Economic Growth Pushed by Space Technology

Theoretical studies done by economists revealed that economic growth is affected by many factors such as the original economic level, capital investment, labor force and technology, resources, etc. These are factors constraining economic growth. However, only capital investment, labor force and technology are the direct driving force behind economic growth. Other factors are the foundation and objective environment for economic growth.

In order to study these three factors, particularly the contribution of technology to economic growth, American economist R. M. Solow (1987 Nobel Laureate) proposed the famous total productivity function based on Cobe-Douglas productivity function. Q, K and L represent real goods produced and capital and labor invested, respectively.

$$Q = f(K. L. t) \qquad (1)$$

where t is a time variable in the productivity function when technology progress is considered.

Solow's total productivity function provided a way to quantitatively assess the economic benefit of technology. Today, we believe that Solow's model can be used to quantitatively determine the economic benefit of space technology within a specific department in a relatively scientific manner.

Contribution of Space Technology to Economic Growth in Shanghai

Shanghai is a key base for China's space industry. The space system in Shanghai not only developed numerous tactical missiles but also made significant progress in large payload rockets in the past 10 years. In addition, space technology has been used to develop commercial products. In recent years, over 140 products in seven major categories have been developed. 50 products received a total of 91 high quality mentions at the ministry or city level and 15 gold or silver awards from the government. Through an analysis of tons of statistical data, we discovered that space technology has become an "engine" for the large scale growth of Shanghai's economy.

A systematic analysis was done to determine the role of space technology in the economic growth of Shanghai's space system in the past 10 years. Based on the model described earlier, the annual growth rate of capital investment (K) and labor input (L) and the contribution of capital and labor to the economic growth rate were calculated. The annual growth rate of total productivity (Q) was also calculated. Our analysis showed that the non-technical factor affecting the relation between space technology and economic growth is primarily due to adjustment and change in product structure. We introduced the concept of "overall productivity index" to quantitatively calculate the effect of product structure in order to separate this non-technical factor from the overall productivity [A(t)/A(t-1)]. Finally, we arrived at the conclusion that space technology made the economy in Shanghai's space system grew at an average annual rate of 17.5 percent. Furthermore, space technology is accountable for 72.3 percent of the growth rate of the economy of Shanghai's space system.

Our study can be summarized as follows (see Table 1):

Table 1. Factors Contributing to Economic Growth in Shanghai's Space Industry (1979-1988)

	Economic growth (net profit)	Investment	Capital	Labor force	Overall productivity	Product structure	Space technology
Promoting economic annual growth	24.2%	3.26%	2.02%	1.24%	20.94%	3.43%	17.5%
Contribution to the speed of economic growth			8.35%	5.13%	14.17%	72.3	

If the above longitudinal study helps demonstrate the economic benefit and potential power of space technology, then the following lateral comparison can make people consider the strategic position and contribution of the space industry in the development of the overall economy.

In 1988, the total industrial product value in Shanghai was 108.27 billion yuan. Compared to 1978, it increased 1.1 times. The average annual growth rate is 7.6 percent. The amazing thing is that the total product value of Shanghai's space industry is 1,191,740,000 yuan. Compared to 63,720,000 yuan in 1978, it increased 17.7 times. The average annual rate of increase is 34 percent. Although our economy grew significantly between 1978-1988, profit has not risen and labor productivity was poor and has even declined. Nevertheless, in the space system in Shanghai, space technology has created high labor productivity. It not only has exceeded the average industrial level in Shanghai but also has jumped from 2876 yuan/person in 1978 to 48,009 yuan/person in 1988. This is an increase of 15.7 times, corresponding to an annual increase of 32.5 percent.

Macroscopic Economic Benefit of Space Technology

The most important thing is that the economic benefit of space technology is not confined within a certain department. Space technology has a profound economic benefit outside the space system.

The economic benefit of space technology is a complex technical economic problem, as well as a system engineering problem. Compared to traditional industry and other technology-based industry, the space industry has many unique characteristics. The highly developing and comprehensive nature determines that its profit making mode is distinctively different from other industries, especially traditional enterprises. The contribution of space technology to the growth of the economy is not limited to large growth in its own department. More important, through its developing nature, space technology changes traditional production methods in many industries. Its widespread direct and indirect use in various departments can promote the growth of their economy. Hence, it can powerfully push the macroscopic economy to grow. Due to this uniqueness of profit making and breadth of benefits, we must break away from conventional concepts and fully appreciate the growth caused by space technology outside the space industry.

We should also be able to understand that considerably more economic benefit of space technology exists in using and spreading space technology in society. Those who benefit from space technology are not the development departments in the space system. Instead, they are the users of space technology. The Shanghai space system provides space technology and products such as large payload rockets and various tactical missiles at no cost or low profit margin to the government and the entire society. Satellite launch services for domestic and foreign customers, sales of tactical missiles and military goods, personnel training, technology transfer, and numerous applications of satellites, including scientific laboratory satellite, communication satellite and meteorological satellite, bring in tremendous profits to our economy.

For example, during the decade of 1979-1988, the Shanghai space system independently developed the "Long March IV" rocket which can send a 1.5 ton payload into a solar synchronous orbit or a 1.1 ton payload into a geosynchronous orbit.

On September 7, 1988, we successfully used a "Long March IV" rocket to launch our first solar synchronous meteorological satellite "FY-1." The data collected by a solar synchronous meteorological satellite within a day is 100 times more than that gathered by conventional weather stations on earth. To forecast the weather by meteorological satellite has tremendous economic benefits. According to a report, because of accurate forecast of a typhoon 72 hours before it landed in Shantou, more than 3000 vessels returned safely to port. People were evacuated in time. Over 3 million mu of crops were harvested ahead of time to reduce losses by 1 billion yuan. Based on statistics, on the average, there are seven typhoon landfall incidents per year. With meteorological satellites, every time we can reduce our losses by 200 million yuan. The benefit in this item alone is 1.4 billion yuan per year. In addition, "FY-1" also monitors and forecasts other natural disasters (such as draught, flood, hail, fire, etc.) for the entire country. Furthermore, it has special channels to monitor weather and other parameters over the ocean. The effect to cost ratio is at least 10:1 using the "Long March IV" to launch "FY-1." If the operating life of the satellite exceeds our projection, then the economic benefit is even higher.

Since 1980, the "Long March" carrier rocket, which was jointly developed by Beijing and Shanghai, has been successfully used to launch four communication satellites and obtained many pleasant economic benefits. According to statistics, the amount of floating bank funds is 50 billion yuan. The average floating period is 6 days. Using satellite communication, we can at least cut this amount by half. This is equivalent to adding 25 billion yuan of available funds to the banks within 6 days. When using satellite communication and location technique in railroad dispatch, the density of trains can be increased from 8 minutes apart now to 3 minutes apart. Without any investment, the capability to transport can be doubled. However, if a second rail is constructed to double the capacity, such as for the line between Beijing and Shanghai, it requires 10.2 billion yuan. To establish satellite communication and location, it only costs 1 billion yuan.

We will launch ocean satellites in the future. Based on the report by the "Ocean Satellite Joint Study Group," the ocean satellite is expected to have economic benefits in the following six areas by 2000:

1. The monitoring of disastrous ocean conditions (such as high tide, huge surf, ice, earthquake and tidal wave) can reduce losses by 2.25 billion yuan/year.

2. Forecasting ocean condition and weather can improve profits and reduce losses for oil, gas and mineral exploration by 0.1 - 0.16 billion yuan/year.

3. In the development and protection of costal zones and harbors, it is expected to have an economic benefit of 5.5 million yuan/year.

4. Satellite data lowers the cost and increases the capture of the fishing industry. This will bring in 1.4-1.8 billion yuan/year.

5. The selection of the optimal route for oceangoing ships will bring in 140 million yuan/year.

6. To conduct oceanographic research will bring in 200 million yuan/year.

The total economic benefit is 3.92-4.38 billion yuan/year.

In conclusion, if the annual economic benefit of the ocean satellite to be launched in the year 2000 is 4 billion yuan, and the useful lifetime of the satellite is 2 years, then the overall benefit is 8 billion yuan. This kind of huge economic benefit can be realized by launching an ocean satellite with a "Long March IV" rocket. The effect to cost ratio is 13:1.

New technologies developed as a result of carrier rocket and tactical missile, development (such as temperature control, composite material, software, etc.) are being redeveloped into commercial products and spread into the society. Some even formed individual industries. These newly created non-space industries have a even wider economic impact. [passage omitted]

Thoughts and Choices Facing World Trend

There is a space technology fever in the world. Developed nations rely heavily on space technology for economic growth. According to the "World Bank's Tables and Charts" published in the U.S. in December 1989, China has the highest average annual increase in GNP per capita between 1980 and 1988. However, regrettably this first place was primarily earned by a great deal of labor and capital. There was relatively little investment in S&T. Space technology only makes up a low proportion.

We must clearly understand that developed nations are using technological progress and high-tech edge as the strategy for economic growth. If we only rely on large sum of capital and labor force to develop our economy to compete in the non-technical or low-tech area, not only we cannot last very long but also we will eventually fail. It has been demonstrated both by theory and practice that using capital and labor to push for economic growth is a slow constant type of process to accumulate wealth. The use of advanced technology, especially high technology such as space technology, to promote economic growth is a way to accumulate wealth in an exponential manner. The development of space technology has a direct impact on the economic competitiveness, military deterrence, political influence and social progress of a nation. Facing this trend, our choice should be to let the entire country fully understand the importance and irreplaceable nature of space technology with regard to economic development. Let us adjust our traditional strategy and put the development space technology as a national policy. In terms of investment, let us pick the strong to support them. Let us stand firm in using space technology to support economic growth.

Strategy of Developing Pharmaceutical Enterprises Studied

91FE0142D Wuchang KEJI JINBU YU DUICE [SCIENCE AND TECHNOLOGY PROGRESS] in Chinese Vol 7, No 5, Sep-Oct 90 pp 34-36

[Article by Ren Dequan [0117 1795 2938]: "Development Strategies for China's Pharmaceutical Industry"]

[Text] Abstract

In today's world of intense international competition, how can China's pharmaceutical industry leap quickly up to advanced world levels? I feel that first, we should reinforce basic system construction, second, we should develop special base areas, third, we should develop staple products and their unit operations, and fourth, we should use industrialized applications of biotechnology to make China's pharmaceutical industry a strong point of our nationality and create wealth for mankind.

I. The Position of Strength of China's Pharmaceutical Industry

Technical strength levels of the pharmaceutical industries of each world nation can be divided into four categories. Category one is large companies with systematic formulation capabilities that can continually develop new patented medicines, play a guiding role in international pharmaceutical markets, and enjoy high prestige in the international pharmaceutical industry. Over 10 countries including the United States, England, Japan, France, West Germany, Switzerland, Italy, and others belong to this category. The new medicines they study and develop account for 95 percent of the world total and the yearly output value of their pharmaceutical industries accounts for about 85 percent of the world's total value. The second category is those who do not have a strong capability for making and developing new drugs but which have a rather strong capacity for absorbing and copying technology and scale of stock drug production. There are also more than 10 countries in the world that belong to this category, including the Soviet Union, India, Hungary, Portugal, Spain, Brazil, and so on. The third category is those with weak stock drug production technology capabilities, but which have definite preparation technology strengths that can process imported stock medicines into injections, tablets, and so on. Many nations and regions fall into this category. They include economically develop nations and regions like Australia, Austria, Singapore, and so on, as well as a substantial number of developing nations and regions. The technical situation in China's Taiwan region belongs to this category. The fourth category is those which have very weak preparation and processing technology capabilities and can only directly import various types of prepared medicines and preparations. China's pharmaceutical situation belonged to this category 40 years ago.

Over the last 40 years, China has gradually established a pharmaceutical industry S&T staff and tracked S&T achievements in the international pharmaceutical industry. We have studied and placed into production over 1,200 types of stock drugs and over 4,000 types of preparations. We have produced our own series of products in 24 major categories ranging from analgesic-antipyretics, antibiotics, cardiovascular system medicines, and contraceptives to hormones, antineoplastics, and so on, and we have unique technical lines that are international vanguards for the production of vitamin C, chloramphenicol, streptomycin, and many other stock medicines. We have formed a national pharmaceutical industry system composed of an army of millions of people with a full complement of disciplines at a substantial scale. China now holds second place in the world in yearly output of stock drugs which basically satisfies the medical and health protection requirements of the Chinese people and has placed large numbers of medicines into international markets since the 1980's. We now export about one-fifth of our annual output of stock drugs. We are now capable of successfully developing and organizing the production of new chemically synthesized medicines that have appeared in the market within 3 to 5 years. It can be said that the overall S&T strengths of China's pharmaceutical industry is now in the vanguard of the second category. China's task during the next phase should be to try to leap up to top world levels. This will be far more difficult than each of the previous development stages because it will involve a fundamental transition from copying to development, from small-scale production to scale economies, and from normal production to intensive production.

II. Characteristics of S&T Competition Among the World's Pharmaceutical Enterprises

At present, the total world sales volume of medicines is about $140 billion, of which the world's top 15 large enterprises have a sales volume of $41.3 billion. In the fight for markets, there is very intense competition among the pharmaceutical enterprises of the economically developed nations. The core is S&T competition, which is manifested in a concentrated way in these four areas:

1. A focus on development and research, reinforcement of patent protection measures

The average schedule internationally for R&D for a new medicine is about 10 years and the cost is $100 to $120 million. Although the investment is expensive, the enthusiasm of all large enterprises for R&D concerning new drugs has not abated. In 1988, the cost of research on new drugs in the United States along was $6.5 billion, up 40 percent from 1980 and it rose again in 1989 to about $7.3 billion. Each of the 10 large drug manufacturing enterprises in the world with the highest yearly research expenditures invests at least $300 million annually and most spend almost $700 million. The average figure is 16 percent of the total volume of sales in these companies. This background of high investments gives the development of new drugs under patent protection a monopolistic quality and this monopolistic quality brings high profits. Thus, development of new drugs has become a primary battleground in international competition among large drug manufacturing enterprises. The new gastric ulcer drug (Ximitiding) which was placed on the market by the American (Shike) Company during the 1970's became the first product with annual sales in excess of $1 billion in 1983. In just 4 years, however, it had been replaced by the new gastric ulcer drug (Leinitiding) produced by England's (Helansu) Company. The international sales of (Leinitiding) in 1989 amounted to $2.37 billion with a profit rate of more than 50 percent. In comparison, China exports over 20,000 tons of stock medicines each year, which is higher than England's total yearly output of drugs, but because all of them are non-patented drug copies, they earn only bout $500 million in foreign exchange. There is no comparison between the economic benefits of copied drugs and new patent drugs. As a result, major drug manufacturing countries try to protect and extend the patent status of new drug. Not long ago Japan extended its patent period limits from 20 to 25 years and the EEC has called for extending new drug patents by 10 years. These measures to strengthen special protections for the status of new drugs have caused big companies to view new drug development as the lifeblood which will determine their prosperity or decline, which has stimulated competition that depends on scientific research. In 1989, there were mergers of the United States' (Shike) Company and England's (Piqiemu) Company and the United States' (Shiguibao) Company and (Boliesiduo-Maiye) Company which rank among the top 10 worldwide, which created a furor. Editorials felt that the basic reason for these mergers was that this was essential for them to have the economic and S&T strengths in new drug development to compete with other large companies. In intense competition, new drug development provides a comprehensive embodiment of the pharmaceutical industry's high-tech, high investment, high benefits, high speed, and high concentration characteristics at the present time.

2. Focus on scale production, take full advantage of modern engineering technology, increase productivity of staple products

Competition among non-patented staple products does not depend entirely on price. The unit profits of this category of products are not high, but they are used in large amounts with substantial volumes. The focus of research on them is technical lines for large-scale production, unit operations technology, key and matching equipment, on-line process control, and other engineering technology issues to achieve production scaling, continuity, and automation. They use low consumption, high benefits, and superior quality to gain primary advantages. The amount of aspirin produced yearly by Monsanto Corporation in the United States, for example, accounts for about one-fourth of total world output. Malinkrodt Company produces 8,000 tons of acetaminophen each year, about one-half of total world output. Switzerland's (Luoshi) Company can produce 36,000 tons of vitamin C at three plants in (Sugelan), West Germany, and the United States, which is equivalent to total world demand at present. Because of scaled production, efficiency in these enterprises must be 10 to 20 percent higher than in medium-sized and small enterprises, their energy consumption must be 50 percent lower, and their per capita labor productivity must be more than 10 or even several 10 times as high.

3. Be concerned with secondary development of medicinal products, use preparation technology as a basis for creating famous brand series

Using chemical stock medicines for studying and manufacturing various types of preparations actually is secondary development of drugs. In the past, preparations were often done by simple processing. After the emergence of biopharmaceutics during the 1960's, preparation grew into a comprehensive discipline. People understood that a good preparation could take full advantage of the effects of the drugs themselves and could reduce their toxicity and side effects while a preparation without sufficient research or technology could weaken the effects of the drug or even intensify the toxicity or side effects of the drug. Bismuth subnitrate is an old product that is used as a gastric ulcer antacid. Holland's (Lede) Company has used a special technology to manufacture bismuth subnitrate into the preparation (Ledewei) after micropulverization that has obviously higher curative effects and it was sold very quickly in many countries. When special preparation techniques are used to turn non-patented stock drugs into brand name preparations, this sort of medicine has monopolistic characteristics in the market and the price of non-patented stock drugs is about 10 times higher after they are processed into preparations. Thus, pharmaceutical companies in many developed nations prefer to purchase and import non-patented stock drugs and focus their scientific research and production on preparations. Holland's "Ledewei" stock medicine bismuth subnitrate mentioned above was purchased from China. Another example is the (Qiangsheng) Company in the United States. It does not produce acetaminophen, but the acetaminophen compound preparation series of products this company developed and produces are marketed throughout the United States and it holds 10th place among the 100 most popular drugs in the United States.

4. Be concerned with biotechnology, implement a strategic shift in technology and products

Biotechnology is a hot point in the new technological revolution at present. Moreover, about 70 percent of international biotechnology research work falls within the scope of medicine. Industrial applications for recombinant DNA and hybrid tumor technology started with medicine. Beginning with the formal marketing of the genetically engineered product "human insulin" in the United States in 1982, there have been 10 genetically engineered drugs marketed so far and their volume of sales over 4 years exceeded $100 million. Medical biotechnology opened up new ground for human endogenous polypeptides and proteins, and some people have said that the 21st Century will be the ago of polypeptide medicines. At the same time, biotechnology has begun to permeate all realms of traditional medical technology. Examples include applications of genetic engineering of antibiotics, amino acids, and so on, cellular fusion, selective breeding of seedling varieties, and fermentation dynamics; organic conversion methods for chemically synthesized medicines; applications of enzyme engineering in separation and purification of various drugs; applications of monoclonal antibodies, lipids, and DNA probe technology in drug targeting preparations, and so on. Not long ago, the Lilly Company in the United States also proposed a new and even broader medical application for biotechnology involving the use of genetically engineered donor effects to replace animal experiments. This was a revolution in new drug research and selection methods. All these things show that the entire medical technology foundation is shifting from a chemical foundation to a combined biological and chemical foundation. With this strategic shift to this type of drug product structure and technical structure centered on biotechnology, all the world's big companies are investing enormous amounts of capital and manpower to develop biotechnology and they have opened up intense competition looking toward the 21st Century.

III. Strategic Ideas for Developing Medical S&T Innovation in China

S&T in China's pharmaceutical industry is now in a key period because we are facing a period of major transitions in the S&T structure, product structure, and enterprise structure of the world's pharmaceutical industry. If we can use our existing foundation, seize the opportunity, and adapt to this transition, China's medical S&T and the entire industry may be able to move up to a new stage within the next 10 to 20 years. Otherwise, the degree to which we lag behind that has been reduced over the past 40 years may once again grow. For this reason, we must suggest new strategic ideas for development of medical S&T in China:

1. Start with basic system construction, achieve a strategic shift from "copying" to "creating"

Since our nation was founded, we have created nearly 100 new drugs but the quality is low and only a few varieties have gained a foothold in the domestic market and are in common use. The research and experimental data and clinical information for this small number of products have not received international acceptance. The main reason is that we lack a complete creative foundation, so we must first establish a complete creative foundation that meets modern technical requirements. This complete foundation includes: 1) Innovative research technology and regulation systems (selection technologies, toxicology technology, preparation technology, innovative research procedure regulations for all types of drugs, etc.); 2) Innovative research base area system (selection base areas, toxicology centers, preparation base areas, etc.); 3) Innovative research staff system (synthesis, analysis, pharmacology, toxicology, clinical, standards, techniques, preparations, engineering, and other related S&T forces matching organizations, etc.). During the Eighth 5-Year Plan, we should try to establish in a preliminary manner matching foundations in these three areas that basically conform to international GLP requirements, perfect them by the year 2000, and truly turn them in perfect creation systems that have internationally acknowledge S&T data and definite strengths. In the 21st Century, we should continue striving to develop them into a creation system at advanced international levels.

2. Develop special base areas, make comprehensive breakthroughs in preparation and production technologies, achieve a strategic shift in our export structure

China's medical preparation technology is more backward than our stock drug production technology. Exports of preparations now account for just 7 to 8 percent of our total exports. There are even some varieties of raw materials that we could export but we have to import their preparations. To change this situation, we must focus on truly achieving specialized preparation research units and put together a special base area network in which each does matching and complementary basic research and highly difficult research. At the same time, we should encourage and support several key preparation plants in establishing their own applied research systems, developing their own special technologies, and using second intensive development of stock medicines to form series of known products for the enterprises. This would integrate scientific research with production that would have their own special focus in biopharmaceutics, physical pharmaceutics, preparation engineering, agent types, supplementary materials, and technical equipment. It may be possible to attain advanced world levels within a relatively short time frame.

3. Focus on staple product types and their unit operations to make breakthroughs, raise production and engineering technology levels, implement a transition from "small-scale production" to "scaled production"

China hold second place worldwide in annual pharmaceutical industry output, so we are a big drug producer. However, we are still a big producer with small-scale production if we look at our enterprise structure. Most of our thousands of pharmaceutical plants are small in scale and have high energy and materials consumption and low labor productivity. To achieve scaled and intensive production, we must solve the engineering and technical problems of large-scale production. For this reason, we should begin now to select certain key staple products as breakthrough points and develop R&D on unit operations, engineering techniques, on-line control of key equipment and processes, and other matching large-scale production technology to mobilize all of our engineering technology research. This would gradually achieve scaled and intensive production for staple products in stages by beginning with high starting points, integrating imports with digestion and absorption, and relying on large-scale social cooperation. At the same time, for medium-sized and small enterprise products of regular market scales and their industrial production technology, we should select unit operations with large coverage rates and acute problems like fermentation, mixing, drying, and so on, integrate with typical products to develop comprehensive research on new technology, new equipment, optimized operations, on-line control, and so on to make breakthroughs on one point, extend several, and comprehensively raise production technology levels in our pharmaceutical industry.

4. Make industrialized applications of biotechnology the core, achieve a strategic shift in the basic structure of medical technology

Biotechnology as an important aspect of high-tech has already received a high degree of attention from the state. We have now made definite progress in upstream basic research. The pharmaceutical industry should focus on industrialization of biotechnology and concentrate on digestion, absorption, and development of organic reactors, separation media, and other key midstream and downstream technologies. Start with these, select upstream achievements in medical biotechnology with market prospects, strive to organize development of breakthroughs in fermentation culture and purification technology, and use them to achieve commodity production for new industry branches for modern polypeptide drugs and protein drugs. At the same time, make major efforts to apply modern biotechnology to transform antibiotic, amino acid, and other traditional medical biotechnology products, and utilize bioconversion to replace complex chemical reactions for chemically synthesized drugs like steroid hormones, and so on. Make biotechnology permeate all realms of the pharmaceutical industry.

Machine-Building and Electronics Industry Ministry's Strategy for Eighth 5-Year Plan

91FE0226A Beijing ZHONGGUO DIANZI BAO in Chinese 2 Dec 90 p 1

[Article: "The Ministry of Machine-Building and Electronics Industry Outlines Main Goals of Eighth 5-Year Plan"]

[Text] Zhang Xuedong [1728 1331 2639], deputy minister, Ministry of Machine-Building and Electronics Industry discussed more improvements and new requirements to digest, absorb and localize the industry.

In the Eighth 5-Year plan, two main changes must come about in the electronics industry when it attempts to digest, absorb and localize imported technology. The first is to shift the emphasis from consuming this technology to investing in it. At the same time, localization of the consumption aspect of the industry must expand and deepen in its development. The second major change is to gradually develop from the surface level to deeper levels, and redevelop hardware, software, equipment, and workmanship.

Zhang Xuedong provided the electronics industry with five suggestions:

First, fully understand how important and pressing the task is to digest, assimilate and localize the industry. This is an important task during the Eighth 5-Year plan where impressive improvements and new achievements are expected.

Second, the selection in the assimilation of key projects must fit the national industrial policy. Assimilation of imported technology cannot be comprehensive. The policy should be emphasizing and selecting key projects for such assimilation. "The Decisions on the Essentials of the Present Industrial Policies by the National Council" stated clearly the technological redesign projects, which must be severely curtailed, to be terminated, and not to be included as key projects for assimilation. Of the more popular products in China, centralized planning will prevent the overabundance of its production and repeat assimilation. In selecting key projects and formulating assimilation and localization policies, attention must be paid to the overall directions, policies and requirements of the principal ministries and that of the Ministry of Machine-Building and Electronics Industry. Products that are needed in small quantities, that change quickly, that remain in the market for a short time, that require a high degree of technological skill, that require serious investment and yet are readily available in the international market need not be 100 percent localized.

The open market conditions should be fully used in order to compete in the international market and obtain the best economic benefits.

Third, emphasizing the turning of assimilation and localization results into productivity. The greatest frustrations encountered have been two-fold: while there is capital to import the technology and equipment, there is no capital to carry out analysis and assimilation; also, even after successful analysis, assimilation and localization, the impact of imports limits the marketing of these localized products. Thus the anticipated productivity of these products does not materialize. To solve the problem, China has to support and protect its industries, and has been taking steps to this end. For example, China has published lists of products that will replace imports and has set quotas for importing these targeted items. Also, China has to compulsorily popularize the use of localized technology and products through administrative avenues. It is important for the industries, in their analysis, assimilation, and localization efforts, to aim at projects that bring significant effects and benefits. They should also consider the factors of technological advances and the needs of the people, thus producing equipment and products suitable for the consumer. It is especially important to emphasize the analysis and assimilation of flexible technology, especially production and exploratory technologies.

Fourth, intensifying the organization and administration of the analysis, assimilation and localization activities. Analysis, assimilation and localization are parts of a system engineering, managers at all levels and enterprises should be guided by the situations that imported the technology during the Seventh 5-Year plan and principles of the Eighth 5-Year plan. Following these principles, administrators will be able to set concrete goals and strategies for the analysis, assimilation, and localization activities in their own units and regions. In the future, the ministry will have scheduled meetings on analysis, assimilation, and localization activities to summarize achievements, discuss policies and exemplify advances.

Intensifying planning and administration is an important step in improving analysis, assimilation and localization activities. In the discussion of the feasibility of technological improvements in units and enterprises, the contents of analysis and assimilation must be included. The procedure and capital required for analysis and assimilation must be included. The procedure of analysis and assimilation includes the designation of cooperative factories and research institutes, and this must be an item for discussions. In accepting projects, the actual analysis and assimilation activities should be inspected. Also 3 years after the project goes into production, a post-assessment should be conducted. It is important to utilize the preferential policies to carry out analysis, assimilation, and localization activities. In addition, the protection of the intellectual rights must be part of administrative duties.

Fifth, units in all areas must intensify the training of cadres and improve the quality of technical and administrative personnel in the area of analysis, assimilation, and localization. This will be needed for carrying out the new responsibilities in analysis, assimilation and localization activities during the Eighth 5-Year plan. While it is important to utilize professional expertise, it is also important to solicit suggestions from the public.

Strengthening Neuroscience Research in 1990s Urged

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[Article by reporter Liu Lusha [0491 6424 3097]]

[Text] Specialists Wang Shurong [3769 2579 2837] and Yang Xiongli [2799 7160 6849], who attended the first CAS Neuroscience Technology Conference, held most recently in Beijing, expressed the view that China should give a high degree of attention to neuroscience research, and give it key status in basic science research.

They stress that neuroscience is next to molecular biology as the high peak of development in the biological sciences. Today's neurological science research is compared with physical science at the start of the 20th Century, or with molecular biology in the 1950s. It is generating major breakthroughs and will, in turn, have an enormous impact on the overall development of science. In the last 25 years there already have been 15 scientists who have been awarded Nobel Prizes in physiology or medicine. Mankind has already advanced from a preliminary understanding of the mind on to a deep investigation of the questions of its very essence. Important progress has been made in identifying a series of important elements related to such workings of the mind as consciousness, behavior, learning, and memory; and this signals the possibility that the ultimate mysteries of the most complex system in the human body—the mind—will eventually be revealed.

On the other hand, by now, the electronic computer, which is based on the principles of physics, has been developed to a rather high level, and it will be very difficult to develop it further. Only with the aid of the principles of the operations of the mind can new breakthroughs be made. Rapid development is being made in neuro-networking and neuro-computers. At the same time, many mental diseases that have been a puzzle to mankind, and the prevention of such diseases, including the cure of AIDS, are creating an urgent need for the development of neuroscience.

For these reasons the advanced countries are giving a high degree of attention to neuroscience. The U.S. Congress passed a resolution to make 5 January 1990 the start of the "Decade of the Brain", and George Bush, President of the United States, signed it into law. The

International Brain Research Organization called on its member nations to turn the "Decade of the Brain" into a global action, Japan enacted a "New Realm of Mankind Research Plan", and the European Community organization formulated the "Brain Program".

Specialists say that in recent years there has been a good development in China's neuroscience research that has achieved some good results, but it has not yet achieved the degree of attention that it should, and neuroscience research has not been placed on the list of key development areas of national basic research.

For this reason, experts ask that neuroscience be listed among the key development areas for national basic research, that research be organized in this field, that a national neuroscience research laboratory be set up, greater support and steady funding sources be established, and that international cooperation and exchange be strengthened to stimulate development of neuroscience in China.

Report on Implementation of 'Director Responsibility' System

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[Article by the "Director Responsibility System" Survey Group in the State Science and Technology Commission S&T System and Management Institute: "Survey Report on the Situation in the Director Responsibility System"]

[Text] Abstract: This article confirms the achievements in implementation of a director responsibility system in some S&T management departments and scientific research organs on the basis of a special survey project and offers some proposals concerning the need for further clarification and resolution of problems and the next step of work.

The CPC Central Committee stipulated in 1985 in its "Decision on Reform of the S&T System" that "research institutes should implement a director responsibility system". To examine the situation in implementation of the director responsibility system over the past 5 years and to move forward with its healthy development, the "Director Responsibility System" Group in the State Science and Technology Commission S&T System and Management Institute visited 24 departments including the Ministry of Agriculture, 14 provinces and municipalities including Hunan Province, S&T management departments, and some scientific research organs to conduct a special survey project on the situation in implementation of the institute director responsibility system (including the academy director responsibility system, same below). At the same time, we also mailed a "Survey Questionnaire Concerning the Situation in Reform of the S&T System" (abbreviated below as the "survey questionnaires") to over 2,600 research organs under the jurisdiction of State Council departments and local areas and provinces throughout China.

Our research analysis and proposal report from the special survey project and 1,139 "survey questionnaires" follow.

I. The Director Responsibility System Has Now Been Implemented on a National Scale

The director responsibility system has now been implemented throughout China on the basis of expanding the decision making rights of scientific research organs and implementing various types of perfected responsibility systems using trial points and a new leadership system for research academies and institutes that was formally decided upon by the CPC Central Committee in 1985.

In the 1,139 "survey questionnaires", 78.9 percent of the scientific research organs had implemented the director responsibility system and 18.2 percent of the scientific research organs are now in the process of implementing an (academy) institute director responsibility system under the leadership of their CPC Committees and an (academy) institute director division of labor responsibility system under the leadership of their CPC Committee.

The director responsibility system has now been widely implemented in a variety of organs. The proportion of organs which have implemented the director responsibility system by categories is basic research organs 78.5 percent, applied research 75.7 percent, technology development 84.3 percent, social public welfare 76.4 percent, and all categories of organs 78.8 percent.

The survey also showed that after a period of trials and summarizing experience, the pace of the director responsibility system has been speeded up in the last 2 to 3 years. In 1987, just 2,678 of China's independent research organs at the county level and above had implemented the director responsibility system, equal to 51.3 percent of the total number of organs. This figure grew to 3,459 in 1988, equal to 70.1 percent of the total number of organs. Among them, scientific research organs which had implemented the director responsibility system in 1987 accounted for 46.6 percent of the total number of scientific research organs under the jurisdiction of departments at the local area and county levels and above and 70.5 percent of the total number of organs under the jurisdiction of departments of the State Council (including the Chinese Academy of Sciences [CAS]). These figures had risen to 66 percent and 87.7 percent, respectively, in 1988.

Now, for all the various systems, the CAS, Ministry of Chemical Industry, China Construction Engineering Corporation, China Petrochemical Industry Corporation, China Coal Corporation, State Construction Materials Bureau, and other directly-administered research academies and institutes as well as independent research academies and institutes at the county level and above in the forestry system have all implemented the director responsibility system. The Ministry of Machine-Building and Electronics Industry and the China Non- Ferrous Metals Corporation have implemented the director responsibility system in 98.2 percent and 95.2 percent, respectively, of the research academies and institutes under their direct jurisdiction, and the figure for the agriculture system is 63.7 percent. For regions, all of the research institutes under city jurisdiction in Shenyang, Dalian, Changchun, Harbin, Ningbo, Chongqing, and other central cities have implemented the director responsibility system. The proportions of provincial and municipal organs among the total number of scientific research organs in provinces and municipalities that have implemented the director responsibility system are Hebei 91 percent, Shandong 85 percent, Shanghai 85 percent, Hubei 70 percent, Henan 66 percent, and so on.

II. The Director Responsibility System Has Followed the Tide of Reform, Adapted to Objective Needs, and Received Wide Support

Implementation of the director responsibility system in China's scientific research organs has occurred and developed in conjunction with intensive reform of China's S&T system. In the early 1980's, as the decision making rights of scientific research organs were expanded and various types of responsibility systems were implemented, some research institutes began trial implementation of a director responsibility system. In the middle and late 1980's, the State Council decided that, after implementation in all research institutes, the director responsibility system would be rapidly extended and gradually consolidated. At the same time, all departments have issued several laws and regulations that have further standardized the director responsibility system.

Implementation of the director responsibility system was an inevitable choice based on correctly summarizing historical experiences and comprehensively assessing advantages and disadvantages, and it received universal approval of leading cadres, management cadres, and all S&T personnel in scientific research organs. In the "survey questionnaires", 80.3 percent of the total felt that implementation of the director responsibility system was "appropriate" and just 4.4 percent felt that it was "inappropriate". Among them, 83 percent of the scientific research organs which had already implemented the director responsibility system felt that it was "appropriate" and 3.7 percent felt that it was "inappropriate". In scientific research organs which are now implementing the (academy) institute director responsibility system under the leadership of their CPC Committees and the (academy) institute division of labor responsibility system under the leadership of their CPC Committees, 71 percent consider the director responsibility system to be "appropriate" and 7.7 percent consider it to be "inappropriate".

III. Implementation of the Director Responsibility System Has Basically Achieved the Expected Results

After several years of practice, the director responsibility system basically has achieved the expected results and brought many changes.

A. It has promoted reform in management of research institutes by administrative departments and reform of the leadership system within research institutes

Implementation of the director responsibility system has further consolidated the previously expanded decision making rights of scientific research organs. Institute directors have leadership direction rights over the internal administration and professional management within their institutes and they have direct responsibility to higher level administrative rights for all work in the research institutes. This helps improves the functions, efficiency, and results of scientific research organs, and it aids in implementing the separation of political and research duties, promotes a transition to administrative functions in management departments, and reinforces macro management, guidance by principles, and coordinated services. As a result, it has been welcomed by both administrative departments and scientific research organs.

B. It has helped in the separation of party and administrative authority, reinforced party leadership, and further coordinated relationships between the party and management

After implementation of the director responsibility system, there is a separation of party and administrative authority and there are clear rights and duties. Party organizations have been removed from administrative affairs, which has helped reinforce party ideological construction and organizational construction and aided in adherence to and implementation of party and state principles and policies and playing their role better in guaranteeing and supervising the socialist orientation in research institutes, which in turn has strengthened party leadership.

For a period in the past, although there was a situation of "one soft hand and one hard hand" on the S&T battlefront, ideological and political work within scientific research organs was weakened to different degrees, but this was certainly not the result of implementating the director responsibility system. Instead, it provided further evidence of the necessity of implementing the director responsibility system to better enable party organizations in research institutes to concentrate on ideological and political work and on construction of spiritual civilization.

According to the statistics from the "survey questionnaires", party and administration relationships within most scientific research organs at present are coordinated. Of 857 scientific research organs which have implemented the director responsibility system, 85.6 percent feel that "party and administration relationships are coordinated", while 4.2 percent feel that "party and administration relationships are not coordinated and affect work". Moreover, the main causes for the lack of coordination are individual factors, not system factors.

C. It has promoted reform of the management system within scientific research organs, promoted the initiative and creativity of all S&T personnel, and strengthened the vitality of research institutes

Implementation of the director responsibility system has effectively promoted reform of the institute director management system for planning, funding, personnel, allocation, and so on within institutes and in organizational structure and other areas. This has greatly activated the operational mechanisms of research institutes and further motivated the initiative and creativity of all S&T personnel.

D. It has helped scientific research organs independently undertake various types of outside professional activities

After several years of reform, most scientific research organs have established their status as legal persons. After implementation of the director responsibility system, they also established the status of institute directors as legal representatives, which has helped research institutes become relatively independent R&D entities oriented toward society and oriented toward the economy that have undertaken various types of activities. In the "survey questionnaires", 95.5 percent felt that it has "strengthened their understanding of orienting toward society and orienting toward the economy" while 82.6 percent feel that it has "strengthened social and economic benefits"

IV. Some Issues That Require Further Clarification

The director responsibility system has now been implemented universally on a national scale with excellent results and it has now gained wide recognition as a leadership system for scientific research organs. However, there will also be a continual process of practice and development in the director responsibility system and it is not yet perfect. The main problems that require further clarification and solution as indicated in a concentrated manner in the survey are:

A. On the question of appointment and dismissal rights and procedures for administrative professional cadres in research institutes

It was discovered in the survey that there was inadequate unity of understanding, insufficient identity of methods, and even several contradictions in regard to the question of the authority of party and administrative cadres and institute directors to appoint and dismiss administrative professional cadres and the procedures involved.

As an example, in regard to this question, the "Provisional State Council Stipulations Concerning Expansion of the Decision Making Rights of Scientific and Technical Research Organs" stipulated clearly some time ago that: "Institute directors are appointed and dismissed by higher-level departments. Deputy directors are recommended by the institute directors and their appointment and dismissal is reported according to stipulations to higher- level departments for approval", "Institute directors can appoint and dismiss middle-level administrative cadres in their own units", and "Recruitment or appointment to special technical positions should be carried out in accordance with the relevant state stipulations". For several years, most units which have implemented the director responsibility system have done so in accordance with these stipulations. Having directors recommend people is good and appointing cadres according to procedure is better, and no major mistakes have occurred.

Thus, the appearance of some contradictions is due mainly to conflicts between directors' rights to appoint and dismiss cadres and party and administrative cadre principles. Party organizations in research institutes are political organizations and their main concern should be to offer their own testing opinions on whether or not administrative cadres conform to job conditions, especially revolutionized conditions, and conscientiously recommend and support those cadres who are capable of adhering to the "one center and two basic points" to assume leadership positions at all levels, especially primary leadership work. In addition, party organizations also have a great deal of arduous and detailed work to do in the areas of supporting, training, educating, and testing cadres. On the one hand, academy and institute directors should solicit and respect the examination opinions of their CPC Committees concerning cadre ideology and politics when they are selecting administrative cadres at all levels. On the other hand, the CPC Committee should patiently listen to and respect the comprehensive analysis and judgement of academy and institute directors concerning the cadres they recommend. The reason is that when an academy or institute director is recommending or appointing a cadre, besides the need to test their ideological and political qualities, they also should consider their professional conditions, work capabilities, health situation, whether or not they cooperate and work together, and various other aspects. These things rely mainly on testing by personnel departments and the decisions of institute directors themselves. Directors should conscientiously and responsibly use their own rights of selection and decision making rights. The survey showed that units which are capable of mutual respect and close cooperation between their CPC Committees and directors have relatively unified cadre elements and work in these academies and institutes is done with vitality.

B. On the question of guaranteed supervision of research institute party organs

Besides deciding that "research institutes should implement the director responsibility system" in its "Decision on Reform of the S&T System", the CPC Central Committee also made clear stipulations concerning the duties of party organizations in research institutes. The "Decision" pointed out that "party organizations in research institutes should use ideological and political work to guarantee and supervise adherence to all principles and policies, support the effective implementation of the director responsibility system, and promote the development of S&T work". It should be stated that clear statements are given here concerning the relationship between the implementation of guarantees and supervision by research institute party organs and the methods, measures, content, and goals of guarantees and supervision. Party organs in most research institutes have adhered to the spirit of the "Decision" and achieved a shift in their work.

The problem now is that, after implementation of the director responsibility system, directors have more authority, and guarantees and supervision of actual decision making and guidance by directors according to party principles and policies has become important. Implementation of the director responsibility system does not it any way imply a weakening or reduction in the status and role of research institute party committees. It is precisely the opposite. If party committees continue to become involved in large amounts of professional affairs together with the administration, this will inevitably weaken party construction, ideological and political work, and construction of spiritual civilization. One of the goals in implementation of the director responsibility system is precisely to enable research institute party organizations to concentrate their efforts on doing all aspects of party construction well and ideological and political work and play their role as a fighting force.

Reform in research institutes is still in the initial stages and even more extensive reform is coming. Existing principles and policies are not yet matched up and the degree of their implementation is uneven. The question of how to integrate with the characteristics of research institutes and concrete conditions in each unit, implement party lines, principles, and policies well, including policies toward intellectuals, and the status of institute directors directly involved in implementation and guidance of course involves heavy responsibilities, but if they lack the support, guarantees, and supervision of party organs they will accomplish less with even greater effort or even lose their direction. Abandoning the role of any aspect will cause losses in research institutes. Party organizations should play their guarantee and supervision roles well, so they must try to raise their own policy levels and rely mainly on arduous and careful ideological and political work and non- administrative measures to complete their various missions. This greatly increases the demands placed on party organs. Party organizations can only use arduous and careful ideological and political work to stimulate party members to self-consciously foster their roles as pioneers and models and turn all party policies into self-conscious activity by all cadres and masses, foster their supervisory role on the basis of guarantees, achieve greater unity and harmony in party and administration relationships, and ensure the development of S&T work.

C. On democratic management in research institutes

As reform of their leadership system has proceeded, changes have occurred in the decision making patterns and procedures for major questions in scientific research organs. At present, in many scientific research organs which have implemented the director responsibility system, decisions on major questions generally adopt a method of collective discussion and study by party and administration leaders, after which the director makes the final decision. In conjunction with this, many research institutes have established party and administration joint conferences, administrative meetings, and auxiliary decision making arrangements and established democratic management organs like institute affairs committees, academic and technical committees, employee congresses, and so on. However, many scientific research organs have still not established scientific and democratic decision making procedures and relationships in the area of decision making, guidance, and supervision are still not coordinated very well. Phenomena like "collective decision making, individual responsibility, and supervision from all quarters" have appeared in many units. As a new leadership system, the director responsibility system is no different from the director responsibility system under leadership of party committees, and it is different from the system of one-man leadership. In decisions on major issues, further exploration is required on ways to prevent collective decision making in which no one has responsibility and having one person make every decision about large and small matters.

The CPC Central Committee "Decision on Reform of the S&T System" points out that "the role of S&T personnel in research organs should be fully respected and fostered. Establish and implement various types of responsibility systems and strengthen democratic management". The State Council stated even more concretely in its "Provisional State Council Stipulations Concerning Expansion of the Decision Making Rights of Scientific and Technical Research Organs" that "research institutes should perfect their management system and reinforce democratic management", "they can establish institute affairs committees, academic and technical committees, employee congresses, and other democratic management organizations, and fully respect and foster the role of S&T and other employees in considering major decisions in the research institute, supervising leaders at all levels including the director, protecting the legitimate rights of employees, and so on".

Implementation of democratic management in research institutes is identical to the spirit of implementing democratic management in state-run enterprises and collective economic organizations as stipulated in the Constitution. The formulation of CPC Central Committee and State Council stipulations concerning the implementation of democratic management in research institutes which do not specify rigid application of the Constitution for state-run and collective enterprises took into consideration the characteristics of research institutes. They gave prominent emphasis to "the need to fully respect and foster the role of S&T personnel" in implementation of democratic management in research institutes. Institute affairs committees, academic and technical committees, employee congresses, and so on are the organizational forms for implementation of democratic management. Research institutes can establish one or more organizations according to concrete conditions in their own units and do not have to force compliance with a single type of arrangement. The function of democratic management is mainly to "discuss major discussions in the research institute, supervise leaders at all levels including the director, and protect the legitimate rights of employees".

D. On protecting the proper rights of institute directors

After implementation of the director responsibility system, the quality of the directors' work is directly related to the success or failure of the research institutes and the personal interests of every employee. Thus, institute directors have great responsibility and heavy burdens, and their work is extremely arduous. Many units have indicated, however, that for many reasons, phenomena like institute directors being subject to high demands and strict supervision while having weak authority and poor treatment and so on are rather common at present. To enable healthy and smooth implementation of the director responsibility system, earnestly protecting the legitimate rights and interests of institute directors and guaranteeing the unity of institute directors' responsibilities, rights, and interests are still problems that must be solved. There are three types of relationships here that must be dealt with properly:

1. The relationship between the responsibilities and rights of directors

If institute directors are to fulfill their duties regularly, they must have the corresponding authority. Although there are already clear stipulations in the relevant documents, the implementation situation is very uneven and their decision making rights in the area of manpower and finances are limited. Actually, an important aspect of system reform in China that is embodied in the relationship between administrative departments and enterprise and business units under the jurisdiction of institutes is a separation of ownership rights and administration rights. Government administration departments have shifted from direct management to indirect management and enterprise and business organs have changed from being subsidiaries into relatively independent legal persons units. Whether or not the responsibilities, rights, and interests of institute directors, who are legal representatives, are unified is an important indicator of whether or not system reform has been extensive. Since the stipulations require institute directors to have "full authority and responsibility" for professional and administrative management of scientific research organs, they should receive "full authority" over them.

2. The relationship between the director responsibility system and cadre posts at all levels in institutes

After implementation of the director responsibility system, the phenomena of "directors controlling all affairs, large and small" and "seeking out directors for all matters, big and small" appeared in many research institutes. Actually, this is a misunderstanding of the director responsibility system. The director responsibility system refers to the establishment of the central status of the director in research institutes and their representation of the institutes to the outside world. Internally, it means full authority and responsibility over professional and administrative management work in a research institute, "establishment and implementation of various responsibility systems", clear job responsibilities for functional organs and cadres at all levels, and everyone having things for which they are responsible and everyone doing their job, with a division of labor and cooperation and coordinated management. The "director responsibility system" should not be used as an excuse for having directors take care of everything or allowing cadres at all levels to shirk their duties that should be the responsibility of their posts.

3. The relationship between placing strict demands on institute directors and protecting the legitimate rights and interests of directors

After implementation of the director responsibility system, directors become people who were the center of attention throughout the institute. Directors had to adhere to principles, lead their men in a charge, be honest in performing their duties, and handle their institute's affairs well. Everyone around them had great expectations and most of the institute directors placed very strict demands on themselves. This was proper. However, the legitimate rights and interests of directors also deserve protection. This was especially true of the need for administrative departments to use inspection and the establishment of healthy systems of relevant regulations to provide full consideration in areas like bonuses, allocation of residences, evaluation of technical duties, wages, job promotions, and so on. The presence or absence of guarantees for these rights and interests has a significance that cannot be neglected for motivating the initiative of academy and institute directors and stabilizing academy and institute director staffs.

V. Some Suggestions

A. On the basis of fully affirming the institute director responsibility system, conscientiously summarize experiences, resolve contradictions, and continue to promote the healthy development of the institute director responsibility system

Comprehensive implementation of the director responsibility system conforms to the overall direction of system reform in China and the implementation situation over the past several years has been good. It has received the endorsement and support of vast numbers of cadres and employees, and it should be affirmed and continually implemented with conviction. As a new type of leadership system for research institutes, however, implementation of the director responsibility system should involve a process of continual practice, exploration, and gradual perfection. Many new problems and new contradiction may appear during each stage of its development. We propose that S&T administration departments at all levels do more survey research, extensively summarize experiences, and provide timely assistance in solving concrete problems in order to continue to promote further development in the width and breadth of the institute director responsibility system.

B. We should work quickly to formulate scientific research organ leadership management system regulations and detailed principles for implementation and consolidate the achievements in reform, including implementation of the institute director responsibility system

Although the CPC Central Committee and State Council have made stipulations in principle for implementation of the director responsibility system in scientific research organs, there are still no regulations and detailed principles for implementation. As a result, it is hard for everyone to achieve unity in understanding and there sometimes is even wavering as the overall environment changes. To perfect the institute director responsibility system, we propose that the relevant areas work quickly to formulate research institute work regulations and detailed implementation principles which include S&T work in research institutes, the institute director responsibility system, party organization work, democratic management, and so on to provide better assurances through legal documents and operational procedures for the central status of institute directors in research institutes, the leadership status of party organizations in ideological and political work, the status of S&T personnel and other employees as the masters of research institutes, clarify the responsibilities and rights of all categories of party, administration, and mass organizations, the work patterns and procedures in research institutes, and so on to provide guarantees that research institute work is scientific, democratic, systematic, and standardized.

C. Reinforce scientific research organ leadership cadre staff construction, provide organizational guarantees for implementation of the director responsibility system

Implementation of the director responsibility system has brought definite changes to party and administrative functions in research institutes. Institute directors and party secretaries must not only be familiar with S&T work, but they must also know how to manage and administer. While guaranteeing that achievements and results are produced, they also must produce an S&T staff that is both red and expert. In the new situation, they all undergo their own process of study, adaptation, and gradually improving management levels and leadership capabilities. Thus, reinforcing scientific research organ leadership cadre staff construction, improving the quality and capabilities of leading cadres, and achieving relative stability in leadership cadre staffs have now become basic guarantees and important measures for adhering to and perfecting the director responsibility system. We propose that all administrative departments truly reinforce training, testing, reward and punishment, and other management work for leadership cadres in scientific research organs. Deal with the current situation in cadre staffs, gradually establish a pre-assignment and on-the-job training system for institute directors and CPC secretaries and a training and examination system for reserve cadres. Take active measures to truly solve their problems in areas like technical job promotions, wages, welfare, additional training, treatment after leaving their posts, and so on, so that they feel at ease in managing research institutes well and make greater contributions to reform and development in research institutes.

D. Actively create excellent external conditions for research institutes, enable even greater development of research and development activities

For the past 10 years, as reform has intensified, major changes have occurred in the internal organizational structure, management system, operational mechanisms, behavior structure, and so on in research institutes and definite achievements have been made. However, it should be soberly noted that research institutes now face many problems, including unclear social functions of scientific research organs, insufficiently strong support, staffing instability, inadequate reserve strengths, and so on. It will be hard to find fundamental solutions to these problems by relying solely on research institutes themselves. As a type of social organization, any aspect of reform and development in research institutes, including implementation of the director responsibility system, is closely linked to their environment. We hope that S&T management departments at all levels and even all areas of society can create a somewhat better environment for scientific research organs to enable them to become independent business unit legal persons and develop themselves, serve society, and fully foster their proper social functions under relatively relaxed and rational conditions.

Technology Development Management Plan for National Key Enterprises

91FE0232D Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 25 Dec 90 p 2

[Text]

Section One. General Principles

Item 1. Measures for standardizing the administration of a plan (sketch of plan follows) for technological development of key enterprises of China.

Item 2. The S&T plan is a component element of the national people's economic and social development plan. The growth plan is one of the principle parts of the national S&T plan; is intimately linked up with the S&T attack plan, the new products testing and production plan, and together with technology importation and transformation, and the capital construction plan, is subsumed into an overall command plan.

Item 3. The stated aims of the growth plan are to make use of planning, financial, and credit economics to execute these measures; to energize technology development of large and medium industries and enterprises; to upgrade enterprise technology development capabilities; to develop to a high level of technology development; to earn notable social and economic returns; to put new products and technology into the market; and to strive for rational adjustment of product and production output structures.

Item 4. Technology development as expressed in these measures means using applied research or imported technology to carry out the design and manufacture of products, technology, and facilities, and to work out batch processing schemes for those products and relevant technologies.

Item 5. Principles of technology development:

1. With enterprises as the main element, enterprises are to be united with research academies and institutes, and

major colleges, to open up cross business and cross zone cooperation so as to eliminate deficient, isolated, and redundant development.

2. Digestion and absorption of imported technology will be the chief means of bringing about national production of products and facilities. Linking up self development and international cooperative development will be the second stage of a multi-directional approach.

3. A complete development package is to be worked up with products as its fountainhead, technology as the foundation, and raw materials, basic parts, and original devices making up the main body.

4. With the market as its guide, economic returns as its heart, and an advanced international level as its fulfillment, the plan will target weak links and hinges in industrial and communications production technologies to lift their development to new heights, to escalate exchange of products, and to raise the level of products and technologies.

Section Two. Profile of Measures

Item 6. Basis of the profile for the growth plan:

1. State Council requirements and dispositions on drafting five-year plans for the development of the national people's economy and society.

2. National enterprise policy, technology policy, technology facilities policy.

3. Direction of adjustment and development of national product structure, and direction and key points for the development of all Chinese enterprises and technologies.

4. Medium and long-range plans for science and technology.

Item 7. Growth plans drafted by the State Planning Commission, State Council industrial and communications departments, provinces, autonomous regions, municipalities, and cities with planning and economic committees.

Item 8. Conditions for placing items in the growth plan.

1. Products and technology that can help develop industrial technology.

2. Products and technology that can achieve advanced world class.

3. Products and technology that can be widely used for escalating exchange.

4. Products and technology that promise savings in energy, materials, and lower costs.

5. Products and technology that can contribute to increasing domestic markets, replace imports, break into world markets, have production value, and can earn and save money.

Item 9. Items in the growth plan are initially requested from enterprises and are listed in the "Schedule of Suggested Items for Technology Development of National Key Enterprises", (referred to below as 'Schedule of Suggestions'), and the "Table of Items Requested for Technical Development of National Key Enterprises". These are passed by the departments in charge of the enterprises, and reported to the State Council departments in charge of industries and communications, or the provinces, autonomous regions, municipalities, and cities with planning and economics committees.

Item 10. The State Council departments in charge, and provincial level economic committees (planning and economic committees) are the authorizing entities. After items are screened and judged by the authorizing entity they are first written into the department's or local area's enterprise technology development plans, and after demonstrating its economic value they will again be reported up to the National Planning Commission.

Item 11. The "Schedule of Suggestions", after passing initial judgement and approval by the State Planning Commission, will become a nominee item. After passing the relevant authorizing entity, the entity may then arrange for the specialists or departments-in-charge at the relevant enterprises, research academies, institutes, and major colleges, or local S&T administrative cadres to proceed, in accordance with the text and content of the "Schedule of Suggestions", to justify the item by writing the "National Key Enterprise Technology Development Item Justification Report", (referred to below as "Justification Report"). After that the candidate unit will be so designated. Depending on the particular circumstances, some items may be submitted in the form of a bid, effecting the actual designation of the candidate unit (demarcated in the schedule, or in its own form), and the "Justification Report" and designated candidate unit will be reported to the S&T Division of the State Planning Commission.

Item 12. The State Planning Commission will rejudge the "Justification Report" and affirm the item, and place it in the "National Key Enterprise Technology Development Plan", and send it down to the authorizing units.

Section Three. Administrative Organization

Item 13. The authorizing entity will arrange for the implementation of the development item. Its responsibilities are:

1. The principles and procedures for placing the item into the growth plan require that the item be reported to the State Planning Commission, and added to the "Schedule of Suggestions".

2. Once the justified item has been reported, and deemed a candidate unit, it is added to the "Justification Report", and the candidate unit list, and then reported to the State Planning Commission.

3. The candidate unit will be concluded and signed into the "National Key Technical Development Item Contract Document" (referred to below as the "Contract Document"), the circumstances of its implementation will be supervised and inspected, and a transcript of the "Contract Document" will be sent to the S&T Division of the State Planning Commission.

4. As required by the plans and contracts, national supplementary funds will be broken down, released, and sent down to the original department or locale. The candidate units will be urged to raise their own funds, and utilization of capital will be supervised and checked.

5. A progress schedule will be set and checked, and exhortations made to meet expected targets.

6. Checks and acceptance of accomplished items will be arranged, and findings reported to the State Planning Commission. Other measures will be appraised and accepted.

7. In March and September of each year the circumstances of implementation of primary items will be separately summarized and reported to the State Planning Commission, and the macro-analysis documentation will be assembled, and written into the "National Key Enterprise Technical Development Items Progress and Completion Situation Report".

Item 14. The responsibilities of the candidate unit in actual implementation of the development item are:

1. To submit the "Schedule of Suggestions" to the authorizing entity in accordance with the principles and procedures for placing items into the growth plan.

2. To participate with collaborating units in writing the justification, and submit all documentation materials.

3. To sign the "Contract Document" together with the authorizing entity and collaborating units.

4. To take overall responsibility for organizing collaborating units in working up an implementation scheme and progress schedule, and assignment of persons for general responsibilities, and for specific task responsibilities.

5. To manage self-earned funds and bank loans, and conduct a rational allocation of funds required by collaborating units, and carry out supervision of expenditures; complete the final accounting of expenditures for the current fiscal year, and the budget expenditures for the following year.

6. Submit timely reports to the authorizing entities on the circumstances of implementing items, and transcripts to the S&T Division of the State Planning Commission.

Item 15. The State Planning Commission's responsibilities for formulating and coordinating the growth plan are:

1. Investigate the circumstances of implementation of items, and together with the authorizing entities, study and correct evident problems.

2. As new situations arise out of the execution of the plan, consider alternatives, and where major questions arise concerning an item, make necessary adjustments even to the point of rescinding an item.

Item 16. Items should be rescinded under the following conditions:

1. Inferior to technology achievements already made in the same category.

2. Duplicates item simultaneously entered in the national level S&T plan (Duplicate Item).

3. When enterprises have received supplemental funds from authorizing entities, but have not generated self-made funds.

4. When a proper linking up with technology advancements, technology transformations, and capital construction plans becomes too problematical.

5. When it is no longer possible to proceed because of leadership inability of the authorizing entity, or great changes are discovered by the technology support or persons in charge.

6. When for other reasons items should be rescinded.

As to the matter of rescinding items, in accordance with relevant national regulations, the authorizing entities will manage the capital and the return of supplementary funds.

Item 17. The State encourages compensation and transfer of rights for achievements in development, and has stipulated that the monetary gains from those achievements be transferred back to the unit that made the achievements in accordance with the concrete provisions of the "Rules for the Transfer of Rights to Technology" promulgated by the State Council. Units that make achievements in development items, can not monopolize and control those items beyond what is specifically stipulated by the government ministries and commissions.

Item 18. Outstanding national new product awards, and other national S&T awards can be requested for development achievements; patents may also be requested.

Item 19. Rewards for S&T personnel who participated in development item work will be handled by the development unit in accordance with relevant national regulations.

Section Four. Administering Capital

Item 20. Funds for the growth plan are raised through many channels. The capital structure is primarily composed of funds earned by the enterprise itself, national supplementary funds and authorizing entity funds. With funds earned by the enterprise as the main part, the primary channels are: production development funds included with reserved profits, new product test production funds, that portion of enterprises' fixed capital that was converted to old capital for use, as was permitted in accordance with national regulations, funds apportioned for production costs within the limits of national regulations, the fixed ratio of sales receipts used to cover technology development expenditures as approved by the Ministry of Finance, and tax reductions on new products, or increased value taxes. National supplementary funds include both allocations and loans.

Authorizing entities supplementary funds, and enterprise self-earned funds should all be listed in the general economic budget for item development, and gaps cannot be left up to the government to solve. At the same time, imports, technology changes and capital construction funds must not be counted as development funds.

After enterprise self-made funds and authorizing entity supplementary funds are put into effect, national supplementary funds may be granted as appropriate.

Item 21. Range of application of national supplementary funds:

1. National allocations of funds must be special funds for special uses, and they can only be used for product R&D, technology design and testing, development of key facilities, purchase of required raw materials, etc.; and must not be used to pay for mechanization of explorations, or dissertations, or printing documents, and certainly not to pay for workers awards, collective welfare, or engaging is aspects of capital construction.

Item 22. Administration of nationally allocated of funds to implement categories of item:

Category 1. In cases where technological difficulties are great, and performance requirements are high, but the requisite capacities are not high; and in cases where indirect economic and social benefits are very good; and for items urgently needed by the country, non-compensatory allocations can be put into action.

Category 2. In cases where technological difficulties are great, and performance requirements high, and specific capacities are needed, small compensations may be repaid.

Category 3. In cases where technological difficulties are great, and performance requirements are high, but requisite capacities can be quickly formed up, and requisite capacities are very great, and the items have economic benefit, then large compensations may be repaid.

After items are categorized, time limits and rate of repayment of assistance funds are determined cooperatively by the National Planning Commission and authorizing entities, the authorizing entities must clearly write them into the contract document. Authorizing entities will see to it that repayments are made to the banks. The State Planning Commission will monitor the repayments, and a fixed ratio will be left to the authorizing entities to use for enterprise technical development funds, and for national growth plan items.

Item 23. The authorizing units and relevant departments must not withhold, or divert nationally allocated funds, and must complete the break down and distribution of the funds within two months after receiving notice of allocations, and then report it to the S&T division of the National Planning Commission.

Section Five. Additional Rules

Item 24. These measures will be implemented upon date of promulgation.

Item 25. The various locations and departments may according to the principles of these measures, and the specific circumstances of those locations and departments formulate the administrative measures for industrial and local enterprise technical development plans.

Item 26. The National Planning Commission will assume responsibility for the interpretation of these measures.

Implementation of State Innovation Management System

91FE0308D Tianjin KEXUE XUE YU KEXUE JISHU GUANLI [SCIENCE OF SCIENCE & MANAGEMENT OF S.T.] in Chinese No 12, Dec 90 pp 4-6

[Article by reporter Kong Deyong [1313 1795 8673]

[Text]

1. Creative Management System SIMS

From a creative and innovative management perspective, a fully free competitive market mechanism is the most suitable to furnishing the most appropriate environment for creativity and innovation.

From the perspective of a political environment, the entrepreneurs should be given full democracy and freedom, then their talents and creative spirit can be given full play.

For this reason the conflicting points at issue should be centered on the economic planning mechanism, on the market mechanism, and on the political question of democracy and central planning.

Scholars of the Soviet Union and Hungarian systems conclude unanimously that the market system is their only outlet, and there is no other choice. Some scholars criticized the Chinese model, "The state controls and regulates the market, the market guides enterprises." Several points of view (on the Chinese model) are given below:

1. Looking at the system, there are no boundaries or restraints. The merits of having a system do not apply.

2. Looking at the actual situation, because of the contradiction of interest to the state, regions, departments, enterprises, and individuals, a purely free and competitive market doesn't exist.

3. The essence of having a good system lies in the integration of planning and the market mechanism.

4. "Macrocosmic control, microcosmic vitalization" is the most vivid and best summary description of the (Chinese) system.

5. Under the two-levels concept, macrocosm and microcosm, as described above, the writer proposes a self adapting control system model, conceived as a macroscopic State Innovation Management System (SIMS). A schematic diagram of this system follows:

In it, R is the regulator, namely the government administrative bureau(s). P is the social, political, and economic development process. I is the system identifier, which includes various statistical, investigative, and soft-science research organizations that collect various important parameters, and put out estimates based on them; and gather information, and send it to the policy making organization, D.

The policy making organization has two levels, one is a policy making support system, and one is the policy makers. The former will not only provide information to the latter, but will supply numerous options to the latter for making policy.

This self adapting control system, SIMS, is gradually being perfected in China. In recent years more than 2,000 soft-science research organizations have developed rapidly, and they have made important contributions in this respect. But, in this sort of system there still are many questions that await development by China's soft-science researchers. For example, first, what kind of indicator system will be used for input at W? Using only the national gross value of industrial output, GNP, will not be nearly enough. Second, what process of parameters F should be identified and sent to the policy making department D, and what parameters should not be identified? Third, what things require policy decisions, should be controlled and regulated, and what things should not be controlled by the government, but should be left alone? Fourth, what is the regulator quantification V, and what are the external inputs at O?

This article will emphasize enquiry into the following two reforms that affect the system, that of the regulator quantification V, and the external input at O since China's opening up to the outside world. The object of the system is the S&T management system.

SIMS can be divided into direct SIMS and indirect SIMS according to whether the government influence on the system is direct or indirect.

2. Direct SIMS

Since reforms began, especially since the CPC S&T system reforms decisions were announced, the government continually promulgated many policies. Those that affect S&T activity, especially those that directly affect creativity and innovation, are summed up as follows:

1. Change S&T funding from former system of simply using a single channel of central government allocation. Now there are many channels of common support. For example, enterprises, local government, and banks. From 1984 to 1989 common funding for S&T development from industrial and commercial banks was up to 6.65 billion yuan.

2. Vitalize S&T personnel, encourage them to hold concurrent jobs to help develop town and village enterprises. According to "Spark Plan" statistics, in the past 5 years, 500,000 scientists and engineers went to the villages to help town and village industries. This caused the town and village enterprises to have an increased annual value of production of 30 percent, and the gross value of industrial production exceeded the total value of agricultural production. 80 million farmers switched from agricultural to industrial production making a great forward step toward industrialization; and industrialization is the foundation of creativity and innovation.

3. The central government and National People's Congress together formulated several important S&T rules and regulations, and administrative ordinances to spur free competition, safeguard intellectual property rights, and to stop subsidizing low efficiency.

4. The central government issued several major plans, with objectives, stages, and levels, that moved toward uniting S&T and economics, and genuinely drove China's S&T and economic development forward.

In pattern with the strategic idea of the three levels (transformation of conventional industries, high-tech research and industrial development, and basic research) the State S&T Commission recently proposed five major plans: 1. The "National Attack Plan" jointly administered with the State Planning Commission; 2. The high-tech development plan; 3. The Torch Plan; 4. The Spark Plan; and 5. The basic research plan. Of these, 1 and 4 are of the first level; 2 and 3 are level two.

5. Technical innovation will get special attention in several important areas of application. For example, lowering the cost of unit production value, consumption of energy resources and commodities, improving product quality, using international standards, and controlling environmental pollution.

6. To encourage high-tech enterprise ventures, in 1985 the first risk-investment corporation was set up.

7. To protect inventiveness and creativity, in 1985 the State Patent Bureau was established.

8. Allowing the existence of the various S&T development corporations that have been created. In addition to the public ones, there are conglomerates, and individual ones.

9. Military industries that have converted to civilian industries have been very successful. Through several years, 1,100 S&T achievements from military research elements have been transferred over to 600 enterprises.

10. Special attention has been given to education and training. Each year one million youths have been trained in the "Spark Plan", and 20,000 high-tech industry administrative personnel have been trained in the "Torch Plan."

11. Reduction of unnecessary organization and procedures. Overseas travel procedures for S&T personnel from the High-Tech Development Zones have been greatly reduced.

3. Indirect SIMS

Indirect SIMS means that the government influence on technical innovation is indirect. It can be summed up in the following aspects:

1. The policy of opening up to the outside world. The fact that, in the long term, whether China's S&T development must emphasize self reliance, or still be supported by imports is a consistent contradiction, and furthermore, it will rise and fall as the world political situation changes. In reality, this question should be regarded on several levels. As far as high-tech development goes, self reliance is the key, because international competition in this area is fierce, it is unrealistic to think of developing high technology through imports. But, some importation, if it is possible and suitable, can speed up China's high technology and industrial development, and policies concerning such importation should be done to support self reliance. As far as technology transformation of conventional industry is concerned, because the level of technology in China is well behind foreign levels, the importation of technology can speed up China's technology transformation, but the focus must be on digestion and absorption of foreign technology, and innovation. In implementing the policy of opening up to the outside world, in certain areas technological progress has been rapid. For example, in black & white and colored television, refrigerators, and microwaves there is already a high volume of exports. If China had depended totally on self reliance, progress couldn't have been that rapid.

2. Building high-tech development zones. There are now 30 high-tech development zones in China, 2,000 high-tech enterprises, and 50,000 employees. The total sales figure for 1989 reached 2.6 billion yuan, and earnings of 56 million U.S. dollars in foreign exchange.

The government has given the high-tech development zones financial, revenue tax, foreign trade and customs tariff preferences to encourage high-tech industrial development. In the 1990s it is planned that 4,000 high-tech enterprises will be set up, with 300,000 employees, and 5,000 high-tech products, to reach a total sales figure of 20 billion yuan.

3. Set up more S&T fairs, high-tech business service centers, and technology markets. The number of technical contracts that were signed in 1989 were 260,000 for a total of 8 billion yuan.

Summary

In the next 10 years, if a concentrated effort can be made to raise the level of creativity and innovation, to boldly eradicate all of the human obstacles, and allow the intelligence and brilliance of the splendid youth of China to reach full bloom, and to utilize the opportunities brought by the new technological revolution to enable the PRC to stand once again among the world's strong nations, China can realize its potential to become an economically, socially, politically, and militarily strong nation.

The market system is emphatically not a panacea, nor is it invincible, and the planning mechanism is not without its merits, for it does have its strong points. The two working together in mutually corrective harmony could be the curative for China's inconsistencies.

Plans to Reform Traditional Enterprise System by Use of Electronics Technology Drafted

90FE0208B Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 4 Dec 90 p 2

[Article by the State Planning Commission: "Plans to Reform Traditional Enterprise System by Use of Electronics Technology Drafted"]

[Text]

I. The Principle of Guiding Thought and Following the Line

Starting from what we have and projecting what we will need to develop our economy, electronics technology should be used whenever possible to reform the traditional enterprise system by following a policy that we should primarily be independent and not totally rely on international cooperation. We must pay attention to developing technology and products that integrate electronics into machines. We have to manage enterprises with the aid of computers. The main objective for each business is to improve profitability and the focal points are to reduce energy consumption and raise product quality. The widespread use of a single technology and the use of a variety of new technologies should be done in parallel. The reform of key technique and equipment and the reform of the overall enterprise should be done at the same time. Each enterprise should be led to develop and use electronics technology by key points and at different levels in order to rapidly convert it into productivity.

Leading Principle:

1. Based on need and feasibility, we should develop and apply at all levels. Based on reality, especially on production need, different levels of electronics technology can be chosen for use. Based on market demand, new machines with integrated electronics and new products involving a variety of applied electronics should be developed.

2. Combine trade technology with electronics technology. From a technical standpoint, to use electronics technology to reform traditional enterprises is to combine trade technology with electronics technology in order to allow electronics technology to permeate into various industries. Thereafter, as far as that industry is concerned, a new technology is created.

3. Pay attention to reliability.

4. Plans at various levels must be included in technology reform plans. Plans to reform traditional enterprises using electronics technology must be included in the technology reform plans for implementation. We should take full advantage of electronics technology to reform the traditional enterprise system.

II. Six Key Issues

1. Continue using electronics technology to update existing equipment.

Updating existing equipment with electronics technology must be done in conjunction with realignment of production lines and processes. Existing equipment must be updated systematically on an individual basis or as an entire line. First, existing equipment must be analyzed and categorized. Equipment that needs to be updated, or is worth rebuilding, will be updated by different levels of electronics technology to meet production needs. Large and heavy duty machine tools will be updated to have digital display and computer control capability. Ordinary machine tools will have economic digital control. Equipment that is obsolete will be replaced as soon as possible. When new equipment is required, priority should be given to computer controlled units in order to raise the overall equipment standard of the enterprise.

2. Develop new machines with integrated electronics and new products using electronics technology.

To develop new machines with integrated electronics and new products using electronics technology, an enterprise should initially focus on its existing products. A product may be redesigned and modified to include an electronic device to become an electronically integrated product. On the other hand, we must pay attention to developing new products with completely new designs. The key products to develop and manufacture include CNC machine tools, computer controlled industrial boilers and furnaces, windmill-driven water pumps with electronic speed control, light textile machinery with computer control, intelligent instrumentation, computer-based automatic control systems, industrial robots and special automation machines, intelligent home appliances, electronic energy-saving lights, and electronic toys.

3. Monitor and control manufacturing process by computer.

Based on its own situation, each enterprise may implement automatic control for a single machine, a unit, or the entire process. Using electronic devices such as a single board computer, programmable controller, modular bus system, and 16-bit microcomputer, a control system can be gradually built up from low to high level.

4. Promote computer aided design (CAD).

During the Eighth 5-Year Plan, CAD technology must be promoted in enterprises that can afford it. Large and medium key enterprises must play a leading role in this effort. The management of each enterprise must concentrate its resources to lay down a good foundation for general software and dedicated database to allow CAD to grow in a healthy manner. It will gradually be widely used in every industry.

5. Use electronics technology for electric power.

In the Eighth 5-Year Plan, we must have a firm grip on the development and production of basic devices of power electronics, i.e. transducers. In terms of applications, we have to focus on ac servo and drive, electronic speed control for windmill-driven water pump and electronic energy saving light in order to conserve energy.

6. Computer aided management.

Computer aided management will be introduced in a step-by-step manner. Advanced computer information management technology will be used in industry to modernize management in industry and to improve overall benefits. An enterprise may begin with a domestically manufactured microcomputer to manage some of its business and then expand afterward. An enterprise can gradually establish a complete management information system and decision support system based on its own unique needs. Then, we can create conditions to make a transition to integrate control, management and decision-making into one system.

In addition, the use of computer technology in agriculture for higher yield must be addressed. This application must be done in combination with the overall governing of agricultural regions to step up production of grains, cotton and oil and to push agricultural technology to a new plateau. Through the use of computer, we can implement scientific management, scientific farming, scientific fertilization and scientific projection to minimize losses and maximize yield per unit area. China has developed some technology to optimize fertilization and to assist decision making in projecting wheat production. The trial results were quite good. We intend to push for their use based on the local situation.

III. Objectives and Primary Tasks

Objectives:

We will focus on the development and use of electronics technology in 12,000 large and medium enterprises all over the country and attempt to convert more than 10 percent of total equipment asset value to computer control. We will save 20 million tons of coal from energy conservation and develop 10 categories of products that have integrated electronics. Computer aided management will be used in large key industries to lower production cost by 1 percent and 1,000,000 computer professionals will be trained. By the end of the Eighth 5-Year Plan, we will have accomplished the following:

In the 300 large and medium key enterprises controlled by the central government, 80 percent of the equipment that needs to be modified and is worthy of updating by electronics technology will be completed. Main production processes (including continuous and discrete type) will have computer monitoring and control for quality control, energy conservation, production safety, environmental protection. In product design, more than 30 percent will be done by CAD. For enterprises manufacturing electrical machinery, electronics must be combined with mechanics to make integrated products the mainstream products. More than 40 percent of the total product value and more than 30 percent of the product types will be electronically integrated products. Computer management information system will be implemented in enterprises and 20 percent of the personnel will be trained to have basic computer knowledge. Among the 12,000 large and medium enterprises and some small key enterprises all over the country, approximately 40 percent of the equipment (which needs to be upgraded and is worth updating) will be modified by electronics technology. Key points in the production line will have automatic control on an individual machine or unit basis. Partial or complete line automatic control will be realized in more than 50 percent of the main production lines. CAD will be used in 15 percent of the design work. For enterprises manufacturing electrical machines, more than 20 percent of product values and 15 percent of the product types will have integrated electronics. Computer management information system will be gradually established in these enterprises. Approximately 10 percent of the personnel will be trained to have basic computer knowledge. As for the large number of small enterprises, electronics will be used for individual technology to provide automatic monitoring and control in critical areas of production in order to ensure quality and conserve energy.

Major Tasks:

In the Eighth 5-Year Plan, every enterprise must identify its goals and objectives to use advanced electronics technology. In addition, it must pay attention to the development and production of products with electronic control technology and system.

IV. Policy and Measures

1. The State Planning Commission and other relevant authorities will promote, plan, organize and coordinate the reform of traditional enterprises using electronics technology throughout the country. Locally, each economic committee (economic planning committee) will be the lead. In conjunction with relevant offices (bureaus) and according to existing system, a dedicated person will be responsible for planning, organizing and coordinating this work.

2. Under the guidance of the economic and social development plan for the Eighth 5-Year Plan, each department and region must prepare its own plan and corresponding measures to reform tradition enterprise using electronics technology in the Eighth 5-Year Plan.

3. Each enterprise must prepare a plan to use electronics technology to reform its technology by adopting advanced electronics technology successfully developed by research institutes, higher learning institutions and other industries. In the meantime, it must dedicate its effort to the development of products that integrate electronics with mechanics and products using various electronics technology.

4. The plan to use electronics technology to reform traditional enterprises must be included in the technology reform plan and S&T plan. When reviewing technology reform plans, items that should use electronics technology and fail to do so will not be allowed.

5. The authority of every industry should formulate regulations to include suitable advanced electronics technology into design guidelines, process guidelines and product technical specifications. As for outdated equipment and products that are obsolete, the State Planning Commission and other relevant authorities will periodically publish a list of equipment to be updated and products that are obsolete. Regulations will be prepared to encourage the replacement of equipment and products.

6. The central and local government must stay in touch with a number of typical enterprises that use a cross-section of electronics technology and provide financial support in the development of new technology and new products, technology reform, and basic construction. Furthermore, site visits and exchange meetings will be held to summarize the work experience for others.

7. Every department, region and enterprise must take strong measures to sponsor various training classes, or to ask universities to teach people electronics technology at various levels. Electronics technology must be included as an important item in employee education.

8. Perfect the service system. Enterprises that offer electronics technology and equipment, organizations that promote new technology and technical consulting firms should provide services to traditional enterprises that wish to use electronics technology.

9. The optimization of electronic monitoring and control systems must be regulated. The State Planning Commission, in conjunction with other relevant authorities, will draft an "optimization regulation," appoint "optimization" testing centers, periodically publish "optimization" systems and products, and issue "optimization" emblems. "Optimization" systems will be included in various promotion plans. Technology reform will be given priority to reach production capability. "Optimization" products will be treated as new products to enjoy tax benefits.

10. The central government will establish an award for "using electronics technology to reform traditional enterprises" to reward outstanding units in applying electronics technology and manufacturers that produce "optimization" computer automatic control systems.

Measures To Cope With S&T Development Discrepancies

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[Article by Yang Shubing [2799 2579 0365]: "Primary Contradictions in S&T Development and Countermeasures"]

[Text] Since reform of the S&T system, the situation of vertical closure in scientific research organs has begun to be broken up and a system of direct cycles between scientific research and production has begun to be established. Now, S&T development problems are not just restricted to S&T themselves. They are also affected by many factors in their external environment. This is particularly true in the area of applied science and technical development. Practice over the past several years has proven this point.

I. Primary Contradictions in S&T Development at the Present Time

A benign cycle between S&T and economic development should involve the continual flow of scientific research achievements into the realm of production and the use of advanced technology to promote rapid economic development; economic development should also return large amounts of capital and scientific research equipment to the realm of S&T to promote the development of S&T. This sort of push-pull cycle is truly the fountainhead of a combined upsurge of the economy and S&T. If this cycle is broken, S&T development will lack a motive force because of capital inadequacies and will stagnate or wither, while the development of production can only be carried out in an extensive way. We feel that a contradiction is now appearing in this type of cyclical relationship in S&T development. The facts are that: 1) Many S&T achievements have been excluded from the realm of production; 2) Many scientific research units do not have sufficient tasks, the utilization rate of scientific research equipment is low, and scientific research forces are idle; 3) There are severe shortages of scientific research funds and improvements in the treatment of S&T personnel have been slow. It must be known that simply relying on limited increases in government allocations will make it very difficult to get out of the difficult circumstances of insufficient scientific research expenditures; 4) The structure of scientific research has turned back toward intermediate research and preliminary research. Although our policies are slanted toward R&D, impeded cycles have prevented objective implementation of these policies.

The reasons for the interrupted cycle between S&T and production should be sought in the three areas of demand for technology, S&T supply, and market intermediaries. For the past several years, enterprises have only been concerned with extensive expansion in production development and have shown no concern for technical progress. They have focused only on hardware imports and neglected the development and utilization of S&T achievements. This obstructs the entry of S&T achievements outside the realm of production and makes it difficult for S&T forces within the realm of production to find opportunities to fully display their talents. In such a situation of insufficient demand for technology, there is naturally no urgency and pressure for establishing and perfecting market intermediaries, nor can they play a pulling role on S&T supply. We are not denying here that obstructions exist in the areas of market intermediaries and S&T supply, but compared to demand for technology, they both become secondary factors.

The causes of insufficient demand for technology in the realm of production (and thereby slow technical progress) are very complex. For example, excessive commodity demand has a definite causal relationship with insufficient demand for technology. For the past several, everyone has been more concerned with shortcomings in the area of the economic system and very few have sought causes in the inherent relationship of technology to the economy, so the problem has never been solved. It is not unthinkable that system defects and obstructions within the technical economy are equally important. This is especially true when readjustment of the economic system serves as a slowing variable (this was also the case during the reform period). The search for the crux of the problem and for methods to resolve it must involve a search for factors in the area of the inherent relationships in the technical economy.

Divided according to the chained relationships involved in mechanical equipment production, manufacture, and utilization, an entire industry system can be divided into the three sectors of basic equipment manufacture (machine tool category), regular machinery manufacture, and mechanical equipment utilization. These three sectors have a mutually restrictive relationship with demand for technology.

Looking at the utilization sector, their demand for technology is: 1) Adoption of advanced mechanical equipment. This is a type of indirect demand for technology because the suppliers of machinery are mechanical equipment manufacturing departments, not S&T departments. 2) Carrying out technical innovation and improvement for existing mechanical equipment. The former has a qualitative effect on technical progress and can cause a leap in technical levels while the latter is only a quantitative change process for technical progress. As a result, the overall process of demand for technology is manifested as the following alternating cycle: advanced mechanical equipment inputs—technical innovation and improvement—more advanced mechanical equipment inputs—further technical innovation and improvement. In this cycle, inputs of advanced mechanical equipment have a promoting or restricting action on technical improvements. The reason is that when advanced mechanical equipment inputs are interrupted or when the original mechanical equipment is too old and outdated, technical innovation and improvement may cease. This is because when the utilization, innovation, and improvement of outdated machinery reaches a certain point, the cost of innovation and improvement may rise relative to the purchase of new machinery and become uneconomical. At this point, enterprises tend to stop innovation and improvement activities and begin accumulating capital again to prepare for purchases of new mechanical equipment. Only when this process is completed can a new round of technical innovation and improvement begin. This is especially true for large-scale technical innovation and improvement projects. This shows that the demand for technology in utilization departments is to a considerable extent restricted by the supply of advanced mechanical equipment. As many have stated, it is precisely because of outdated mechanical equipment and insufficient advanced mechanical equipment that enterprises must carry out technical innovation and improvement. When it is not known whether or not mechanical equipment is too outdated or when advanced mechanical equipment exists that can be used for demonstration, enterprises will lose the motivation for further technical innovation.

Demand for technology in machinery manufacturing departments has the following characteristics: First, because they are not just machinery manufacturing departments but are also machinery utilization departments, they have the basic characteristics of regular utilization departments. The difference is that their mechanical equipment suppliers are both basic equipment manufacturing departments and transfers of machinery within their own departments. This means that their demand for technology is subject to restrictions by supplies from the basic equipment industry and the new mechanical equipment within their own departments, especially the latter. Second, in regular machinery manufacturing departments, no strict corresponding relationship exists between their mechanical equipment they use and the products they produce, meaning that they can use existing mechanical equipment to develop and produce new products (of course, when products are replaced, the mechanical equipment they utilize cannot go completely without readjustment), whereas the development of new products (the conversion of soft technology into hard products) inevitably involves extremely great demand for technology. In contrast, if they abandon product development, this implies to an even greater extent that they had lost demand for technology. This is what distinguishes them from regular utilization departments. It can be discovered by summarizing these two aspects that new product development is the key effect on demand for technology in regular machinery manufacturing departments. They also restrict progress in technical innovation and improvement not just because they require large amounts of technology themselves, but also serve as a primary source of advanced mechanical equipment supplies in their own departments.

Basic equipment manufacturing departments do not account for a large proportion of the industry system as a whole, so their own demand for technology does not comprise a significant proportion of total demand in technology markets. However, they are one source of mechanical equipment for regular machinery manufacturing departments, which plays a restricting role in their demand for technology and progress.

Considering the current situation in demand for technology in China on the basis of the fundamental principles described above, we feel that the main reason for inadequate demand for technology and slow technical progress is insufficient development of new products in machinery manufacturing departments. The eliminates extremely large demand for technology for themselves, and it induces the following chain reaction: advanced mechanical equipment supplies are obstructed; this restricts technical innovation and improvement in their own departments; and this restricts technical innovation and improvement in mechanical equipment utilization departments. This is particularly true in the situation in China of the mechanical equipment in most of our large enterprises being relatively outdated at the present time and the existence of demonstration effects of highly efficient advanced mechanical equipment, when this sort of restricting relationship becomes acutely apparent. Most mechanical equipment users are willing to use advanced technical equipment, but when the development and supply of advanced mechanical equipment is inadequate, they are helpless.

This fact can be confirmed by the large amounts of hardware imports we have made in the past several years. First, it is precisely China's inability to supply sufficient advanced mechanical equipment that has compelled enterprises (mechanical equipment manufacturing departments as well as utilization departments) to import them from foreign countries. Second, given China's present micro-mechanisms, enterprises are not completely lacking in initiative to pursue technical progress. It is just that supplies of advanced mechanical equipment are restricted and this leads to poor results, which has resulted in enterprises losing the development pattern of technical innovation and improvement.

The main factor which causes insufficient new product development in machinery manufacturing departments is not a lack of ability (technical forces and basic equipment). It is instead insufficient motivation. There are two reasons for the insufficient motivation: 1) Unlike many simple consumer goods, new product development for mechanical equipment goes through research, design, trial manufacture, the formation of batch production, and market acceptance, which requires the expenditure of large amounts of manpower, finances, and materials as well as a long period of time, so enterprises are faced with the risks of large inputs, small benefits, and even losses. Thus, if there are sales avenues for old products, few enterprises are willing to develop new ones. Since implementation of a limited system of contractual responsibility for management, this tendency is even more apparent. 2) Although the importing of large amounts of mechanical equipment over the past several years has weakened our domestic manufacturing industry and market, economic overheating and investment inflation by also provided even greater market demand. Moreover, given our shortage of foreign exchange, imports have gradually been restricted, which also provides market opportunities for domestic supplies. This is the reason for our inadequate new product development. Of course, we are not saying that China's mechanical equipment manufacturing departments have a very strong capacity for new product development, but it is a problem of secondary importance compared to insufficient motivation.

In the realm of agriculture, the reason for the breakdown in the S&T—production cycle is also inadequate demand for technology. However, this insufficient demand for technology mainly refers to the traditional conservative cultivation concepts of the peasants and their lack of understanding of advanced agricultural technology.

II. Primary Countermeasures for S&T Development

One way to promote development of S&T in China is to stimulate demand for technology, and another is to expand S&T supply. At the present time, the main task is to stimulate demand for technology in the realm of production, open up the cyclical relationship between S&T and production, and thereby take full advantage of existing S&T forces as quickly as possible. If the problem of demand for technology is not resolved, nothing can be done about other problems. One point that must be stressed is that the relationship between supply of and demand for S&T achievements is different from the supply and demand relationship for regular commodities. When demand for the latter is insufficient, suppliers may be forced to improve quality, readjust structures, and reinforce marketing. For the former, because of the research elasticity and professional choice elasticity, concept of value and so on of S&T personnel, the "buyer's effect" actually does not exist in the S&T realm. This is different from the supply and demand relationship of commodities.

In the industrial realm, the key to stimulating demand for technology is major efforts to promote new product development in machinery manufacturing departments. By expanding supplies of advanced mechanical equipment, a chain reaction occurs in demand for technology in the entire industrial realm. To resolve the motivation question, we should adopt measures in the following areas: establish new product development funds in the machinery manufacturing industry; provide preferential treatment in the areas of loans, taxation, and materials supplies; restrict and abandon the production of outdated mechanical equipment; control imports of large amounts of hardware, and so on. While solving the motivation problem, we also should reinforce the improvement of ability and quality.

In the realm of agriculture, the key to stimulating demand for technology is to establish a powerful extension and demonstration system for agricultural S&T achievements. Change the traditional cultivation concepts of the peasants and make them understand and accept advanced agricultural technology. Of course, actually imparting agricultural technology is also our duty. After implementing the system of contractual responsibility for output quotas, the peasants began having initiative for adopting advanced technology. The problem now is with the scattered administration of contractual responsibility for output quotas which leads to a certain amount of difficulty in S&T extension and demonstration work, so we should make greater efforts in this area.

In the long term, the primary contradiction in China's S&T development will still be the problem of expanding S&T supply. Overall, S&T levels in China are relatively low. At present, it is not just that the contradiction of insufficient demand for technology is more acute, but actually we are facing a dual situation of insufficient demand for technology and shortages of technology supply. As soon as demand for technology is stimulated, existing levels of S&T supply will be incapable of satisfying demand no matter what. Moreover, from the perspective of the S&T—production cycle, if we say that the main obstacle at present to initiating the cycle is insufficient demand, then the supply problem will eventually become the main factor which restricts expansion of the cycle. After solution of the problem of insufficient demand, an external condition, the problem of S&T development levels, an internal cause, will rise very quickly to become the primary contradiction. Thus, if we wish to promote S&T development in China, we must begin now to formulate a "technology absorption" strategy.

Looking at how China lags behind world S&T levels, it can be said that China is now in a "tracking and imitation" stage. In this situation, the only route to S&T development and supplying technical achievements is "technology absorption". Concretely speaking, "technology absorption" includes three levels: 1) Importing all sorts of technical software and hardware prototypes from foreign countries; 2) Organizing and mobilizing

S&T forces in China to carry out digestion and absorption; 3) Completing the process of hardening or copying imported technology software, and carrying out batch production and improvement. These three levels are an integrated whole with inherent relationships. We must organically integrate foreign S&T forces, domestic S&T forces, and the realm of production to be able to complete the entire process of technology supply and conversion. The first level makes use of foreign S&T achievements to gain technical insights and thereby conserve manpower, materials, and time. Relatively speaking, importing software costs less and is not restricted by shortages of foreign exchange. The second level involves the direct participation of domestic S&T forces who use analysis and research to gain a concrete grasp of advanced foreign technology. In terms of capabilities, China's existing S&T forces are entirely capable of accomplishing this task. This level is the focus and difficult point of the overall strategy. The third level is carrying out technical conversion to form real forces of production. The starting point is machinery manufacturing departments.

Adoption of the "technology absorption" strategy will transform repeated importing and continued importing seen in hardware imports in the past. This will have advantages for conserving foreign exchange and raising S&T levels in China. The "technology absorption" strategy stresses digestion and absorption of technical prototypes. Digestion and absorption as well as technical hardening may be an arduous process and the rate at which forces of production are formed may be slow during the early stages, but it will be compensated many times over later. There can be no doubt of this. The "technology absorption" strategy can promote S&T development and the supply of technical achievements, and it can directly increase demand for technology in China. Because it is established on the basis of integrating S&T with production, it can avoid problems in the conversion of S&T achievements. It may be accepted as a concrete model for the S&T—production cycle.

Need To Establish New-Tech Enterprise Groups Explored

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[Article by Cha Weihang [2686 5517 2635] of the Ministry of Metallurgical Industry Central Structural Research Academy: "Establishing New Technology Enterprise Groups Is A Strategic Choice for Promoting Reform of China's S&T System"]

[Text] Abstract: This article analyzes the current demand situation in China's technology markets. It begins with the current technology supply situation and limitations of technology markets in China, explores the inevitability of developing new-tech enterprise groups, and analyzes the characteristics of production enterprises capable of fostering scientific research units' technology-intensive advantages and problems that should receive attention in developing new-tech enterprises.

The main goal in reform of China's S&T system is to truly transform the current situation of a mutual detachment of S&T and the economy. Since the reform, vast numbers of S&T personnel have used different routes to serve social production directly and achieved outstanding social benefits. It must be noted, however, that there has still been no basic turnaround in the situation of a detachment of S&T from production. No major changes have occurred in the internal operational mechanisms of independent S&T units, and the role of the S&T system in our national economy is still extremely weak. Many applied research and technology development units have begun to ask higher-level administrative departments to increase part of their professional allocations because they find it difficult to obtain sufficient income directly from the realm of production through technology markets to fill in the holes left after reductions in professional expenditures. Now, many S&T units lack a clear understanding of the direction of reform in the S&T system. Practice in several years of reform has also been unable to find a path to self-development for these units in the overall environment of economic system reform. At the same time, many S&T units have begun to explore the route of creating S&T vanguard production enterprises and there is still much disagreement at present over whether this method is the direction of system reform in S&T units. This article will attempt to analyze the current development situation and development trends in technology markets, one of the main products of current reforms in the S&T system. It will also examine the relationship between S&T vanguard production enterprises and social and technical progress and explore the importance of S&T vanguard production enterprises run by S&T units for reform of the S&T system and development of the national economy. Of course, these views will require confirmation by practice. To facilitate discussion, this article will use the term S&T units (organs) to refer to independent applied research and technical development units (organs) that do not include basic research organs.

I. The Current Situation in Technology Market Demand

Technology markets are the main link that integrates S&T units and production enterprises after present reductions in allocations of professional expenditures. They are also the main source of income for S&T units. As a result, the development situation of technology markets has a decisive influence on reform of the S&T system during the present stage. According to the general concept of markets, demand is the primary motive force that creates supply. Similarly, demand for technology is also the key factor in creating supply of technology as well as a determinant of the technology market development situation. What is the demand situation in China's technology markets?

During the process of industrialization, mechanical systems are the primary means of production. Thus, demand for replacement of mechanical equipment can to a considerable extent reflect in a comprehensive way the strength of overall demand for new technology in China's industrial and agricultural production system. Table 1 shows that during the 4-year period from 1985 to 1988, China's investments in purchasing and replacing equipment averaged less than 14 percent of total investments in replacement and upgrading, whereas investments in construction and installation projects accounted for over 43 percent in all cases. Although the proportion of investments in construction and installation has continued to drop somewhat, the proportion of investments to purchase and replace equipment has not risen. If investments in purchasing and replacing equipment are compared with the overall scale of investments in productive construction in China over these 4 years, it is even more apparent that they are inadequate. We feel that the main causes behind this phenomenon lie in four areas.

Table 1. Utilization of Investments for Replacement and Upgrading in China, 1981-1988

Year	1981	1982	1983	1984	1985	1986	1987	1988
Investments in replacement and upgrading (billion yuan)	19.530	28.978	35.783	44.203	44.914	61.921	74.263⟩95.451	
Of which: Investments in structures and installation (billion yuan)	11.371	17.096	20.652	25.129	19.623	30.858	33.798⟩46.149	
Purchases and replacement of equipment (billion yuan)					5.836	8.885	9.806	11.999
Structures and installation as proportion of investments (percent)	58.3	59.0	57.7	56.8	43.7	49.8	45.5	48.3
Purchases and replacement of equipment as proportion of investments (percent)					13.0	14.3	13.2	12.6

Source of data: ZHONGGUO TONGJI ZHAIYAO [Statistical Abstract of China], 1985, 1986, 1989.

A. Enterprise system factors

Under the traditional system, enterprises were producers of goods whose ultimate goal was the completion of production tasks, so they were not responsible for being concerned with enterprise technical progress or product renewal and replacement. After implementation of reform of the economic system, this contradiction was never fundamentally resolved. Now, all types of state-run industrial enterprises have commonly implemented a system of contractual responsibility for plant managers (general managers) involving goals during their period of service and the main indices for inspecting enterprises are a system of indices centered on value of output and profits. As the role of the command planning system has grown weaker, individual incomes of enterprise employees and other short-term management goals have played a greater role in affecting enterprise management behavior. Because technical upgrading in enterprises mainly involves investments which provide benefits in the long run that can even affect short-term income of the enterprises, it usually does not receive attention in enterprises. In view of the current situation, implementation of the contractual responsibility system which has powerful short-term characteristics would not be sufficient to cause China's enterprises to detach themselves from the effects of the old system completely and most enterprises would still not take the path of using technical progress to seek development.

B. Too-rapid inflation in total demand in the national economy has greatly weakened enterprise initiative for technical progress

Table 2. Comparison of Supply and Demand Shortfalls and GNP in China, 1979-1988

Year	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Amount by which supply is smaller than total demand (billion yuan)	1.4	5.4	7.2	1.1	10.0	20.9	37.7	71.1	142.1	294.3
GNP (billion yuan)	398.8	447.0	477.3	519.3	580.9	696.2	856.8	976.2⟩1,135.1	1,385.3	
Yearly increase in GNP (percent)		12.1	6.8	8.8	11.9	19.8	23.1	13.5	16.7⟩22.0	
Yearly increase in supply and demand shortfall, in percent		385.7	133.0	- 84.7	909.0	209.0	180.0	188.0	199.9	207.1

Source of data: ZHONGGUO TONGJI ZHAIYAO 1989 [Statistical Abstract of China 1989] and JINGJI YANJIU [Economic Research] No 4, 1990 p 23.

Table 2 lists the total shortfall between supply and demand in China from 1979 to 1988 and compares this with our GNP. We can see that not only has the rate of growth in the shortfall between supply and demand more than doubled each year, but also that its increase has greatly exceeded the rate of growth in our GNP. This powerful pulling effect of demand stimulated rampant blind behavior to expand the scale of production in enterprises. On the one hand, product costs in many enterprises have risen continually due to outdated equipment, poor quality personnel, and low management levels, and on the other hand old products which have consistently been manufactured for decades are still selling well. A sample survey in the fourth quarter of 1988 by the State Technology Supervision Bureau shows that only 74.4 percent of 1,241 types of products produced by 886 enterprises met specifications. However, estimates indicate that 91 percent of China's enterprise products have no problems with finding marketing avenues, and that 51 percent of these enterprises are selling their products well while only 8 percent of enterprises have stagnant sales. Rapid inflation in the scale of total demand has forced the state to employ administrative measures to shrink the scale of capital construction and tighten the money supply. However, "indiscriminate" policies have been incapable of eliminating growth in total demand and restraining the capital famine. Instead, many production enterprises with higher technical levels and better results have been restricted by shortages of raw materials and capital and they have been unable to increase effective supply and reduce the shortfall between supply and demand during the period of readjustment. As soon as the money supply is loosened, a new surge of investments reappears and the shortfall between supply and demand is expanded even further.

In this sort of economic development model, replacement and upgrading of technology and equipment, which plays a key role in improving the industrial structure, receives very little attention from enterprises. To avoid missing periods of peak demand, some enterprises exhibit no concern for product quality and even consider restarting some production techniques and equipment they have abandoned. Moreover, the unstable macroeconomic environment has very negative effects on the formulation of medium and long-term technical upgrading plans in enterprises on the basis of economic and technical development forecasts. Thus, the distorted macroeconomic environment is a primary factor that restricts development of technology markets.

C. A weak technical foundation is not conducive to the diffusion of new technology into the realm of production

The primary characteristics of China's technology structure are a prominent multiplicity of technical structures and a rather substantial difference in the eras of advanced technology and backward technology. The primary technologies in the technology structure are backward. The main production equipment in Chinese industry with relatively advanced technical equipment are basically products of the 1960's and 1970's. They have a poor degree of processing precision and low levels of automation. There was severely rough and slipshod manufacturing of equipment during the 1970's. There are great disparities in regional technical development levels. We can use the situation in equipment levels, worker cultural levels, and technical equipment levels to describe the current situation in the technical structure of China's industrial enterprises. Statistical data indicate that, in 1985, equipment from the 1980's accounted for 32.99 percent in China's large and medium-sized industrial enterprises, while the 1970's accounted for 44.03 percent, the 1960's for 13.43 percent, the 1950's for 8.6 percent, and the period prior to the nation's founding for 0.95 percent. Educational levels for workers were university and college 0.46 percent, polytechnical 1.81 percent, senior middle school 19.33 percent, junior middle school 48.84 percent, and elementary school or below, 23.5 percent. For the technical equipment used by workers, only 2.60 percent is automatically operated, 24.85 percent is mechanically operated, 33.76 percent is semi-mechanically operated, and 38.79 percent is manually operated. The technical structure of China's agricultural production system is even more backward. The amount of fixed assets held by each agricultural laborer is 1/11.5 the amount held by industrial workers. It is quite difficult to develop appropriate technology for a production technology system that is so extremely unevenly developed. The scope of applications for technical achievements and the results of utilization are greatly reduced by the intersecting restrictions of vertical age differentials in the technical structure of users and horizontal levels of technology utilization. Correspondingly, certain types of technology demand proposed by the existing production system often have only a small scope of actual utilization, which substantially reduces the ratio between benefits and costs in technology development. Thus, there are substantial real problems in relying on this production system with its relatively low technical levels to automatically create significant demand for technology.

D. Redundant imports of technology and equipment occupy a substantial portion of our domestic technology market

Since reform and opening up, the downward transfer of some administrative authority over foreign trade and increases in the ratio of profits and taxes turned over versus retained earnings in all regions and departments have played a great role in invigorating the economy, but the phenomenon of redundant technology and equipment imports that followed is becoming increasingly serious, while work to digest and absorb the imported technology lags far behind. Statistics indicate that 70 percent of China's technology development over the past several years has come from imported technology, while enterprise expenditures to digest and absorb technology imports account for only 1/9.43 of expenditures on imports. A State Science and Technology Commission survey of 2,300 imported technologies showed that only 9.2 percent of China's import projects have now been digested and absorbed. The 100-plus color TV production lines imported over the past few years are a typical example of redundant imports. Compare this to Japan after the war, when the government led the way in establishing a complete set of mechanisms that successfully promoted technology imports. On the basis of controlling inspections, they were extremely concerned with organizing forces inside Japan to copy and improve on imported technology and equipment. Imported equipment accounted for ⅓ of the total volume of imports in Japan in 1954 but this had fallen to 1/9 by 1960, to the extent that foreign enterprises found that selling technology was the only way to earn money in Japan. The Japanese scholar (Nanjinliang) said: "understanding why Japan was able to import technology successfully will reveal the secret of Japan's economic growth"[1]. This policy of the Japanese government led to geometric growth in demand for technology development in Japan and established a solid concept of basing technology on national strengths of all its people. In contrast, China has not just failed to digest and absorb its technology imports. They have also substantially reduced the role of domestic demand for technology. This method in which the losses outweigh the gains is extremely unfavorable for the long-term development of China's industrial technology.

Summarizing the factors that affect the strength of technology demand in China, technology demand is inevitably very weak compared to the needs of national economic development.

II. The Current Situation in Technology Supply

The quality of supplies of technical commodities is an important pillar for consolidating and developing existing technology markets. According to a research report from the Chinese Academy of Social Sciences, however, 85 percent of enterprises at present consider the levels of technical achievements supplied by scientific research and design departments to be low, and 75.9 percent of large enterprises and 71.1 percent of medium-sized and small enterprises clearly indicate that they are apprehensive about accepting the technical achievements of Chinese scientific research and design departments[2]. As a result, production enterprises find it difficult to accept existing technical achievements and the main reason is that applied research and technical development are detached from the production process.

Generally speaking, with the exception of the primary "software" or "hardware" systems that are the core part of a technical achievement, a great deal of supplementary work is required before it can actually be utilized. This includes additional research and improvement of the auxiliary equipment necessary for implementation of the technical achievement and making further improvements and supplements in it on the basis of the special batch production and quality requirements of industrialized production. For example, research personnel in the research institutes of several large Japanese companies coordinate closely with production and quality management departments during the process of developing new products and revise designs according to the views of the production aspect to eventually formulate the specifications of the new product by achieving unanimity with development and design departments. This is an important magic weapon in Japanese technical development that has been imitated by many countries in Europe and the United States. (Senguzhenggui) in Japan's (Yecun) Institute feels that if technical achievements cannot be improved in conjunction with the production process, the results of enormous investments in development will be substantially reduced. This is one of the main reasons that Japan has quickly caught up with the United States despite the fact that it spends four times as much as Japan on R&D[3]. In another example, Japanese S&T policy expert (Qianyou) feels that the places where information cannot play its role smoothly between R&D organs and users in England is precisely a main cause of England's problems[4].

China has been influenced by the Soviet model. Our many S&T organs were not only independent from production enterprises when they were established, but there are also serious detachment phenomena within S&T organs which are manifested mainly in two areas.

A. There are detachments among applied research, technical development, engineering, and technical design

Everyone knows that China's S&T organs and design organs were established separately, while our engineering and technical design organs usually do not have special technical development departments. Similarly, technical development organs also lack complete design measures. As a result, with the exception of copying design standards for a long time, independent design organs have made very few technical innovations, and the form of expression of the technical achievements of technology development organs is usually simply restricted to long and tedious technical articles and non-standard engineering and technical explanations. There are no clear standard blueprints, so it is difficult to place them quickly and accurately into use.

B. A configuration of separation in the technical expert group structure within S&T and design organs

Technical development in Europe, the United States, and Japan usually involves the selective assignment of technical personnel from different specializations based on project characteristics to form a project group to undertake the work. China's S&T and design organs are divided internally into different special offices (groups) according to different specializations. Cooperative relationships among them are restricted by different organizational and economic accounting patterns and are weak as a result, so it is hard for them to organize a highly-integrated and well-coordinated research group to become involved in special research topics. This is especially true over the past several years, when the accounting and allocation methods used by special offices (groups) as basic accounting units made cooperative relationships among different special offices (groups) a superficial relationship for the allocation of economic interests. This made it even harder to reinforce cooperation among technical personnel in different special fields and led to increasingly divided and narrow special project groups within S&T and design organs. This in turn caused the technical achievements they created to fail to conform to the laws of technology development, so naturally they were not welcomed by users.

Production technology development as it has developed up to the present time has been in complete harmony with the production process, and the mutual intersection of different technical realms have become the primary source of new technology. If we fail to change the current situation of a vertical and horizontal separation of applied research, technology development, and engineering and technical design, how will we ever be able to expand our present total technology supply?

III. Limitations of Technology Markets and the Inevitability of Developing New Technology Enterprise Groups

Analysis of the current situation in both the supply and demand aspects of technology markets leads one to the conclusion that China has still failed to form a technology market that is adapted to development of the national economy. On the one hand, we are still subjected to interference from mistaken guidance by production enterprises under the old system which arises from their weak technical foundation and distorted macroeconomic environment, which only generates weak demand for technical commodities. On the other hand, our S&T organs are quite incapable of providing large amounts of high- quality applied technical achievements. The result of mutual restriction by both the supply and demand aspects inevitably leads to the prices of technical commodities being at a relatively low level overall. Statistics from technology market management organs indicate that about 6 billion yuan was spent on technology trade among all types of technology contracts that were fulfilled in 1989[5]. This is an average of less than 630 yuan per person among the 9,618,900 S&T personnel in units under ownership by the whole people at the end of 1989[6]. Because there is little likelihood of a substantial improvement in unfavorable factors that restrict development of technology markets within the near term, the short-term economic behavior of technology users and the unstable macroeconomic environment will directly lead to withering of the applied research and technology development functions of S&T units. Thus, relying solely on technology markets to provide an adequate economic foundation for reform of the operational mechanisms within S&T units and the overall S&T system is not realistic.

Relying solely on technology markets for reform of the S&T system also has a key effect, which is that the development of technology markets in China cannot solve the contradiction of the detachment of S&T from production. Regardless of how a technology market develops, it will always only be able to quantify the relationship between technical commodity producers and industrial and agricultural producers into a relationship for the allocation of economic interests. As a result, technical commodity trade will for the time being be subjected to the unfavorable effects of China's very imperfect commodity economy markets. Because setting market prices for technology in itself is very difficult, those who develop technology face considerable economic risks when they invest in technology development and sell technology. Thus, during the process of technical progress, artificially setting market price demarcations by stages for technology will only cause continual contradictions among the two aspects in technology trade and form several boundaries between technology developers and users that are based on the allocation of economic interests. In the end, this will still create a situation of separation of the technology development process from the production process. Thus, establishing many enterprises centered on technology markets that specialize in the production of technical commodities is both uneconomical and incapable of ensuring the effective return of capital to technology developers, which is also not conducive to technology development.

This shows that developing technology markets will only solve one of China's problems, which is a conceptual clarification that technical achievements are a type of commodity and that the producers of technical commodities as a result are and should be commodity producers. However, technology markets as they have developed so far have been unable to use market avenues to provide sufficient capital and income for S&T units and have forced these units on the basis of maintaining their original independence as units to shift from being non-commodity producers, or so-called business units, to entirely commodity producers or enterprises. Reform of the internal mechanisms in many S&T units simply involved importing some contractual responsibility methods in most cases. From the long-term perspective, technology markets are also only capable of serving as a supplementary measure for disseminating technology into the realm of production. A clear revelation that practice in reform of the S&T system over the past several years has given us is that maintaining simplicity in the organizational structure of S&T units cannot solve the problem of S&T being detached from production. Thus, it is essential that we break the deadlock of merely improving internal mechanisms in S&T units during the technology market development stage and merge the organizational structures of S&T units and production enterprises. Merging of organizational structures as mentioned here is not limited to simple combination of enterprises and S&T units. Using S&T units as a core to establish production enterprises is another way to merge organizational structures.

China has done some work over the past few years in regard to merging the organizational structures of S&T

units and production enterprises. The State Council led the way in 1987 in its "Stipulations on Promoting Further Reform of the S&T System" and "Stipulations on Promoting the Entry of Scientific Research and Design Units Into Large and Medium-Sized Enterprises". All departments and local governments made further stipulations regarding the entry of scientific research and design units into large and medium-sized enterprises. However, with the exception of a few scientific research and design units that entered enterprises after they were shifted from their original enterprise jurisdiction and placed under management by various ministries and commissions, most scientific research and design units have still not been able to enter enterprises in this manner. At the same time, the "S&T vanguard" enterprises established by some S&T units have displayed rather good development momentum. We feel that the route chosen for merging the organizational structure of S&T units and production enterprises should be determined primarily by whether or not this route is capable of taking full advantage of the technology density of S&T units. The production enterprises that can take full advantage of the technology density of S&T units have the following attributes:

A. Limited enterprise scale

In general, expansion of the scale of production is a function that is directly proportional to time. As the pace of technical renewal accelerates, the lifespan of technology becomes shorter. In adapting to this type of situation, medium-sized and small enterprises that are limited in scale have obvious advantages compared to large enterprises because they can ensure that the enterprise is capable of keeping up with gradual developments in technology with a rather small amount of investments. At the same time, small enterprises find it hard to pursue the optimum product scale costs that large enterprises have, so they must accelerate technical progress if they want to gain a foothold in market competition. This characteristic of small enterprises has received considerable attention in the developed nations. In Japan, for example, small enterprises account for 99.4 percent of the total number of enterprises in the country and employ 81.4 percent of the total number of employees[7]. For example, Toyota, a big enterprise that produces several million automobiles each year, also has a large number of small enterprises that produce parts for it. The role of small enterprises is particularly apparent in rapidly growing leading technology industries in the world at present like machinery, electronics, and so on. Large enterprises mainly focus on key technologies which consume enormous amounts of capital while technical competition among small enterprises promotes continual renewal of production technology for each particular product. The technology achieved through products is diffused in two directions between large and small enterprises and leads to technical progress in the industry as a whole. The developed nations are now applying this mutually complementary mechanism of technical renewal to sustain a relatively rapid pace of technical progress, which has also substantially reduced the commercial risk arising from an accelerated pace of technical progress. It is apparent that enterprises which rely mainly on technical advantages to maintain a winning position in competition can only expand the scale of production as appropriate by giving preference to promotion of technical progress.

B. High degree of specialized division of labor

A specialized division of labor is a prominent attribute of modern socialized large-scale production. The reason is not simply that a specialized division of labor helps expansion of the scale of production. Instead, it also helps accelerate the pace of technical renewal. This is an effective weapon mankind has in dealing with the growing complexity of production technology. In China, enterprises that are universally "big and complete" and "small and complete" severely obstruct technical progress. The role of some technical renewal within enterprises is weakened and they also restrict diffusion within the scope of society of new technology in order to protect their own interests. After some large enterprises combined with S&T units, besides being "big and complete" they added "another complete" and it was hard to foster the role of S&T units well. To develop and apply new technology, many large enterprises in Europe and the United States often adopted the method of repeatedly establishing small specialized companies. Thus, based on the principle of a specialized division of labor, enterprises which use technical renewal as their primary means of competition and have a full matchup of production specializations can only scattered their limited capital and manpower resources, which weakens their own special technical advantages. Thus, we must continually raise the degree of a specialized division of labor.

Starting from these two points, enterprises which are capable of fostering the technical advantages of S&T units after merging their organizational structures should be enterprises which have a limited scale and a relatively high degree of a specialized division of labor. Obviously, the new enterprises created after the combining of large and medium-sized enterprises with S&T units in China do not meet this requirement, so this type of organizational structural merging arrangement has no development future. Moreover, production enterprises established around a core of S&T units have their scale restricted by capital and materials supplies, product marketing channels, and conditions in other areas. If these enterprises expand their scale of production too quickly, or if they rely on "small and complete" enterprises to reduce their outside purchases of raw materials, semi-finished goods, and so on, they will restrict the ability of S&T units to foster their technical advantages. Of course, it may be possible for some S&T units to establish several small enterprises that are related to their technical specialization in order to accumulate capital or because they lack production management experience, but competition will lead to most of these small enterprises being abandoned because they have no technical advantages. It may even be possible for there to be a small number of extremely well-managed non-technology dense enterprises (including several specialized enterprises involved in commercial trade activities) because their development is not directly related to the fostering of the technical advantages of S&T units, but these examples will not be discussed here.

In summary, production enterprises established by S&T units which use their technical advantages are not only capable of establishing the central status of technical progress in the enterprise economy, but are also adapted to the demands of the characteristics of technical development and socialized large- scale production. Thus, they are one form of organizational merger that is capable of fostering the technology density advantages of S&T units. Starting from this point, we can include this type of enterprise among so-called new- tech enterprises which have already appeared in China and which use added value from product technology as their primary means of earning profits. Of course, new-tech enterprises are not always established by S&T units but the new-tech enterprises established by S&T units have more favorable factors.

At this point, we can summarize the long-term significance of S&T units creating new-tech enterprises. The flourishing development of new-tech enterprise groups is the most fundamental change in the existing S&T system and it is a transition in S&T capital allocation and utilization patterns in society as a whole. The allocation and utilization of capital among applied research, technology development, engineering and technical design, and production activities that is carried out with commodity producers not only at the macro level but also within enterprises makes S&T activities truly become an organic part of the commodity production process that is subject to market regulation in a planned commodity economy. This is entirely suited to the overall goals of reform of China's S&T system. The establishment of this type of S&T capital allocation model will fundamentally change the current situation in which the S&T system serves as a non-productive professional system that is independent of the production system. This is extremely important for promoting a shift to higher levels in China's industrial structure and changing the current situation of coarse development of our economy. Thus, developing new-tech enterprise groups should become a clear strategic goal for reform of China's S&T system.

IV. Explaining Some Points in the Development of New-Tech Enterprises

Creating new-tech enterprises is a new thing in China and many theoretical issues during the development process require discussion. Here, we will first offer a supplementary discussion of several key problems that will be encountered during the process of S&T units changing from a professional system to an enterprise system.

A. On encouragement and guidance policies

Creating new-tech enterprises is a new problem encountered by China's S&T units. We have almost no mature experience in the area of administration and production management and there is a definite market for conservative views from traditional concepts of S&T personnel engaged in managing production activities. As a result, it is very possible for a lack of clear industrial direction in new-tech enterprises, administrative losses that are the result of imperfect management, and other problems to appear. To guide S&T units in successfully overcoming these problems encountered in the transitional stage, and to form an economic environment in China that is conducive to accelerating the movement to higher levels in our industry, we should have clear policies for encouraging S&T units to establish new-tech enterprises, such as copying the successful methods of the Beijing New Technology Experiment Zone that provide preferential treatment for this category of enterprises in the areas of taxation, foreign exchange utilization, bank credit, and so on. To avoid policy biases during the implementation process, we should substantially reinforce new product authentication work in existing enterprises as well as augment this sort of policy as appropriate to encourage people in S&T units who establish this special type of enterprise to accumulate capital and thereby provide more relaxed economic conditions to accelerate this transition in the internal system of S&T units. We also should gradually reduce preferential policy treatment that is provided only to professional S&T units and avoid having S&T units refuse to make a transition to an enterprise system because they do not want to lose these preferential policy treatments.

B. On a change in the economic qualities of S&T units

China's independent S&T units are basically professional units. After creating new-tech enterprises, the property and personnel of S&T units are gradually shifted into the enterprises. This will inevitably cause changes in the economic qualities of S&T units, and it is not a foregone conclusion now that the ultimate economic qualities of S&T units will be enterprise-like qualities. We feel that as new-tech enterprises become stronger and fundamental changes occur in the S&T capital allocation model in society as a whole, profound changes will occur in the concept of professionals in which state allocations of professional expenditures are their main economic source. With the exception of those organs that are mainly engaged in basic research and research with social welfare qualities, S&T units in which enterprise economic strengths hold an absolute advantage already have the entire social, political, and economic status of industrial and commercial enterprise legal persons, so retaining the qualities of non-productive professional units would only hinder these units in straightening out their internal operational mechanisms and restrict the further development of new-tech enterprises. Of course, as the backbone of S&T work, S&T units which have become enterprises could still participate in scientific research project work proposed by government departments at all levels under state directive or guidance plans. Thus, after understanding that technical progress is an inseparable part of the commodity production process, we should not be overly cautious in dealing with the contradiction between the new and the old system.

C. The relationship between S&T and production within new-tech enterprises

Rapid product technology progress is the basic means of existence of new-tech enterprises. Thus, compared with regular enterprises, S&T work occupies a prominent status in new-tech enterprises. In the area of organization, S&T personnel can organize product technology development departments according to the needs of production and technology development and do their work in a manner which integrates applied research, technology development, engineering and technical design, and production management personnel as appropriate. For example, the technical organizations in enterprises in Japan, United States, and other countries that are responsible for a product development project are not just responsible for technical research work. They also track the placement of products into trial production and production when they go into batch production, and adopt "recommendation" methods to directly enable normal production of the product. We should borrow from this successful experience. In the area of accounting within enterprises, to guarantee enterprise technology development, we should set aside a rather large portion from enterprise profit allocations as an S&T development fund and ensure that regular technology development funds are included in enterprise costs. To stimulate the enthusiasm of S&T personnel for their work, we should clarify the central status of S&T personnel in the enterprises and we can provide higher wage treatment for S&T personnel.

Footnotes

1. (Nanjinliang), "The Vigor of Japan's Economy", Aviation Industry Press, 1988, pp 47, 51.

2. "Technical Progress and Economic Benefits", China Finance and Economics Press, p 103.

3. (Senguzhenggui), "The War for Technology Development in Japan, the United States, and Europe", Science and Technology Abstracts Press, 1984, p 41.

4. (Qianyou), "Science and Technology Policy in Japan", Science and Technology Abstracts Press, 1987, p 119.

5. "Beijing Municipality Technology Market News Brief", No 1, 25 May 1990.

6. Zhongguo Tongji Zhaiyao [Statistical Abstract of China], China Statistical Press, 1989.

7. Xin Jishu Geming Yu Shijie Jingji Fazhan Qushi [The New Technological Revolution and World Economic Development Trends], Economic Sciences Press, 1984, p 192.

Strengthening Enterprise Technology Development Organization

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[Article by Liao Gangxuan [1675 4854 3551] of the Beijing Municipal Science and Technology Information Institute: "Strengthen Enterprise Technology Development Organs, Promote Enterprise S&T Progress""]

[Text] Abstract: This article analyzes the current situation in China's enterprise technology development organs and their role in promoting S&T progress and enterprise development. It discusses factors which restrict development of enterprise technology development organs and offers some ideas and opinions concerning reinforcement of enterprise technology development organ construction.

Technology development organs under the jurisdiction of enterprises are an important part of China's S&T staff. They are enterprise departments with relatively concentrated S&T personnel as well as the main army in enterprise adoption of new technology and new equipment to continually perfect and improve technology and equipment, renew products, improve quality, and train key technical staffs. They are characterized by being highly specialized, having S&T personnel as their main force, directly serving enterprise development and product production, and so on.

I. The Current Situation in China's Enterprise Technology Development Organs and Analysis

A. Personnel structure and management system

China's enterprise technology development organs are mainly concentrated in large and medium-sized industrial enterprises. China had a total of 10,738 large and medium-sized industrial enterprises in 1988. Of these, 5,119 enterprises, equal to 47.7 percent of the number of enterprises, had established a total of 5,525 technology development organs. These enterprises had over 273,000 personnel working in technology development organs, including over 113,000 scientists and engineers, equal to 42.2 percent of the total number of scientists and engineers working in all of China's large and medium- sized industrial enterprises. However, the personnel working in enterprise technology development organs accounted for just 1.03 percent of the total number of employees in China's large and medium-sized industrial enterprises and 34.3 percent of the total number of personnel in the enterprises involved in technology development activities (see Table 1).

Table 1. Structure of Personnel in Technology Development Organs Run By Large and Medium-Sized Industrial Enterprises in China, 1988

Technology development organs in large and medium-sized industrial enterprises (number of organs)	Number of personnel in technology development organs (1,000)	Number of these personnel who are scientists and engineers (1,000)	Total number of employees in large and medium-sized industrial enterprises (1,000)	Proportion of this total which are technology development organ personnel (percent)	Number of personnel involved in technology development in large and medium-sized industrial enterprises (1,000)	Proportion which are technology development organ personnel (percent)	Scientists and engineers in large and medium-sized industrial enterprises (1,000)	Proportion which are similar categories of personnel in technology development organs (percent)
5,525	273.2	113.6	26,469	1.03	797	34.3	269	42.2

Table 1 shows that a substantial portion of the personnel in China's large and medium-sized industrial enterprises involved in research and development activities are concentrated in various enterprise technology development organs. The organizational forms of these organs at present include: technology development institutes (academies) run by plants (or companies), technology development departments (offices), new product development laboratories, and so on. A survey of 100 key large and medium-sized industrial enterprises in Beijing showed that through 1987, 65 enterprises, equal to 65 percent of the number of key industrial enterprises, had already established 78 technology development organs. Beijing, China's capital, has a galaxy of talented personnel and dense technology. As a result, the proportion of key large and medium-sized industrial enterprises that have established technology development organs is higher than the national level. In terms of scale, the number of technology development personnel in technology development academies (institutes) run by large enterprises (companies) is 400 to 500 people, while plant-run institutes in medium-sized enterprises have about 100 and a few have just 20 to 30. Most technology development research institutes run by enterprises were expanded and evolved from central laboratories, design sections, and other offices in the various enterprises.

With the exception of implementing independent accounting in a few technology development academies (institutes) run by plants (companies), the existing management system in most of China's enterprise technology development organs is departments under the jurisdiction of enterprises. Decision making authority concerning manpower, finances, and materials is centralized in the hands of the enterprises and the technology development organs do not have the qualifications of legal persons. However, during the process of intensive reform, the management system in enterprise technology development organs is now changing and it is rather common for enterprises to have implemented an internal technology post responsibility system or contractual responsibility system to promote technology development work. The main forms of contractual responsibility arrangements in industrial enterprise technology development organs at present are:

1. Enterprise technology development organs assume full contractual responsibility for the enterprise with independent accounting and responsibility for their own profits and losses. With a prerequisite of making technical progress in their own enterprises their central task, they also carry out compensated transfer of S&T achievements within and outside of their enterprises, but they are not separated from enterprise leadership.

2. Enterprise technology development organs assume contractual responsibility for the enterprise but they do not implement independent accounting. The main aspect of contractual responsibility is S&T development projects, S&T achievements, external services, physical and chemical testing, and so on. The enterprises allocate bonuses on the basis of the contractual responsibility task completion situation. They usually provide most of the initial support (50 to 70 percent) and the remaining portion is paid later or supplemented after the tasks are completed. S&T development achievements are used directly in the enterprise and additional bonuses or deductions are given from the economic benefits they generate after going into operation. The enterprise technology development organs divide contractual responsibility tasks among research offices or laboratories and the offices or labs in turn assign contractual responsibility to groups and technology development personnel.

3. Bids for technology development projects are used for contractual responsibility. The enterprises implement bidding within the enterprise technology development organs for projects assigned by higher authorities, key technical problems in production, new product development projects, and so on. Contracts are signed between enterprise administrators or technology management and the "five fixed things" (fixed contractual responsibility offices, groups, or individuals, fixed contract content and completion indices, fixed assurance conditions, fixed completion schedules, and fixed reward standards) are implemented for those awarded the bids.

4. Fully integrated contractual responsibility is implemented for scientific research, production, and marketing. This contractual responsibility arrangement is used mostly for new product development projects. Enterprise technology development organs assume responsibility for the entire range of market information

survey research, product design, development, intermediate testing, operationalization, and trial marketing for the enterprise. Task documents are assigned after permission is granted by enterprise managers and a contract is signed between both parties which stipulates completion indices, assurance conditions, methods for allocation of economic benefits, and so on. Implementation of the contractual responsibility has reinforced the vitality of enterprise technology development and substantially motivated the initiative of technology development personnel.

B. Tasks and funding sources for enterprise technology development organs

The tasks of enterprise technology development organs include projects assigned by leadership departments of the state at all levels, technology development projects selected by enterprises themselves that are required for the development of production, and horizontally assigned projects. Of the 2,746 technology development projects undertaken by large, medium-sized, and small enterprises in Beijing Municipality during 1987, 80 percent were taken on by large and medium-sized enterprises. As for the sources of the projects, about 50 percent were projects selected by enterprises themselves on the basis of production development needs. Topical projects assigned by leading departments at all levels were second. The proportion accounted for by horizontally assigned projects was very small, less than 10 percent in small enterprises (see Table 2).

Table 2. Sources of Technology Development Projects in Beijing Municipality Industrial Enterprises (1987)

Type of Enterprise	Total (projects)	Assigned by State Ministries and Commissions, Municipal and Bureau Level Leading Departments		Selected by Enterprises Themselves		Assigned Horizontally	
		Project topics (projects)	Proportion of total projects (percent)	Project topics (projects)	Proportion of total projects (percent)	Project topics (projects)	Proportion of total projects (percent)
Large and medium-sized industrial enterprises	2,243	887	39.5	1,116	49.8	240	10.7
Small state-run enterprises	503	172	34.2	285	56.7	46	9.1
Total	2,746	1,059	38.6	1,401	51.0	286	10.4

The total number of technology development projects in China's large and medium-sized industrial enterprises in 1988 was 26,888. Enterprises selected 11,731 projects themselves, equal to 43.6 percent. Higher-level leadership departments assigned 13,110 projects, equal to 48.8 percent. Horizontally- assigned projects numbered 2,047, equal to just 7.6 percent. The situation in Beijing Municipality was roughly the same as the national situation.

The main sources of funds in enterprise technology development organs at present are: allocations from higher authorities, special bank loans, funds raised by enterprises themselves, income from horizontally-assigned projects, and other sources. While most of the technology development projects taken on by enterprise technology development organs were projects selected by enterprises themselves, although projects assigned by leadership departments at all levels did provide funding, development projects that involved long schedules often had insufficient funds, and there have been reductions in allocations each year, so enterprises have been forced to raise some capital on their own to be able to complete their development work. Funds raised by enterprises themselves accounted for the largest portion of all channels used to raise technology development funds. Total expenditures on technology development by China's large and medium-sized enterprises in 1988 were 12.44 billion yuan, and funds raised by enterprises themselves accounted for more than half at 6.39 billion yuan. Special loans were 4.19 billion yuan, equal to 33.7 percent. Allocations by higher authorities accounted for less than 10 percent. In 1987, Beijing had 450 large and medium-sized industrial enterprises that raised a total of 475.89 million yuan in technology development funds. Allocations by higher authorities accounted for 16.05 percent, funds raised by enterprises themselves for 45.79 percent, special bank loans for 31.53 percent, and the total for income from horizontally- assigned projects and other funds raised for 6.63 percent. It is apparent that funds raised by enterprises themselves and special bank loans have become the main source of funds for enterprise technology development organs. The structure of technology development funds raised by enterprises themselves includes enterprise retained profits, new product tax exemptions and reductions, fixed asset depreciation, and deductions that can be shared to total costs and product sales volume.

Table 3 shows the situation for technology development funds raised by enterprises themselves for 100 key industrial enterprises in Beijing Municipality in 1986.

Table 3. The Situation for Technology Development Funds Raised By Enterprises Themselves for 100 Key Enterprises in Beijing Municipality (1986)

Fund Raising Channel	Total Funds Raised (million yuan)	Proportion of Total Funds Raised (percent)	Notes
Enterprise retained profits	47.378	42.84	5.6 percent should have been deducted, 3.82 percent was actually deducted
New product tax reductions and exemptions	2.161	1.95	Tax exemptions and reductions totalled 15.184 million yuan, less than 15 percent was used for technology development
Fixed assets depreciation	28.595	25.86	Equals 5.7 percent of total depreciation funds
Shared into costs	18.856	17.05	
Product sales volume deductions	13.592	12.30	
Total	110.582	100.000	

Administration of funds in enterprise technology development organs takes the following forms:

1. Establishment of technology development funds within enterprises, with all technology development funds raised through capital raising channels serving as enterprise technology development funds, with independent accounts and using special funds for special purpose.

2. Unified control of technology development funds by enterprises with allocations made to project plans submitted by technology development organs that are examined and approved.

3. Technology development organs implement economic independent accounting and assume responsibility for their own profits and losses. Enterprises provide preliminary funding support for technology development or make allocations in the form of loans on the basis of contractual responsibility contracts with enterprises. If achievements are transferred to their own enterprises, the enterprises pay transfer fees.

4. Enterprises use the funds that are allocated along with the projects assigned by leadership departments at all levels and income from horizontally- assigned projects as their own technology development funds for direct allocation to enterprise technology development organs. They are not turned over to higher authorities, no deductions are made, and there are not additional supplements.

C. When new product development occupies the primary status, enterprise technology development organs have sustained growth

New products are the foundation for the formation of new industries. They are concentrated embodiments of the application of new technology, new techniques, and new materials. Industrial enterprises are departments engaged in material production. Their primary tasks are continually improving product quality, increasing output, and putting out new products, which are also the source of enterprise existence in competition and pillars of development attempts. Thus, developing new products is the core of reinforcing technical progress in enterprises and they occupy a leading status in enterprise technology development. For example, industrial enterprises in Beijing Municipality undertook a total of 2,746 technology development projects in 1987. New product development projects accounted for 56.2 percent or 1,544 projects (1,336 projects in large and medium-sized industrial enterprises and 208 projects in small state-run industrial enterprises). New technology development projects were second at 571 projects, equal to 20.7 percent.

Establishing and perfecting enterprise technology development organs is an important way to accelerate technical progress in enterprises, increase product competitiveness, and increase economic benefits. This is becoming understood by growing numbers of entrepreneurs. As time has passed, the establishment of enterprise technology development organs has tended to increase each year. In 1987, large and medium-sized industrial enterprises in China had established a total of 5,021 technology development organs. This figure rose to 5,525 in 1988, a 10 percent increase. The number of R&D organs in enterprises under the jurisdiction of Beijing Municipality has grown from four in the 1950's to 78 in the 1908's (in 1987), which makes this growth trend increasingly obvious.

To encourage and support enterprises in establishing independent accounting technology development organs, motivate the initiative of enterprise personnel for technology development, and push forward with reform of the S&T system, central authorities and the Beijing Municipal People's Government have issued several related documents in the past few years clearly stipulating the need to establish technology development organs in enterprises having the proper conditions. They have permitted implementation of an institute director responsibility system and independent economic accounting. They have permitted new product tax exemptions and reductions to be treated like the economic benefits indices completed by enterprises and included them in enterprise technology development funds. They have stipulated that enterprises should establish technology development funds with independent accounts and special funds used for special purposes. They have also encouraged the development of horizontal integration among large and medium- sized enterprises, scientific research units, institutions of higher education, and design departments, and they have made the corresponding stipulations on policy measures in regard to the entry of scientific research units into enterprises or enterprise groups.

II. Enterprise Technology Development Organs Have Been Effective in Promoting Technical Progress and Enterprise Economic Development

Establishment of enterprise technology development organs has promoted the integration of S&T with production, produced results, and provided benefits. The number of major S&T achievements made in China from 1981 to 1987 show that industrial and mining enterprises have consistently held a leading position, exceeding the number of achievements by independent scientific research units and institutions of higher education in China (see Table 4).Technology development organs are the main force involved in R&D in industrial and mining enterprises, and there is no doubt that they embody the arduous labor and enormous contributions of all S&T personnel in enterprise technology development organs. Comparison of the output situations in enterprises which established technology development organs with those which have not also shows that the new product net output value proportions and new product sales volume in enterprises which have established technology development organs are both obviously higher than enterprises which have not established technology development organs. For example, survey and analysis of the industrial net output value and product sales volume of large and medium-sized industrial enterprises under the jurisdiction of 10 industrial corporations in Beijing Municipality shows that there are obvious differences in the new product output situation and enterprise economic growth depending on whether or not the enterprises had established technology development organs. This shows fully that enterprise technology development organs play a role in promoting S&T progress and strengthening enterprise vitality. The yearly value of output in China's large and medium-sized industrial enterprises exceeded 62 billion yuan in 1988, equal to 8.41 percent of the gross value of output. New products provided 6.3 percent of total profits realized.

III. Main Factors Restricting Construction and Development of Enterprise Technology Development Organs

A. Lack of relative independence

The management of technology development organs in most of China's large and medium-sized enterprises at present still follows the original system. Their status is merely equivalent to functional departments of enterprises and they lack relative independence. Even with implementation of a contractual responsibility system, most have still not changed this type of jurisdictional relationship. There are still very few technology development organs which have implemented independent accounting within enterprises. A random sample survey of 24 large and medium-sized industrial enterprises including the Beijing Central Combustion Engine Plant and others shows that plant-run technology development organs which have implemented economic independent accounting and responsibility for their own profits and losses account for just 20.8 percent. Most enterprise technology development organs still do not have fund utilization rights, personnel hiring authority, reward and punishment rights, and the authority to make their own decisions regarding the acceptance of horizontal technology projects. Because they lack relative independence, internal transfer of achievements and technical services by enterprise technology development organs are uncompensated. Income from external transfers of achievements or provision of technical services is still under unified allocation by enterprises. Bonuses for S&T personnel in technology development organs are allocated according to second-line personnel standards, and they receive average rewards for the entire plant. The contributions they make to technical progress in enterprises are linked to construction and development of different organs and they are detached from the personal interests of S&T personnel. This influences fostering of their initiative to a substantial extent and causes many S&T personnel to flow out, so the technology development organs themselves lack vitality.

Table 4. Major S&T Achievements Completed in China from 1981 to 1987

Units completing	Year		
	1981-1985	1986	1987
Total	98,245	22,740	29,893
Independent scientific research units	31,450	5,497	9,285
Institutions of higher education	11,438	3,746	5,052
Industrial and mining enterprise	36,842	9,235	11,553
Other	18,515	4,262	4,003

B. The lack of indices for assessing enterprise technology development work affects establishment and development of enterprise technology development organs

During the universal implementation of the plant manager term of service objective responsibility system, the main indices for assessing enterprises are value of output, profits and taxes, and other economic results indices. They are also closely linked to increases in wages as well as to increases in enterprise capital, deductions and rewards, and even to promotion of enterprise officials, and other things. Enterprise technology development has been seen as having "soft" indices. During their term of service, enterprise officials quite naturally pay more attention to increases in output value and in profits and taxes, so it is difficult to undertake projects involving longer schedules and larger investments. Less than half of China's large and medium-sized enterprises have established technology development organs and technology development personnel account for less than 2 percent of their total number of employees. In November 1989, the Ministry of Machine-Building and Electronics Industry took the lead in formulating and promulgating the relevant assessment indices for technical progress in large and medium-sized enterprises in the industry. They included nine items, among them the annual rate of technical progress, the new product output value rate, the yearly rate of research and development capital, the rate of S&T personnel, and others, as well as scientific assessment calculation methods. This was an excellent beginning and it will certainly promote technical progress work in the enterprises.

C. A loss of balance in overall development of enterprise technical progress, some technology development organs lack regular tasks

Technical progress contains many aspects and each of the aspects has a close relationship of dependence on the others. In present work to promote technical progress in enterprises, however, while there is a focus on product development, insufficient attention is being given to overall development coordination. For example, there is concern only for expanding production of commodities that are in short supply in the market, but there is no concern for improving quality and rationalizing the industry structure, imports are stressed while digestion is neglected, and so on. During the Sixth 5-Year Plan, import work in several enterprises in Beijing Municipality was managed only by foreign trade departments or import offices under direct leadership of plant managers. Technology development organs in the same enterprises were often excluded and were unable to play their roles. The result was the formation of a situation in which on the one hand no one was involved in digesting and absorbing while on the other hand technology development organs in some enterprises had too few tasks. Neglecting an important link in reinforcing enterprise technical progress, digesting and absorbing, led to an unavoidable pernicious cycle of imports-backwardness-more imports-more backwardness, which weakened the primary status of enterprise technology development in promoting technical progress.

D. Existing channels for raising technology development capital are not being fully utilized

Compared with the developed nations, China's inputs of R&D funds are rather low. They are lower than India's as a proportion of GNP. Because China is still a developing nation with limited financial resources, outlays for S&T accounted for just 4.6 percent of the state's total financial expenditures in 1987. We spent a total of 5.67 billion yuan on R&D, of which 1.685 billion yuan, equal to 29.7 percent, was allocated to industrial enterprises. In contrast, the developed nations' expenditures on R&D that are invested in industrial enterprises usually account for 60 to 70 percent of total expenditures on R&D, more than double the amount in China. Given the state's current situation, this condition will persist. Thus, we face definite problems in substantially increasing state investments on R&D in enterprises in the near term. Of the total of 12.44 billion yuan in technology development funds raised by all of China's industrial enterprises in 1988, capital they raised themselves accounted for 51.4 percent and loans for 33.7 percent. It is apparent that the greatest portion came from funds raised by enterprises themselves or from special loans. To reduce the shortages of enterprise technical progress capital, the state has provided relatively preferential policies and a relaxed environment for technology development funds raised by enterprises themselves to ensure the primary role of enterprises in raising technology development funds. The problem now is that, on the one hand, there are appeals that enterprises have insufficient technology development funds, while on the other hand all channels that enterprises can use to raise their own capital are not being fully utilized. For example, 100 key enterprises in Beijing Municipality could have deducted 5.6 percent from their retained profits in 1986 for use as technology development funds, but they actually deducted just 3.82 percent. The total tax reductions and exemptions for new products in 1986 should have been 15.184 million yuan, but they actually used only 2.161 million yuan for investments in enterprise technology development. Likewise, just 5.7 percent of fixed assets depreciation was used as a technology development fund (see Table 3). As a result, 20.5 percent of the 78 technology development organs under the jurisdiction of these 100 enterprises had no stable development funds. Similarly, 34 percent of technology development organs in large and medium-sized enterprises in Shanghai Municipality lack stable funding sources. Inputs of funds are not being fully guaranteed and enterprise technology development organs find it hard to develop.

IV. Ideas and Proposals for Strengthening Enterprise Technology Development Organ Construction

A. Focus on key large and medium-sized enterprises, establish and perfect enterprise technology development organs

Establishing and perfecting enterprise technology development organs is one important way to promote integration of S&T with production in China. Science and technology promote economic development and economic prosperity is a prerequisite for S&T development. An underdeveloped economy places no further demands on S&T, nor can it provide the required conditions for S&T activities. Key large and medium-sized enterprises are the backbone in invigoration of China's economy and the pillar of national and local production activities. For example, 450 of the 5,070 industrial enterprises with independent accounting in Beijing Municipality are large and medium-sized enterprises and the Beijing Municipal Government has maintained that 100 of them are key enterprises. These 100 enterprises account for just 2 percent of the total number of industrial enterprises in all of Beijing Municipality but their output value accounts for 41 percent of the gross value of industrial output and their profits realized for 42 percent in the entire municipality. It is apparent that they play a crucial role in development of the industrial economy in Beijing. These enterprises have a rather thick economic foundation, relatively abundant technical reserves, and rather concentrated S&T personnel. Thus, they have the basic conditions for establishing and developing technology development organs. By focusing on construction of technology development organs in these key large and medium-sized enterprises, we are focusing on the key factor to enable them to play their role fully in integrating S&T with production development and thereby promoting and expanding S&T progress in all industrial enterprises. For this reason, I propose that all of China's key large and medium-sized enterprises should establish their own enterprise technology development organs during the Eighth 5-Year Plan. Those which already have technology development organs should allow them to play their role fully and provide them with guarantees in the areas of tasks and funds.

B. Foster comprehensive benefits from enterprise technical progress, focus on the leading status of technology development organs

Starting with actual conditions in China, all aspects of industrial enterprise technical progress should be centered on increasing labor productivity and producing more and better products to increase benefits and meet the needs of the four modernizations drive. Thus, technical upgrading, technology imports, new product development, promoting rationalization of the industrial structure, perfecting production organization, improving personnel quality, and so on are organic parts of enterprise technical progress. All links are mutually complementary and mutually established. None of them is dispensable. They have extremely strong comprehensiveness and the ability of each part to develop in a coordinated manner and foster comprehensive benefits is directly related to increasing the strength of enterprises and exploiting potential, and they are even more strongly related to future enterprise development. Thus, focusing on product renewal and replacement and improving quality are of course a concentrated embodiment of enterprise technical progress, but there can be absolutely no neglect of the other parts. During the process of fostering comprehensive benefits of technical progress, we should be concerned with the leading status of technology development organs. Only in this way can we ensure that technology development organs have regular technology development projects and sufficient tasks. Otherwise, they will be empty shells without anything to do, and it will not be possible to perfect and develop them. Thus, all aspects of work related to enterprise technical progress should be placed under unified leadership of the primary officials of enterprises so that technology development organs can be implemented in a concrete manner.

C. Strengthen enterprise technology development tasks to promote technology development organ construction and development

The goal of establishing enterprise technology development organs is to promote technical progress, develop production, and increase strength in enterprises or enterprise groups. Technology development organs must certainly focus on this central aspect of work. It should be stressed that permitting technology development organs in large and medium-sized enterprises to have relative independence and decision making authority requires better motivation of initiative in enterprise technology development organs and S&T personnel and intensification of enterprise technology development work. Technology development organs must protect the interests of their enterprises, and the enterprises should guarantee that technology development organs have stable development funds and normal development projects. They should not create jobs to accommodate people, and they especially should not set up these organs and then go looking for work. Otherwise, the significance and role of establishing technology development organs will be lost and they will become burdens on enterprises. For this reason, during construction of enterprise technology development organs, we must adhere to the policy of using tasks to promote development. Whether or not they implement independent accounting, there should be clear assessment indices for enterprise technology development organs that specify tasks, specify projects, specify guaranteed conditions, and specify results. The development prospects of technology development organs should be linked closely to the success or failure of enterprises.

D. Implement a technology development fund system, combine internally and link up externally to open up funding channels

Implementation of technological development funds is an important condition for undertaking enterprise technical progress work and a necessary guarantee for being able to establish and develop enterprise technology development organs. At present, technology development funds raised by enterprises themselves has become the major source of investments for promoting enterprise technical progress. To fully utilize the existing capital raising channel of funds raised by enterprises themselves, we should keep a sufficient amount from enterprise retained profits, product sales volume deductions reductions and exemptions from new product taxes, and other funds raised according to the relevant state stipulations and unify them for inclusion in an enterprise technology development fund. Implement an enterprise technology development fund system, establish special separate accounts, and use special funds for special purposes and do not allow anyone to intercept them or divert them to other uses. When enterprises with import projects request that such projects be established, funds for digesting and absorbing should be included in the matching investment plan, and this should be made one of the necessary conditions for examining and approving import projects. After receiving approval from the relevant departments, these funds also should be placed in the enterprise technology development fund and treated as special funds for special uses. At the same time, projects to attack key problems in digesting and absorbing imported technology should be assigned. Technology development organs should organize their implementation under leadership by enterprise plant managers and technical officials. Technology development organs also should actively fight for support from enterprise leaders, reinforce horizontal integration, accept assigned projects, take on technology development or technical upgrading projects assigned by higher-level departments, and create the conditions for targeted international cooperation and attract foreign investment. To reinforce management of enterprise technology development funds, enterprises can establish technology development fund committees to be responsible for inspecting and supervising the utilization and allocation of the development funds. The management committees should be composed of representatives of enterprise technology administration officials, enterprise technology development organs, technology management departments, financial and planning departments, and others. After the technology development fund project fund allocation plan or contractual responsibility contract passes inspection by the management committee, the enterprise plant manager can approve allocation.

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Rules for Managing National-Level New Products Trial Production Plan

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[Article: "Trial Production Plan Management Methods for New National-Level Products"]

[Text]

Section I. Overall Principles

Article 1. These methods have been formulated for the purpose of standardizing management work for the National-Level Key New Products Trial Production Plan (abbreviated below as the National-Level Trial Production Plan).

Article 2. The new products referred to in these methods are new products from civilian industry. They are defined as: the adoption of new technical principles and new design concepts in development and production or obvious improvements over old products in areas like structure, materials, technique, and so on which lead to significant improvements in product properties or products with an expanded range of applications and functions.

These methods are not suitable for use for products which are assembled using imported parts and components and which are not yet being produced in China or products which simply have decorative, external, or packaging changes.

New products are divided into national-level new products and regional-level new products according to their regional characteristics. National-level new products refer to new products that were developed and produced for the first time within China. Regional-level new products refer to new products that were developed and produced for the first time within the scope of a province, autonomous region, or municipality directly under the central government.

Trial production of new products refers to the trial production stages from after the successful trial development of a prototype (sample) until prior to going into formal production to form definite batch quantities.

Article 3. The National-Level Trial Production Plan is a policy-type plan designed to encourage large numbers of enterprise and business units to develop high-level, high-benefit, high-performance new products and to move them quickly into commodity production. It is also the basis for implementing taxation, pricing, credit, import substitution, export foreign exchange earning, materials, and other support policies.

Article 4. The National-Level Trial Production Plan is compiled annually in a conference of relevant departments in the State Planning Commission, State Tax Bureau, State Materials Prices Bureau, Industrial and Commercial Bank of China, and Ministry of Materials.

The National-Level Trial Production Plan only includes national-level key new product trial production projects. For new product trial production development tasks assigned by the various departments of the State Council that have not yet been included in the National-Level Trial Production Plan, economic commissions (planning and economic commissions) in the various provinces, autonomous regions, and municipalities directly under the central government, and cities with province-level economic decision-making authority should consider preferential arrangements when formulating new product trial production plans for their particular regions.

Section II. Project Establishment Principles

Article 5. Organization and compilation of the National-Level Trial Production Plan should select new products which have attained advanced levels within China (those which hold a vanguard status among similar industries or similar products in China), international levels (product technical parameters attain current international standards or advanced performance indices of similar modern products in foreign countries), and advanced international levels (those which hold a vanguard status among similar industries or similar products internationally). These products should also be new products which conform to state industry policies, be adapted to readjustments in product mixes and development directions, have market outlets in China and foreign countries, and have obvious social and economic benefits.

Article 6. Items which meet one of the following conditions should be given preference for inclusion in the National-Level Trial Production Plan:

1. New products that have received Chinese or foreign invention patents.

2. New products that have received national or international invention awards.

3. New products from high-tech industry.

4. New products with high added value.

5. New products that increase effective supply in domestic markets.

6. New products that earn substantial foreign exchange or can replace large amounts of imports (or have great potential for doing so).

7. New products that conserve large amounts of energy and raw materials.

8. New products that support agriculture.

9. New products that increase communication and transport capacity.

10. New products that can protect the environment and be used safely.

Article 7. The following items are not suitable for inclusion in the National- Level Trial Production Plan:

1. Products that simply outfit military industry.

2. Traditional handicraft products.

3. Products assembled from imported parts.

4. Products that consume large amounts of energy and pollute the environment.

5. New decorations and new product varieties.

Section III. Reporting Procedures

Article 8. The scope of reporting to the National-Level Trial Production Plan:

1. New product items included in the various plans of the State Planning Commission.

2. New product items included in the plans of the relevant departments of the State Council.

3. New product items included in the various plans of planning commissions and economic commissions (planning and economic commissions) in provinces, autonomous regions, municipalities directly under the central government, and cities with province-level economic decision-making authority.

4. New product items developed by enterprises themselves.

Article 9. A graded reporting system is adopted for items submitting applications for inclusion in the National-Level Trial Production Plan.

1. Enterprise and business units under the jurisdiction of regions or enterprise and business units which are assigned new product development tasks by regions are submitted by the economic commission (planning and economic commission) of the region or city in which they are located to the economic commission (planning and economic commission) of their province, autonomous region, municipality directly under the central organization, or city with province-level economic decision-making authority. After being inspected by responsible industry departments assigned by province-level (including cities with province-level economic decision-making authority) economic commissions (planning and economic commissions), comprehensive evaluations are made and a summary report is compiled according to the ranking categories of administrative departments in the State Council.

2. Enterprise and business units under the jurisdiction of relevant departments of the State Council or new product development task items assigned by relevant departments to enterprise and business units are reported to the relevant departments. A copy of the report is also placed on file at the economic commission (planning and economic commission) of the province, autonomous region, municipality directly under the central government, or city with province-level economic decision-making authority in which they are located. After departmental inspection, separate reports are compiled for the province, autonomous region, municipality directly under the central government, or city with province-level economic decision-making authority in which they are located.

3. Projects from enterprise groups listed in state plans compile unified summary reports for professional administrative departments.

4. New products which have already received invention patents are submitted by regional patent departments to the China Patent Bureau and the China Patent Bureau compiles a unified summary report.

Article 10. Items of attention for reporting:

1. During the reporting process, enterprise and business units responsible for trial production tasks should submit reports themselves to the relevant region or departments. No regional economic commissions (planning and economic commissions), relevant departments of the State Council, ore other units should submit trial production plan projects on their behalf.

2. No projects which have already been included in the National-Level Trial Production Plan should submit additional reports or revised reports. When several parties are simultaneously involved in trial production of the same product, this in principle should not be reported to the state.

3. Identical products should not be reported simultaneously to state National- Level Trial Production Plan and the trial development inspection and acceptance plan compiled by the State Science and Technology Commission.

4. Trial production units must fill out an "XX Year National-Level Key New Product Trial Production Plan Report Form" (abbreviated as a "Report Form", issued separately) for all reported projects and attach an inspection and acceptance certificate. New products which have already received invention patents should attach an invention patent certificate, and new products which have already received invention awards should attach an invention award certificate.

Article 11. Report format. After the various regions and departments have inspected reported projects, the "Report Form" is input onto a floppy disk (issued separately) according to the State Planning Commission unified compiled computer input method. At the same time, the completed "XX Year National-Level Key New Product Trial Production Plan Report Summary Form" (abbreviated as the "Summary Form", issued separately) and one floppy disk with the "Report Form" and two printed copies of the "Report Form" from the floppy disk are submitted yearly to the State Planning Commission S&T Department. Two copies of the "Summary Form" and two copies of the examination and acceptance document are also submitted. New products which have already received invention patents or invention awards also must attach two copies of the patent or award certificate.

Section IV. Examination Assignment

Article 12. Examination of items is divided into technical examination, expert consulting, and policy examination.

1. The content of technical examinations:

1) Whether or not it is a new product.

2) Whether or not this is the first trial production in China.

3) Whether or not it is at a national level.

The initial examination is organized by the regional economic commission (planning and economic commission) or by professional administrative departments of the State Council. The re-examination is organized by responsible industrial management departments.

2. The content of expert consulting:

1) Checking the conclusions of the technical examination.

2) Ranking according to assessments of the technical levels, degree of importance, and size of the role of new products.

3) Preparation of a comprehensive analysis and assessment report.

3. Content of policy examination:

1) Whether or not it conforms to industrial policies.

2) Whether or not it conforms to readjustment of product mixes and development directions.

3) Whether or not it received preferential treatment.

The policy examination is organized by the State Planning Commission in conjunction with the State Tax Bureau, State Materials Prices Bureau, Industrial and Commercial Bank of China, Ministry of Materials, and other departments.

Article 13. The National-Level Trial Production Plan is compiled in its entirety by the State Planning Commission, the State Tax Bureau, The State Materials Prices Bureau, the Industrial and Commercial Bank of China, and the Ministry of Materials. Moreover, after making stipulations concerning tax collection, prices, credit, import substitution, exports to earn foreign exchange, materials, and other areas, it is jointly assigned to the economics commissions (planning and economics commissions), tax bureaus, materials prices bureaus, branches of the industrial and commercial bank, and materials bureaus of each region, which organize its implementation in conjunction with the relevant departments of the State Council.

Section V. Support Policies

Article 14. The State Tax Bureau selects items and compiles and assigns a list of names for national-level new product tax reductions and exemptions on the basis of the National-Level Trial Production Plan and in accordance with the relevant stipulations concerning tax reductions and exemptions for new products, and it makes concrete stipulations concerning reductions or exemptions from product taxes and added value taxes.

Article 15. The trial marketing period for new products that fall into the category of production materials that the State Materials Prices Bureau decides to include in the National-Level Trial Production Plan and for which the state sets prices is 3 years. The trial marketing period for trial marketing prices for new products which fall into the category of civilian consumer goods is 2 years. For important new products which involve substantial technical difficulty and longer trial production periods, professional administrative departments of the State Council submit requests. After the State Planning Commission makes a comprehensive assessment and submits them for approval to the State Materials Prices Bureau, the trial marketing period for trial marketing prices can be extended as appropriate. After the trial marketing period has been completed, professional administrative departments submit suggestions in principle for prices according to stipulations on the basis of administrative authority over materials prices grades and report them to materials prices departments for examination of the formal prices.

This stipulation is not suitable for use for regional new products.

Article 16. The Industrial and Commercial Bank of China uses the National- Level Trial Production Plan as a guide for allocating S&T development loans and the industrial and commercial banks in each area give preferential consideration when they are selection S&T loan projects. Under conditions in which the credit capital supply capabilities of banks permit, preferential support can be given to the circulating capital needed for trial production of key new products in enterprise and business units.

Article 17. The State Planning Commission can select new products in the National-Level Trial Production Plan which can replace imports, which are comparable to similar types of imported products in performance and quality, where the extent of domestic production exceeds 70 percent, which have achieved batch production, and which can basically satisfy domestic demand for inclusion in the "National Import Substitution Product List" and restrict the import of similar products.

Article 18. With a prerequisite of completing their contractual responsibility tasks of turning over a baseline amount of foreign exchange to central authorities, enterprise and business units which increase their foreign exchange income from exports in trial production of new products that can earn foreign exchange which are included in the National-Level Trial Production Plan can divide up their retained foreign exchange earnings in excess of baseline amounts in accordance with state stipulations.

Article 19. For items in the National-Level Trial Production Plan which have matching key state plans, the materials required by the various ministries and departments and regional materials departments should be provided with active support in accordance with stipulations in the existing materials system.

Section VI. Organization and Implementation

Article 20. After the National-Level Trial Production Plan is assigned, it is organized and implemented by the region or department which submitted the report.

The concrete content of the organization and implementation are as follows:

1. The pace of trial production of a project is examined on a fixed schedule and the attainment of its expected objective is supervised and urged.

2. Various preferential policies are organized and implemented. Projects which are reported by regions are implemented by each region's economic commission (planning and economic commission) in conjunction with tax, materials prices, industrial and commercial bank branches, materials bureaus, and other departments. Projects which are reported by departments are

implemented by regional economic commissions (planning and economic commissions) with support by the relevant departments (or offices or bureaus under the jurisdiction of departments) of the State Council in conjunction with tax, materials prices, industrial and commercial bank branches, materials bureaus, and other departments.

3. Examination and acceptance of trial production projects (examination and acceptance of operationalization) which have been completed are organized and objective evaluations are made of the economic and technical indices attained by trial production projects and whether or not they have the conditions to go into formal operation. Additional stipulations regarding the examination and acceptance methods used in the work involved in organizing examination and acceptance can be made through discussion among professional responsible management departments of the State Council in conjunction with professional administrative departments and regional economic commissions (planning and economic commissions).

Article 21. When regions or departments encounter problems during the process of organizing the implementation of the National-Level Trial Production Plan, they should immediately notify the State Planning Commission S&T Department, State Tax Bureau Circulating Tax Department, State Material Prices Bureau Light Industry Department, Heavy Industry Department, and Agricultural Prices Department, Industry and Communications Department of the Industrial and Commercial Bank of China, and Ministry of Materials. Regions and departments should summarize the implementation and completion situation during the first quarter of the second year, submit summary reports to higher-level departments, and do so for 3 years. There should be written materials for macro analysis of the summary of the completion situation and they should fill in an "XX Year State-Level Key New Product Trial Production Plan Xth Year Completion Situation Form" (abbreviated as a "Completion Situation Form", issued separately) whose concrete content is as follows:

1. Progress and benefits in the trial production project (with explanatory data).

2. Which products have played major roles in industrial development, readjustment of product mixes, markets, benefits, and other areas (with explanatory examples).

3. The implementation situation for preferential policies.

4. Problems and suggestions.

The "Completion Situation Form" is entered onto a floppy disk in accordance with State Planning Commission unified compiled computer input methods. One copy of the floppy disk and two printed copies of the materials based on the floppy disk are submitted to the State Planning Commission S&T Department.

Article 22. The State Planning Commission uses the implementation and completion situation as a basis for determining the number of national-level trial production projects for each region and department during the subsequent year. It also serves as one basis for assessing national-level superior new product awards and assessing new product development work in each region and department. The concrete award and assessment methods will be determined separately.

Section VII. Appendix

Article 23. These methods go into effect on the date of their promulgation.

Article 24. All provinces, autonomous regions, municipalities directly under the central government, and cities with province-level economic decision- making authority can formulate their own management methods for regional key new product trial production plans (or similar plans) in accordance with the principles in these methods and concrete conditions in their own region.

Article 25. The State Planning Commission is responsible for discussing these methods to explain them to the State Tax Bureau, State Materials Prices Bureau, Industrial and Commercial Bank of China, and Ministry of Materials.

(Editor's note: This article was promulgated in October 1989 and is now being published here in its entirety in response to requests by many enterprises.)

Provisions for Managing Technology Trade Promulgated

91FE0282K Beijing BEIJING KEJI BAO [BEIJING SCIENCE AND TECHNOLOGY NEWS] in Chinese 29 Dec 90 p 3

[Article by chairman Song Jian: "People's Republic of China State Science and Technology Commission Decree No 10, 'Provisional Management Methods for Technology Trade Fairs' Now Promulgated, Become Effective on 1 Jan 91"]

[Text]

Section I. General Principles

Article 1. To strengthen management of technology trade fairs, accelerate the conversion of technical achievements into commodities, and promote the invigoration and development of technology markets, these methods have been formulated in accordance with the relevant state policies and stipulations.

Article 2. Technology trade fairs as referred to in these methods are technology trade activities carried out at a specific location and time for centralized exhibition of technical achievements and organized discussion and signing of agreements by the parties concerned.

The content of technology trade fairs includes:

1. Exhibition and trade of technical achievements;

2. Solicitation of bids for S&T projects;

3. Announcement of technical information;

4. Sales of new products of scientific research;

5. Negotiation and conclusion of technology contracts and other activities associated with technology trade.

The items which participate in trade should be those technical achievements and technical products which the state allows to be traded and which have extension and application value.

Article 3. The organization of technology trade fairs should adhere to the principles of promoting the integration of S&T with the economy and promote the extension and utilization of technical achievements.

Article 4. The organization of technology trade fairs should respect the principle of running such fairs industriously and thriftily and being concerned with real results, advocate the practice of fair deals, honesty, and trustworthiness, and raise the quality and level of technology trade.

Article 5. Science and technology commissions at all levels and the relevant professional administrative departments should strengthen their management and guidance of technology trade fairs. Industrial and commercial management bureaus at all levels should do good supervision and inspection work.

Article 6. These methods are not suitable for organizing technology trade fairs outside China or for foreign groups or individuals who organize technology trade fairs in China.

Section II. Examination and Approval, Administration

Article 7. The following units can organize technology trade fairs:

1. Professional administrative departments with government relationships;

2. Enterprise and business units involved in technology trade which also have legal person qualifications;

3. S&T-type social groups.

Article 8. Technology trade fairs can be organized by a single unit or jointly by several units, or they can be jointly organized by primary units and contracting units through assignment agreements. Written agreements between primary units and contracting units should clearly specify the rights, duties, and responsibilities of both parties.

Article 9. The organization of technology trade fairs should have the following conditions:

1. Clear goals and real needs;

2. Organizing units which conform to the stipulations in Article 7 of these methods and the necessary work personnel;

3. A specific number and level of technical achievements;

4. The necessary capital and material conditions;

5. Exhibition halls or buildings and other necessary facilities which meet requirements.

Article 10. To organize technology trade fairs, the organizing units should submit a fair organization application to administrative organs and submit a technology trade fair application registration form. The application registration form should include:

1. The goal and significance of organizing the fair;

2. The name of the technology trade fair;

3. Analysis of supply and demand conditions in domestic markets;

4. The organs making preparations and their work personnel situation;

5. The content and arrangements of the fair organization;

6. Methods for organizing the parties involved in supply and demand;

7. Scheduling arrangements;

8. Expenditure budgets;

9. The area of the exhibition site and a configuration chart;

Technology trade fairs run jointly by a primary organizing unit and assigned responsible unit should attach a written agreement.

Article 11. For the organization of national comprehensive technology trade fairs, after gaining the agreement of the science and technology commission in the province, autonomous region, or municipality directly under the central government where it is to be held, an application should be submitted to the State Science and Technology Commission ½ year in advance.

National comprehensive technology trade fairs should collect items from all departments and industries throughout China. The exhibition stalls should be not smaller than 100 standard stalls (3 m X 3 m) and there should be no fewer than 500 items on display.

The words "China", "Chinese", "national", and so on can be used before the names of national comprehensive technology trade fairs.

Article 12. Those organizing national industrial technology trade fairs should submit an application to administrative departments of the State Council on the basis of jurisdiction relationships ½ year in advance and the examination and approval documents should be reported to the State Science and Technology Commission and placed on file.

National industrial technology trade fairs should collect items from their industry system on a national scale. The exhibition area should be no smaller than 50 standard stalls (3 m X 3 m) and no fewer than 300 items should be on display. The names of national industrial technology trade fairs can be preceded by the words "China", "Chinese", "national", and so on, but their special system must be noted.

Article 13. For technology trade fairs organized within the scope of a province, autonomous region, or municipality directly under the central government or technology trade fairs organized jointly by two or more provinces, autonomous regions, or municipalities directly under the central government, the organizing units should submit an application to the science and technology commission of the province, autonomous region, or municipality directly under the central government where the technology trade fair is to be held.

These stipulations do not include information exchanges and technology discussions undertaken by organs, enterprise and business units, S&T-type social groups, or other economic organizations or those which have an exhibition area less than 100 square meters and fewer than 50 items on display. Individual units themselves can make their own decisions to organize these technology trade activities.

Article 14. Examination and approval organs should make a decision on their examination and approval and notify the unit making the application within 30 days of the time they receive the application. When no decision has been made within this period or when the examination and approval decision is not acceptable, the unit making the application can submit one application for reconsideration according to administrative reconsideration procedures.

Article 15. After an application to hold a technology trade fair has been approved, the organizing unit should notify their local industrial and commercial administration management bureaus of the approval for placing on file and undertake preparations according to the scale and requirements of the approval.

Prior to the holding of a technology trade fair, the responsible organizing unit should place the approval document on file with public security and fire departments at the location where it is to be held.

Section III. Organization and Funding

Article 16. After the application to hold a technology trade fair has been approved, the organizing unit can use the news media to announce the news publicly to society, issue invitations to all parties, and entrust relevant units with organizing groups to participate in the exhibition. A written agreement of assignment should be signed when units are entrusted with organizing groups to participate in the exhibition.

Article 17. Organizing units should use various means to obtain technical information, ensure the quality of the displays at each stall, and increase the benefits of technology trade fairs.

Organizing units should do good work to hold special report meetings, professional discussion conferences, item bid solicitation meetings, and other technology trade activities and social service work and so on.

Article 18. Units participating in the fairs should assign work personnel with the authority to serve as their legal representatives to participate in the exhibitions. Work personnel participating in the fairs should understand the technical and economic content of their items and have a certain amount of knowledge concerning technology trade.

Article 19. The funds for holding technology trade fairs should be raised by the organizing units or participating units. To promote the successful exchange of technology trade items, the primary organizing units should actively obtain financial system investments or loan support.

Article 20. Accounting of funds should be carried out following technology trade fairs. For those held jointly by several units or those held jointly by a primary organizing unit and contractual organizing unit, each unit should distribute profits or assume responsibility for losses according to the agreement.

Article 21. Organizing units should write a summary report within 1 month after the conclusion of a technology trade fair and send it immediately to the examination and approval organ. National industrial technology trade fairs should place the summary report on file with the State Science and Technology Commission.

The content of this summary should include: the basic situation in the trade fair, the situation in signing technology contracts, a list of items exhibited, experiences and lessons, suggestions, and so on.

Section IV. Rewards and Punishments

Article 22. Organizing units can organize assessment and award activities for superior quality technology items at the trade fairs and submit award recommendations according to the relevant state stipulations to the relevant departments. Personnel who make prominent contributions to organizing technology trade fairs and involvement in technology trade activities should receive commendations.

Article 23. For those who violate the stipulations in these methods and hold unauthorized national or local technology trade fairs, or raise the specifications of technology trade fairs without authorization, the science and technology commission in the location where they are held should issue a notice of criticism and local industrial and commercial administrative management departments have the authority to investigate and punish.

For those who make use of technology trade fairs to engage in illegal activities, besides giving them administrative punishments, those cases where circumstances constitute serious violations of the law should be turned over to judicial organs to pursue criminal responsibility in accordance with the law.

Section V. Appendices

Article 24. All provinces, autonomous regions, and municipalities directly under the central government can formulate concrete implementation methods according to actual conditions in their area.

Article 25. These methods go into effect on 1 Jan 91.

Managing Enterprises Organized By Military Product Research Institutes

91FE0282E Beijing KEYAN GUANLI [SCIENCE RESEARCH MANAGEMENT] in Chinese No 1, Jan 91 pp 6-8

[Article by Zeng Jianlong [2582 1691 7893] of the Ministry of Aerospace Industry Institute No 608: "Management Characteristics of Horizontal Joint Venture Enterprises of Military Industry Scientific Research Institutes"]

[Text] Abstract: Joint venture enterprises formed by the combination of military industry scientific research institutes and local or civilian industry play a role that cannot be neglected in the rapid conversion of military industry technology to civilian uses and its commercialization and in using high technology to bring innovation to enterprises. These high-tech enterprises, which are a new organizational form that was created during reform, face definite problems in management work. This article will analyze several characteristics in the area of the administration and management from different perspectives and examine these characteristics to systematically suggest ways to strengthen management of this category of high-tech enterprises to achieve continual development and perfection of this new thing.

Joint venture enterprises created by military industry research institutes and local or other civilian industry are a new form for transferring military industry technology to civilian industry that has appeared in the past few years. They can rapidly convert high-level military industry technology to civilian uses and commercialize it and they can play an important role in breaking down regional blockades and open up existing relationships, reorganizing enterprise structures, and injecting high technology into enterprise innovation. This article will offer some preliminary views concerning their management and offer a few commonplace remarks by way of introduction so that others may come up with valuable opinions.

Joint venture enterprises formed by military industry scientific research institutes with local or civilian industries usually involve scientific research institutes providing technology and personnel for joint management of the partner's capital and sites, with the goal being to become involved in high and new technology projects. They employ an inseparable or semi- inseparable integrated body composed of an enterprise arrangement. From their inception, these high-tech enterprises are different from the regular enterprise form and conversion of military technology to civilian purposes form, but solely from analyzing their administration, they have these characteristics:

A. Indirect administration

The factors of production in joint venture enterprises are supplied by all parties together, their ownership rights belong to different owners, and each party is allocated profits according to their factors of production with are involved in production. Ownership rights are held jointly and each of the two rights are separate. The scientific research institute cannot interfere directly in enterprise management, which gives them indirect characteristics. Their characteristics are manifested in a board of directors or management committee composed of all parties in management which make joint decisions on major questions like the enterprise's long-term development plans, management objectives, important management principles, financial budget and account reports, personnel arrangements, profit distribution, and so on. The board of directors becomes an intermediary between the scientific research institute and the other parties for implementation of indirect administration of the enterprise. The indirectness of management is also manifested by the scientific research institute using its high-tech advantages to infiltrate the management of technology for the objective of the joint venture, high-tech products, for example, providing technical training for personnel, concrete implementation of shareholder technology, continued application of the developed achievements, technical services and guidance, and other areas.

B. Participatory management

Examining the relationship of the scientific research institute with the joint venture enterprise reveals the indirect qualities of management. Because all parties in the joint venture have voting rights on major questions in the enterprise, the administration of a joint venture enterprise in this area by a scientific research institute can only be manifested as participatory management. Another meaning of participatory management at a different level is the distinction of this type of administration from regular enterprise management which distinguishes the joint venture contract from regular technology contracts.

C. Duality of risks

Risks refer to indeterminate qualities that permeate this type of high-tech enterprise. Foreign countries call these high-tech enterprises risky enterprises. Their high-tech characteristics make the importance of risk analysis decisive, which can be analyzed in two areas.

One is risk dispersion factors. These enterprises are composed of multiple shareholders, which means that their risk is proportional to the burden of shareholding for each of the parties in the joint venture, so the risks can be dispersed. Each of the parties in the joint venture have their own advantages, their own advanced technology, their own solid capital reserves, their own abundance of raw materials, and so on. Overall, these increase the power and competitive abilities of these enterprises, increase the possibility of enterprise expansion and development, and reduce the risks of management.

Another aspect is risk increasing factors. 1) Internal management. Joint venture enterprises are a hard-to-manage form of organization. This has been proven by practice in China and foreign countries. Because there are two or more management parties and the rights of each party in the joint venture are divided among the board of directors, management departments, and various functional departments which comprise the organizational structure of the enterprise, it is extremely easy for shortages, stagnation, and low operational efficiency to appear at each level within the enterprise, which obstructs the flexible reaction of the enterprise to frequent market changes and increases the economic risk. 2) High technology risk. This includes three areas. One is the degree of advancement of a technology, which refers to the extent of replacement by the same type of products. The more advanced a technology, the higher the extent of replacement and the smaller the risks. Otherwise, the risks become greater. The second is the degree of maturity of a technology, which refers to whether or not the technology has undergone intermediate testing and has the conditions for conversion to products. The third is the degree of market acceptability. There is a process of market acceptance in the conversion of a high or new technology into a commodity, which includes an understanding of the two areas of product effectiveness and costs. If the cost is too high or product effectiveness is too small, it will not be accepted by the market. A high-tech product must have low cost and high effectiveness before it can be accepted by the market. 3) Other risks. These include illegal capital sources for the capital parties or other conditions which prevent the enterprise from implementing the investment risks, unopposable forces, and so on that are involved in their investment activities.

Based on this analysis, we fell that the indirectness and participatory nature of employees and the duality of risks constitute important characteristics of the administration and management of this type of high-tech enterprise.

Based on an analysis of the characteristics of this type of high-tech enterprise, we can better see the difficulty involved in managing this type of enterprise. I feel that we must work on strengthening management in the following areas:

1. Improve understandings, reinforce the consciousness of cooperation. The appearance of this type of high-tech joint enterprise is a product of reform of the economic system and reform of the S&T system. It has destroyed the fences of closure in the past and taken a new route for using high-tech for civilian purposes and moving toward the world. It cannot be denied, however, that the effects of the feudal natural economy can lead to the appearance of some improper ideas both in the research institutes themselves and in other parties in the joint venture, such as the large deceiving the small and the strong towering over the weak, harming others to benefit oneself and making selfish calculations, seeking strong backers and eating from the big common pot, and so on. These motives are all mistaken and they act in a way that defeats their original intentions of promoting technical progress and developing forces of production and are widely divergent. They must always adhere to the principle of "voluntarism, equality, fairness, compensation at equal value, honesty, and trustworthiness" throughout the entire process of joint operation. Both parties in the joint venture will foster advantages and avoid disadvantages for mutual benefit and joint development, carry out mutual discussion in work, open up and reinforce cooperation, and unify knowledge and coordinate activities on major issues.

2. Do good preparatory work for the joint venture, lay a foundation for successful management. The solidness of work in preparation for the joint venture is directly related to the success or failure of a joint venture enterprise. If the work is carefully done and all possible situations are taken into consideration, no types of situations will pose dangers. Preparatory work refers mainly to:

1) Feasibility research on joint venture projects. Conscientious technical and economic feasibility discussions are required for participation in joint venture high-tech projects and there can be no doing one thing while neglecting other things. This includes evaluating the project's scale of production and the advanced qualities, applicability, and reliability of the technology itself, forecasting raw materials and sales markets, project investment budgeting, estimating costs and profits, handling the three wastes [waste gas, waste water, and industrial residues] and environmental protection, verification of capital sources, and so on.

2) Investigation of the credit-worthiness of the other parties in a joint venture is done through on-site inspections, direct inquiries, consulting with local government organs at the location of the other parties, and other arrangements to determine the current economic situation, investment capabilities, administrative reputation, capital sources and conditions, property and debt situation, certification of the qualifications of legal persons, scale and scope of production management, and so on of the other parties.

3. Straighten out relationships among the various parties, perfect contractual responsibility management. In the actual operations involved in managing a joint venture enterprise, most adopt an arrangement in which the board of directors has contractual responsibility for the joint venture enterprise. The question of how to straighten out the three-sided relationship of the contractual responsibility enterprise, each of the parties in the joint venture, and the state has become the crux of the problem in management. At present, work in the following areas appears to be particularly important.

1) Selection of contractual responsibility arrangements. Practice over the past several years has proven that implementation of collective contractual responsibility for a joint venture enterprise by a board of directors is superior to other arrangements. It turns individual responsibility over the property of an enterprise into collective responsibility over the property, which helps motivate the initiative of engineering and technical personnel, administrative personnel, and workers, and it increases their sense of responsibility and increases the risk-bearing capability of the enterprise.

2) Selection of persons with primary contractual responsibility. Selection of persons with primary contractual responsibility and especially selection of persons with contractual responsibility over high-tech enterprises certainly must adhere to the principle of having both ability and political integrity. In politics, they must adhere to the four basic principles and adhere to the principle of socialist administration; in moral character, there must be honesty and uprightness, unity with comrades, and clarity, correctness, and honesty before they can both understand administrative management and be familiar with their own special technology.

3) A design contractual responsibility index system. Because joint venture enterprises are a special type of enterprise, the question of how to control their short-term behavior obviously is extremely important. A scientific index system must include both value of output and profit indices as well as indices for technical upgrading, property increases, equipment completion rates, quality, and so on.

4. Apply all types of measures to reinforce readjustment, control, and supervision. The management of this category of high-tech enterprise by a research institute mainly involves the two areas of readjustment and control and supervision. In terms of their time sequence, they can come before, during, or after.

1) Readjustment and control. Readjustment and control of the personnel, finances, systems, and other areas of a future enterprise must begin when the joint venture contract and regulations are signed. These include such things as restrictions on the authority of the board of directors and general manager, financial accounting, personnel assignments, and other areas. Another route is based on the indirect characteristics of management and the board of directors is used to carry out control. Technical management of the joint venture enterprise by the research institute also can be used to implement indirect readjustment and control.

2) Supervision. Supervision of a joint venture enterprise by a research institute usually involves three types of supervision measures: financial, auditing, and technology.

Financial supervision. Analysis of financial reports and inspection of financial accounts to understand an enterprise's property and debt ratio, management strengths and capital strengths, circulating capital and fixed assets situations, self-owned capital and borrowed capital situation, cost plan implementation situation, enterprise "three funds" retention conditions, and tax and profit payments situation is done to gain a comprehensive understanding of an enterprise's economic benefits and management quality to provide information for management decision making.

Auditing supervision. Internal auditing organs in an enterprise and auditing of an enterprise on a fixed schedule are done to investigate and verify the legality of economic facts, correct errors, prevent mistakes, and provide suggestions for improving management work in an enterprise.

Technical supervision. Because military industry scientific research institutes are suppliers of high technology, they of course have supervision rights over the implementation of technology. This concerns, for example, whether or not an enterprise has the conditions to implement a high technology, whether or not product quality levels attain standards, whether or not technical operation regulations are perfect, and so on.

5. Carry out advance surveys, undertake decision making research.

Because these enterprises are a new product that appeared during reform, their own development is not yet complete or perfect. This presents substantial difficulties for management work. Scientific research institutes should organize survey research of them, collect information, strengthen managerial decision making, and accumulate experience for future use.

State To Put $79 Billion Into Technical Upgrading

40101004A Beijing CHINA DAILY in English 8 Jan 91 p 1

[Article by staff reporter Li Hong]

[Text] Research and development and technical upgrading are being put at the top of the government's agenda for industrial restructuring—with an investment of 410 billion yuan ($79 billion) earmarked for the purpose over the next five years—according to the State Planning Commission.

Through the successful introduction of new technology in a number of key industries over the past five years, the country has seen the development of 4,000 new products, bringing 8.4 billion yuan ($1.6 billion) in increased output value and 1.8 billion yuan ($34 million) in additional profit and tax income for the State.

During the next five years, State industrial investment will again centre on technical revamping of existing enterprises, and especially research and development, a commission official revealed.

Though the government's retrenchment programme is still in effect, it plans to invest more than 400 billion yuan ($77 billion) in technological upgrading of industries in the 1991-1995 period, and another 10 billion yuan ($1.9 billion) in research and development of new products.

This marked a sharp increase over the 1.5 billion yuan ($290 million) invested in technological renovations of key State enterprises during the 1986-1990 period.

The official with the Department of Technological Advancement under the State Planning Commission said that the money was expected to come from both central and local government allocations, self-funding enterprises and, possibly, also from foreign loans.

The hefty investment is anticipated to give a major boost to energy conservation, the variety and quality of products, and the country's exports.

The budgetary allocation of the investment must first be approved by the Fourth National People's Congress plenum in March, he said.

Currently, China is launching a nationwide drive to mark 1991 as "The Year of Quality, Variety and Efficiency."

The official told CHINA DAILY that the State Planning Commission had suggested that other ministries recommend 300 large and medium-sized factories in different industries and set preferential policies for them to develop new products.

He added that some tariffs would be cut when a new technology is imported.

The official said that technological renovation and development had major consequences on the country's industry, which is decades old with many machines nearly worn-out.

China's industry remains "rough and slipshod," though showing signs of rebounding. Its growth still relies on high investment and high consumption of energy and materials because of backward technology.

In manufacturing a certain product, a car, for example, Chinese producers may consume power, materials and time, at several times that consumed in the developed countries.

But anyhow, technological development of the past five years has reaped the country notable benefits. PEOPLE'S DAILY reported yesterday that the 4,000 new technologies and products developed during the period were all of world good or even advanced level.

Utilization of these technologies has brought China handsome profits. Statistics from the planning commission revealed that they have produced an output value totalling 8.4 billion yuan and saved import funds up to 700 million yuan.

S&T Fund Allocation System Reform Reviewed

91FE0428C Beijing ZHONGGUO KEJI LUNTAN [FORUM ON SCIENCE AND TECHNOLOGY IN CHINA] in Chinese No 1, Jan 91 pp 32-35

[Article by Zhu Haixiong [2612 3189 7160]; editor: Ge Yaoliang [5514 5069 5328]]

[Text] Fund allocation system reform is an important component of the S&T system reform. The goal is to establish a new operating mechanism. By reforming the fund allocation method, S&T results may be commercialized. Using the leverage of the economy and the adjustment of the market, S&T may be combined with the economy and the research institutes may acquire the ability for self-development and the vigor to serve the economic construction.

In 1986 the State Science and Technology Commission began a nationwide fund allocation system reform for scientific endeavors. In the same year, business fund allocation for research institutes in the departments in the State Council and the classification of research units were completed. Today, among the 42 provinces, municipalities, and autonomous regions and 57 departments of the central government, 6,767 research units at the county level and above involving 680,000 workers have gone through the reform process. In 1989, the total operation fund was 3 billion yuan. Funds were allocated for technological development, social benefits, basic research, and multi-purpose activities. In provincial and municipal research institutes, the breakdown is as follows: 33 percent to development units, 2.5 percent to multi-purpose units, and 64.5 percent to contracting units. The breakdown of research units in the central departments is: 37 percent to development units, 21 percent to basic research, and 42 percent to social benefits (including agriculture). Judging from the way the fund increased, the science operation funds have increased every year with the help of financial departments of the central and local governments after the management of the science operation funds was assigned to the various science commissions. This has changed the situation that existed for decades before the reform that research units did not have a unified science operation fund item. The science operation fund of the provinces and municipalities increased from 750 million yuan in 1986 to 1.05 billion yuan in 1989; the annual average rate of increase was 12.8 percent. The science operation fund of the central departments increased from 1.39 billion yuan in 1985 to 1.87 billion yuan in 1989, at an average annual rate of 6.8 percent.

In the last several years the effort to reduce the operation fund for development units has progressed steadily. According to 1989 data, provincial and municipal development units were reduced by 54 percent. In 1990 progress has been made in different regions on the reduction of operation fund. Based on the accounting method used by the central government, with the exception of the eight remote regions, the average rate of reduction in 33 provinces and municipalities has reached 63 percent. Seventy-five percent of development units of the central government have completed their operation fund reduction. The fund reduction of provincial, municipal and central government units should be basically completed by 1991. Research units engaged in agricultural S&T research and social public welfare research have followed the policy of funding linked to mission and instituted a contract system. In 1989, the science operating fund of this type of research units in China reached 1.05 billion yuan, which was 25 percent higher than the 1986 level (the operating fund for agricultural research organizations increased at an average annual rate of 10 percent). In the meantime, the units were also encouraged to commercialize those products that could be commercialized after meeting the missions assigned by the state. In 1989, these research institutes in the central government departments had a gross income of 581 million yuan; for provincial and municipal units, the figure was 375 million yuan. These incomes were 141 and 91 percent respectively of the base operating funds. The allocation to basic research was a mixture of operating fund, foundation fund and special item allocation. Over the last several years the operating fund increased by 14.28 percent, the funding from the National Natural Science Foundation grew from 80 million yuan to the present 150 million yuan. An additional 80 million yuan was allocated as special items.

It is fair to say that the progress of the allocation system reform has been encouraging. In a few years, the feature of China's S&T front has changed profoundly. The main manifestations are:

1. It met the needs of socialist planned commodity development, and changed China's S&T operating mechanism.

In the five years since the reform of the fund allocation system, a milestone marking the change of the operating system was that, in 1989, research units in China achieved 5.03 billion yuan of gross income (contract income, not counting operating funds), which was equal to 1.73 times the total financial allocation at different levels. This ratio of 1.73 showed that there had been some structural changes in the make-up of lateral financial income and administrative allocation in China's research units. China's research units have been transformed from pure, confined academic research to business management. In recent years there have been improvements in the capability and self-development ability of research units. While the nation has faced some temporary economic difficulty in the last few years, the activity of research business of the research units has grown at a rate of 20 percent or more. The transformation of the operating mode helped the research units to endure the difficulty of the economic adjustment.

2. The reform mobilized most of the S&T personnel to the main arena to serve the national economic development and promoted the intimate connection between S&T and economy.

The allocation system reform encouraged S&T workers to devote their talents and skills to the advancement of the society's science and technology, industrial restructuring, the revitalization of the agriculture economy, the development of high-tech industry, and basic research. Today, more than 60 percent of workers in research units in the central government and some 70-80 percent of local S&T workers have entered the main arena of serving economic development. About 20-30 percent of S&T workers are devoted to basic research and to follow high-tech development in the world.

Today, the applied and development efforts in research units have noticeably strengthened and rate of converting research results into commercial products has been accelerated substantially. In 1989 there were 52,700 (63 percent of the total number of projects) applied and development projects in central government and local research units. Last year, 7,406 research results were certified and converted into commercial products. These products had a gross output value of 1.53 billion yuan and accounted for 30 percent of the total income of central and local research units. Among the research units of the central government departments, 4,384 of the research results from last year were certified and transformed into commercial products, which was an increase of 41 percent from the previous year and created an additional 24 percent in output value.

While the ranks of S&T workers contributed to the economic development, their compensation and working conditions were also improved. For example, in the development units of the central government, the average bonus per person in 1989 was equal to 6.91 months of salary and the collective benefits were increased by 33 percent from the year before. These improvements played an active role in boosting the morale and strengthening the stability of the S&T ranks.

3. In the reform process, research units have devised a number of good ways to enter the economy. A large number of development research units are steadily moving in the direction of unified research, management and production.

In the last few years the research units have continuously searched for ways to combine S&T and the economy in order to survive and grow. They have actively explored various good methods that suited their particular situation and provided steady economic support. To date, research units have created a total of 1,055 S&T development enterprises and more than 10,000 research-production consortia and engineering or technology companies. In the future, the new system of integrated research, production, and business emerged from the practice of reform may well be the main direction of China's development-type research units reform. The growth and maturing of these organizations will be the hope of China's research unit reform.

4. The reform of the allocation system has helped to promote S&T development on three levels.

An important component of the allocation system reform, the science foundation system, is a major reform measure to promote basic research and part of applied research developments. A competition mechanism was introduced and a "peer review, merit support" system replaced the previous rigid, uncreative allocation system. The new system has put new vigor into basic research and created a sound environment for cultivating talent and scientific research. The allocation method that combined administrative allocation, special project allocation, and Natural Science Foundation [allocations] has given basic research solid support. The amount of money devoted to basic research by the state has increased year after year. With the sustained support of the administrative expenses, an increasing natural science foundation, and the building of the national key laboratories, more than 100,000 talented S&T workers have been attracted to the frontier of natural sciences.

In the meantime, based on the experience of reforming the science expense allocation system, reform measures were also taken for China's second tier S&T effort—the allocation and management of high-tech R&D money. A system of management by experts was adopted and, in the selection of units to carry out projects, the principle of merit and open bidding was adhered to. A responsibility system that respects expert opinion was practiced in funding scientific research and project selection. With a funding level equal to 10 times the usual level, the new system has attracted 10,000 of the best researchers in China's science and technology fields.

On the main arena of the national economic construction, the State Science and Technology Commission has put forth three plans: the "Spark Plan" designed to improve the rural economy, the "Torch Plan" designed to establish China's high-tech industrial development, and the "Results Promotion Plan" designed to promote major S&T results related to national economy. A common feature of these three major plans was that the main source of funds came from S&T loans. In the beginning of 1990, S&T development loan was officially established in China's national loan system and the loan amount was substantially increased (it reached 2 billion yuan in 1989). This was a major matching policy in China's allocation system reform. It provided China's development type research units with a bright future following the path of loans, development, building plants, forming business groups, and entering foreign markets. It also provided funding security for the formation and development of the three major S&T plans.

5. The gradual formulation and completion of matching policies has created the necessary external conditions for reform, development and innovation.

The formulation and perfection of the policy to "stop one direction and open a different area" was very important to the progress of the reform. In the reform of the allocation system in the last few years, under the strong support and cooperation of the financial, revenue, monetary and commercial departments, a more systematic policy has been formulated for S&T reform and business development. In the reform of the S&T system, especially in the various stages of the allocation system reform, the following matching policies were formulated:

(1) A policy was adopted to reduce or waive the tax on income generated in compensated technology transfer in order to open the technological market. There was also a policy for the research units to join up with the enterprises and form a research-production consortium so that the return of the research units was protected.

(2) A policy to encourage the research units to acquire financial gains from entering the economy and to link the distribution of economic returns with the reduction of operating fund allocation.

(3) Implement the new economic verification system and accounting system that are compatible with the commercialization of research results.

(4) Promote the transformation of research results into productivity, encourage tax breaks for the development of high-tech enterprises and high-tech zones, promote closer ties between S&T and the economy, create opportunities for loans, and policy measures in finance, loans, and business management that support the transformation of research units and the commercialization of products.

The emergence of the above policies has strongly promoted the depth and progress of the allocation system reform.

6. Allocation system reform has profoundly affected the thinking of S&T workers.

The reform has made S&T workers consider the economic and societal needs from the selection of research topics, the conduction of research and development, until the application of the research results. The concept of commercialization of technological results has taken root. In the past, no matter what was the field of research, papers were the only criteria for evaluating S&T workers. Now, promotion of S&T results and contribution to the economic construction have become important gauges for evaluating the performance of S&T workers. People's thinking has changed. Reform has also changed the concept that research should rely entirely on the state. The only way out for research units, especially development units, is to acquire financial gains from facing up to the economic issues and from creating material wealth for the society.

The conceptual change has renewed the societal thinking and was a big theoretical and practical breakthrough in China's S&T system reform. It provided the ideological foundation for the S&T effort to meet the needs of the socialist planned commodity economy.

While we enumerated the achievements of the S&T profession in the reform, we should not forget the strong support and assistance provided by financial, tax, and commercial departments. These departments have made important contributions in planning and transformation of science operating funds, promotion of S&T results, helping research institutes entering the economy, invigorating the research units, and development of high-tech industries. We should also realize that the road of revolution is not smooth and problems and difficulties remain. Comrade Song Jian said this when he reported S&T progress to the Standing Committee of the National People's Congress: "In the last five years our comrades working on S&T reform have worked diligently and received the understanding and support of the S&T profession and the society in general. However, the basic mission set forth in the Party Central Committee's 'On the Decision To Reform the Scientific and Technological System' have not been completed. The problem that S&T is disconnected from the economy has not been solved. Much remains to be done in the coordination of policies in different areas. New problems and conflicts which emerged in the reform need to be studied carefully and resolved."

Recently, some comrades concerned about the difficulties in today's S&T profession raised questions about the direction of S&T system reform. They believed that the S&T system reform had gone off the course of development stages, which in turn led to a shortage in funding and made the research units and S&T workers act in a short-term manner. They claimed that the technology contract system had led the research organizations astray and lowered research standards. On the issue of evaluating the allocation system reform, we believe the following questions must be considered:

1. The correct perspective is to look at problems from the overall effect of the allocation system reform. The motive of the Party Central Committee for starting this reform was to correct the problem of a "disconnect" between S&T and the economy, the problem of a slow pace for research results to be converted into productivity, and the problem of the S&T workers not developing their full potential. To judge whether the reform has succeeded, one should look at whether the reform has improved the connection between S&T and the economy, whether productivity grew, whether the reform promoted the development of the economy, technology and society, and whether S&T workers are motivated and are playing their role. This is the basis for analyzing issues in dialectic materialism and historical materialism.

2. The government has not reduced investment in S&T because of the reform in the funding allocation system. The operating costs cut from the development units are returned to the research units in the form of contracts. Because the commercialization of S&T results has acquired an established status and the policy to give research units more freedom was implemented, the entire S&T effort has been strengthened. The experience showed that the technological contract system and the introduction of the competitive mechanism have helped the optimization of allocation utilization and the improvement of research efficiency. For many years the S&T and education professions in China advocated the protection of intellectual property [rights]. The "Patent Law" formulated by the National People's Congress did just that.

As to prevention of short-term thinking and the deterioration of research standards: the root of the problem goes back to the ability of the nation and the society to invest in S&T. The reality in China today is such that basic research, applied research, and long-term scientific research in the nation's economic construction can only rely on the state's investment. Of course, in the research institutes themselves the relationship between the present effort and the long-term development must be resolved. The research standards in some institutes have slipped; some of this was related to the practice of the competitive system and the support of selected units based on merit. Some of the research units did not play their potential fully and therefore felt a certain pressure in the current practice, which is a normal phenomenon. History has proven that research units cannot rely entirely on the support of the state. We cannot say that short-term projects are always bad and long-term projects are always good. In developing countries short-term projects may stimulate the economic development. The problem is how to maintain a proper balance between short-term and long-term projects. We should follow Comrade Li Peng's instruction and properly treat the relationship between short-term and long-term efforts.

3. The failure to include research units in the nation's major economic construction projects has to some extent

affected the elevation of the S&T research standards. The solution of this problem involves not only the economic system but also the political system and the need of S&T by the enterprises. It involves the major policy of how to develop China's economy based on our own S&T capability. The solution of this problem is in the joint efforts of all S&T workers and personnel of all levels.

4. In the present economic situation, the question is not whether the research institutes should face up to the economy and transform their research results into productivity, instead, the question is how can the research institutes best contribute to the economy and how to transform their results most effectively. This has become the basis for the survival and further development of research institutes.

The reform of the S&T system is an enormous system engineering. It would take some time to establish a new system that combines a planned economy and the market modulation, and combines S&T with the economy. In the macroscopic sense, future S&T development in China relies on three things: continuation of the reform policy, adjustment of the economic policy, and increasing the investments in S&T. Subjectively, the S&T profession cannot delay the reform until the national economy improves and wait for the technological market to mature. Self-reliance is the key. The establishment of a new system takes persistent efforts.

Solving Capital Construction Problems in High-Tech Development Zones Urged

91FE0232B Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 17 Dec 90 p 3

[Article by Yan Xingen [0917 2450 2704], State Science and Technology Commission, Requirements and Finance Division]

[Text] The world's first high-tech development zone, Stanford Industrial Park, was established in America in 1951, and as international high-tech competition heated up, numerous high-tech industrial development zones were set up, one after the other, by various countries around the world. In this respect, although China took the step rather late, since the "Spark Plan" was implemented in 1988, the building of high-tech development zones in China got into high gear. Today more than 30 high-tech development zones have been established around the country. In the past 2 years, these zones did not receive direct state investments, but maintained their independent initiative, and with self reliance and hard work, visible progress and huge results were made. According to statistics from the first 22 zones that were set up, by the end of 1989, 1704 enterprises were in business employing up to 48,000 staff and workers, among whom S&T personnel accounted for 58.3 percent. In 1989, technology and industrial trade earned up to 3.06 billion yuan, 260 million yuan in export items, and returned 150 million yuan in taxes. A large number of academies, institutes, and colleges strove to commercialize and industrialize their high-tech achievements, and to develop economies of scale, to internationalize, and to help rebuild China's conventional industries and adjust the product structure. Now, the high-tech industrial development zones have concentrated talent and technology into genuine "Spark Plan" implementation bases. These zones have been the tours de force in uniting science, technology and economics, taking advantage of collective knowledge, unleashing S&T potential, activating the precipitated production elements, and in converting S&T achievements into production power.

In respect to present circumstances whereby the zones are encountering some obstacles to their progress, it is useful to reflect on the why's and wherefore's of the capital construction "coffer" issue, chief manifestations of which are as follows:

Policies favorable to capital construction investment in high-tech industrial development zones have not yet been put into effect. Taking the Beijing high-tech industrial zone an example, the State Council in May 1988 approved the "Beijing Municipal New Technologies Industrial Development Test Zone Temporary Regulation" which comprises 18 articles of favorable policy, among which the sixth article clearly stipulates "capital construction projects for production and management of new technology enterprises in the test zone, according to the unified plan for disposition of construction, will not be limited in fixed capital investments". But, a later national policy on reducing the scale of national fixed capital investments had not yet clearly stipulated a favorable policy on capital construction investments in high-tech industrial development zones, and had not reached a decision on whether the zones would be in the limit of fixed capital investments, and because of this the progress of capital construction in the zone has been seriously affected.

Capital construction channels for high-tech industrial development zones are a hindrance; capital construction targets are not being met. High-tech enterprises can be divided into two types according to the administrative channels for capital construction investments. One has registration units or departments in charge. Their capital construction work is the responsibility of the registration unit or department in charge, and they may be referred to as "channels". But, the channels are inconsistent, and so the capital construction administrative work for planning, scheduling, designing, and constructing etc. is still not done according to the overall program for the high-tech zone or according to the specialties of high-tech production and management, and they are not responsive to the needs of high-tech enterprises that are trying to industrialize. The other type comes under the jurisdiction of high-tech industrial development zone office. This type of capital construction investment channel is an obstacle. Even if an enterprise has capital and projects it is still suppressed. Because of this some newly developed products that have evident economic promise never get into batch production because there is no factory space.

Capital construction at high-tech industrial development zones is weak, and the requisite development test bases are lacking. There is still no unified model for China's high-tech industrial development zones, and they are basically springing forth from the local circumstances. Some zones were built in cities where S&T advantages were concentrated, and still rely on the original foundations and conditions, and although great efforts were made to get started, the original foundations of these zones were deficient. Many are very far away from ever meeting the conditions that developing high-tech industries absolutely demand if they are to be augmented and perfected. Their geographic situations already dictate that large scale industrial production bases can't be built there, and new development and test bases can only be opened up elsewhere, outside of the zones. Still others are carved out of an overall city plan, and left a plot of land on which to develop. The capital construction tasks faced by such zones are even more formidable, from programming to basic design and construction they must start all over from the beginning. For this reason, those development zones all face variant and formidable tasks in augmenting, perfecting or reconstructing basic facilities and developing test bases.

The above real and difficult problems, and the effects they have on the urgent capital construction in the development zones are: 1. They affect housing construction for production, development, management, and life services facilities that are urgently needed for the growth and self development of high-tech enterprises; 2. They affect the construction of basic facilities required for growth of the development zone; 3. They affect high-tech products, and construction of test bases urgently needed for technology development. The construction of these three items are the important indicators as to whether the support system for the high-tech industrial development zones (hard environments) is complete. If these things are not done in good time the hard environment will be less than ideal, or even detrimental, and can directly restrict China's high-tech industrial growth, and can be harmful to the confidence and stability of China's high-tech forces that are inseparably bound with the genesis and efflorescence of high-tech talent, money, and technology from the zones. This will seriously impair the desired effects of sustained development in the zones, even to the point of causing deterioration of the zones.

To solve the capital construction "coffer" issue, which in light of all of the above, is thrust into the forefront, it is recommended that capital construction channels be put into order as soon as possible, that the scaling of capital construction be taken into the national planning mill, and that appropriate funds, goods and materials be allocated to set the conditions for further development of China's high-tech industrial development zones.

Developing New, High-Tech Enterprises Using Foreign Capital

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[Article by Qiu Chengli [6726 2052 0448] and Yang Lincun [2799 2651 2625] of the State Science and Technology Commission Policy, Law, and Regulation Department: "On Some Questions Concerning the Use of Foreign Capital To Develop High and New Technology Industry"]

[Text] Since the beginning of the 1980's, as the world's new high technology revolution has developed, high and new technology and the high and new technology industries have attracted the attention of all nations of the world and become the focus of international economic and technological competition and the key to comprehensive competition of national strengths. As a strategic focus in the development of S&T in China, high and new technology industry has received universal attention from the government and society. Implementation of the "863" Plan and "Torch" Plan have provided an excellent opportunity for the development of high and new technology industry in China, but insufficient investments have restricted their development. In the current situation of limited state financial resources, difficulty in making substantial increases in inputs, and hardship for regular enterprises in facing their risks, utilizing the favorable opportunity of reform and opening up in China, improving the investment environment in the S&T realm in China, actively utilizing foreign capital, undertaking international S&T cooperation, and participating in competition in international high-tech markets can be accepted as an effective way to develop high and new technology industry in China.

I. The S&T Realm Already Has the Conditions for Utilizing Foreign Capital, Changing Directions in Foreign Investment Provide a Favorable Opportunity for Utilizing Foreign Capital in High and New Technology Industry

1. China has made several high-tech achievements which are competitive internationally. These achievements have excellent development prospects and potential international markets. They include space technology, nuclear energy technology, new materials, bioengineering, laser technology, and other realms in which China has made advances and breakthroughs in the world and in which we have a vanguard status in certain areas. Development and utilization of these high-tech achievements offer the prospects for high added-value products and high profits. They have powerful attraction for foreign businesses and they offer us prospects for using foreign capital for cooperative development of high-tech industry to squeeze into international technology market competition and are the source of our advantages.

2. Development and change in the direction of foreign investment provide a favorable opportunity for using foreign capital in the high-tech realm. Since reform and

opening up, China has made great strides in the area of attracting foreign investment and Chinese and foreign joint investment, Chinese and foreign cooperation, and independent foreign business enterprises have developed rapidly. The scope of investment by foreign businesses has continued to expand and the amount of investment has grown continually. After gaining success in large investments in tourism, household products, and processing industry production, the interest of foreign businesses in the realm of industrial production in China is growing. The direction of foreign investment has begun to shift toward the industrial realm. Large-scale projects and integrated project development have become a new investment pattern and large influxes of capital from Taiwan have further promoted changes in the direction of foreign investment. The potential international market for China's high-tech products and the possible high added value have attracted the attention of investors, while the abundance of capital by foreign investors and their rich experience in international markets can compensate for our shortcomings in these areas. Combining the two and having mutual supplementary advantages would greatly increase our competitiveness and become a new way to promote development of high-tech industry in China as well as an effective compensation.

3. Intensive reform of the S&T system has accelerated the conversion of S&T achievements into commodities and the growth of skilled managerial personnel. The conversion of S&T achievements into commodities and the rapid development of technology markets have promoted changes in scientific research organs, adapted initially to the requirements of the commodity economy, and substantially shortened the time required to convert S&T achievements in commodities. Large numbers of S&T personnel have shifted into the realm of technology development and become involved in production management activities, creating several skilled administration and management personnel and S&T-type entrepreneurial colonies. The broad undertaking of economic and technical cooperation and exchanges with foreign countries and the modernization of information and communications measures has also gradually given them the capability of international cooperative management.

4. High and new technology zones have provided appropriate regions and conditions for investment in high-tech industry by foreign businesses. All of China's provinces and autonomous regions have now established 38 high and new technology industry development zones. These development zones are usually established in coastal cities that are opened to the outside world and in large and medium-sized cities with rather good economic foundations. They have centralized various categories of skilled personnel from scientific research units and institutions of higher education, which has given them technical and personnel advantages. With support by the state and various local governments, they have implemented several preferential policies, centralized substantial capital, improved their external environment, and created the policy environment and conditions required for utilizing foreign capital, which has made them definitely attractive to investment by foreign businesses.

5. Importing and utilizing foreign capital to develop a nation's economy, especially high-tech industry, is one of the methods commonly used by many countries. Rapid development of the world economy and the increasingly close economic relations among nations have made it impossible for any nation to modernize itself in a closed situation. Utilization of foreign investments to develop high-tech industry is one of the main reasons for the rapid growth of the emerging industrialized nations of Asia. Singapore has used this point effectively in achieving a high rate of economic development, opening up and capturing some international high-tech markets, and achieving an economic take-off. Economic development in South Korea has also been due to a substantial extent on its strategy of using foreign capital in a major effort to develop high-tech industry and open up international markets. These experiences deserve our earnest study and borrowing.

II. Key Issues in the Development of High and New Technology Industry at the Present Time

We have made extremely significant achievements in using foreign capital (including capital from Hong Kong, Macao, and Taiwan) to develop our high-tech research achievements and place them into production. The Beijing New Technology Industrial Development and Experiment Region, for example, now has over 60 joint venture enterprises. The Sino-Japanese joint venture (Suotaike) Company had a gross output value of 190 million yuan in 1989. Gross income in the Lianxiang Group Hong Kong Joint Venture Company was $200 million [Hong Kong dollars] in 1989. The Shanghai Caohejing New Technology Development Zone has approved 27 foreign business investment enterprises for a total investment of $210 million, including $96 million in foreign capital that they attracted. These will undoubtedly play a substantial role in the industrialization of high-tech and accelerating construction of development zones.

1. Further improve the investment environment in the S&T realm and reinforce construction of basic facilities in development zones, especially communication, electric power, communications, and so on, create a superior investment environment, further attract scientific research organs and scientific research personnel from inside China to participate in the development of high-tech industry, attract advanced technology from within China, increase the density of skilled personnel and technology, strengthen information exchange, and strive to develop and utilize high-tech research achievements. Make major efforts to develop service industries, perfect all types of service measures, raise the level of services, optimize the "soft environment" of high and new technology development zones, and gain effective capital support.

2. The question of the status of research academies and institutes as legal persons. China's existing laws have no clear stipulations regarding the question of research academies and institutes utilizing foreign capital and cooperation with foreign partners and they have no legal protections. On the other hand, the counterparts with which foreign countries are interested in cooperation are precisely the fountainheads of technology and research academies and institutes. This contradiction now restricts the enthusiasm of research institutes for utilizing foreign capital to develop high-tech industry and has forced research institutes to seek third parties to accompany them in joint ventures with foreign business or to establish a new organ. This has led to a loss of technical benefits due to their division, which has negative effects on attracting large amounts of foreign investments and is not conducive to fostering the role of research institutes in the area of developing high-tech industry. Attention should be given to supplementing and revising the relevant laws and regulations, clarifying the status of research institutes as "special legal persons", and encouraging them to use foreign capital to establish high-tech enterprises or companies to enable them to attract foreign capital more effectively.

3. Pay attention to the question of economic scales and development foci. Formulate high-tech industry development strategies based on changing demand in Chinese and foreign markets, make full use of our technical, personnel, and resource advantages, use foreign markets as a guide, establish and develop high and new technology enterprises in a planned and focused manner, readjust the industrial structure and product mix, continually develop new products, increase the technical content of products, promote technical upgrading in traditional industries, and improve technical levels and product quality in China's industrial enterprises. Special attention should be given to project selection and evaluation and to market analysis when making product and industry choices to prevent redundancy in projects, products, and industries. There must be prominent foci and we should strive to attain a definite economic scale. Concentrate forces, reinforce coordination, allow each to have a bias, ensure that superior industries develop and quickly form scales, strive to produce name-brand products, continually expand market shares, and reduce product costs to form new industrial pillar industries. An example is the focus on development of the Chao microelectronics R&D base area in the Shanghai Caohejing Development Zone, where a full-function computer software production scientific research group has already taken shape.

4. Reinforce high-tech product exports, open up international high technology and product markets. China has made great achievements in using foreign capital and importing technology. However, China's existing technological advantages are still not being effectively utilized. We must change our concepts and cast off our conservative ideology, start with the overall trend of the internationalization of S&T, strive to promote a bidirectional technological shift, formulate the corresponding policies, laws, and regulations in accordance with international practices, and push several non- incisive high-tech achievements which we are unable to develop in China toward international markets. Statistics show that high and new technology products accounted for just 5.2 percent of the products China exported in 1989. We should expand the scale of their exports in the future and improve our export product mix. In areas where China has definite technological advantages, strive to develop technology exports and participate in cooperation using technology as shares. We can also consider cooperative research and cooperative plants in foreign countries. This can develop "soft foreign exchange earnings" and return some of the capital we urgently need to continue doing research to accumulate reserve strengths for future development.

III. Some Issues that Require Attention in High and New Technology Product Exports

1. In accordance with international practices and the methods used by other countries, work further on formulating and perfecting various preferential policies and reinforce macro guidance and management. All areas should formulate clear development strategies based on requirements in the "Torch" Plan, demand in domestic and international markets, and their own advantages to encourage foreign businesses to invest in high-tech industry. We should implement preferential credit, taxation, and import/export policies for high- tech enterprises which utilize foreign capital and encourage them to develop toward becoming export-oriented high-tech enterprises.

2. Speed up the formulation of laws. Completeness and perfection of laws and legal protections for the interests of investors are important guarantees for attracting investment by foreign businesses. At present, many developing nations are competing to formulate laws to attract foreign capital and providing preferential conditions, but Chinese laws in this area are not sufficiently perfected, especially in the area of protecting the intellectual property rights of foreign countries. We should make additional efforts to ensure our patent rights over high technology that also help us attract and utilize high technology from foreign countries, promote bidirectional circulation in the high-tech realm, and raise research and applications levels in the high-tech realm in China.

3. Make timely applications for patents in foreign countries. We must study and gain an understanding of the necessary knowledge concerning patent law and knowledge and experience in opening up international markets. Many high-tech enterprises have not been able to make timely applications for patents for their technology in foreign countries, with the result being that advanced products and technology cannot be marketed internationally or that they are required to pay high patent utilization fees. Exports have been substantially restricted and they have suffered enormous losses.

4. Take full advantage of sales avenues in Hong Kong, reinforce technical services. The biggest problem we face in placing mainland Chinese high-tech products into international markets is that we lack global marketing networks and mature marketing personnel who are active in all areas of the world. Another cause is the failure of after-sales services to keep pace. Hong Kong is a world finance and trade center which has already established wide-ranging and effective marketing channels in all areas of the world. It has dynamic information, convenient communications, enormous amounts of capital, strong abilities to open up markets, convenient movement, and many other advantages that cannot be had in the interior of China. It also is facing a difficult situation of weak high-tech forces and insufficient technical development reserve strengths. In the area of high-tech product exports, a truly feasible route is to utilize Hong Kong's marketing channels, promote the entry of high- tech products from the interior of China into international markets and their occupation, improve and reinforce after-sales services, and improve the quality of services, and it would aid in training our marketing staffs and gradually establishing marketing networks for high-tech products in foreign countries.

5. Reinforce propaganda in foreign countries. For various reasons, especially backward propaganda measures toward the outside world, foreign countries lack an understanding of China's many superior achievements in the S&T realm, especially changes that have occurred since reform of the S&T system in China and our accomplishments in the high-tech realm. We should use various forms to do propaganda concerning China's S&T policies, our stipulations on utilization of foreign capital, our urgent need for high and new technology supported by foreign capital, and so on. We can focus now on Hong Kong, Macao, and Taiwan, take advantage of their greater familiarity with conditions in mainland China and their concern for opening up new markets to make them quickly understand the advanced qualities and development prospects of our technology and carrying out market analysis, and thereby provide investment support for them to form effective combinations of technology, skilled personnel, and capital and quickly open up and occupy international markets.

The new technological revolution is changing every day, competition in high and new technology industry is becoming increasingly intense, and international markets are changing very quickly. We must strengthen basic research, prepare good technical reserves, continually push high and new technology achievements into domestic and international markets, optimize local environments, promote the rapid development of high and new technology enterprises within high and new technology development zones, and move toward becoming export-oriented, industrialized, forming groups, and internationalization.

State Council Approves Twenty-Six High Technology Industrial Zones

91P60156 Beijing JINGJI RIBAO [ECONOMIC DAILY] in Chinese 19 Mar 91 p 1

[Article by XINHUA News Agency]

[Summary] In addition to the Beijing New Technology Industrial Experimental Zone, approved as a state high and new technology industrial development zone in 1988, the State Council has now approved the following 26 such industrial zones:

1. Wuhan Donghu New Technology Development Zone
2. Nanjing Pukou Foreign-Oriented High and New Technology Development Zone
3. Shenyang Nanhu S&T Development Zone
4. Tianjin New Technology Industrial Park Zone
5. Xi'an New Technology Industrial Development Zone
6. Chengdu High and New Technology Industrial Development Zone
7. Weihai Torch High Technology Industrial Development Zone
8. Zhongshan Torch High Technology Industrial Development Zone
9. Changchun Nanhu-Nanling New Technology Industrial Park Zone
10. Harbin High Technology Development Zone
11. Changsha S&T Development Experimental Zone
12. Fuzhou S&T Park Zone
13. Guangzhou Tianhe High and New Technology Industrial Development Zone
14. Hefei S&T Industrial Park
15. Chongqing High and New Technology Industrial Development Zone
16. Hangzhou High and New Technology Industrial Development Zone
17. Guilin New Technology Industrial Development
18. Zhengzhou High Technology Development Zone
19. Lanzhou Ningwozhuang New Technology Industrial Development Experimental Zone
20. Shijiazhuang High and New Technology Industrial Development Zone
21. Jinan High Technology Industrial Development Zone
22. Shanghai Caohejing Emerging Technologies Development Zone
23. Dalian High and New Technology Industrial Park Zone
24. Shenzhen S&T Industrial Park
25. Xiamen Torch High Technology Industrial Development Zone
26. Hainan International S&T Industrial Park

To ensure the healthy development of these high and new technology industrial development zones, the State Council has also approved regulations formulated by the State Science and Technology Commission, including 'Measures for Ratifying High and New Technology Enterprises in the State High and New Technology Industrial Development Zones', the 'Provisional Policy for the State High and New Technology Industrial Development Zones'. The 'Tax Policy for State High and New Technology Industrial Development Zones', formulated by the State Administration of Taxation, has also been approved.

Beijing Zhongguancun High-Tech Zone Profiled

91FE0225A Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 44, 14 Nov 90 p 5

[Text] The nation's largest high-tech market took form in Zhongguancun within 2 years. Last year, the Beijing new technology development experimental zone's total technology trade reached 1.68 billion yuan.

In those two years, the experimental zone developed over 2,000 new products, and assumed 50 percent of the Beijing "Torch Plan" projects. The zone has adequate capacity here for developing and producing many kinds of microcomputers and minicomputers The Legend Serial microcomputers and the Taiji minicomputers are especially well-known. The products have entered international market and this year's foreign exchange value is expected to reach U.S. $40 million.

Zhongguancun is the center of the Beijing new technology development experimental zone. In the past 2 years, over 900 enterprises have been established, most are developing micro-electronics, computers, and combined electronics and computer technology, and the embryo of this S&T industrial park was thus established.

In 1987, before the establishment of the zone, the foreign exchange value of the electronics street in Zhongguancun was only U.S. $3 million. After the establishment of the zone in 1988, exports in that year were U.S. $13 million, an increase of 330 percent. In 1989, it reached U.S. $34.3 million, a 164 percent increase over the year before. This year, it is expected to reach U.S. $41 million. Among the exported products, electronics and communications technology and products accounted for

70 percent, electronics and computer integrated technology and products accounted for 15 percent, and 15 percent for others. Since the establishment of the zone, the foreign exchange gained from export increases annually.

1. Develop High, New-Tech Products, Increase Exports To Earn Foreign Exchange

The zone is vigorously developing high- and new-tech products, encouraging enterprises to expand export and earn foreign exchange which has been used as one of the criteria for selecting well-sold high-tech products. A group of renowned companies such as Stone, Syntone, Kehai, Jinghai, and Legend are located here. The products of these companies are of new technology, high quality, high profits, good reputations, and able to earn foreign changes. Some of the famous well-sold products are: Kehai's laser printers, "Stone's MS series Chinese/foreign language processors, Jinghai's UPS model uninterruptible power supplies, and Syntone's Chinese/English voice translation machine. Export value from 60 items is close to U.S. $20 million.

2. Follow World Advanced Level, Develop Import Substitutes

The zone encourages the enterprises to follow the developmental trend of the world's technology and speed up the replacement of new-generation products. They are also encouraged to put out their own special products with high quality and high performance in order to earn confidence of foreign and domestic customers. In the past 2 years, the zone produced about 100 products to replace imported ones. The Huanguang series electronic publishing system developed by the Peking University's New Technology Company has made a break through in the critical hardware chip design, and allowed the company to make a more suitable Chinese publishing and editing software. Compared with the foreign products, this is a better and cheaper product, and it has moreover pushed the foreign models out of Chinese market, saving the country millions of U.S. dollars. Currently there are over 400 customers in China including all the central and provincial level newspaper publishers. This year this series of machines are to be exported to Hong Kong and Macao. Similarly, Shidai Machinery and Electronics Company's HL series hardness-testing machine is of world standard and has been exported to the Soviet Union, South Korea, and other Southeast Asian countries.

3. Develop Overseas Investment, Open Up International Markets

Several new-tech enterprises in the zone have used technology as capital in overseas investment to develop international markets. Currently fifteen new and branch companies have been established in the Soviet Union, America and Hong Kong. Beijing Legend Computer Group has used its superior computer technology as capital in establishing a joint venture in Hong Kong, and has sent many of their qualified personnel there, and quickly produced the advanced design Legend series 286 micro-computers. This machine achieved fame at the Hannover International Exposition in West Germany, and won contracts of exporting 8,000 sets per month to America, Canada, and Southeast Asian areas. The most recent products, Legend 386 and 486 which were just passed the National "Torch Plan" assessments, have formed a Legend product series and increased their competition strength in the international market. The enterprises like Legend micro-computer company with certain market coverage rate, production scale, new technology, and capability of earning foreign exchange from exporting their serial products are several in number. Now the three kinds of foreign-owned enterprises established in the zone has already reached 54.

The establishment and development of the Beijing new technology development experimental zone has attracted world-wide attention. In the past 2 years, several hundred friends representing over 30 countries and territories have come to the zone to talk about cooperation matters. In 1989, the zone sponsored four exhibitions overseas, took part in four international conferences and invited over 60 foreign businessmen to visit China. In November 1989, with the approval of the World Science Park Association, the zone was formally admitted as a member. The success of Zhongguancun has clearly demonstrated China's high-tech capability. With further development of high-tech enterprises, many products with the label "Made in China" will be available all over the world.

Shenyang Nanhu High-Tech Development Zone

91FE0225B Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 44, 14 Nov 90 p 7

[Text] Shenyang is a major heavy industry base. In the past, because of the enterprises' irrational operation organization and production structure, and out-dated production equipment, Shenyang never satisfied market demand. To change this situation, Shenyang decided to establish the Shenyang Nanhu S&T Development Zone in May 1988 and vigorously engaged in development and production of high-tech products, promoting adjustment of production structure and traditional enterprises reform. In past two years, the zone itself has developed 380 high-tech products, 9 have been listed in the "Torch Plan" national agenda and total technology-trade reached 340 million yuan. The zone is also responsible for local technology improvement of over 80 products, such as underwater robots, and whole-body computer fault scanning machines. All these high-tech products are of the international advanced technology level of the 80's. In the improvement of machine tools, the use of computer-controlled technology leads the nation.

In the National High-Tech Enterprise Development Zone Exhibition recently held in the Beijing Exhibition

Hall, a series of high-tech products developed by Shenyang Nanhu High-Tech Zone received much attention. Among them are:

PC Numerical-Control Linear Cutting Machine System

This series of machine was developed and produced by the Shenyang Xinhua S&T Development Company. CAD/CAM models with voice control and Chinese language menu were used. It is completed with all basic linear cutting machine tool control functions and supplementary functions. Its structure is simple and is easy to operate. It has high resistance to interference and high precision, and doubles the efficiency of traditional cutting machine tools.

Recently, the Xinhua Co. produced MHC numerical control linear cutting machine control board. This is a combination of TP-801 single-plate machine, a dedicated patch-control software, electrical receptor and step-drive machinery. The new machine can be used to replace the old separate moduls or integrated circuits control board. The new machine is small, reliable, easy to operate and repair and maintain, and is cheaper. In addition, this board can easily connect with the customers' old numerical control board to increase the cutting machine's tooth space compensation, enhance processing ability for short circuits and broken wires, and changes in processing coordinates. This new machine is ideal for renovation of old cutting machines with numerical control boards and for as an accessory part of the new linear cutting machines.

24-Channel Numerical Type Communication Recording Instrument

This instrument has been awarded an invention patent. It is capable of recording voice from 24 channels simultaneously with all-channel display and monitoring capability, broadcasts the voice from 8 channels simultaneously. It is also capable of converting voice into numbers and the vocal quality is good. This instrument is controlled by a micro-computer, easy to operate, and is especially convenient for use at airport, harbor, and the central offices of public security, hydropower, hydroelectric, railroad, military, and other command where voice communication is needed for recording and investigating accidents in order to provide original information. This product has been developed by the Shenyang Military Region Air Force Headquarters' Communications Department and plans are to mass-produce it immediately to fill the blank of China's multi-channel numerical voice recording facility.

Lantian No. 1 (BS-7501) Numerical Control (CNC) System

The Shenyang Computer Research Institute of the Chinese Academy of Sciences and Shenyang Third Machine Tool Factory jointly developed and produced BS-7501 series numerical control system. This Chinese-made high performance numerical control system has reached the international advanced level of the same product in late 80's, and filled another blank in the field of numerical Control Systems. The system involves 4 CPU's and 5-step building-block structure, it is very flexible in manipulation and is suitable for use in combination processing center or cutting center requiring high degree of machine tool control system. It also provides softwares for procedures, operations, control, and development. The use of this system will enhance the capability and value of machine tools, improve the old-type cutting machine tools and revolutionize the die-set manufacturing industry.

KSJ-STD Industrial Control Machine Series Products

The Shenyang Computer Research Institute of the Chinese Academy of Sciences developed STD mainline series products including 8-digit, 16-digit, multi-CPU, and single chip systems. The CMOS transistors, color displays with Chinese/English operating system, many useful softwares, and many kinds of I/O modular plates were used. It is a series of products with high standard, reliability and good performance and is suitable for real-time processing control, circuit monitoring and data-collection. It is ideal for industrial control use. The system has been awarded with the Academy's technical advancement medal and is now widely used in the country.

Chongqing High-Tech Zone Profiled

91FE0150B Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 31 Oct 90 p 1

[Article by reporters Han Yuqi [7281 3769 3825] and Xie Ning [6200 1337]]

[Text] The Chongqing High-Tech Production and Development Zone has gradually evolved from its own road, to form a street, a park, and a division. Cao Yang [2580 7122], who is deputy chief of the zone, says that since the zone was built in May 1988 it has grown rapidly until by the end of 1989, in just over a year, its total earnings had reached 50.29 million yuan, of which 71 percent was from technology items.

The Chongqing High-Tech Industrial Development Zone was set up in the intellectually affluent district of Shapingba. It started out as a 1 kilometer S&T Street on Shazhong Road outside of Chongqing University, a total area of 4,000 square meters with 105 sites. Chongqing University was the first to build its own S&T park along S&T Street. In 1989, as over 100 high-tech enterprises came on to the street, it became the technology, information, and trade center of the Zone. The Municipal Science Committee also made the Municipal Technology Development and Exchange Hall located within the zone the base for building the High-Tech Development Park. Most recently, a 3-square-kilometer section of Shiqiaopu was designated to be an experimental zone for the developing industries. From this point the pattern of a street, a park, and a division within the 45-square-kilometer zone has emerged.

Since the Chongqing Development Zone was built the universities, major institutes and enterprises have played the part of the main force of the High-Tech Zone. In addition to Chongqing University, the 3rd Military Medical University, Chongqing Architectural Engineering College, Chongqing Space Machinery and Electronics Design Academy, and the Chongqing Specialty Steel Factory have set up a passel of high-tech enterprises within the zone, and have infused some of the essential ingredients for energizing the power of production. By the end of 1989, the zone had 229 S&T enterprises.

The high-tech enterprises in the development zone applied the "four fundamental principles" to its economic development. They accumulated 15 million yuan in investment capital, and put it into production by a ratio of one to four, greatly raising the input-output ratio for Chongqing industrial enterprises. By the end of the present year it is predicted that the development zone will earn 70 million yuan, and realize a profit tax of 15 million yuan. By now, Chongqing Development Zone has started up more than 420 technology and production items, among which are three national level spark plan items and 24 local level spark plan items, and 29 items of the 420 have won national awards. After Chongqing University's Tongling Optomechanical and Electronic Intelligent Facilities S&T Corporation had completed its "CGS" rough optical pattern displacement survey system it could foresee a new increase in annual production value of more than 50 million yuan, and a new tax profit of more than 12 million yuan. When the Sida Bioengineering Corporation operated by the Chongqing Municipal Biological Research Institute came into being its capital investment was only over 40,000 yuan. They strove to develop the HCG products, and in 1989 they earned 660,000 yuan for a total profit of 210,000 yuan. In 1990, according to plan, they could earn 10 million yuan and a profit tax of 4 million yuan. The printed circuit board numerical controlled drill-lathe developed by the Chongqing Kefa Machine-Electronics Technology Research Institute already represents an advanced level among similar national products, and is already in batch production. With the development of new materials, modular technologies, bioengineering, chemical engineering, machine-electronics technology, environmental engineering, and microelectronics technology the starters, the Chongqing Development Zone is steadily developing even more subjects, categories, levels, and economic ingredients of the high-tech world.

'Jinling Silicon Valley' Aims at Cutting-Edge Technology

91FE0150A Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 41, 24 Oct 90 p 35

[Article by reporter Wang Yan [3769 3601]]

[Text] The Nanjing Pukou High-Tech Expo Development Zone, the renowned "Jinling Silicon Valley", that opened up two years ago taking aim at international advanced standards has blossomed in all respects, and has become a cutting-edge S&T colony combining R&D, intermediate testing, and production all in one body. By August of this year 30,000 square meters of standard factory buildings and necessary facilities were completed, and 45 high-tech items were approved for development there. Last year total sales reached 28 million yuan, profit taxes were 7.25 million yuan, and 2 million yuan in foreign exchange was earned. It is forecasted that by the end of the Eighth 5-Year Plan a sales total of 2 billion yuan may be realized.

The Nanjing area has a deep cultural and educational foundation, an abundance of technology, rich intellectual resources, a concentration of major mainstay enterprises, high level schools, an assemblage of academies and institutes, and very prosperous township and village enterprises, all of which provides an outstanding environment for the development of high technology. In September of 1988, after approval from the State Council, the Nanjing Pukou High-Tech Development Zone broke ground and took off. The builders adhered to the policy of " First open up, proceed step by step, build gradually, and roll on ahead", and now they have already completed the first 2.27 square kilometers of basic construction, and the water, electricity, and telecommunications are already coming through. The general program for opening up the district, and the detailed program for first segments, as well as the draft plans for the S&T and economic growth schedule are completed. At the same time the "soft environment" for the district is being appropriately set up; the pioneering service center being jointly built by national, provincial, and municipal science committees, and the electronic specialties "incubator" being set up by the Zhongshan Group are already under construction. Management of the High-Tech market within the district has begun, forming a basic framework with high-tech industry as a main body with two flanks, high-tech hatchlings as one and high-tech circulation as the other to be developed in a "one body, two flanks" coordinated effort.

The development zone, using microelectronics technology as the point of attack, has given precedence to developing information technology, computer technology, and machine-electronics, and this has obtained remarkable achievements. Information technology and machine-electronic projects make up 30 of the 45 items already studied and approved for national, provincial, and municipal spark plans. Seventeen high-tech enterprises (22 high-tech project items) have come into the district already. Among them is Xinlian machine factory that is producing microcomputerr power load monitoring systems that employ radio remote control, telemetering, and remote signaling, microcomputer technology, all with centralized power control. The Nanjing Municipal Government has decided to invest 10 million yuan to install these types of microcomputer control systems in 1,000 enterprises by the end of 1992, of which the first batch of 256 will be installed by the end of this year. The Nanjing Lathe Factory's Huaning Numerical Controlled

Machinery Manufacturing Corporation is producing a numerical controlled multi-lathe at a national production rate of over 90 percent that sells for more than 600,000 yuan. It can serve as a lathe, a miller, a boring machine, and a tapping machine, and with programmed control it can automatically process a variety of complex parts. The Nanjing Microelectronic Machine Factory has built a 6,000 square meter factory building in the development zone. They produce a JWK model economical lathe numerical control system that greatly raises the efficiency of ordinary lathes, saves on investments, is sufficiently fast, and is slated to be entered in the first batch of national level spark plan items. The Ministry of Machine Building and Electronics and the State Planning Commission has designated this factory as the sole economic lathe numerical controlled system producer in the country. Also, Southeast University's ceramic discharge tube, Nanjing University's special crystal materials, East China Technology Institute's "sequential pulsed laser transient holograph imager", and Nanjing Radio Factory's uninterrupted power source (UPS) will be going into production in the development district.

In May of this year, the State Council commission member, and the State Science and Technology Commission Minister in Charge, Song Jian, led the Second National Level Spark Plan Working Committee, to inspect the Pukou High-Tech Development District, and upon learning about the conditions and spark plan achievements there, gave the development district a very high appraisal. State Science and Technology Commission Vice Minister, Li Xu'e, wrote for inclusion in the speech given by Song Jian before the National Spark Plan Working Committee: "The development of high technology enterprises, and implementation of the Spark Plan is of a level of significance and importance to the strength and prosperity of the country and the welfare of the people as the building of the missile and the atom bomb were in those years".

The Pukou High-Tech Development Zone, a flower in the S&T garden, is thriving and flourishing, and has a brilliant future!

Development of CAS Open Laboratories Reviewed

91FE0085B Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 7 Sep 90 p 1

[Text] After 5 years of development, the open laboratory system of the Chinese Academy of Sciences [CAS] has completed its first step toward molding it into a new research organization that is in accordance with our national circumstances and the specific realm of the CAS. It has adequately fulfilled the policy of openness and mobility. While producing high level research accomplishments, it has also nurtured many young scientists and technicians.

Since 1985, in order to comply with the need to reform the organizations of science and technology in the country, the CAS has initiated experimentation of an open laboratory system. Its purpose has been to overcome many past obstacles to the development of science and technology, and to create a scientific research environment which is open, mobile, coordinated and conducive for individuals to apply their talents without hinderance. At the moment, there are close to 100 open laboratories in the CAS.

According to 1989 CAS statistics, 63 open laboratories are engaged in 2470 research projects. Among them, 1050 belong to the National Special Project, "863" Plan, Natural Science Fund, International Cooperative Project and CAS Emphasis Project. 1255, 68.5 percent of the total, are supported by the fund approved by the Science Commission. 4829 papers have been published. Twenty-six achievement awards at the national level and 108 awards at the ministerial, departmental, and commission levels have been obtained. It has organized and held 18 international scientific meetings and 52 national meetings.

These open laboratories have yielded many high level research results in a short period of time. Examples are: in the area of basic theoretical research, research on the nature of the wide-ranging quantum field, on the origins of localized vibration in polymers, and semi 1-dimensional system in bipolymers; and in the area of important experimental validations and experimental discoveries, discoveries of 8th, 10th and 12th order symmetrical semi-crystals, research on deflection of atomic beams by excitation light and validation of statistical order of sub-Poisson photons. At the same time, many instruments that are on the advanced international level have been developed by the open laboratories, e.g., electron probe, electric mirror for tunnel direction, etc.

The establishment of open laboratories has also provided many excellent young scientists with a good and stable research environment, and nurtured and assembled quite a number of talents. Close to 30 of them have been commended as young scientists making outstanding contributions. Many have received various special awards. A great many of them have gone overseas to study, and many returned scholars have successively joined the open laboratories to become the backbone of the laboratories.

This healthy development of open laboratories of the CAS has proven the correctness of reform of our science and technology organizations. It has promoted the development of our scientific enterprises and created a conducive atmosphere for national and international scientific exchanges.

Sensor Technology Key National Laboratory Profiled

91FE0225G Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 25 Nov 90 p 2

[Text] The Sensor Technology United National Key Laboratory established in 1987, contains two main elements, the Chinese Academy of Sciences Shanghai Metallurgy Institute Sensor Laboratory (the Southern base) and the Chinese Academy of Sciences Semi-Conductor Institute's section related to semi-conductor sensor (the Northern base), which include the Chinese Academy of Sciences' nine sensor research specialized areas. In November 1990, after passing the national level acceptance test, the Laboratory opened to the public domestically and internationally.

Sensor technology is the science of sensor research and its related technology. Its basic components are material physics, chemistry, and biological effects and their interactions. It is an emerging technological science of the combination of physics, chemistry, biology, material sciences, apparatus/technological physics and electronics technology. Currently sensor technology is widely used in leading-edge weapons, aeronautics and aerospace, industrial and agricultural processings, bio-engineering, household appliances, medical and public health, transportation and environmental protection. Increasing application of sensor technology is also found in the fields of robotics, energy resources, natural resources development, and life sciences.

The Laboratories' research aims at the urgently needed sensors, sensors with general technological guidance and high future potentials, and the development of new type of sensor and its related technology. The laboratories focus on new types of solid-state sensors and their associated meters, materials and techniques, and the basic research of the presence of sensors.

Established in 1987, the Laboratories' Academic Commission which is composed of 29 experts of the country, has designated over 40 subjects for R&D, and has assumed about 20 itmes of the national key S&T projects, the "863" plan projects, and the national natural science foundation projects and local organizations projects. The expenditure for these work is over 4 million yuan. Most of the results have been used in the nation's economic constructions, such as the urgently needed basic sensors for bio-engineering, the heat-resistant PH electrodes, the penicillin FET sensor and the defoamers. Tellurium-cadium-mercury infrared sensor is already being used on the remote sensing of meteorological satellite "Feng Yun No. 1."

The Director of the United Laboratories is Professor Wang Weiyuan [3769 3262 3293]. The laboratories are staffed with 44 research scientists, half of them are visiting scientists, and additional 12 technicians. The United Laboratories have the nation's first class laboratory conditions and the equipment that is of international level of the 80's. Both northern and southern bases have several hundred square meters of super-clean processing lines. Their important equipment includes: laser repair-adjust systems, reactive ion etching/carving machine, light-chemical-vapor-deposition (CVD) systems, magnetic-control sputtering machine, semiconductor parameter measuring instrument, low pressure chemical gas deposition systems, glucose analyzer, network analyzer, freeze-dry system, impedance analyzer, Weiji 4-level analyzer, spray drier, and silk screen printing machines.

Key National Macromolecule Laboratory Profiled

91FE0417A Beijing ZHONGGUO KEXUE BAO in Chinese 1 Feb 91 p 1

[Article by reporter Zhang Yaguang [1728 0068 0342]]

[Text] At the close of the 1980s, Chinese scientists' theory about the flexibility of enzymes caused a great interest in international biological circles. According to incomplete statistics, a series of important journals carried over 60 articles on this theory, and employed its methodology to carry out research on the mechanisms of the functions of enzymes. In addition to this, the process of changes in protein functional groups and their quantitative relationship to biological activity worked out by Chinese scientists was recognized internationally and became the Zou Shi (Chenglu) [6760 2110 7627] formula or Zou Shi method, and it has been published in many textbooks.

These achievements came out of the National Key Macromolecule Laboratory of the CAS Institute of Biophysics. The achievements of this laboratory have proliferated. In the 3 years that it was being set up and built, 31 dissertations were published in important international academic publications and journals; 12 treatises were published in "Science in China"; the laboratory was awarded the Chen Jiageng [7115 0857 1649] Life Science Award, the National Natural Science 2nd Class Award and two 3rd Class Awards, two CAS Natural Science 1st Class Awards, and one 2nd Class Award. In the 3 year period, six post-doctorate researchers (three from the U.K. and the U.S.), eight doctoral and 21 masters degree candidates came to this laboratory.

This sort of success not only places it among the best of the 80 national key laboratories, but gives it status internationally as well. In 1990 it became one of seven outstanding key laboratories and received acclaim from the State Planning Commission, the State S&T Commission, and CAS. Early this year it was nationally appraised and accepted.

How is this laboratory able to achieve such successes: A study was conducted an and the following were found to be the reasons:

A Clear Direction, A Firm Foundation

In 1988 actions were taken to form a strategy for China's biotechnology and scientific research. China invested over 5 million yuan to establish this laboratory. It was formed from a molecular enzymology laboratory, and it was combined to encompass the macromolecule lattice structure and biomembrane studies being done at the Institute of Biophysics. Its research does not duplicate those done at the other laboratories in the country, and it formerly already had a good international reputation.

The purpose of the laboratory is specifically to develop its own excellence, and struggle to become an international leader in the field of biology, and thereby become a laboratory that is able to maintain its academic position.

A Competent S&T Leadership and A Rational Talent Structure

Among the complement of 23 research personnel at the laboratory there are two members of the CAS Academic Committee, four PhD teachers, and eight researchers. The laboratory chief and academic committee member, Zou Chenglu, is one of those who initiated the work on synthetic insulin, and recipient of many national level science awards. The deputy chief and academic committee member, Liang Dongcai [2733 2767 2724], who in the late 1960s was one of the main leaders who participated in determining the crystalization structure of swine insulin down to a resolution of 2.5 Angstroms, also has since received many national-level natural science awards. The age make-up of the laboratory is quite ideal: four are over the age of 60, nine are between the ages of 50 and 59, five are between 36 and 49, and seven are under the age of 35. The make-up of the laboratory's academic committee includes members 60 and 70 years old, and others who are over 50 and over 40. Some are from the academy, the institute, and others are from the medical field and well known major colleges. This makes the committee authoritative, wide-ranging, and vigorous.

A Distinctive International S&T Committee

In order to strengthen international S&T exchange the laboratory set up an "International Science Commission" composed of 16 internationally famous scientists. The laboratory chief and academic committee maintain a close relationship with the International Science Commission, consults with the committee members for guidance and opinions relating to the academic direction for the laboratory, and requests them to critique laboratory papers. The laboratory separately requests the committee members to participate in the academic activity of laboratory organizations. There are two Nobel Prize scientists in the International Academic Committee, and all of the members are CAS academicians or members of equivalent organizations.

An Ideal Apportionment of Assignments

The availability and flexibility of the national key laboratory is reflected in its undertaking of external assignments in cooperation with outside elements. If upon receiving a task, excessive consideration were to be given to benefitting the original scientific research unit, it would be a deviation from the purpose of the national laboratory.

National Key Optoelectronics Laboratory Opened

91FE0417B Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 19 Jan 91 p 1

[Article by reporter Zhang Fengsha [1728 7685 5446]]

[Text] The "Integrated Circuit Optoelectronics Joint Laboratory", a key national laboratory, product of a joint effort by Qinghua U., Jilin U., and the CAS Institute of Semiconductors has passed appraisal and acceptance, and has formally gone into operations.

Optoelectronics is the vanguard technology of new-generation optoelectronic systems. It can make optical systems into compact two-dimensional structures, and can be integrated with microelectronic systems to form monolithic or hybrid integrated circuit (IC) optoelectronic systems, which can at the same time be connected up with optical fibers and optical waveguides to become the basis for optical communications, line-of-light sensors, and optical information processing technologies. The research aim of the IC Optoelectronics Laboratory is to employ compound semiconductor materials as a basis for integrating microelectronics and optoelectronics technologies to explore new physical mechanisms and research manufacturing of new semiconductor optoelectronic devices, optical fiber and optical waveguide devices, IC optoelectronic devices, and basic technology optoelectronic IC's to develop applied technology for new-generation fiber-optics communications, line-of-sight sensors, and other optoelectronic systems for the purpose of achieving ultra-high speed, high capacity, multi-functional, and low consumption systems.

The IC Optoelectronics Laboratory has three testing areas: the Qinghua U. area, Jilin U. area, and the CAS Institute of Semiconductors' area. This laboratory was under development in 1987, and making full use of its capacities while still under development undertook numerous Seventh 5-Year Plan projects, high-tech (863) projects, and National Natural Science Fund projects, and in several research areas it achieved national and international advanced levels.

The laboratory was built 3 years ago, and has already gained four post-doctorates, and trained 12 doctoral and 51 master's degree students.

Laboratories Established at Qinghua University

91FE0225C Beijing GUANGMING RIBAO in Chinese 9 Nov 90 p 2

[Excerpt] Upon the founding of the PRC, there were only 12 laboratories in Qinghua University. Now there are 141 of all kinds. Good and well equipped laboratories for the university's education and research efforts. Recently, the university was awarded an honorary certificate as the first to receive 81 experimental technology achievements.

Qinghua University's 141 laboratories have a total of 1500 personnel. [passage omitted]

The level of the university's laboratories is as high as other domestic or international laboratories. They provide the experimental support to courses in physics, electrical engineering, electronics, and material mechanics. Recently, the nation accepted the friction science and intelligence technology & system laboratories as two key national laboratories. Under construction are other laboratories such as integrated photo-electronics, combined chemical engineering, biological membrane and membrane bio-engineering. Those being used for education and research are the computer center, the analysis center, the electronics-teaching center, and the strength and vibration center. Those already opened to the public are: CIMS Experimental Engineering Research Center, Structural Engineering & Shock Center, and Nuclear Power Plant Simulation Training Center. Many world-level high-tech research projects are being accomplished here, one of them, the 5 megawatt low-temperature, heat-supply reactor, pioneering a path for China in nuclear energy development and utilization.

Shandong University Crystal Materials Institute Detailed

91FE0225F Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 20 Nov 90 p 1

[Article by Ji Yang [3444 7122], Wen Wu [2429 2976]]

[Text] Shandong University Crystal Materials Institute got down to the ground and did solid basic research work and made contributions since the crystal materials national key laboratory was established. The laboratory has received first and third National Invention prizes, 2nd National S&T Advancement prize, first National Education Commission S&T Advancement prize, and first Gold & Silver medals from the National and International Invention Exhibitions. In 1988, in addition to receiving subsidies from the National Natural Sciences Foundation Fund, sales of crystals netted over 3 million yuan, and this year's income is over 1 million yuan.

Since its establishment 30 years ago, the crystal materials institute has successfully developed nearly 100 different functional crystals, most of them at the national and international advanced level. In 1987, the National Crystal Materials Key Laboratory was established.

In recent years they have conducted basic research (including application research) on several items with good potential. After making progress, they fought to have them included in research plans as starting points for new research subjects. In the 80's they aimed at an international hot item—considered by the Americans as a strategic material—a new type of nonlinear crystal KTP. Another item was a compound of lithium and tantalum (lithium tantalate) which is widely used in color TV sets. Today,they have aimed at two international state-of-the-art items—metallic-organic compound vapor depository (MOCVD) technology and research on sources metallic-organic compounds.

In attacking the difficulty in the crystal growth of KTP, they picked their most experienced research personnel, analyzed the limited amount of foreign reference materials and their own research results, and started on the basic research on the melted salt and its components, and finally achieved the first internationally growth method of "salt-melting method" to replace the "water-heating method." This achievement brought them the 2nd national S&T advancement prize. The other one with initial potential was the frequency self-doubling laser crystal. Subsequent intensified research efforts also brought good results.

In the past, the KTP crystal was produced with a loan for building the production base. The loan was paid off in the same year, and a profit of several thousand dollars was made. This item has now earned over U.S. $1 million.

Agricultural University Makes Progress in Biotechnology

91FE0225E Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 14 Nov 90 p 1

[Article by Reporter Fan Jian [5400 1696]]

[Text] The Beijing Agricultural University's Agro-Biotechnology National Key Laboratory was built on the foundation of the World Bank loan-financed Central Laboratory. Preparation and construction of the laboratory began in October 1987. While construction, research and operation were taking place, the laboratory concentrated on basic and application research of important crops, livestock, agricultural micro-organisms, and application research on economic values. They have made 19 significant results with domestic and international advanced level, and trained a number of high-tech personnel for the nation.

Although the laboratory has only 40 researchers, it is equipped with the most advanced facilities. In the past three years, experts from America, England, and Ireland came to do short-term research work or promote joint research. Researchers from most developed countries' agricultural institutes and research organizations have come to visit and exchange their ideas. Many domestic higher agricultural education and research units have sent people to this laboratory to conduct their research works. In order to promote the opening up of the laboratory, a open research fund was established and 200,000 yuan was raised annually. In the past 3 years, they have assumed two projects of the "863" Plan, four of the 7th 5-Year key projects, two international cooperation projects, ten ministerial key projects, six natural science foundation funds subjects, two doctoral research funds projects. The two international advanced-level achievements are the discovery of corn gibberone as higher plants' internal hormone and the successful transfer of the fast-growth, salt- and alkali-resistance characters from fast-growth-soybean root nodule bacteria to slow-growth-soybean root nodule bacteria to obtain a combination strain of root nodule bacterium with salt-resistant ability and high nitrogen-fixation capability. The successes indicate that China's capability in plant genetic engineering and nitrogen-fixation has reached international advanced level. Those approaching world levels include plant growth hormone, high-lysine producing gene, high-tryptophan protein gene, transgenic livestock and photosynthesis chlorophyll protein gene. Other remarkable results include the cloning of hog growth hormone producing gene that was successfully expressed in E. coli; and the cloning of cow's rennin gene which is also expressed in E. coli. In the area of plant virology successes in cloning cucumber mosaic virus, bamboo, potato, and sugar beets. They also began trial use of gibberella on hybrid rice and then on wheat. Various types of growth hormone have entered world market.

This high-level laboratory has nurtured excellent personnel for theoretical and practical studies. In 3 years they have graduated 16 doctors and 25 masters in addition to sponsoring many technology-training courses in genetic engineering. All are expected to have great effects in using biotechnology in agricultural fields.

Radiation Research Laboratory Established in Shanghai

91FE0085C Shanghai WEN HUI BAO in Chinese 23 Aug 90 p 1

[by Reporter Huang Xin [7806 6580]]

[Text] The first open radiation research laboratory has recently been established in Shanghai. It has passed the evaluations by the experts organized by Chinese Academy of Sciences [CAS], and it will be simultaneously opened to scientists from China and other countries.

The open radiation research laboratory which is located in CAS' Shanghai Atomic Nuclei Research Institute will primarily study radiation physics and chemistry of biological substances, with emphasis on research on the radiation damage of biological tissues and the functions of molecules in controlling the damage. These will provide important significant new ideas and theories for many research areas of life science of the future. At the same time, they will be able to adequately demonstrate their overall superiorities in time allocation, measurement technologies and radiation research. There will be cooperative research with scientists from China and other countries in the carcinogenesis of chemical toxins, mutation of microorganisms and functions of molecules in irradiated seeds, functions of free radicals in aging and anti-aging, kinetics of molecular reactions, etc.

Molecular Genetics Institute of Chinese Academy of Military Medical Sciences Profiles

91FE0085A Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 23 Aug 90 p 2

[Article by Zhao Liquan [6392 4539 2938] and Gao Jinzhong [6750 2516 0022]]

[Text] The first spring of the 90's welcomes the 10th anniversary of the establishment of the Molecular Genetics Institute [MGI] of the Chinese Academy of Military Medical Sciences [CAMMS]. This assemblage has been recognized as a cultural unit of Beijing, and an overall advanced unit in science and technology. It has realized many achievements as an entity. Two of its scientists have been recognized as "March Eighth" Red Flag Carriers. The Central Military Commission and the National Affairs Institute have respectively conferred the honorary titles of "Model Scientific Worker" and "Progressive Worker" to Professor Huang Cuifen. They are undertaking three projects of the National "863" Plan, two specialized projects of the Seventh 5-Year Plan and six projects of the National Natural Science Fund. In addition, they have trained many talented researchers with outstanding achievements in this scientific field and become a scientific research entity with a definite status and influence in the nation and within the military establishment.

Self Reliance and Creation Under Difficulties

Genetic engineering is a study of life science at the molecular level. A group of scientists with Professor Huang Cuifen as its leader had observed the status and the future of this newly advancing science, proceeded to plan and establish MGI with the concern and the support of the Communist Party Commission of CAMMS and the renowned scientist, Qian Xuesen.

The original research laboratory was established inside a kindergarten. As there was no drainage in the room, an opening was made in the corner of the wall and a pipe was connected from there to the underground sewer. The toilet with a water tank still hanging on the wall was converted into the experiment preparation room. The reception room which was a little over 10 square meters was partitioned with fiberboard to make three sterile rooms. Even the triangular space under the stair where brooms and mops were kept was by their careful design converted into a precious constant-temperature room with an electric heater and blankets hung on the wall as insulation. The cold room was also of their own design and assembled from many different parts by themselves. Most of the equipment and apparatus were those used previously in the 60's. They were repaired, modified, adjusted and tested by the scientists themselves. Along the path of extreme difficulties, they relied on themselves and with the revolutionary spirit of overcoming adversity, started the new field. They conducted research while learning and summarized while accumulating data. The MGI was thus established and developed.

Diligent in Practice and Daring in Creation

Taking advantage of the reform and openness which brought forth the opportunity of developing scientific research and faced with the realties of the accelerating pace of knowledge and intensified scientific competition, the scientists at the MGI through hard work have achieved numerous research accomplishments in the past 10 years.

They were the first in the nation to obtain clones of a toxin gene. Using a design different from that used in other countries, they transformed the clone of a toxin gene into the clones of the toxin B subunit gene which is non-toxic but retains the antigenic property. They also developed a production bacterium strain, a type with a high secretion capacity; the yield from it is much higher than that reported overseas. Upon this foundation, they purified the product of the production bacterium, the B subunit, and obtained an electrophoretically pure substance which retains the antigenicity and the original immunity of the natural toxin. The new BS-WC vaccine which is formed by linking this electrophoretically pure substance with killed cholera vibrio has shown a good protective effect in animal tests, and has been proven to be safe without inducing adverse reaction when tested on human volunteers. It attained the advanced international level according to the experts' evaluations.

They developed "swine dysentery vaccine" research. On the basis of the genes of adhesive factor and enterotoxin, they proceeded to conduct research on the vaccine preparation. After repeated experiments, they designed and constructed a bivalent live vaccine which has been proven to be extraordinarily effective by animal tests. It has been tested on more than 5,000 sows and more than 50,000 piglets in over 10 large swine farms in Beijing, Tianjin, Guangzhou, Shaanxi, Hunan, etc. It has greatly raised the survival and growth rates of piglets, and has been very welcomed by the populace.

In order to catch up with and to overtake the advanced level of the world, and to cultivate its own scientific cadres in the genetic engineering of eucaryotes, MGI organized and developed a research project in the genetic engineering of eucaryotes by choosing to study the gene of therapeutically useful thrombus dissolving eucaryotes urokinase. The project was a rather difficult one, particularly under the circumstances where the basic facilities were inadequate, the technical expertise was feeble and funds were insufficient. But by their perseverance, in a short time, they were able to obtain many experimental results of overseas research laboratories such as obtaining the antiserum and immune serum, and extraction of mRNA. Finally, this small group of researchers obtained unexpected progress in 1988 after many years of hard work. In 1989, they accomplished the cloning of the whole sequence of the gene, thus laying a good foundation for the genetic engineering of urokinase in our country.

Concern for the Overall Situation and Organize to Cooperate

"For a few people to engage in individual endeavors is not the way to conduct modern scientific research. It is necessary to organize the manpower and physical facilities under a unified leadership to carry out an overall attack." This is the conclusion they reached through practice. As the workers were few and their research techniques feeble, their efforts needed to be concentrated to overcome the obstacles. As funds were insufficient and materials were lacking, the involvement of the entire institute was needed to facilitate the project. As time was short and the workload heavy, the work force was organized to attack the problem in a coordinated manner.

In the summer of 1983, the research on "type B hepatitis core antigen" showed a promising lead. It called for more people to be organized to take up the concerted attack on that research project. MGI resolutely decided to temporarily suspend eight other research projects so that their researchers could all serve in this one project. The first to be suspended was the research project of Professor Huang Cuifen and her assistants. This charging ahead of the pack of foot soldiers to lead the way is much more effective than an eloquent speech or a pep talk for others to follow. Very soon, almost 30 researchers joined in this single endeavor. Even an associate professor more than 50 years old gladly gave up his own research project to play a supporting role. The "Core Antigen" project thus was able to engage in an early battle that ended in early victory. In only 2 months, success was attained. Through reformation of the sequence, they increased the power of expression of the bacterial strain by 1,000-2,000 times, thereby joining the rank of advanced nations of the world. Furthermore, they chemically transformed the core antigen of the production bacterium into the e antigen, which brought acclaim from many experts in the country and facilitated its clinical trials of the experimental result. Its application has been widely extended to the whole nation and all military personnel. It took first place in the nationwide comparison and evaluation of diagnostic agents for type B hepatitis at the end of 1983. This accomplishment was awarded the first prize of the National Advancement in Science and Technology.

Eying the Future, Emphasis on Nuturing Talent

"Talent is the life of science". The number of high-ranking researchers has increased from two at the beginning of MGI to 11 at present. There have been 18 masters and three doctorates who have finished their degree programs there. In the early days of MGI, in order for more people to master various new techniques in this new branch of science, the older-generation researchers sent out more than 20 of their workers to eight research institutes such as the Chinese Academy of Sciences to study and learn, even though by doing so, they had to take on themselves more of the heavy workload pertaining to planning and establishing the institute. In order to pursue the advanced international level, MGI sent 16 of its research workers to the U.S. and five other countries to study in depth. Even though these people were separated by many mountain ranges and oceans, MGI did not forget them. One after another letters of encouragement and expectation went out to those studying overseas, and they have responded by coming back one after another to the institute to work in and for the motherland. These returnees with their in-depth knowledge of the field and attendant high level of skill in research techniques have obtained fruitful results in the procaryotic gene of dysentery vaccine, the eucaryotic gene of thrombus dissolving therapeutic peptide, the research in the structural analysis of genes and their functions, and other projects. Some of them have become prominent in particular subjects, some have received awards and some have attained leadership positions.

"View fame lightly, but place importance in accomplishing the task at hand." This thought and the moral standard have inspired the comrades at MGI to work hard for advancing science and technology of the motherland.

Qingdao Becomes Research Center for Marine Science

91FE0150C Beijing RENMIN RIBAO in Chinese 7 Nov 90 p 3

[Article by reporter Zhang Rongda [1728 2837 1129]]

[Text] Qingdao is not only a beautiful seacoast summer tourist attraction and important foreign trade port, but it is a famous marine science city.

Before liberation, marine science was nonexistent at Qingdao. Shortly after the birth of the People's Republic, the Ministry of Agriculture's Central Marine Products Experimental Institute was moved from Shanghai to Qingdao, and then it became the Huanghai Water Products Research Institute of the China Marine Products Scientific Research Academy.

In August 1950, China's first marine science scientific research organization, the Chinese Academy of Science Aquatic Biology Research Institute Qingdao Marine Biology Research Laboratory, was established by China's famous marine biologists, Tong Dizhou [4547 4574 0719], Zeng Chenggui [2582 0701 1145], and professor Zhang Xi [1728 3886], and continued to grow and develop into the largest marine research laboratory in China. Thereafter, China's only ocean academy was established at Qingdao, known today as the Qingdao Oceanology University.

When the PRC was established and in critical need of talent, several marine biologists who were detained overseas overcame every sort of obstacle to return to serve the fatherland, and became the founders of Chinese marine science research.

Professor He Chongben [6378 4378 2609] came from the U.S. to Qingdao, and set up the Shandong University Department of Oceanography that became the birthplace of the marine physics research center and marine meteorology. The famous physical oceanologist, Mao Hanli [3029 3352 4409], abandoned his position at a well known American marine research institute to work at the Qingdao Marine Research Institute, and became a leader in physical oceanology. Aquatic products specialist, Zhu Shuping [2612 2885 1456], returned from England, and the patriotic overseas Chinese, Zheng Shouyi [6774 1343 5030], returned from the Philippines, and they too made major contributions from their roles in marine research.

There are now 20 ocean research units that combine the studies of marine physics, marine meteorology, marine chemistry, marine geology, marine paint science, marine pharmacology, and marine instruments, together with scientific research, teaching, and production, and all together they form a unified marine science research system. There are more than 4,600 specialists and technicians engaged in marine science research, among them are more than 800 high-level research personnel who are roughly 50 years of age. The age range of middle level scientists and technicians is under 45 years. The number of middle and high level technical personnel in marine science and research units at Qingdao make up respectively about two-thirds and one-third of the total number in the whole country. From start to finish, the scientists and technicians have kept the faith in their struggle for the glory of the country, conscientiously buried themselves in their labors, and set the foundations and forged the way for China's marine science and technology. Throughout they initiated and completed many comprehensive investigations, natural resource studies, and basic theory and research work on China's near ocean currents and water masses, tides, waves, ocean bottom profiling, distribution of marine biology and classification of China's ocean plants and animals, reef building biology and forms and ecological characteristics of the biological community.

Within 10 years after reforms began, Qingdao marine science achieved nearly 500 technological objectives, an unprecedented number, of which, some were world-class and a few were the first ever achieved in the world. China's marine science is moving up in the world, and has gained international attention. Since 1979 a thousand foreign marine researchers and specialists have visited Qingdao, and during the same time, Qingdao research units sent over 1,000 to more than 10 different countries to participate in academic activities and technical work.

In the eyes of the world, China has become a strong player in marine science. Qingdao's strength in world marine science is in aquatic plant research. What is a wonder is that China was not formerly a kelp producing country, nor were there any laver farmers, but after 10 years of arduous research by Qingdao marine biology specialists, and popularization among countless producers around the country, China has become a major seaweed-producing country.

The Chinese Academy of Sciences Marine Research Institute, the Chinese Academy of Marine Sciences Huanghai Aquatic Products Research Institute, the Shandong Province Sea Cultivation Research Institute, and Qingdao Oceanology University have done fruitful research on classification, planting, and cultivation of seaweeds. In their capacity as host country they have sponsored such international events as the "Eleventh International Seaweeds Symposium" and "Pacific Ocean Economic Seaweeds Conference".

The "International Commercial Seaweeds Production and Utilization Conference" held at Qingdao and Hainan Island from 25 May to 15 June 1987 drew visitors from over 20 Third World countries. This was the first successful effort by China to interest Third World countries that have seaweed resources in rapid development of seaweed research and utilization, and it earned high praise from the attendees. The famous marine biologist Zeng Chenggui presided over the Third World Seaweeds Association.

In the fields of marine physics and marine biology, Qingdao Oceanology University's "Universal Wind and Wave Chart", and professor Feng Shizuo's research work, "Storms and Tides", the State Oceanography Bureau First Marine Research Institute's geohydromechanics research, and the Chinese Academy of Sciences Marine Research Institute's professor Wu Baoling's work on polychaeta are all world class achievements.

In 1985, the Chinese Academy of Sciences Marine Research Institute, in order to keep abreast of the world research on ocean-atmosphere relations, went on the attack, and for successive years went out onto the Pacific Ocean for large- scale research and investigation of ocean circulation and atmospheric relationships, dynamics of ocean currents in west pacific coastal regions, and the effects of ocean circulation on climate in China and East Asia. Notable contributions were made in these efforts, such as the first charting of submarine currents in the west pacific coastal regions, and the important discovery and naming of the "Mianlan deep ocean undercurrent". This achievement earned high praise in the international marine science world.

This year China has plunged ahead of the world into the artificial cultivation of shrimp, mussels, and bay scallops, and this should bring credit to Qingdao marine research units and personnel because they are the ones who started it, organized it, and converted it from science into production.

Qingdao, the marine science city, is continuing on to the pinnacle of marine science and research, and wholeheartedly welcomes the coming of the marine science age.

Measures To Solve S&T Personnel Shortage

91FE0180D Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 12 Nov 90 p 3

[Article by Wang Xianyu [3769 0341 3768]: "Countermeasures for Solving the Question of Personnel Faults"]

[Text] The question of faults [duan ceng 2451 1461 geological fault] in S&T personnel is revealing its serious nature as the economy and S&T develop and has attracted wide attention in society. Starting now, the selection of what concrete measures and methods to solve this problem has become and urgent task for serious consideration and action.

If we examine the question of "faults", we see that it has two aspects: One is temporal and numerical rigidity, meaning that by about the year 2000, over 60 percent of our S&T personnel (those now above 46 years of age) will retire in great numbers. Second is elasticity (or plasticity) in the quality and capabilities of S&T personnel, such as how to make leap-type improvement in the capabilities of young people. Analysis shows that the main shortages in 2000 will be high-level and some mid-level S&T personnel. Thus, the key to resolving the current problem of personnel faults is creating expected changes in the quality and capabilities of existing S&T personnel to ensure that we basically can meet our needs in the year 2000. I propose the following countermeasures for this purpose.

1. Macro regulation: This mainly involves ensuring the role and status of key projects, key items, and key units in development of the national economy as well as their continuity and tendencies toward improvement in scientific research and technical progress. We should select and regulate several S&T personnel who meet our requirements on a national scale in a planned and gradual manner, enrich them, and ensure a rational group structure.

2. Full circulation: In the future, the unbalanced distribution of personnel among localities and units will continue. Besides planned allocation and redistribution, we must formulate national matching personnel circulation systems to ensure the suitability of S&T personnel circulation, utilize bi-directional selection and competitive mechanisms, and encourage more skilled personnel to reveal themselves. Relax restrictions on personnel in the areas of residency permits, employment, housing, and so on, and increase the attractiveness in work, treatment, conditions, and other areas.

3. Importing from many parties: Formulate more feasible policies to create a better knowledge and personnel importing environment, entice students sent abroad and overseas Chinese to return to China bravely, entice high-level personnel in foreign countries to come to China and provide services, lecture, cooperative research, or register.

4. Conscientiously persuade: Persuade existing personnel in a targeted and planned manner. We cannot ask for a son-in-law and give up a son. We must truly solve several real difficulties for S&T personnel, provide them with better conditions and environment, and achieve natural retention, local retention, personal retention, kind retention, and emotional retention.

5. Conduct assistance: All scientific research units should immediately adopt measures to ensure that scientific research projects select and entice S&T personnel under 45 years (especially young people) to participate, with older senior-level experts transferring knowledge, guidance, assistance, and leadership during practice in scientific research to form an personnel terrace with different age segments.

6. Education and training: All units should work from the perspective of "training skilled people for the nation", overcome short-term behavior, and conduct continuous education and training for S&T personnel. There should be strict stipulations to provide full guarantees of training periods, content, and goals to reinforce intellectual development, renew knowledge, and optimize quality. There should be specific standards for progress and leading ensured for the training and the adoption of various arrangements such as going abroad for study, job releases for training, participation in academic conferences, going to special high-level laboratories and research centers established by the state for training and studying and carrying out special research projects, self-study, and so on.

7. Provide burdens earlier: Superior quality middle-aged and young S&T personnel should be placed in key scientific research positions as soon as possible to take on heavy scientific research burdens and allow them to temper themselves and improve. In addition, we should provide rewards to senior experts or leading cadres who discover, training, and produce superior middle-aged and young personnel.

8. Postpone retirement: S&T personnel from 55 to 70 years of age still have rather high innovative capabilities and working abilities, so there should be clear written stipulations and the use of tests and physical examinations to confirm their physical health and vigorous innovative capabilities, their personal willingness to continue to participate in scientific research activities without having to retire or to allow them to extend to age 70 before retiring again.

9. Two categories of staffs: Allowing the "retirement" of many elderly experts to account for a specific proportion of staffs may influence to promotion for middle-aged and young personnel. As a result, we should implement a new staff system of a first staff and second staff. All those under 60 belong to the "first staff" and are the primary force in the staff system and have their existing staff functions. Elderly experts over 60 belong to the "second staff" and they hold positions to work in but do not account for the various indices in the "first staff" The

"second staff" is the auxiliary to the "first staff" and is under direct state management and is not subject to restriction by concrete units. This can fully foster the talents of elderly experts, fill in the "faults", and link up scientific research capabilities.

Manpower Comparison Among Four Major Science Research Systems

91FE0282F Beijing KEYAN GUANLI [SCIENCE RESEARCH MANAGEMENT] in Chinese No 1, Jan 91 pp 9-15

[Article by Zhang Liye [1728 4539 6851] and Ling Wenquan [0407 2429 6520] of the ICSOPRU China State Research Group[1]: "A Comparison of Manpower Resources in China's Four Large Scientific Research Systems and Their Effect on Scientific Research Achievements"]

[Text] Abstract: This article uses statistical analysis of ICSOPRU survey data to compare the manpower resources of China's four main scientific research systems (Chinese Academy of Sciences [CAS], institutions of higher education, departments, and local areas). It also uses correlation analysis to explore the facts at the research group level which affect scientific research achievements in these four major systems. It concludes that the quality of research personnel is the main factor which affects scientific research productivity.

Scientific research productivity is an important index for evaluating the achievements of scientific research organizations. It is subject to the effects of many complex factors. At the macro level, state S&T policies, capital input directions, the S&T management system, the ability of society as a whole to absorb S&T, and so on can serve as atmospheric factors which affect scientific research productivity. At the micro level, research organ management levels, scientific research topic selection, degree of equipment and funding sufficiency, personnel hiring and promotion, the quality of research personnel, capabilities of disciplinary leaders, working environment, personnel relationships within the organization, working styles, and so on can directly affect the quantity and quality of scientific research outputs.

Scientific research is a creative, uniquely practical activity and high- quality manpower resources are the most basic factor of production. Making full use of manpower resources is the basic way to increase scientific research productivity. Below, we will compare manpower resources in research groups in China's four main scientific research systems (CAS, institutions of higher education, departments, and local areas) and analyze the correlation of these manpower resource factors with scientific research productivity to explore those manpower resource factors which have the greatest effect on scientific research productivity in the four main systems to provide a scientific foundation for formulating S&T policies and improving scientific research management.

I. Comparison of Research Organ Manpower Resource Factors in the Four Main Systems

Research personnel are the main factor in scientific research. The scientific research achievements of a research organ depend to a great extent on the quality of its research personnel. As a result, the quality of scientific research staffs historically has been an issue of extremely great concern to scientific research management departments. To briefly explain the effects of personnel quality on scientific research achievements, we selected four indices which reflect personnel quality and compared the manpower resources of research units (RU) in the four main systems: the CAS, institutions of higher education, departments, and local areas. These indices were: 1) The number of years members of the RU have been working (in China); 2) The number of years members of the RU have worked in foreign countries; 3) The number of people with Ph.D.'s in the RU; 4) The number of people in the RU who have experience in using computer programs.

Table 1 shows that the CAS ranks first in all four of these indices and that local areas hold last place. Given the significance of the differences, the differences between the CAS and departments and local areas in the average values for the four indices all reached significant or extremely significant levels. Thus, the CAS is obviously higher than departments and local areas in these four indices. The differences between the CAS and institutions of higher education do not reach significant levels in three indices, but in the index "R&D work history in foreign countries for members of research groups", they reach extremely significant levels. The results in Table 1 show that in the areas of manpower resources and personnel quality, research groups in the CAS are obviously superior to the three other systems.

Table 1. Comparison of Manpower Resources in Research Groups of the Four Main Systems

Manpower resource factors	Mean for each system				T value (two-tailed test)	Significance of difference	Rank
	System	Mean	System	Mean			
Number of scientists and engineers in research group (N=516RU)	CAS	6.605	Institutions of higher education	5.514	1.618		CAS > Institutions of higher education > Departments > Local areas
	CAS	6.605	Departments	5.232	3.107	**	
	CAS	6.605	Local areas	3.976	6.321	***	
	Institutions of higher education	5.514	Departments	5.232	0.628		
	Institutions of higher education	5.514	Local areas	3.976	3.677	**	
	Departments	5.232	Local areas	3.976	4.512	***	
Number of Ph.D.'s in research groups (N=513RU)	CAS	0.506	Institutions of higher education	0.324	1.160		CAS > Institutions of higher education > Departments > Local areas
	CAS	0.506	Departments	0.155	3.262	**	
	CAS	0.506	Local areas	0.066	4.419	***	
	Institutions of higher education	0.324	Departments	0.155	1.921		
	Institutions of higher education	0.324	Local areas	0.066	3.563	***	
	Departments	0.155	Local areas	0.066	1.623		
Number of years of R&D experience in China, research group members (N=1,877 people)	CAS	16.9	Institutions of higher education	15.4	1.846		CAS > Institutions of higher education > Departments > Local areas
	CAS	16.9	Departments	14.0	4.776	***	
	CAS	16.9	Local areas	12.7	6.791	***	
	Institutions of higher education	15.4	Departments	14.0	2.014	*	
	Institutions of higher education	15.4	Local areas	12.7	3.834	***	
	Departments	14.0	Local areas	12.7	2.504	*	
Number of years of R&D experience in foreign countries, research group members (N=1,877 people)	CAS	0.489	Institutions of higher education	0.150	4.002	***	CAS > Institutions of higher education > Departments > Local areas
	CAS	0.489	Departments	0.082	7.632	***	

Table 1. Comparison of Manpower Resources in Research Groups of the Four Main Systems (Continued)

Manpower resource factors	Mean for each system				T value (two-tailed test)	Significance of difference	Rank
	System	Mean	System	Mean			
	CAS	0.489	Local areas	0.021	8.759	***	
	Institutions of higher education	0.150	Departments	0.082	1.780		
	Institutions of higher education	0.150	Local areas	0.021	4.429	***	
	Departments	0.080	Local areas	0.021	2.804	**	
Number of people in research groups with computer program applications experience (N=516RU)	CAS	3.309	Institutions of higher education	2.270	1.814		CAS > Departments > Institutions of higher education > Local areas
	CAS	3.309	Institutions of higher education	2.443	2.145	*	
	CAS	3.309	Local areas	0.934	6.965	***	
	Institutions of higher education	2.270	Departments	2.443	-0.429		
	Institutions of higher education	2.270	Local areas	0.934	4.049	**	
	Departments	2.443	Local areas	0.934	6.156	***	

*P)difference, *** P)(groups), R&D = Research and development

In another article, we compared the scientific research productivity and effectiveness of research groups in the four major systems and discovered that in 13 scientific research productivity indices and six scientific research effectiveness indices, the CAS led the three other systems in most main indices. The comparison in the present article of the quality of manpower resources also may become an important reason which explains leadership by the CAS in the primary scientific research productivity indices. However, determining whether or not manpower resources actually are a major factor which creates the differences in productivity among the four major systems requires confirmation through subsequent correlation analysis.

II. Correlation Analysis of the Factors Which Affect Scientific Research Productivity

Many factors can affect scientific research productivity, and it will be hard for a while to make scientific demonstrations of the extent to which they affect scientific research productivity. Below, we will merely use several quantifiable factors for correlation analysis among scientific research productivity indices to see what effects they might have on differences in the scientific research productivity of research groups in the four main systems.

A. On the effects of scientific research funding factors

Some may have suggested that differences in scientific research productivity among the four major systems might be due to funding factors. Indeed, scientific research funding may be a factor which affects scientific research achievements because without funds, scientific research work could not proceed. If funds are inadequate, it will be hard to complete research projects. Thus, funds are an essential condition for scientific research work. However, is the funding factor a major cause for the differences in scientific research productivity among the four major systems? To clarify this issue, we began by comparing the research funding increase and reduction situation in the research groups of the four major systems. Table 2 shows the results of statistics based on responses to overall increase or reduction trends in scientific research funds over the years according to responsible persons in the scientific research groups. The answers were prepared on the basis of five grades: rapid growth (5), a tendency toward growth (4), stability (3), slight reductions (2), and rapid reductions (1). The figures in the table are the number of research groups for each grade and the figures in parentheses are percentages. A chi-square (X^2) test was used to explain the differences in the degree of fund increases or reductions among the four major systems and the mean values serve as references.

Table 2. Trend Distribution of Funding Increases and Reductions in Research Groups in the Four Major Systems (N=531RU)

System	Trend Distribution of Funding Increases and Reductions in Research Groups in the Four Main Systems (RU number)					Mean of five grades
	5	4	3	2	1	
	Rapid growth	Tendency toward growth	Stability	Slight reduction	Rapid reduction	
CAS	4	23	39	29	7	2.938
	(3.92)	(22.55)	(38.24)	(28.43)	(6.86)	
Institutions of higher education	3	14	33	20	4	2.892
	(4.05)	(18.91)	(44.59)	(27.03)	(5.41)	
Departments	6	50	68	60	7	2.937
	(3.14)	(26.18)	(35.60)	(31.41)	(3.66)	
Local areas	3	37	68	40	16	2.823
	(1.83)	(22.56)	(41.46)	(24.39)	(9.76)	

X^2=10.937, Df=8, 0.05)

The chi-square (X^2) test shows that fund increase or reduction trends in the four major systems are basically identical. This shows that the funding factor is not the main cause for the differences in productivity in the four major systems. If "slight reductions" and "rapid reductions" are combined, the proportion of research groups with scientific research fund reductions in the four major systems are CAS 35.29 percent, institutions of higher education 32.45 percent, departments 35.08 percent, and local areas 34.15 percent. The proportions for the four are extremely close. Thus, there would appear to be no significant relationship between differences in scientific research achievements and funding increases or reductions. To test this conclusion further, we again examined the degree of correlation for funding increases and reductions and six major scientific research productivity indices. Table 3 shows that the correlation coefficients among the funding increases and reductions trends and scientific research productivity indices for research groups in the four major systems are very low and none attain a significant level. Thus, we can consider the extent of funding increases or reductions not to be a major factor affecting differences in scientific research achievements in the four major systems

Table 3. Correlation Between Research Group Funding Increase or Reduction Trends and Scientific Research Productivity (Pierson coefficient r)

Influencing factor	Scientific Research Productivity Index					
	Number of articles published in Chinese publications	Number of articles published in foreign publications	Scientific proposal consulting within China	Technical services within China	Unpublished research reports	Patents and patent applications
Funding increase or reduction trend	0.0443	0.0287	0.0197	0.0119	0.0044	0.0290

B. On the effects of time utilization rates

Effective utilization of time by research personnel is a guarantee of scientific research. Time utilization rates to a certain extent are a reflection of the efficiency and management situation in scientific research activities. For various reasons, scientific research personnel are often involved in non-scientific research activities. These activities inevitably take up time for research work to a certain extent (about 20 percent, according to surveys). Moreover, because the proportion of technical personnel and auxiliary personnel in research groups is too small or they are absent, this often forces research personnel to do work that originally could have been completed by this type of personnel (around 13 percent or more). These two time categories occupy about one-third of the work time of scientific research personnel, which is certainly a waste of talented people.

Table 4 lists some main correlations for scientific research personnel in the four major systems in the area of work time allocation. The results show that the proportion of time spent on research and development is greatest within RU (research units) in the CAS (about 74 percent), which is significantly higher than in institutions of higher education and local areas, but there is no significant difference from departments. In the ratio between scientific research time used outside the RU (research units) and time spent on non- scientific research activities, there is a significant difference between RU in the CAS and local areas but no significant difference for institutions of higher education and departments. There are no significant differences among the four major systems in the proportion of time spent on low-level work.

Table 4. Comparison of Scientific Research Personnel Time Allocation Proportions in the Four Major Systems

Content of time allocation	System	Percentage of time allocated	T value (CAS and other systems)	Significance level of difference	Rank
Proportion of time spent on research and development work within RU (N=1,799 people)	CAS	74.1			CAS > Departments > Local areas > Institutions of higher education
	Institutions of higher education	56.7	9.470	***	
	Departments	72.6	1.024		
	Local areas	70.1	2.794	**	
Proportion of time spent on research and development work outside RU (N=1,799 people)	CAS	4.0			Local areas > Departments > CAS > Institutions of higher education
	Institutions of higher education	3.4	0.796		
	Departments	4.5	-0.712		
	Local areas	5.6	-2.067	*	
Proportion of time spent on low-level work (N=1,794 people)	CAS	19.5			Departments > Local areas > Institutions of higher education > CAS
	Institutions of higher education	19.9	-0.280		
	Departments	21.2	-1.460		
	Local areas	21.1	-1.280		
Proportion of time spent on non-S&T activities	CAS	12.8			Local areas > Departments > Institutions of higher education > CAS
	Institutions of higher education	13.2	-0.339		
	Departments	13.7	-1.166		
	Local areas	14.7	-2.324	*	

* P

Are time utilization rates a factor which affects scientific research achievements in the four major systems? To answer this, I did a sample of six scientific research productivity indices and computed their correlation with time allocation to explore the extent to which time utilization rates actually affect scientific research achievements. Table 5 shows that there is a positive correlation between the time spent on R&D work in research groups and these six scientific research productivity indices, but it attains a significant level only for the item of patents or patent applications. The correlations for the other indices are not significant and the correlations are very low. There is a very low positive correlation between time spent on work outside the research group and time spent on low-level work only with scientific proposals or consulting and technical services. The others are negatively correlated. There are apparently negative correlations between time spent on non-S&T activities and productivity indices. This negative correlation shows that time spent in these areas can obstruct output of scientific research achievements.

Table 5. Correlation Coefficients for Scientific Research Productivity and Scientific Research Personnel Time Utilization Rates (N=1,877 people)

Productivity indicator	Content of Time Allocation By Scientific Research Personnel			
	Time spent on research work within the RU	Time spent on research work outside the RU	Time spent on low-level work	Time spent on non-S&T activities
Articles published in Chinese publications	0.0093	-0.0395	-0.0152	-0.0562
Articles published in foreign publications	0.0344	-0.0263	-0.0005	-0.0251
Scientific proposals and consulting in China	0.0200	0.0072	0.0323	-0.0159
Technical services in China	0.0126	0.0123	0.0137	-0.0116
Patents or patent applications	0.1197**	-0.0521	-0.0509	-0.0356
Unpublished research reports	0.0011	-0.0199	-0.0215	0.0374

** P

Overall, the correlation between time utilization rates of research personnel in the four major systems and scientific research productivity is very low. Thus, this is not a major cause of the differences in scientific research achievements among the four major systems.

C. On the effects of manpower resources

We have seen in Table 1 that there are differences in manpower resource factors among the four major systems, which are the CAS, institutions of higher education, departments, and local areas. In another article which compares scientific research achievements in the four major systems[2], we also noted differences in the scientific research achievements of the four major systems. Are these differences in achievements due to manpower resource factors? To explore this question, we selected six main scientific research productivity indices and five main manpower resource indices for correlation analysis. The results are shown in Table 6, and the explanation follows that.

Table 6. Degree of Correlation Between Scientific Research Productivity and RU Manpower Resources (N=537 RU)

Scientific research productivity indicator	Manpower resource factor				
	History of involvement in R&D in China	History of involvement in R&D in foreign countries	Number of Ph.D.'s in RU	Number of people capable of using computer programs	Number of scientists and engineers in RU
Articles published in Chinese publications	0.0817**	0.1741**	0.3050**)reset	0.2481**	0.4022**
Articles published in foreign publications	0.0276	0.2672**	0.3171**	0.21 46**	0.3168**
Scientific proposals and consulting in China	0.0488	0.0610	0.2066**	0.0257	0.1580**)eset
Technical services in China	0.0092	0.0238	0.0683	0.0547	0.0986*
Patents or patent applications	0.0472	0.0686*	0.1364**	0.215 3**	0.3259**
Unpublished research reports	0.0566	0.0241	0.0445	0.0884*	0.0064

* P)correlation

1. Looking vertically at Table 6, we can see that there is an extremely significant correlation only between experience in involvement in research work in China and number of articles published in Chinese publications. Although there are positive correlations with the five other productivity indices, they do not reach a significant level. History of involvement in R&D in foreign countries has an extremely significant or significant

positive correlation with number of articles published in Chinese publications, number of articles published in foreign publications, and number of patents. The number of Ph.D.'s in a research group has an extremely significant positive correlation with number of articles published in Chinese and foreign publications, scientific proposals and consulting in China, and number of patents. The number of people in a research group with experience in using computer programs has an extremely significant positive correlation with the number of articles published in Chinese and foreign publications and the number of patents, and there is a significant correlation with unpublished creative research reports. The number of scientists and engineers in a research group has an extremely significant correlation with the number of articles published in Chinese and foreign publications and the number of patents. A positive correlation indicates a promoting role while a negative correlation indicates an obstructing role. Correlations which attain significant levels indicate significant effects in the statistics.

2. Looking horizontally, the number of articles published in Chinese publications has an extremely significant positive correlation with all factors in manpower resources. For the two productivity indices of number of articles published in foreign publications and number of patents, with the exception of the factor of history of involvement in R&D within China, they have an extremely significant or significant positive correlation with the four other manpower resource factors. Although there are positive correlations between the indicator of technical service within China and the five manpower resource factors, they do not attain significant levels. Moreover, the indicator of scientific proposals and consulting within China has an extremely significant positive correlation only with the number of Ph.D.'s. Unpublished innovative research reports have an obvious positive correlation only with the number of people who have experience in using computer programs. Correlations of these two indices with the other four manpower resource factors do not attain significant levels.

3. In summary, we can see clearly that the four manpower resource factors of number of people with Ph.D.'s in research groups, number of people with experience in using computer programs, history of involvement in R&D work in foreign countries, and number of scientists and engineers in the research group have the greatest influence on scientific research productivity. We can also see that the various manpower resource factors have the greatest influence on the three most important scientific research productivity indices, which are the number of articles published in Chinese and foreign publications and number of patents, whereas their influence on technical service within China, scientific proposals and consulting, and unpublished innovative research reports is relatively small.

III. Summary and Conclusion

1. Comparison of manpower resources in the three major systems shows us clearly that the quality of scientific research personnel in the CAS is higher than in the other three major systems, and they are especially higher than departments and local areas. The quality of scientific research personnel in institutions of higher education is second only to the CAS and is significantly higher than local areas in all factors and significantly higher than departments in some factors. The quality of scientific research personnel in the department system is higher than local areas in most items. The overall ranking in the quality of scientific research personnel is the CAS, institutions of higher education, departments, and local areas.

2. Our comparison of scientific research productivity and effectiveness in the four main systems produced results similar to those for the manpower resource situation. Research groups in the CAS were higher than the other three main systems in most indicators used to assess scientific research achievements and the ranking was CAS > institutions of higher education > departments > local areas. A certain correlation between the two can be inferred from this: it is quite possible that manpower resources are the main factor creating the differences in scientific research achievements among the four major systems.

3. Correlational analysis of certain factors which affect scientific research productivity leads to the discovery that the trends in scientific research fund increases and reductions are roughly the same for the four major systems and that their correlation with scientific research productivity in the four systems is very low. Thus, funding increases and reductions are not a major cause of the differences in structure achievements among the four major systems.

Moreover, it was also discovered from the correlation analysis that with the exception of a significant correlation between patent indices and time spent on research and development in the research groups, there were no significant correlations for the others and all the correlations were very low. Thus, time utilization rate factors are not a primary cause for the difference in scientific research achievements among the four major systems.

4. The correlation analysis shows that there is an extremely significant correlation of manpower resource factors with number of articles published in Chinese and foreign publications, number of patents, and other primary productivity indicators. This shows that manpower resource factors are important sources of the differences in scientific research achievements among the four major systems. This is particularly true for the number of people in the research groups who hold Ph.D.'s, the number of people with experience in using computer programs, history of involvement in research work in foreign countries, number of scientists and engineers in

research groups, and other factors which have obvious effects on scientific research productivity.

5. These research results show clearly that the quality of scientific research personnel plays a decisive role in scientific productivity and effectiveness. Thus, to promote the development of science and technology in China, state S&T management departments should work quickly to formulate effective concrete policies and regulations to ensure that the S&T system produces achievements and skilled personnel. All of the scientific research systems should adopt effective measures to attract superior scientific research personnel. At the same time, we should continually improve the quality of existing scientific research personnel, further reinforce scholarly exchanges and personnel exchanges with foreign countries, and give more key scientific research personnel an opportunity to gain experience working in foreign countries to expand their horizons, enlighten their scientific ideas, and strengthen their scientific research capabilities.

Modernization of science and technology are the key to achieving China's four modernizations drive. Manpower resources in the S&T realm are also the key to modernization of science and technology. Protecting, nurturing, and fully fostering the role of China's scientific research manpower resources is an urgent problem that requires solution. This should receive the attention of all of society and should especially draw the concern of the relevant leadership departments.

Footnotes

[1] The ICSOPRU China State Research Group is composed of relevant personnel in the CAS Psychology Institute and Science and Technology Policy and Management Sciences Institute.

[2] ICSOPRU Research Group, Woguo Si Da Keyan Xitong Keyan Shengchanlu Bijiao [Comparison of Scientific Research Productivity in China's Four Major Scientific Research Systems]

Song Jian on Roles of Higher Education S&T Personnel

91FE0282J Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 28 Dec 90 p 1

[Article by KEJI RIBAO reporter Fan Jian [5400 1696]: "Song Jian Stresses at the National Higher Education S&T Work Conference That Institutions of Higher Education are Both Centers of Education and Centers of Scientific Research"]

[Text] "In our many enterprises, on the Huang-Huai-Hai Plain, on the San Jiang Plain, on the Qinghai-Tibet Plateau, on our 18,000 kilometers of coastline and beaches, and in every corner of the motherland, one can see teachers from institutions of higher education leading students in using science and technology to invigorate agriculture, doing arduous work to develop township and town enterprises, to develop and utilize natural resources, and to protect the ecological environment, and making outstanding contributions to China's economic construction, social progress, and popularization and dissemination of scientific knowledge." This was the assessment made by State Council member and State Science and Technology Commission chairman Song Jian [1345 0256] on 27 Dec 90 at the National Institution of Higher Education S&T Work Conference held in Beijing concerning the powerful S&T crack force in institutions of higher education.

Song Jian said that scientific research workers in institutions of higher education have created a completely new experience that integrates education, S&T, and production and that they have created a new pattern and experience that integrates S&T workers with the laboring people. Practice over the past 10 years has proven that institutions of higher education are an extremely important force in the high S&T realm, in tracking research and opening up new research realms, and in promoting the formation of high S&T industry.

Song Jian used world-renowned achievements like Beijing University's Chinese character laser-illuminated arrangement system, Qinghua University's 5MW nuclear reactor, Shandong University's artificial crystals, Central China Physics and Engineering University's high-power laser, and so on to prove that scientific research in institutions of higher education is a guiding force in the realm of high and new technology research in China's attacks on key S&T problems and industrialization. He said that, with support from the powerful high S&T forces in institutions of higher education, all colleges and schools have established several high-tech industries, divided some S&T staffs, and directly entered the main battlefields of economic construction. This has played a promoting role in the establishment and development of high and new technology industry in China, in transforming traditional industry, and in raising S&T levels in China's industry and agriculture.

After describing the advanced experiences of teachers from institutions of higher education in the United States, England, Switzerland, Australia, Thailand, and other countries in establishing scientific parks and participating in the establishment of new industries, he pointed out that the involvement of universities in the establishment of high and new technology parks and supporting some S&T workers in being directly involved in the formation and development of high S&T enterprises is a new trend in the world's institutions of higher education.

When discussing the question of "personnel division", Song Jian said that, given China's present situation, an appropriate degree of "personnel division" to facilitate their participation in, support for, and promotion of the formation and development of high-tech industry conforms to the basic lines of the party, conforms to the direction of reform in the educational and S&T systems, and conforms to the trends of S&T development in the modern world. It should be included as a relatively long-term principle for S&T work in institutions of higher education and given confirmation. This is very important for economic construction, social progress, and development of the cause of education itself.

Song Jian also stressed the question of basic research. He said that he was willing to reaffirm a common concept in our scientific circles, which is that we must maintain a powerful and crack staff involved in basic research. In physics, mathematics, astronomy, geology, molecular biology, human studies, life sciences, and other basic scientific fields which are the most important in modern times, we should maintain a staff of young scientists. We should create possible conditions for them and encourage them to go all out on the stage of world science and technology and strive to make achievements of world importance during the next 10 years. This is another extremely important task for development of the cause of S&T by the Chinese nationality. During the next 10 years, we hope that China's S&T personnel will be able to write a new chapter in the history of the development of S&T by the Chinese nationality and create new contributions to the new record of accumulations for this new chapter.

Song Jian said that there are now 500,000 to 600,000 relatively mature S&T workers in institutions of higher education, including 120,000 people who can be considered to be involved exclusively in S&T work and another 100,000-plus graduate students. This is a treasure of the Chinese nationality as well as a key force and vital army for China's S&T staff during the 1990's, and in particular is a fountainhead for training and creating an even younger scientific staff during the next century. We deeply believe that our even more magnificent achievements in the future will be created by this generation of young people. We also hope that all ministries and commissions of the central government and government departments at all levels will understand fully the strategic significance of running institutions of higher educations as both centers of education and centers of scientific research, and thereby strengthen support for their work, strive to increase inputs, and provide them with preferential policies.

Information indicates that during the past decade, institutions of higher education (including adult colleges and schools) have trained and created nearly 5 million S&T personnel for the state who cover nearly all the disciplines and fields in modern science and technology.

In regard to China's nearly 10,000 young science workers who are now studying and doing research in foreign countries, Song Jian expressed great hopes, saying that he believed they were the sons of the Chinese people and that studying and struggling for the prosperity of the motherland and the people are a magnificent duty and hope for every student studying in foreign countries. We must encourage them to go all out on the world S&T stage and strive to make achievements of world significance during the next decade. We also must do good work in all areas, create possible conditions for them, and hope that they return to China. This will substantially strengthen China's future scientific staff.

In facing a completely new situation that has been created in institutions of higher education over the past 10 years, Song Jian predicted that S&T work in institutions of higher education will leap from an important role in China's S&T to a become central force and thereby keep abreast with world levels.

Deeper Reform in CAS To Provide Better Environment for Young S&T Personnel

91FE0282L Beijing BEIJING KEJI BAO [BEIJING SCIENCE AND TECHNOLOGY NEWS] in Chinese 2 Jan 91 p 1

[Article by reporter Shi Wenjie [0670 2429 1240]: "CAS To Reform Management System To Allow Superior Young S&T Personnel To Display Their Talents"]

[Text] I learned at the Chinese Academy of Sciences [CAS] Young People's Work Conference convened in Beijing on 1 Jan 91 that the CAS will begin extensive reform in an effort to eliminate the old system that was characterized by eating from the big common pot, eating from the iron rice bowl, departmental ownership, and low efficiency to gradually form a new system that is full of vitality, competitive, more open and circulating, and capable of making greater contributions to social and economic development and S&T progress.

The CAS has formulated this new management system to adhere to high levels, high standards, and strict requirements in personnel selection, training, and utilization, to bring in competitive mechanisms, and create more opportunities for the development of young people in an effort to create a young S&T staff that is full of vitality and competitive and to gradually form a set of new management systems that are conducive to the growth of talented young personnel. New entering young people must have substantial study histories and degrees, strict recruitment tests, implement bidirectional selection, and promote early circulation. They must arrange for newly entering young people to quickly participate in scientific research practice to have a specific proportion of young people participate in major scientific research projects. Key young personnel must be selected and assigned to take on leadership work in research offices and topical groups, participate in academy and institute scholarly evaluation and consulting work, and participate in scholarly activities in China and foreign countries. Various types of scientific research funds should be established to support young S&T personnel in carrying out topical research. Reward systems must be established and perfected and preference given to solving the relevant treatment and residential problems for superior young S&T personnel. There must be clear stipulations regarding the degree requirements and years of service requirements for promotion to specialized technical posts. Young S&T personnel must comprise a specific proportion of the number of people promoted to high-level specialized technical posts. On-the-job training should be carried out for young people in a planned manner and focused training should be carried out for superior quality personnel. There should be open testing for on-the-job graduate students who have registered for examinations, for applications for on-the-job degrees, and for going abroad for additional training, and so on.

The CAS has implemented this reform in a bold effort to utilize young S&T personnel and provide them with a "performance stage". Certain stipulations in the new system implemented following the reform will provide guarantees of on-the-job training for young people at important posts and bring fully vitality to research institutes, offices, and groups and to academic assessment and other organs due to the increased entry of young people. The CAS will continue to actively assign young people to go abroad for study and additional training in accordance with the principles of reform and opening up, and be concerned with fostering the role of personnel who return to China after completing their studies. Young people who base themselves on the vast territory of the motherland and dedicate themselves to making outstanding contributions to flourishing of the cause of S&T in China and invigoration of our nationality will receive much more concern and careful training to enable them to display their talents as quickly as possible.

I learned that while the CAS is focusing on providing young people with greater support and concern, it will also show concern for other S&T personnel and work personnel, adhere to the consistent principle of comprehensively motivating the initiative of all categories of personnel at all levels, and when conditions permit, truly assist them in resolving several real difficulties in their work and life.

CAS Measure To Attract Returned S&T Personnel

91FE0428F Beijing GUANGMING RIBAO in Chinese 1 Feb 91 p 1

[Article by Huang Xiao [7559 2556]]

[Text] Every year CAS sends an average 500 people abroad for visits and study. To date, 3,700 of them have returned from abroad. To find out how CAS manages the returning S&T personnel, this reporter recently visited Guo Shengwu [6753 4939 2976], the chief of the Overseas Division of the CAS Education Bureau. According to Guo, CAS has long been paying attention to the management of people going overseas. Some measures were also taken in recent years for selecting, managing and placing returning S&T personnel.

Guo said that CAS established a "CAS Foundation for Studying Abroad" in 1990. Every June, CAS formulates a "foundation guide" and selects people to send abroad. The selection was based on recommendation, open competition, and evaluation based on merit. The process followed the policy of "sending people based on need, and preference being given to major scientific research projects with strategic significance." The costs for the selected people to conduct research and participate in academic activities overseas and to purchase the necessary reference material and equipment for bringing back to China were provided by CAS. The returning S&T personnel were required to work a certain number of years in units specified in the "foundation guide" or to complete a certain research project. After that, these people may remain in the same unit by mutual agreement or move to other units.

In discussing the costs for studying overseas, CAS personnel repeatedly mentioned the Wang Kuancheng [3769 1401 6134] Education Foundation in Hong Kong. Since 1988, this foundation has provided CAS with loans to send superior students and scholars overseas for study or academic exchange. When the students or scholars return on time and make accomplishment, they are considered to have repaid their loan; otherwise, they have to pay back the full amount of the loan. This year, the Wang Foundation has also established the "CAS Wang Kuancheng Research Award" to fund 10 overseas Chinese or foreigners with Chinese descent and outstanding students sent out from China to do 12 months' research in CAS. The award provides the costs for conducting research, travel, living and medical expenses.

In order to encourage overseas Chinese students to work hard and produce results, and to more effectively select and cultivate academic leaders and key personnel, CAS announced in October 1990 a "Tentative Regulation for Managing Outstanding Overseas Chinese Students." The recommendation will be based on a combination of the organization and the individual, and the qualified students will be included in a talent pool of outstanding students. Their study abroad will be followed and monitored and they will be attracted to return and serve according to the needs in China. After the return of the outstanding students and scholars, they will be assigned to a unit more favorable for developing their business based on agreements prior to going overseas and mutual consent. Their housing problems will be arranged with priority. After evaluation and approval, they may be promoted to specialist professional positions without satisfying the seniority requirement and without using up the promotion quota of the unit. CAS will also help them solve their problems with husband and wife working at separate locations and children's educational problems.

CAS Hastens To Nurture New Generation of S&T Personnel

91FE0329A Beijing LIAOWANG ZHOUKAN [LIAOWANG WEEKLY] in Chinese No 3, 21 Jan 91 pp 21-23

[Article by Tang Hua [3282 5478] and Sun Yinglan [1327 5391 5695]]

[Text] In the world of Chinese science, the "Praetorian Guard", 90,000 strong, nearly 150 research institutes and units directly subordinate to the Chinese Academy of Sciences (CAS) has again reached an historical pass.

As the CAS was being created in the 1950s and young people were entering the academy, they accepted their missions without any particular pattern of assignment, and many went on to become well known world experts. Ten busy years later, in the 1960s, the middle aged contingent supported by the leadership of older scientists, again quickly advanced to the front to become the S&T standard bearers of today's academy and institutes. Now, as these academic leaders move into the mid and late 1990s, they will be retiring en mass and few will remain. For this reason, training of the new people who entered during the 1980s will be escalated, and many of the qualified S&T successors, as they step between the centuries, will be thrust into the imminent strategic endeavors that will be underway throughout CAS.

The famous physicist and president of CAS, Zhou Guangzhou, asserts that from now on, as the old are replaced by the new, they must pass on the mold, and work for 5 to 10 years to carry the burden of the first line of scientific research, and steadily transfer that burden to the hands of those youths resolved to dedicate themselves to Chinese science in China, and select and nurture a new generation of S&T leadership and staff.

The Onrush of the New Century Beckons the Talented

The CAS personnel affairs bureau issued its most recent statistics received from 43 research institutes, which found that among the 488 chiefs of research labs, none were under 35 years of age and 4.3 percent were between the ages of 36 and 45; among 440 deputy chiefs of research labs, 8.2 percent were under the age of 45; among 1,300 chiefs of task groups, only 5.2 percent were under the age of 40.

At the CAS youth working conference recently adjourned, it was learned that the average age of S&T personnel in all of CAS was already 44, and those near or over 50 years of age comprise more than 50 percent of all S&T personnel. Of the 13,000 high level specialists and professionals, the average age was over 53, of which the average age of research personnel was over 55, and assistant researchers was about 50. Less than 650 are under the age of 45. It is estimated that by about the year 2000, almost all of the 20,000 or more S&T personnel who had come to CAS in the 1950s and 1960s will retire and leave their positions, including the present majority of academicians and staff.

It is evident that CAS is facing an aging work force, and there is a gap in the talent ladder, too few will be staying on, and there is a distinct shortage of new-generation academic leaders and supporters.

In recent years CAS made great efforts to train talent, but in the past there were disparities in the recognition of the seriousness and urgency of the talent issue. Leaders of many institutes and laboratories believed that scientific research and results were most important, and they were soft on training talent. Many middle aged and older S&T workers, because of the intercession of the "Cultural Revolution", could only engage in S&T pursuits after they were in their 40s and 50s, and few thought anything about the issue of succession. For historical reasons, among those who came into CAS in the 1970s who should have been selected and nurtured, whether the matter be looked at quantitatively or qualitatively, only a few are able to handle the job. The brief work experience of young people who came into CAS in the 1980s, the tide of exodus out of the country, and the fervor of commercialism, all affected the stability of the work force, and the debate about the difficulty of breaking the rules for qualification and succession, and whether to start up this or that...all make it clear that while there is hope for "natural growth" of talent, there can be no assurance of a smooth transition and succession of S&T talent.

As the world today enters a new period of competition with emphasis on economics and S&T, the sum strength of a country, the measure of the endurance of its economic development depends on S&T, and the key to raising the stature of S&T is talent. Poised on the starting line of the 1990s and facing the heated S&T competition of the 21st Century, the sense of mission and responsibility of CAS leadership is driven to recognize that the acceleration of training of a new generation of S&T talent, in order to realize a large scale turnover of the S&T work force, plays an important part in the very existence and development of CAS, and to a great extent affects the whole of national socialist modernization. The inescapable truth is that the burden of the future development of S&T lies irrevocably on the shoulders of the youths who came into CAS in the 1980s.

In truth, the bulk of the new people who came to CAS in the 1980s, because many were not familiar with the state of the nation, knew little about the world, and lacked any real experience, they had many obvious deficiencies and shortcomings. There were those who, to varying degrees, had suffered the effects of erroneous trends of thought, and lacked a strong sense of social responsibility and spirit of struggle. But, the main current of their thinking was good, the majority were dedicated to work for their country, and the CAS leadership rightly observed that.

Last year CAS, for the first time since its inception, called a youth working conference on building an S&T youth corps. CAS vice president, Wang Fosong, said in his report to the conference that CAS will have complete confidence in such a youth corps. They are not only predominate numerically, but they possess a high quality of political thought and sense of affairs. Under the guidance of the older-generation scientists and the middle-aged S&T staff, they have already become the fresh troops in support of scientific research, and have abruptly emerged as a body of excellent scientific talent, and have joined the front ranks in several scientific fields. They are the hope and the future of science and technology.

The Tending of New Growth Can Brook No Delay

One thing CAS President, Zhou Guangzhou, said worth pondering was, "Our time for nurturing talent is short. In essence, there is a missing generation, and delaying retirement is not the way to solve the generational overlap problem. If the young are not given the opportunity to shoulder the burden now, and allowed to be drilled on the front lines of scientific research, then a body of qualified successors cannot be readied in the next 10 years. If the problem is put off until the end of the century it will be too late. Succession not only depends on the advantage of age, but youth must pay the price of hard work and sustained practice, then they will be able to grow."

In these several months, CAS leaders have used every occasion and opportunity to discuss and form public opinion on the urgency of nurturing young talent. At the same time, research on formulating policies and measures beneficial to bringing out excellent young talent has been stepped up.

According to current statistics, CAS has, altogether, 13,607 young S&T personnel under the age of 35 who make up 29.1 percent of the academy's S&T personnel (adding the 36 to 40 age group on to that, it would be 39 percent). Among these, there is a group of 123 who have been promoted as elevated special S&T professionals (41 researchers and 82 assistant researchers) who are at an average age of 36, the youngest being 25. One-third of these 123 people are chiefs or deputy chiefs of laboratories. CAS also has 7,000 research students and coop student/researchers who are an important supplementary source of the academy's special high level talent.

Many illustrious CAS experts and teachers analyze it this way: The reason the youths were willing to come into CAS under somewhat deficient conditions, took on difficult tasks and achieved success, was because they could give flight to their intelligence, could quickly get into the forefront of scientific research, and had the hope of making great contributions to China's major scientific research. For this reason, in addition to creating the best possible conditions for them to do creative work, it is important to let them tackle the most important scientific research tasks, and train them under demanding circumstances.

In recent years, several institutes and units of CAS got into the task of nurturing talent rather early. With a sense of purpose, they selected the quick starters, provided for their participation in major scientific research tasks, and tested and nurtured them through the experience. CAS's Dalian Chemical Physics Institute, in late 1989, began to lay out a 10-year talent work program, and from among those youths who had arrived in the 1980s, 45 exceptionally talented youths from the two institute and laboratory levels were selected to be candidates for the new generation of academic leaders. Of these, 15 at the institute level were assembled and put through a training process at the main research labs of national laboratories, and achieved good results in taking on the high level technical track and basic research projects.

The experience of a CAS Institute of Chemistry doctoral student in the class of 85, Bai Chunli, is exemplary. After he returned to China from a science and engineering college in California, be offered a plan for building a scanning-tunneling microscope (STM). The academy and institute leaders took a great interest in this international cutting-edge scientific project. Zhou Guangzhou used over 300,000 yuan from the Academy President's Fund, the Institute of Chemistry put up a small laboratory, detailed 10 or so able young assistants, and the STM testing lab headed up by Bai Chunli quickly took shape. In April 1988, Bai Chunli and the small team built China's first STM, and won the 1990 national science advancement 2nd-class award. In November 1990, Bai Chunli and coworkers, using their own manufactured STM, directly observed and studied the world's first DNA primary genetic structure—the triple-bonded helical structure.

Several units of CAS were also able to break the rules of assignment to important tasks, and through the course of their scientific research brought forth leaders from the new and promising youths of excellent talent. The Institute of Semiconductors, and the Qingdao Institute of Oceanology boldly started to use a group of youths to be deputy chiefs of the institutes, official deputy chiefs of research laboratories, and official group chiefs of task groups. The Shenyang Institute of Automation, for more than a year now, has assigned 5 people of age 35 and under to be deputy chiefs of laboratories, and 12 to be chiefs of task groups. Wang Yuechao [3769 6390 6389], only 30 years old, was asked to be deputy chief of the robotics research lab and take charge of carrying the load of a special national "863" high-tech research task. This institute also clearly decreed that deputy chiefs of high-tech research labs and official deputy team chiefs assignments be allotted to those 35 or under, or there would be no such assignments nor their equivalent positions.

Highly commendable it is that the middle-aged and older experts, and teachers of many units at CAS, have given a great deal of energy to the business of nurturing, and emphasis to systematic and strict basic training, and have not used novices as laborers. As the youths possessed rather strong genuine enthusiasm and ability, they were allowed to take the load in scientific research upon themselves, and they were nurtured into creative scientific research, and became a very competent body of quite high level scientific researchers. A doctoral student at the Institute of Metals, Lu Ke [4151 2688], under the able direction of a teacher, Wang Jingtang [3769 2529 0781], not only within something more than a year completed his doctorate with honors, but made a breakthrough in the high-tech research attack on mechanism of amorphous alloy crystallization. By the end of 1990, at the age of only 26, he produced 30 theses on a new method he discovered for making an ultra-fine metallic micro-powder—the amorphous crystallization process—regarded internationally as a unique technology—for which achievement he received the national invention award.

To further advance the process of nurturing new people, these units and individuals who first demonstrated their successes were recently appraised by the CAS leadership, and conscripted to share their experiences and spread their influence at the academy youth working conference.

Prepare the Best "Speedway" for the Young

The great majority of middle-aged and older comrades approve of giving outstanding youths a piece of the action ahead of schedule, but as to the point of actually assigning them to take charge of laboratories and task groups, there are those who are not so sanguine, and they are having second thoughts. If such assignments were left to the middle-aged and older, it would enhance their titles, and especially if the old comrades were allowed to be in charge of tasks in covert projects it would be some recompense and consolation to them. Concerned leaders are hesitant about the fairness in granting the young such advancement. This is real picture of what many CAS units face in bridging the succession gap.

In this regard, CAS president, Zhou Guangzhao, at a conference of academy and institute leaders, made this earnest pronouncement: It will be of the greatest benefit to help these novices gain a foothold in the struggle on Chinese territory, and allow them to develop their talents early. The middle-aged and older comrades must relinquish their genuine positions and situations to help them really take responsibilities in task groups and in research labs. There can be no selfish approach to bringing along the younger generation. As inside the family, hope is vested in the children, the CAS family's future also depends on the next generation of scientists and technicians. These novices are the sons and daughters of CAS, and they must be cherished as if they were its own children, and attention must be given to their growth and the display of their talents and abilities.

Now, CAS leadership is getting involved in reforming the administrative structure, and will be striving in the 1990s to get out of the old organizational system characterized by the big pot, the iron rice bowl, inbreeding, compartmentalization, and low efficiency, and into creating a viable, competitive, more fluid, new organizational system capable of making a greater contribution to social and economic development, and developing progressive science and technology to pass on to the next generation. While the effort is being made to effect a smooth generational changeover in the S&T work force, the struggle is also on to replace the old organizational system with a new one.

After numerous investigations and summarizations of past practical experience, CAS laid out its "Views on implementation of a new administrative system among the young scientists and technicians", and is now prepared to test it out throughout the academy. It is understood that the main features of this new administrative system are:

Newly arrived youths are required to posses sufficient record of formal schooling and academic degrees, and take a rigorous employment examination. There will be a two-way selection system and an accelerated advancement program. Arrangements will be made for them to participate as quickly as possible in scientific research, and major S&T projects are required to have a specific proportion of participating youths.

Youth staffs will be selected to take responsibility for research labs and task force leadership work, to participate in academy and institute academic appraisals and consultations, and attend national and foreign S&T activities.

A variety of S&T funds will be set up to support young scientists and technicians in task force research.

An awards system will be established and perfected that gives priority to resolving problems of services and living quarters for exceptional youths with S&T talents.

Academic requirements and age requirements will be clearly defined for promotions to special technical jobs, and there will be a fixed proportion of young scientists and technicians among those promoted to high level special technical jobs.

There will be on-the-job training, and for the exceptionally talented there will be focused training, on-the-job examinations for research students, and open testing for those requesting on-the-job academic positions, and even advanced study abroad.

CAS Vice President, Wang Fosong, indicated when he introduced this new program, that three main points must be stressed: First is that an environment of fair competition should be created for the young. The heart of the new system is to invite and intensify the competitive system and guarantee more equal competitive opportunities for young scientists and technicians. The second is to aggressively apply the "show piece" approach for novices, and in the new system there should be certain regulations for offering assurances that youths will be put into positions of importance. The third is to perfect, as much as possible, the working and living conditions for youths, and have new systems to provide certain priority support and awards, and within reason, give novices rather more support and consideration, and guarantee the building and advancement of a new organizational system.

He reiterated, as special efforts are made to give novices even greater support and attention, the past policy of bringing into play all levels and types of personnel will still be adhered to. The older experts lead the way for the young, and their services will continue to be employed with due remunerations, and the guarantees and appropriate regard for their lives after retirement will be assured. The middle-aged scientists and technicians, in the early 90s, will form the link between the former and the latter, will continue to bring their important services to bear, and they must be helped to solve their own real problems of life and labor to enable them to be fulfilled in their work, and at the same time they must be encouraged to steadily transfer their workload to the younger generation. CAS will set up a "Veteran's Good Service Award" and a "Youth Development Fostering Award" to encourage the middle-aged and older comrades to make outstanding contributions as selectors, nurturers, and employers.

The future of China, the enrichment and development of CAS attends on the middle-aged and older scientists and technicians adopting a spirit of seizing the moment in giving guidance to the new and gifted, in fostering posterity, and calls on the younger developing generation that is straining to catch up, to achieve an early succession.

S&T Personnel Returned From Overseas Take On High-Tech Mission

91FE0308C Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 17 Nov 90 p 1

[Article by reporter Li Jing [2621 0352]]

[Text] Throughout the 41 years of reconstruction China sent more than 100,000 exchange students to more than 70 countries and regions, of whom over 50,000 finished their studies, and returned to China. They have become the mainstay of various industries and scientific research organizations. Among them, nearly 20 percent have participated in national Seventh 5-Year Plan attack-projects, the national "863" high-tech projects, National Natural Science Foundation projects, and such major tasks. Nearly 63 percent are involved in high-tech jobs, and another 30 percent have joined leadership groups.

After the new China was established, in accordance with the needs of socialist construction and the raising of talent, China, overall, dispatched many students to study in the Soviet Union, the U.S., Japan, England, Canada, Australia, eastern Europe, and northern Europe. After the Third Plenary Session of the 11th CPC Central Committee, the party and government made the dispatching of exchange students an important element of reform, and sent out exchange students, graduate students, visiting scholars, and cooperative research personnel, on a scale unprecedented in history. Now, among those who have returned home, are 30,000 who were supported by the central government, 21,000 who were supported by their units, and over 1,000 who were self-financed. Among those, more than 40,000 returned during the period of reforms, which began more than 10 years ago. For 41 years, returned students have worked closely with in-country specialists and technicians; they struggled, studied hard, laid foundations, and made great contributions in advancing China's S&T and the people's economic development by uniting scientific research and academics, and strengthening international cultural exchange. Returned students have been instrumental in the development of shipboard maritime satellite communications, the positron-electron collider, the 5-megawatt low-temperature nuclear heat-supply reactor, and such cutting-edge projects.

Over 90 percent of the returned students have published theses and treatises, and have received patents. There are over 22,000 who have earned various S&T achievement awards, including 500 international awards given to 280 returned S&T personnel; about 3,900 scientists won national level awards, and over 5,000 project awards; more than 11,000 scientistshave won provincial level awards, and 21,000 project awards. In addition, there are also 34,000 scientists who have entered 500,000 articles in academic publications both at home and abroad, nearly 16,000 have published treatises and have translated more than 40,000 articles, and nearly 1,500 who patented 2,200 items. These were achievements of remarkable benefit to the economy and the society.

Chinese Academy of Military Medical Sciences Takes Measures To Improve S & T Personnel

91FE0085D Beijing RENMIN RIBAO in Chinese 22 Aug 90 p 3

[Article by Zhang Shi [1728 4258] and Tang Pingyue [0781 1627 1471]]

[Text] The Chinese Academy of Military Medical Sciences [CAMMS] passionately supports scholars to further their studies in other countries, is concerned about their progress overseas, and strives to create conducive working conditions for the returnees. These efforts have stimulated their enthusiasm in repaying the mother country for nurturing them. During the 10 years of reform and liberation, CAMMS has had more than 80 scientists who completed their degrees, engaged in research projects or further study programs abroad, returned to the country to engage in construction of modern China, and made great accomplishments. Up to the end of last year, among the research projects undertaken by them, nine had been awarded National Natural Science Awards, National Invention Awards or National Advancement in Science and Technology Awards; and 56 had acquired better than third place for Military S & T Accomplishment Awards.

CAMMS has insisted on sending young and middle-aged scholars abroad to study so that the S & T personnel may be promoted faster. Because the number of scholars who are supported by the government to study abroad is rather limited, they have mobilized those in leadership positions and renowned professors to help the young scholars to find the means to study abroad through their international colleagues in the same field with whom they are well acquainted. While these comrades are studying abroad, CAMMS sends them greeting cards and other gifts on New Year and the Spring Festival (Lunar New Year). At other times, the leaders of CAMMS, the party functionaries at various levels and leading professors often write to these overseas students, or visit them personally utilizing the occasion to encourage the latter to concretely establish the correct thought of studying for the sake of the socialist motherland. At the same time, their families and children are well cared for, so that the worries the overseas students have about their families are reduced as much as possible.

This care and protection by the organization stimulates those overseas students to study hard to attain the goals of moving China forward and developing medical enterprises of the motherland. Many comrades have overcome numerous difficulties and completed their research projects ahead of time and attained outstanding grades in their courses. While studying at the Pasteur Institute in France in 1987, Research Associate Ten Ying completed his dissertation and research project, scheduled to take one year, in 5 months, and finished his oral defense to obtain a doctoral degree one year ahead of time. In 1988, Research Associate Yang Peiying was sent by the government for further study at the International Virus Research Institute. She regarded time as gold, and in 15 months had completed the research project, which should have taken her 2 years. Her research results were of international caliber. When she returned to China, she brought with her laboratory reagents worth about 30,000 yuan.

CAMMS has been very attentive in giving opportunities to the returnees to use their talent by allowing them to play important roles in research. Among 80 returnees, 10 have already attained high ranking titles by skipping some ranks. Thirty of them have ascended, one by one, to leadership positions in research laboratories and groups to be the principal investigators of 36 research projects of National Science Special Research Project, National "863" High Technology Plan, National Natural Science Fund and Military Special Emphasis Project. Those who returned to China after studying abroad have turned their desire to pay back the motherland for nurturing them into individual action. The Molecular Genetic Institute [MGI] has sent out 11 comrades abroad to study in the past 10 years. Six have already returned to China and have become the backbone of this special field. Each of them has obtained fruitful results in scientific research. Huang Peitang, who is 45 years old this year, refused job offers in the U.S. after finishing his study there in 1986, came back to China 3 months ahead of time, has been engaged in research work, and has been twice awarded Military S & T Accomplishment Awards. Now he has succeeded to be the head of the institute. At the same time, he is engaged in three research projects that includes the National High Technology Plan. He is the youngest researcher in CAMMS. Researchers Bai Yan and Shen Beifen have gone abroad many times to study and to attend scientific meetings. They have introduced advanced techniques from other countries to develop a research program in molecular immunology, have obtained fruitful results every year since, and have been awarded seven National and Military S & T Accomplishment Awards in 5 years.

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