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China Report

SCIENCE AND TECHNOLOGY

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CHINA REPORT

SCIENCE AND TECHNOLOGY

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[Article by Xiao Liang [2556 0081]: "On Several Theoretical Questions Concerning the Commercialization of Technology"]

[Text] Commercialization of Technology Is An Important Way of Transforming Science and Technology Into Direct Productivity

What is the relationship between technology being commercialized and science and technology being productivity?

When we often say that science or technology is productivity, we do not mean that science or technology is direct productivity at the very outset. It calls for a process of transformation.

The transformation of science or technology into direct productivity involves a process, because it first exists in the form of knowledge. For it to be applied to the process of production calls for its being grasped by workers and put in material form as various elements of productivity. Therefore, the transformation of science and technology into direct productivity also means the application of science and technology in production. This covers the shifting of science and technology from the mental workers, inventors, and scientific research departments to users and production departments and also covers the popularization and introduction of science and technology from a portion of workers with a working knowledge thereof to another portion without a working knowledge, the transfer from one department or area to another department or area, and so forth.

Generally speaking, science is somewhat removed from production and technology is somewhat closer to production. For most scientific knowledge to be applied to the direct process of production, technology must be used as link. But it is not easy to apply technology to the process of production. Certain major inventions in particular must go through various intermediate and enlarged tests before they can be applied to the process of production. This is because given different circumstances and conditions, the application of what comes out of a laboratory to a

wide area involves not only a problem of proceeding from reality but also a problem of further examination and verification, especially where the solution of a series of technical problems in application are concerned.

But all these are being discussed from the angle of productivity and of technology. In addition, there is also a problem of the relations of production. The problem of production technology is of course very important. If problems in production technology are not solved, this means that a given scientific or technological product has not been a success or has fallen short of the stage of being widely applied. But if that scientific or technological product is a success from the angle of productivity while problems in the relations of production are not solved, then it still cannot be transformed into direct productivity thereby improving social production. The problems in the relations of production mentioned here refer to the abovementioned problems of economic relations, such as the shift of science or technology from mental workers, inventors, and scientific research departments to users and production departments, the popularization and introduction of science or technology from a portion of workers with a working knowledge of it to another portion without a working knowledge thereof and the transfer from one department or area to another department or area. Give the socialist commodity economy, these activities involving shift, transfer, and popularization and introduction can only take the form of compensation or the form of commodity exchange.

Concerning the transfer of technology with compensation (science, being relatively complicated, is temporarily left out), given a vague idea on our part in the past, coupled with the influence of "leftist" ideas, we actually seriously overlooked this matter. This was one of the causes of the slow development of our science and technology and our low labor productivity. Many scientific and technological products remained at the stage of being exhibits, gifts, and samples and cannot be universally introduced and applied. There was not even the courage to describe technology as a commodity. Now, the central authorities have explicitly called for the commercialization of technology and the opening up of the technology market. This is a major breakthrough in the reform of our economic system and especially in the reform of our scientific and technological system. It carries unusually great significance in developing productivity.

Technology Is a Commodity Because It Is an Exchangeable Product of Labor

In "Das Kapital," Marx said that a thing is a commodity, because apart from its having use value, its "production consumes human labor, with an accumulation of human labor involved." ("Collected Works of Marx and Engels," Vol 22, p 51) This applies to not only material products but also products in the form of knowledge (scientific and technological products). We say that technology is a commodity because it has use value and also has consumed people's labor.

But compared with material products, knowledge-related products have still greater use value and their production calls for the consumption of still greater labor.

We mean two things when we say that knowledge-related products have still greater use value. The first is that labor spent on the production of knowledge-related products has accounted for an ever greater percentage of the value of material products. To develop productivity and add to social products, we must develop science and technology. This also explains why we often say that modernization of science and technology is the key to success in the four-modernization effort. Another thing is that the use value of knowledge-related products is relatively unlimited by time and regional factors. For example, the given use value of a foot of cloth or a jin of grain produced by workers or peasants can only provide for a small number of people's use and can no longer be used after being used. On the other hand, after they come out, scientific and technological products such as inventions can be used by people in many areas over a relatively long period of time. This is to say that science and technology plays a still greater role in production.

We say that relatively much labor is spent on the production of knowledge-related products, because this is dictated by the features of scientific research work. It is common knowledge that all scientific research products and knowledge-related products, involving the discovery of a law or principle, the creation of a new technological process or new work method, or the invention of a new technique or new product, are mostly the results of years of assiduous study or research. This is what sets them apart from general material products. Labor required for the production of general material products is mostly repetitive. It will do to simply repeatedly complete certain processes. Moreover, every type of fixed labor allows only the production of a fixed product (or a product of coordinated labor, given the division of labor). Therefore, the value in every product is limited to necessary social labor and time spent to produce it. Labor required for the production of knowledge-related products is of a highly exploratory, creative, and pioneering nature and is not within the competence of general people. Many scien tific research products often call for expenditure of large amounts of mental work. Some major inventions even take the lifelong efforts of many scientific workers and go through many tests and setbacks before they are marked with success. Because scientific research is a kind of complicated labor and can be fruitful only after the expenditure of large amounts of mental work, Marx said: "The estimated value of a product of mental work--science--is always lower than its value, because the time of labor required for reproducing science cannot be compared with the time of labor required at the very outset for its production. For example, a student can master the binomial theorem in an hour." ("Collected Works of Marx and Engels," Vol 26, p 377) Even so, some major projects in the stage of research call for large amounts of investment and involve risk taking.

Of course, the time of labor involved in the transfer of certain advanced technologies already mastered by a number of people is less than the time of labor spent at the very outset upon their creation, production, and exploration. But any technological product is the crystallization of creative labor on the part of scientific and technical workers. Therefore, the value contained in it is undoubtedly always greater than that in a material product and the price received at the time of transfer should also be much greater than those of general commodities.

What Should Be the Basis for Calculating the Prices of Technology Commodities?

What should be used as the basis for calculation in the transfer (sale) of a technological product? Or should the general time of human labor consumed in its production be used as a basis or the economic results that it brings be used as a basis? This is an important problem worth studying.

If the time of labor consumed or required for its production at the very outset is used as a basis for determining its value, this is in line with the Marxist idea of value of labor. But there are several factors to be taken into consideration. First, given a product as the only one of its kind, there is no way of making comparisons. Second, there is no way of computing the time of labor that is after all required for such a product. Third, the actual time of labor spent on such a product is not necessarily in proportion to its results. For example, certain new technological products which have exacted an equal amount of labor time in their research and manufacture can be successes or failures. Therefore, in practice, we cannot adopt the way of determining the value of a technological product on the basis of the labor time spent on it at the very outset.

If the economic results that a certain technological product can bring are used as a basis of calculation, this seems on the surface to be far removed from the Marxist idea of value of labor. But a close look at it shows that it does not run counter to the theory of value of labor. This is because the economic results that a certain technological product can bring after its application actually show how much labor it can save for society. The great economic results that it brings mean that it makes a great contribution to society. This is exactly a problem that people must take into consideration in effecting technical transactions and technical transfers, given the commodity economy. Moreover, with the obtainable economic results taken as a basis of calculation, not only are things made easy for both sides in the transfer but also a relatively good basis is provided for calculation and determination.

Therefore, I think that the value of technology depends not on the labor time spent on its production but on the economic results that it brings. As an invention or technological product is often the only one of its kind, there is no way of making comparisons. Though it also involves a cost of production, the translation of such a cost into a price is not direct but circuitous. It will not do to directly use the labor time spent on its production as a basis of calculation. The only way is to let society determine its price in trading on the basis of different economic results brought by different technological products, in line with the principle of benefiting both sides concerned.

CSO: 4008/315

NATIONAL DEVELOPMENTS

GUANGDONG SCIENCE, TECHNOLOGY CONFERENCE OPENS

HK260123 Guangzhou Guangdong Provincial Service in Mandarin 1000 GMT 25 Apr 85

[Text] The provincial conference on scientific and technological work opened in Guangzhou this morning. The main contents of this conference will be to study the decision of the CPC Central Committee on reform of the system of science and technology and the instructions of leading comrades of the central authorities on reform of the system of science and technology, and to study and discuss the steps and specific measures of our province for implementing the decision of the central authorities and carrying out reform of the system of science and technology.

The opening ceremony was presided over by Huang Qingqu, vice governor of Guangdong Province. Li Jianan, member of the provincial CPC committee standing committee and vice governor, delivered the opening speech.

At the opening ceremony, Comrade Li Jianan said: The current system of science and technology has been found more and more unsuitable to the needs of the four modernizations. To carry out reform of the current system of science and technology, it is necessary to solve very well the problem of science and technology being divorced from production and to turn technological achievements into commodities, so as to give scientific research the motive force to gear itself to the needs of production. It is essential to smash the shackles of conventions and to open up the technological market so as to make scientific research units have the vitality to serve the whole of society. It is imperative to change the system of appropriation of funds, so that scientific research units can regularly go on their own initiative to enterprises to conduct research. Through the economic method of concluding contracts for technological assistance, scientific research units and production units can establish a modern close relationship.

Comrade Li Jianan demanded: science and technology circles, education circles, enterprises circles, and all departments concerned of the government must be responsible for doing a good job in reform of the system of science and technology in our province.

CSO: 4008/315

GANSU OPENS CONFERENCE ON SCIENCE, TECHNOLOGY

HK280318 Lanzhou Gansu Provincial Service in Mandarin 2300 GMT 27 Apr 85

[Excerpts] A provincial conference on science and technology work, convened by the provincial CPC Committee and government, opened in Lanzhou on 27 April. This is a very important meeting in the history of science and technology in Gansu. Vice Governor Liu Shu presided at the opening of the conference.

Governor Chen Guangyi made a speech. He pointed out: Seriously implementing the CPC Central Committee's decision on reform of the science and technology structure is a major affair related not only to the development of science and technology but also to the smooth progress of reform of the economic structure and the smooth development of the four modernizations.

Governor Chen Guangyi said: For Gansu's economy to be invigorated, science and technology work is facing extremely arduous tasks. The current issue is that due to the fact that the fundamental problem--the science and technology structure--has not been solved, scientific research has long been out of line with production, and the effort to bring into full play the enthusiasm of the science and technology personnel has been hampered. Whether judged by the defects in the existing science and technology structure or from the achievements already gained in reform, the positive and negative experiences all show that it is imperative to carry out reform of the science and technology structure, and it is imperative to do so now.

He said: We should focus on the following cardinal links in carrying out reform of the science and technology structure in Gansu:

1. Reform the system of allocating funds. This is the key and the vital point in reforming the science and technology structure.

2. Open up the technology market. Turning the fruits of technology into commodities marks the point of breakthrough in reform of the science and technology structure.

3. Strengthen the technological development capability of the enterprises and the rural areas.

4. Train and cultivate talented people. The methods for solving the current serious shortage of talent are to do everything possible to keep the existing science and technology force stable, advocate rational mobility of talented people, and actively attract talent from elsewhere.

5. Get a good grasp of internal reforms in the scientific research organs. The departments in charge must streamline administration and delegate powers, to give the research units self-determination powers in planning, expenditure, personnel, and so on. All organs must institute the director responsibility system this year.

In short, we are demadning a new situation in the science and technology structure throughout the province within 5 years.

CSO: 4008/315

NATIONAL DEVELOPMENTS

GUIZHOU GOVERNOR ON REFORM IN EDUCATION, SCIENCE, TECHNOLOGY

HK040142 Guiyang Guizhou Provincial Service in Mandarin 2300 GMT 2 May 85

[Text] In his government work report at the third session of the Sixth Provincial People's Congress, provincial Governor Wang Chaowen pointed out that this year the province will reform the education structure and the science and technology structure in a planned way in order to score more achievements and develop more talented people.

He pointed out that in accordance with the decision of the CPC Central Committee on reform of the science and technology structure, this year the province will take a step toward reforming the system of allocating funds, opening up technological markets, reforming the agricultural science and technology system, carrying out comprehensive exploitation of mountainous areas, strengthening enterprises' ability to exploit technology, practicing the compensation contract system in scientific research units conducting exploitation, and extending the decisionmaking power of research units. The province must also pay attention to new technological revolution trends and start studying necessary countermeasures. This year the province must grasp the building of the experimental base of [words indistinct] and the development of a software and channel center for electronic computers for scientific and technological use.

Governor Wang Chaowen pointed out that while carrying out reform of the science and technology structure, we must actively and steadily reform the education structure, speed up intellectual exploitation, and cultivate more and better talented people. We must continue to change the previous unitary method of running schools. We must adopt various methods to run schools, with the state running schools as the main form, collectives running schools as an important component, and other social groups running schools as a supplement. We must vigorously develop various higher education for adults, encourage people to become talented people through self-study, further train in-service cadres and scientific and technological personnel, and develop talented people through multi-tier and multi-channel training. We must vigorously develop urban and rural vocational education and secondary technical education. Universities, colleges, and secondary technical schools must properly enroll and assign students and actively train various types of talented people for poor and backward areas and national autonomous areas. In addition, we must properly run schools for teachers' advanced studies and upgrade the professional quality of teachers.

CSO: 4008/328

NATIONAL DEVELOPMENTS

ROLE OF YOUTH IN SCIENCES, REFORM DISCUSSED

Beijing ZIRAN BIANZHENGFA TONGXUN [JOURNAL OF DIALECTICS OF NATURE] in Chinese No 1, 10 Feb 85 pp 1-2

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

[Text] The decision made at the 3d Plenary Session of the 12th CPC Central Committee regarding the reform of urban economic system and the soon-to-be-made decisions regarding the reform of science and technology system and education system will have profound and far-reaching impacts on our country's economy, culture, science and education. The reform of the irrational system currently in operation will certainly arouse the enthusiasm of the masses. A lively and prosperous situation is fast developing on all fronts.

Just as true to other fronts, there is no way out for science and technology front without reform. The purpose of reform is to arouse the enthusiasm of all scientists and technicians and to move the enthusiasm toward the needs of the nation. What is urgently needed at present is to closely link and combine science with production and to overcome the phenomenon of despising knowledge and qualified talents.

For historical reasons, the average age of our experienced scientists and technicians is over 45 years. We urgently need to train a large number of youth. This is an extremely important task. If we do not handle it right or promptly, our science and technology force of the 1990's will be seriously hampered, which in turn will impair the rise of entire production level. One important part of this reform must be creating an environment in which young scientists and technicians can grow to maturity quickly.

Reform is a great school, in which all scientists and technicians will be able to bring into full play their initiatives and creativity, and be tempered and tried with scientific research and on the active technical market so that they will be conditioned to more quickly become core members of scientific research and science-and-technology-based entrepreneurs.

Young scientists and technicians are full of reform spirit. They are less burdened, enthusiastic and vigorous. They are determined to initiate new undertakings. But they also have weaknesses, which are the lack of knowledge

and experience and the resulting onesidedness. In the process of reform, we must set them free to venture and to give full play of their intelligence and strength. We ought to help them overcome their weaknesses too.

There are different levels of scientific research. There are basic research, applied research, and developmental research. They have different degree of closeness in their ties to production and have different characteristics. But they are all indispensable parts of an organic whole. At present, we encourage part of our scientists and technicians to carry out technological development. At the same time, we open up technology market and encourage invention and innovation. In so doing, we are able to maintain close ties between science and technology and production, to quickly transform results of scientific research into productivity, and to quickly transform the needs of production into scientific research projects. The value of science and technology will thus be fairly judged and the compensations for scientists and technicians will thus be improved. But this is not to say that basic science and basic research are not important. From long-term point of view, it is likely that today's basic research results will find large-scale applications after a few years or a few decades, or even will shape brand new enterprises. We hope many youths will commit themselves to the research that are directly geared toward the service of production. We also hope some youths will make up their mind to dedicate themselves to basic scientific research. Individuals have different talents and are inclined to different jobs. Choice should be made based on one's talent, but do not indiscriminately devote all their talents to enterprises.

Youths ought to keep a good relationship with middle-aged and old scientists. The advancement of science is boundless. New generation certainly will surpass the old one. But this can not be accomplished by being supercilious and regarding oneself as infallable. It can be done only through humbly learning from senior persons, inheriting the excellent scientific achievements of the world, and hardworking on ones part.

Youths also have to reinforce their own solidarity and establish a common goal of devoting to the science of one's own country. Modern science is advancing faster and faster with wider and wider scopes. Every scientist must increase exchange and cooperation with others, must be part of a scientific research entity. Without the great, open mind to accommodate people of different opinions and without the common goal of planting Chinese flag at the peaks of science, it is unlikely to accomplish great deeds and achievements.

If our youths can correctly understand and deal with their relationship with science, with older generation scientists, and with one another, then under the correct guidance of central reform policy, a glorious chapter will be written for the revitalization of China and for the revitalization of Chinese science.

12922
CSO: 4008/272

GANSU DEFENSE INDUSTRY SUPPORTS CIVILIAN PRODUCTION

HK031413 Lanzhou Gansu Provincial Service in Mandarin 2300 GMT 2 May 85

[Text] Gansu's defense industry enterprises and institutes under the astronautics industry, aeronautic industry, communications, general logistics and general staff departments, and so forth are implementing the central policies of converting military production into civilian production, and making the production of civilian goods support the army. The enterprises and institutes have actively cooperated with the provincial departments in charge of civilian goods, and have made remarkable achievements.

Over the past year, some 33 defense industry enterprises and institutes made use of their technological, personnel, and equipment advantages, and established cooperative relations with the province's 100-odd enterprises. They concluded more than 200 contracts in various trades. In addition, they carried out technical exchanges among military and local civilian scientists by means of forums on new technology, exhibitions on the application of microcomputers, and meetings for publicizing new technology.

In the course of establishing cooperation links between defense industry enterprises and local enterprises, the province has paid attention to publicizing the application of new technology. Factories No 135 and 22 of the Ministry of Aeronautics Industry gave full play to their advantages and expedited the work of developing and popularizing microcomputers for civilian use. They developed a card puncher for a Lanzhou textile enterprise that can improve the work efficiency many hundredfold. When cooperating with local enterprises, the defense industry enterprises have also paid attention to the development of new products. Institute No 510 of the Ministry of Astronautics Industry developed a small cryopump for the Lanzhou branch office of the Chinese Academy of Sciences thereby filling China's gap in this respect.

CSO: 4008/328

PRC LANDSAT GROUND STATION READY FOR OCTOBER

OW161643 Beijing XINHUA in English 1610 GMT 16 Apr 85

[Text] Beijing, 16 April (XINHUA)--China's first landsat ground receiving station, in Beijing's suburban county of Miyun, will be completed in October this year, said Wu Jiaxiang, deputy director of the New Technology Bureau of the State Science and Technology Commission, here today.

Delivering a report entitled, "Remote Sensing Technology and Policies for its Development in China," at a seminar on development and applications of the technology for planning, management and decision-making, Wu said the station would receive multi-spectral scanning and mapping data from a U.S. Landsat and provide information for the country's agricultural, forestry and water conservancy departments.

More than 80 specialists and planners from over 20 countries, regions and international agencies are attending the 10-day seminar, which opened here today.

Wu said, China started satellite and airborne remote sensing studies in the mid-70s.

Findings have been applied to agriculture, forestry, water conservancy, geology, energy, transport, environmental protection and city planning.

From 1980 to 1983, China used 560 landsat images on a scale of 1:250,000 and topographic maps to derive area information for the whole country, and produced an up-to-date land use map of China.

Since 1975, China has completed a regional geological survey on a scale of 1:200,000 by using "aviation photos" and satellite images, and drawn up a linear structure map of China.

In recent years, projects surveying agricultural resources in Shanxi Province and detailed land use in Tianjin have been completed with the help of landsat images and airborne color pictures. Remote sensing has provided Beijing with scientific data for its city planning.

In addition, China also uses data from meteorological satellites for typhoon forecasting.

China has successfully launched a number of experimental satellites and obtained remote sensing data from space for domestic users. At present, China has 14 national specialized remote sensing organizations with 180 research and production units, involving over 3,000 scientific workers.

In 1981, China established a national remote sensing center responsible for formulating overall policies and plans, coordinating scientists of various departments to tackle key technical projects in the national economic construction and promoting international cooperation in the field.

Wu said, although China had made progress in remote sensing application, the country still lags behind the developed countries. Therefore, China should actively conduct international cooperation and learn from other countries' advanced experience for developing the technology, he added.

During the seminar the participants will compare notes on applications of remote sensing for planning, management and decision-making in their respective countries and discuss the possibilities of cooperation.

CSO: 4010/1001

MICROCOMPUTERS EXHIBITED IN NEI MONGGOL

OW021720 Beijing XINHUA in English 1510 GMT 2 May 85

[Article: "Inner Mongolia Produces Own Microcomputers"]

[Text] Hohhot, 2 May (XINHUA)--The new technological revolution has crashed open the door of the industrially less developed North China Inner Mongolia Autonomous Region, where once people roamed around with their herds.

An ongoing exhibition showing the application of electronic computers showed that the region now has more than 500 microcomputers in operation since the first electronic computer was introduced at the end of the 1970s.

Twenty types of microcomputers are used in industry, agriculture, communications, construction, military operations and enterprise management.

The Iron and Steel Design Institute in Baotou worked out a Mongolian-language information processing system last year, facilitating cultural research into the Mongolian nationality.

There are over 700 computer technicians in the region, and computer courses are offered in middle schools and universities. Several thousand children have received training in basic language.

The exhibition, which opened 25 April and will close 5 May, is aimed at further spreading the application of electronic and computer technology research results in this secluded, economically backward region, which was even unable to produce nails when the first electronic computer was born in the world.

An engineer of Mongolian nationality at the exhibition revealed that the region produces nearly 300 varieties of electronic products, including color television sets, animal mating period detectors, and wool-testing instruments.

Solar electricity-generating devices, which are used for lighting and as the power source for televisions and other appliances in the nomads' tents, are popular items.

CSO: 4010/1001

CHINA'S RESEARCH ON ARTIFICIAL INTELLIGENCE SUMMARIZED

Beijing GUANGMING RIBAO in Chinese 17 Jan 84 p 2

/Article by staff reporter Zhou Wenbin /0719 2429 2430/: "Initial Results of China's Research on Artificial Intelligence; Algorithmic Lanugage Teaching System developed by East China Normal University May Compare Favorably with Popular US Computer Assisted Instructional System"/

/Text/ China's research on artificial intelligence is gradually expanding and some preliminary results have been achieved in industry, agriculture, medicine and education.

Artificial intelligence is a new science. The aim of research on artificial intelligence is to simulate and replace some human brain activity with machines. This science is now highly regarded worldwide and "expert systems" for resolving complex problems in the real world are rapidly springing up in large numbers. In recent years, Chinese scientists and technicians have undertaken extensive explorations in artificial intelligence so that this science has begun to enter the realms of industry and agriculture, medicine and education. In the petroleum exploration and extraction process, it is necessary to determine the type of oil, gas and water in a reservoir stratum. The traditional method was to measure the physical parameters of each stratum and then have experienced specialist technicians carry out manual calculations and an overall interpretation. Due to limitations of the interpretive method and the variety of geological conditions, the method of manual analysis was frequently slow, inaccurate and did not adequately take into account the overall situation. For this reason, the Institute of Automation of the Chinese Academy of Sciences in cooperation and the Huabei (North China) Institute of Oil Field Petroleum Design jointly developed an oil well measurements interpretive inquiry system to replace the manual interpretations of the past. This year this system was tested on 21 unknown strata of a certain oil well and proved that its rate of interpretive coincidence was 80.9 percent and nearly double that of the rate of manual interpretive coincidence of 42.8 percent. To solve some energy saving problems

on the Tieling to Dalian oil pipeline in the Northeast, the Institute of Automation is cooperating with the Institute of Petroleum Planning and is preparing to apply artificial intelligence to improvements in the oil pipeline. They have already proposed a self-study nonlinear plan and a heuristic dynamic plan, and have obtained results of a certain degree. The Institute of Applied Mathematics of the Chinese Academy of Sciences in cooperatin with the Guizhou Mountainous Region Farm Machinery Office completed a computer assisted design program for plwo curvature which has been approved by the Ministry of Machine-Building Industry and has opened a new path for applying artificial intelligence to agricutural machinery design. In medicine, Specialist Guan Youpo's /7070 1635 0980/ dignostic and treatment system is being developed in cooperation between the Beijing Industrial College and the Beijing Hospital of Traditional Medicine and systems have already been developed for treating 5 diseases including cough, gastric disease, diarrhea, and dystentery. Since the end of September they have been tested at the School of Medicine of Beijing Industrial University and recently, effectiveness of treatment has been nearly 94 percent. The comprehensive shock treatment and dignostic system developed by the Beijing Municipal Hospital No 2 and the Institute of Automation of the Chinese Academy of Sciences have been tested with 30 patients and the machine diagnosis has been in complete conformity with clinical dignosis in 25 cases. The Zhu Renkang /2612 0088 1660/ traditional medicine dignostic and treatment system developed cooperatively by the Research Institute of Chinese Medicine and Jilin University also has the capabilities of writing prescriptions and interpretations in Chinese characters. In education, the Institute of Modernized Educational Technology of East China Normal University has developed China's first algorithmic language teaching system. In addition to graphic displays it has synchronized Chinese language explanations and the teaching results are very good. After viewing this system, Bork, a member of a US educational delegation, said that this system "may compare favorably with a popular US computer assisted teaching system."

8226
CSO: 4008/253

ELECTRONICS INDUSTRY CONCENTRATES ON KEY AREAS

Nanjing XINHUA RIBAO in Chinese 2 Mar 84 p 2

[Article by reporter Shi Baohua [2457 1405 5478]]

[Text] The meeting of provincial administrators concerned with China's electronics industry concluded today with the decision that the electronics industry should focus on the production of military electronics equipment, large-scale integrated (LSI) circuits, and computers.

In their analysis of the new challenges facing China's electronics industry, the directors, who came from all parts of China, pointed out that the industry faces a new era of rapid development spurred on by the revolutionary technological breakthroughs being made worldwide and by China's modernization requirements. The electronics industry has been considered to be of vital strategic importance for some time; now China's electronics industry must gear up to meet important military, national economic, and consumer needs. The more than 1,300,000 workers employed in the industry must go all out to accomplish the important and arduous task of speeding up the pace of China's electronics development.

The meeting concluded that development should be based on practical considerations in accordance with China's capabilities, and fruitful and appropriate policies should be pursued. Strength should be concentrated on the most critical techniques and products, and important breakthroughs in these key areas should guide and stimulate overall development of the industry--that is, the policy should be one of "comprehensive development with specific target areas."

In accordance with this policy, the committee singled out military equipment, LSI circuits, and electronic computers as the critical areas for development which can form a nucleus for an orderly, well-proportioned development of radar, communications and navigation systems, television broadcasting, electronic components, measurement instruments, and other products and technologies, thereby achieving a comprehevsive, harmonious development.

The conference members also studied other policies and measures for accelerating the development of China's electronics industry. It was suggested that a unified policy of comprehensive planning be implemented to intervene actively in all areas of the electronics industry and lay out paths for

proportional, healthy development. Other suggestions were to regulate production in order to increase the relative proportion of capital equipment produced by the electronics indsutry; continue to rely on progress in science and technology and expedite the technical transformation of the electronics industry and the development of new techniques and products; promote education, redouble efforts to encourage talent, adopt various methods to train workers, quickly update the skills of all levels of leading cadres, administrators, and scientific and technical personnel, and intensify the cultivation of the ablest technical people and specialists.

State Councillor Zhang Aiping [1728 1947 5493] presented a talk at the conference of China's electronics leaders, which took place from 21 Feb through 1 March in Beijing.

12617
CSO: 4008/309

ENGINEER DISCUSSES HOW TO DEVELOP CHINA'S COMPUTER INDUSTRY

Beijing GUANGMING RIBAO in Chinese 2 Apr 84 p 2

/Article: "How to Develop China's Computer Industry; Tianjin Computer Plant Engineer Han Lu Thinks It Is Necessary to Resolve the Question of Knowledge and the Question of Policy"/

/Text/ Han Lu /7281 6424/, a female engineer at the Tianjin Computer Plant expressed some views on problems which must be solved in the current development of China's computer industry. She said:

The two mistaken ideas of being willing to be backward and following the fashion should be corrected in developing the computer industry.

There are now two mistaken ideas about China's electronic computer industry. One holds that China's population is so large and its level of scientific and technological development is so backward that developing and applying computers is not in the foreseeable future so we do not dare or want to talk about it. I think that we should admit that we are backward, but we cannot be content to be backward. With the technological revolution engulfing the entire globe, we should try hard to catch up, otherwise we will be ashamed before our sons and grandsons. There is no lack of people among leadership comrades who hold this mistaken idea. We propose that knowledge of computers be spread among these comrades. The other mistaken idea is that of following the fashion without regard to China's national circumstances or the actual situation of one's unit, thinking that they must have the most advanced electronic equipment, even to the point of wanting only high grade things and not low grade things. This is merely pursuit of form and not considering actual results and must of necessity lead to a great deal of waste.

I hope that a policy is formulated that conforms to China's national circumstances and is favorable to the development of the computer industry.

(1) Concerning importing. In the sixties the state emphasized self-reliance and engineers and technicians worked hard to design and build things ourselves so that China's computer industry spent a rather long time at a low level and took many detours; later we

summarized experience and at the same time emphasized making computers national products and our computer industry made greater progress, and a great many qualified people were trained. Since importing was emphasized in the eighties, China's computer industry has suffered a great blow. Importing is a correct policy, but how to organize imports properly has not been resolved very well. Any unit can now arrange for its own imports, but what is being imported is mostly equipment, not technology. This is not only wasteful, it also hits domestic industrial production and scientific research work hard. Computer plants are now worried about their own production, since now the more they produce the more they lose money, and if they insist on carrying on with production they may even be bankrupt. In contrast, they make a lot of money by selling imported machines either with changed outside appearances or by selling them as soon as they are imported for everyone thinks these are imported goods. There is a policy problem here.

(2) There is also a lack of specific policies and measures concerning training personnel. For example, in addition to requiring that technically qualified personnel have higher level specialized knowledge at present, we also need a great many computer operators who are middle level specialized school graduates, but there is a great lack of such middle level technicians. This is because computers are now at the stage of promotion and extension in China. The use in a plant or unit of a single-board computer or silicon processor to control a partial link or solve a certain problem can save manpower and materiel, can rapidly improve results, and furthermore can also lay a foundation for further development of the computer industry. The present problem is that since there are no people and there is no policy stipulations which correspond to the training of such qualified personnel, there is work to be done but there are no people who can do the work.

(3) The question of key points and areas should also rouse serious consideration. Developing and popularizing computers are now going on everywhere and can lead to a great deal of waste. There should be some proposals and stipulations: computer applications should be undertaken depending on the conditions of a unit, it should not be unconditional. Technical transformation can be done first, then the technical equipping. Applying computers can be funded by the business and an applications center operated to improve rate of use and to train personnel.

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NATIONAL DEVELOPMENTS

ROLE OF MICROCOMPUTER IN NEW TECHNICAL REVOLUTION

Beijing GUANGMING RIBAO in Chinese 30 Mar 84 p 2

/Article by Yang Zhonghua /2799 1813 5478/: "In the New Technical Revolution; Chinese Academy of Sciences Accelerated Promotion of Microcomputer Application"/

/Text/ In the new technical revolution, the application of microcomputers is getting more consideration daily. What is the Chinese Academy of Sciences doing about promoting the use of microcomputers? We recently visited Comrade Cao Jinhuan /2580 6930 3562/, Adviser to the Microcomputer Applications Technical Coordinating Group of the Academy, with these questions.

Comrade Cao Jinhuan recently participated in an Academy Microcomputer Application Technical Coordinating Group experiment in system automation and a technical exchange meeting with the Huadong (East China) Region group. She said with great animation that the work of the Chinese Academy of Sciences in applying microcomputers developed slowly and that in August 1982 when the Academy convened a microcomputer application technical exchange meeting, there were only a little over 100 microcomputers in the entire Academy (not counting single-board computers). However, in a little over a year, signs of vigorous development began to appear. Now every unit in the Academy has microcomputers, including 204 in the units under the East China Region alone. Over 1,000 persons are engaged in microcomputer work in the Academy, and there are over 250 microcomputer application research topics. In a few units which have advanced quickly, microcomputer use has already spread to the laboratory.

Cao Jinhuan said that in recent years, many units in the Chinese Academy of Sciences have applied computers to scientific research work for scientific calculations, automatic collection and processing of data, partially or completely automating instruments and equipment and experimental processes with obvious results. For example, in the process of a national key project to develop a scanning radiometer, the Shanghai Institute of Technical Physics used a microcomputer system to control over 40 instruments, clearly improving performance and precision so that the **entire system achieved internationally**

advanced levels. The Shanghai Institute of Silicate /Chemistry and Technology/ successfully used a microcomputer in controlling the industrial process of developing optical fibres, greatly improving the precision and accelerating the progress of research so that a key proejct which was to have been completed in 1985 was completed in September 1983. In the appraisal, the performance of the optical fibres is in first place domestically and in some norms achieved international advanced levels. In addition, in managerial work, some units have used microcomputers in payroll, personnel, scientific and technical files and equipment and materials management, calculating project expenses and bibliographic searches all of which has greatly improved the level of management and work efficiency.

Cao Jinhuan said that due to the serious regard and support of the leadership of the Chinese Academy of Sciences and the leadership of the branch academies and units, in August 1982, the Microcomputer Applicatinns Technical Coordinating Group and Software Exchange Station was established by the Academy with three specialized groups; Intelligent Scientific Instrument, Experiment System Automation, and Computerization of Management Work. Six regional groups were also established by the six major regions. In a little over a year, the specialist groups and regional groups have cooperated closely, focusing on different objects, adopting different methods, holding different kinds of classes, and carrying out technical training in a planned and measured way. According to incomplete figures, over 30 study classes, exchange meetings, and seminars in which nearly 2,000 persons have participated (not counting the study classes held by institutes of the Academy) have been held on basic knowledge of microcomputers, interface technology, DOS system software analysis, Chinese character systems, BASIC language, data acquisition and repair technology.

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URGENT NEED TO TRAIN QUALIFIED COMPUTER PERSONNEL DISCUSSED

Beijing GUANGMING RIBAO in Chinese 3 Mar 84 p 2

/Article by Chen Yifan /7115 0001 0416/, Deputy Director of Branch School 2 Research Office, Beijing University: "Urgent Need to Train Qualified Personnel for Computer Industry"/

/Text/ The electronics industry, and the computer industry in particular, is a production sector in which technology, intellect, and resources are concentrated. In comparing China with the developed countries of the US and Japan, the gap in technical personnel is large, the proportion of technical personnel in the total force is small, and the ratio of software and hardware personnel is 1:4, while abroad it is generally 3:1; few of the factory technical personnel have received systematic computer education; recent university graduates lack the ability for independent work and technical cadres about 30 years of age with 5-10 years work experience are few; among older technical personnel the rate of reeducation is slow, they are not suited to the characteristic phenomena of the computer industry: high speed development, high changeability, high elimination, high personnel mobility.

The small numbers and imbalance in technicians has created difficulties for the development of the computer industry, and if positive and effective measures are not taken, they will continue to bind us hand and foot.

First of all, when considering ways to deal with development of the computer industry, leadership sections should treat training personnel and investment in knowledge from the perspective of strategy. The turnaround time for training personnel is long; those students entering university this year will not be available until the latter part of the Seventh Five-Year Plan period, and graduate students who continue their studies after graduation from university will not be available until the middle of the Eighth Five-Year Plan period.

Secondly, we should adopt a variety of ways to train personnel at different levels and in different scales. Not only should we train personnel in computers, but also personnel in other specializations related to the information industry. In addition, we should introduce other specialists to knowledge of computer applications and carry out continuing education of computer specialists. Various kinds of training networks should be multi-leveled and multi-scaled.

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SAFEGUARDING USER RIGHTS, INTERESTS, NATION'S PROFITS IN COMPUTERS

Beijing GUANGMING RIBAO in Chinese 3 Mar 84 p 2

/Article by Cao Changjiu /2580 7022 0036/ Secretary of the China Computer Users Society: "Safeguard the Computer Users Rights and Interests and the Nation's Profits"/

/Text/ On the foundation of summarizing the history and present circumstances of China's computer development, production, and applications development, we should draw lessons from the technology and experience abroad and safeguard, continue and develop series of the best choices so that domestic production, application, and resources will have absolute precedence. Currently, domestic priority 1000, 2000, and 3000 minicomputers series and the 8000 large and medium sized computer series have been very successful. This is an enormous resource and leadership agencies should give this serious consideration.

Formulate policies to safeguard and develop the national computer industry, accelerate the construction of a computer production base, form an industrialized large production capability, and rationally control computer and imports of completed sets and parts for assembly. At present our blind and duplicate importation is still very serious. For some imported computers the functions are not complete, software is insufficient, applications software is not suitable, technological materials are incomplete, spare parts are inadequate, technological forces are weak, the mission is inadequate, use rate is low, repairs are not prompt. I propose that we quickly establish a spare parts supply and repair center to guarantee the normal operation of user equipment.

Formulate a staged equipment policy which suits applications needs and state finances and computer research and development production, development and application. It is necessary to set a "tolerance" period for computer development and production in the light of national circumstances.

Encourage the selection of equipment produced in China through pricing, transform old computer models technologically, and lengthen service life. Computer plants should take ultimate responsibility for the computers they produce.

Gradually supply users with computer applications systems so that users will get economic results quickly. I propose, on the foundation of the computer applications systems which have already been developed in China, that we work on strengthening, generalization, and standardization; and that industrial departments be responsible for installation, training, testing, and maintenance to lighten the burden on the user as much as possible and increase the benefits of use.

Quickly establish a management system and network for computer scientific research, production, applications development, technical service, software management, user cooperation and extension of results and take the road of specialization.

Increase Chinese character information processing function to facilitate use by society, in particular gearing the microcomputer for use in such areas as information processing, enterprise management, office processing, and office automation. There must be a Chinese character processing function. I propose that within the next year or two, that all computers produced in China, including those assembled from imported parts, have a Chinese character information processing function. This may promote a gradual improvement in the level of domesticizing production.

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JIAOTONG UNIVERSITY MICROCOMPUTERS PASS EVALUATION

Beijing GUANGMING RIBAO in Chinese 4 Apr 84 p 2

/Article: "Shanghai Jiaotong University Develops 10 Microcomputers; 'MIC-58C Chinese Language Smart Terminal' Can 'Change' Foreign Language Computers to Chinese Language Computers"/

/Text/ On 2-3 April 10 Shanghai Jiaotong University microcomputers passed evaluation testing. The successful development of these microcomputers demonstrates that China's computer industry has taken another step forward.

One of the items, the "MIC-58C Chinese Language Smart Terminal;" received good evaluations by thespecialists. This is a device which can "change" a foreign language computer into a Chinese language computer by using a Chinese language smart terminal in place of a foreign language terminal and while not changing all the functions of the foreign host computer, the imported computer can "make foreign things serve China." The Chinese language smart terminal uses an input keyboard and hardware character library which involves encoding Chinese characters as two elements. For example, if you want to input the Chinese character "chen" /7115/, you need only press the keys "fu" /7079/ and "dong" /2639/ and the character "chen" is spelled on the CRT and can also be printed on paper. The keyboard has 1,756 Chinese character side radicals and basic character forms and from this over 7,000 character can be spelled.

This technology can be used by various kinds of computers and by connecting the Chinese character smart terminal Chinese and foreign computers can be made compatible.

During the time of developing microcomputers, Shanghai Jiaotong University was very concerned about application of microcomputers in national economic construction. The "Microbearing Automated Measuring System" developed in cooperation with the Shanghai Miniature Bearing Plant uses the microcomputer as a controller so that inspection of the microbearings is automatic, which improved both the precision and the efficiency of the inspection so that one inspection systen could replace the work of 30 trained workers. It not only can inspect, but also can process relevant data. This system is a first, domestically, and was welcomed by users.

There were new products and some upgraded replacement products among the 11 items. The "DJS-053 Microcomputer" which Shanghai Jiaotong University developed several years ago has been used in many fields, such as petroleum, railways, and medicine, but its high cost has limited its further promotion. After many improvements, they developed a second generation "DJS-053A Microcomputer" which is one-fourth the size of the first generation machine and the cost was lowered by two-thirds.

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BRIEFS

PRC APPLIES COMPUTERS TO TELEGRAM RELAYS--Beijing, 17 April (XINHUA)--China has installed computer systems in telegram relays in a dozen cities, according to the posts and telecommunications ministry today. As a result, efficiency has been raised tenfold, an official said. The project started in 1982 in Shanghai, and now it has spread to Chengdu, Shijiazhuang, Shenyang, Wuhan, Harbin, Hangzhou, Zhengzhou, Jinan, Nanjing, Urumqi and Changchun. [Text] [OW170826 Beijing XINHUA in English 0711 GMT 17 Apr 85]

CHEMICAL MINISTRY TO EXPAND, IMPROVE--Beijing, 1 May (XINHUA)--The Ministry of Chemical Industry has decided to speed up expansion of the industry and improve economic efficiency. Quantity, quality, and variety lag behind growing demands by the national economy and the consumer market, according to the ministry. Compound fertilizers and basic materials for the industry especially soda ash and caustic soda will receive special attention. Output will be increase of agricultural pesticides, dyestuff, chemical reagents, sensitive materials, additives for food and fodder, which are low in energy consumption and high in output value. Factories run with collective funds will be given preferential treatment and technical guidance. China now produces 30,000 varieties and specifications of chemicals. Chemical materials are replacing steel, timber, natural rubber, cotton, hemp, woolen, silk and leather in many products. The ministry plans to study international trend and latest scientific and technological information more closely and import advanced technology. [Text] [OW011308 Beijing XINHUA in English 1301 GMT 1 May 85]

ELECTRONICS INDUSTRY BASE DEVELOPED--Guangzhou, 2 May (XINHUA)--A production line to produce 300,000 color TV sets annually will go into operation soon in an area designated as a base for the development of the electronics industry in Haikou, capital city of Hainan Island, Guangdong Province. Also, a refrigerator production line is to go into operation later this year there, local officials said. Thirty-three hectares of land will be developed during the area's first phase of construction, at a cost of 100 million yuan. Construction of the base, in the southern suburbs of Haikou, began last March. It is being built by the China Nanda Electronics Enterprise Corporation, a joint enterprise established last November by local firms, the Hang Fat International Trading Co of Hong Kong and major Chinese electronics enterprises. Nanda plans to build in the area a complete electronics industry system for the production of basic materials, elements, components, meters and instruments. It will also undertake other lines of business including production of films for theaters and

television, tourist hotel services, aquaculture and transport. Hainan Island is one of China's coastal areas granted greater power to attract foreign trade and investment. [Text] [OW021736 Beijing XINHUA in English 1621 GMT 2 May 85]

XINJIANG LEADER ATTENDS GATHERING--The first Xinjiang regional gathering to exchange and do business in the fruits of technology solemnly opened in Urumqi today. This gathering is being held to better implement the CPC Central Committee decision on reform of science and technology, stimulate the work of turning science and technology into commodities, promote the progress of science and technology, and invigorate Xinjiang's economy. At around 1200, responsible comrades of the regional CPC committee and government, Urumqi Military Region, the regional CPPCC, and the production and construction corps Wang Enmao, Tan Shanhe, Ismail Amat, Tomur Dawamat, Amudong Niyazi, Ba Dai, and Song Hanliang arrived at the hall to attend the opening ceremony. [Excerpts] [Urumqi Xinjiang Regional Service in Mandarin 1300 GMT 20 Apr 85]

SCIENCE WORK CONFERENCE--The Provincial Science and Technology Work Conference convened by the Provincial CPC Committee and government concluded in Lanzhou on 4 May. The meeting stressed seriously carrying out reform of the science and technology structure, closely linking science and technology with economics, and speeding up the invigoration of Gansu's economy. Provincial CPC Committee Secretary Li Ziqi spoke at the closing session. He demanded that the party committees and government throughout the province continue to eliminate leftist influence, so as to clear the way for developing science and technology and bring into full play the wisdom and talent of science and technology. He expressed the hope that the comrades in science, technology, and knowledge circles in the province will establish the lofty ideal of communism and boldly plunge into the flood-tide of the four modernizations. They should create as soon as possible a new situation in reform of the science and technology structure. [passage omitted] Vice Governor Liu Shu delivered a summation. Other leading comrades present included Chen Guangyi, Liu Bing, Jia Zhijie, and Hou Songbin. [Excerpts] [HK050339 Lanzhou Gansu Provincial Service in Mandarin 2300 GMT 4 May 85]

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RAPID DEVELOPMENT SEEN IN CHINA'S MICROCOMPUTER INDUSTRY

Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese Extra No 1, 29 Apr 84 p 1

[Article: "Rapid Development of China's Microcomputer Industry is Gratifying"]

[Text] Our reporter Du Haiping [2629 3189 5493] has learned from relevant sources that China's microcomputer industry is currently undergoing unprecedented development. With the sharp increases in demands for various areas and the great increase in domestic productive ability, the volume of China's microcomputer output this year will increase several-fold over last year. Last year China's microcomputer output (not including single-board computers, similarly below) was 3,500 units. This year's production plans call for over 8,000 units, but currently, the demands coming successively from various areas have revised plans to increase output. According to estimates, this year's actual output might greatly surpass the planned number.

There have also been rapid improvements in production conditions and technical levels. North China (Beijing, Tianjin, Baoding), East China (Shanghai, Ningbo, Hangzhou), and South China (Guangzhou, Shenzhen) are building a group of plants with batch production capability and this year and next year more than eight plant points which have modernized facilities and testing capability will go into production. Most of the microcomputers produced last year were assembled from imported discrete components. This year, nationalized production capability will greatly increased, and a large part of the products will be assembled from imported key components assembled domestically, and peripheral equipment will be provided by domestic peripheral equipment plants. Last year, because the 0520 microcomputer (the Great Wall 100), developed and designed by the Ministry of Electronics Industry Sixth Bureau and other units, was so comprehensive, had abundant software and also had a practical Chinese character system it was compatible with the IBM PC/XT put out by the U.S. IBM Company in 1981 and thus was welcomed by domestic users. This year the cost of the computer has been lowered considerably (nearly 30 percent lower than last year) so that it has become the most hotly sought "demand item" in the domestic market, and is becoming an important microcomputer model of high output.

Popularizing microcomputers in China requires resolving the problem of inputting and outputting Chinese characters. This year, the key computer model can

provide the user with a Chinese character system. Relevant departments are organizing forces to develop Chinese character application software packages and estimate that they will begin in the last half of the year. These Chinese character applications software packages will be handed over to users successively.

With the development of production and the spread of applications, a maintenance and technical training network centered on the China Computer Technology Service Company is being constructed nationwide on a preliminary scale. Fourteen provinces and cities have set up service branches, computer plants, research institutes and universities and technical schools in some provinces, municipalities and autonomous regions have also joined to establish training centers. In the network there are currently over 200 full-time and part-time instructors and 10 or so special training classrooms.

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STATE-OF-THE-ART, CHARACTERISTICS OF CHINA'S MICROCOMPUTER PRODUCTION

Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese Extra No 1, 29 Apr 84 p 21

[Article by Cao Changjiu [2580 7022 0036] and Zhou Xiwei [0719 6932 5898]: "The Present Situation and Characteristics of China's Microcomputers"]

[Text] China's microcomputer research and production has been going on for a decade and there are now more than 100 scientific research and production units, and over 100 product models. However, there is still a big gap between production level and actual social needs. Currently there may be domestic 8-bit microprocessors (8080, 6800) which are batch produced and some peripheral chips in the market, but their prices are rather high. For this reason, fully nationalized microcomputer products are very few. For the most part they are microcomputer systems assembled or produced from imported LSI chips and some nationalized microcomputer systems. The main products are the Apple II-compatible Cijin II microcomputer (CPU is a 6502 microprocessor) and ZD-2000 Chinese character terminal (CPU is a Z80 microprocessor), the IBM PC (with an 8088 microprocessor as the CPU) compatible 0520 microcomputer and an 8-bit microcomputer equivalent to the TRS-80 and CROMEMCO. In addition there are miniaturized minicomputers (PDP-11/23, PDP-11/24). These microcomputers which are produced (or assembled) in China have the following primary characteristics:

1. Technical support. The system software of domestic computers, regardless of whether they are designed in China or assembled from imported parts, is basically commercialized software comparable to popular foreign software, such as the CP/M operating system and CDOS operating system. This system software has a great volume of analysis and research documentation abroad and has been digested and applied by many microcomputer technicians, thus very detailed technical materials can be obtained and users can develop applications work with fairly good technical support conditions.

2. Application foundation. The above microcomputer products have good applications foundation because: similar computers are popular abroad and domestic applications volume is the greatest, the most people understand them, and in many years of applications work, many users have developed a great quantity of applications software and accumulated an abundance of experience.

3. Function characteristics. The internal memory of 8-bit microcomputers (such as the Apple, ZD-2000, and TRS-80 compatible computers) is generally 64 K bytes, they have powerful operating systems and easy to use data base management software, and 1 or 2 floppy disk drives (each with a capacity of 0.5-1 megabytes). Such microcomputer systems are suited to small scale data processing and control systems, and can be equal to such applications as inventory control and personnel management (with a capacity of approximately 100,000 items of data).

The internal memory of the 16-bit microcomputer (such as the IBM PC, and micro PDP compatible computers) is larger and generally can be 0.5-1 megabyte, the system may also have a hard disk (with a capacity of more than 10 megabytes) and can satisfy the demands of comprehensive business management of such units as medium and small enterprises.

4. Chinese character processing capability. Currently domestic microcomputers basically have Chinese character processing capability, and most microcomputers have added a Chinese character processing function to the operating system so that using high level programming languages can directly call and use them is convenient.

The Chinese character stock is generally of two types: one is fixed in ROM. The operational speed of this type is very fast, but the cost is high. The other type is to store the Chinese characters of magnetic disk and thus the cost is much lower, but operational speed is also clearly reduced and the user must make his choice on the basis of the actual situation.

An Overview of Some Domestic 8-bit Microcomputer Plants

No.	Production Plant	Model	CPU
1	Shenyang-Liaoho Experimental Institute	DJS-060 series	MC6800
2	Sichuan Solid State Circuit Institute	DJS-060 series	MC6800
3	Shanghai Computer Plant	DJS-054	8080A
4	Nanjing Wired Radio Plant	DJS-033	6502
		Cijin-II	6502
5	Beijing Wired Radio Plant	DJS-044	Z80
		DJS-045	Z80A
6	Beijing Industrial University Electronics Plant	TP-803	Z80
7	Beijing Computer Plant No 5	BCM-II	Z80
		BCM-III	Z80
8	Tianjin Wireless Plant No 5	DJS-065A	6800
		LWJ-064	6800
		DJS-062T	6800
9	Guangzhou Computer Plant	DJS-28	Z80
		PZ80	Z80
10	Weifang Computer Plant	DJS-303	6502
11	Guangdong-Shaoguan Wireless Plant		6502, Z80
		PJ-1	8080
12	Beijing Computer Technology Institute	BCM I,II,III	Z80
13	Fuzhou Wireless Plant No 3	FO-3	6502
14	Nantong Computer Plant	MIC	Z80
15	East China Normal University Microelectronics Institute's Experimental Plant	DJS-083A	6502,Z80
		DJS-033	6502

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COMPACT TEA-CO_2 LASER WITH LONG LIFE DEVELOPED

Shanghai YINGYONG JIGUANG [APPLIED LASER] in Chinese Vol 5, No 1, Feb 85 pp 39-42

[Article by Yin Yiyan [0603 5030 6056], Liu Jingshou [0491 6855 4849], Zhang Yixiang [1728 5065 5046], Wang Zongjin [3769 1350 6651], Wei Xianren [7614 0341 0117] of Nanjing Institute of Technology and Sun Hongqing [1327 3163 1987] and Gao Chunguang [7559 2504 0342] of Nanjing Electron Tube Works: "Compact TEA-CO_2 Laser With Long Life"]

[Text] Abstract: A compact TEA-CO_2 laser for ranging application has been made. The laser is 100x100x300 mm^3 in size, the maximum output energy per pulse is 500 mJ and the laser has been operated over 10^6 pulses at 60 mJ output energy. This paper is an experimental and theoretical study of the laser plasma charge.

The TEA-CO_2 laser range finder is a new type of far-infrared laser range finder developed in recent years. Since the far-infrared radiation of a CO_2 laser at 10.6 μm happens to be in the low absorption window of the atmosphere, its distance of propagation in the air is far greater than the YAG laser light. Also, since the far-infrared has a greater penetration power through smoke, dust, and fog than that of visible or near infrared light, the TEA-CO_2 laser range finder has distinct advantages. The CO_2 laser is a molecular laser and has several hundred spectral lines in the 9-11 μm range, branch selection and tuning can be easily achieved. Since the TEA-CO_2 laser may be operated at a specific wavelength, the new laser range finder is very likely to replace the existing solid state laser range finders.

To meet the needs of the CO_2 laser range finder, we have developed a compact long life TEA-CO_2 laser using a dual discharge preionization technique. The maximum energy output of the device is 500 mJ per pulse and one charge of gas allows a continuous operation over 10^6 pulses at 60 mJ per pulse.

An outstanding problem in the development of compact TEA-CO_2 laser range finders is the miniaturization of the device and prolonging the service life so that military and civilian range finding needs may be met. In the meantime, sufficient glow discharge must take place in a small volume for a high laser output. To ensure the stable operation over a long service life and

the uniform discharge under a high energy density, we employed the dual discharge preionization technique and used low inductance discharge loop and compact electrode wire pattern.

Preionization methods used in compact TEA-CO_2 laser include the ultraviolet preionization, the free potential electrode preionization, and the dual discharge preionization technique. Although the first two methods only require relatively simple structure, the ultraviolet light generated during preionization can easily dissociate the working medium and shorten the service life of the laser. We therefore used the dual discharge preionization method and experiments showed that the dual discharge method helped to increase the stability and the service life of the laser.

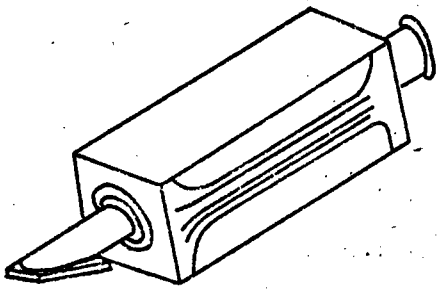

Fig. 1. Schematic diagram of the CO_2 laser

Figure 1 shows the construction of the laser. In order to promote large area uniform discharge, the surface profile of the laser is after the Zhang linear profile. Compared to the Rogovski profile, the Zhang profile is much more compact and is smaller in size for the same discharge area. For this reason, compact TEA-CO_2 lasers often use the Zhang profile. The equipotential of the Zhang profile is given by[1]

$$\left.\begin{aligned} x &= u + k\cos v \sinh u \\ y &= v + k \sin v \cosh u \end{aligned}\right\} \tag{1}$$

The profile line is derived from the conformal mapping $\xi = \omega + k \sinh u$ and the electric field E determined from the profile can be expressed as

$$E^{-2} = (1 + k\cos v \cos h\, u)^2 + (k \sin v \sin h\, u)^2 \tag{2}$$

where $k>0$, $|v|<\pi$, u and u is an operational variable. Generally speaking, the greater the value of k, the closer together are the electrodes and the greater the nonuniformity of the electric field. In our design k is 0.02.

However, in a compact TEA-CO_2 laser, the Zhang profile is sometimes still not enough. To make better use of the electrodes, we modified the Zhang model to increase the usable area. Computer calculation shows that the modification does not affect the uniformity of the space electric field very much.

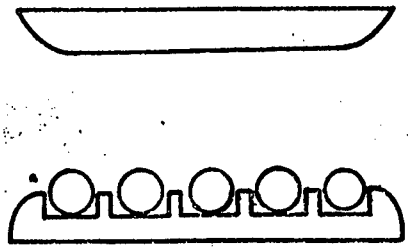

Fig. 2. Schematic diagram of the electrodes

The cathode of the laser has a teeth structure on an aluminum plate, see Fig. 2, where the tooth width is 4 mm, the separation gap is 3 mm and the depth is 2 mm. A row of glass capillaries is uniformly placed in the grooves. Nickel wires 0.7 mm in diameter are threaded through the capillaries to serve as trigger electrodes. To ensure the uniformity of the preionization, the inner and outer diameters of the glass tubes are held to close tolerance.

Both the cathode and the anode are made of forged aluminum to ensure material integrity. After a long period of operation the reflecting mirror may be contaminated by the severe cathode sputtering caused by the violent bombardment of the positive ions accelerated by the high voltage between the electrodes. This will cause a reduction in reflectivity and an increase in loss. Since aluminum has the lowest sputtering coefficient, the contamination of the mirror is kept to a minimum.

The tuning cavity is a planar-concave stability cavity, one end is a gold-plated total reflecting mirror with a radius of curvature of 1 meter and the output mirror at the other end is a germanium plane mirror. One face of the germanium plate is coated with an antireflecting film and the other face is coated with a reflecting film. Experiment shows that the optimum transmissivity is 25 percent.

Another effective method for obtaining a uniform glow discharge is rapid discharge. There is a transition period between the glow discharge and the arc discharge. The arc discharge may be avoided if the voltage between the main electrodes drops to below the arc voltage before arc discharge appears. In order to have a rapid discharge, the inductance of the discharge loop must be kept to a minimum. To achieve this, we made a series of improvements to the device structure. The electrodes became part of the outer shell of the laser and the capacitor is installed directly on the shell. This has not only decreased the volume of the device but also avoided the inductance of the leads. Both the shortage capacitor and the main discharge capacitor are inductance-free capacitors and parallel connections are used to further reduce the inductance of the loop. We have carefully measured the voltage and current waveform of the discharge loop and calculated the resonance characteristics of the loop. Results showed that the improvements are substantial and the inductance of the entire discharge loop is only 21 nf.

In the dual discharge TEA-CO_2 laser, spark between the preionization electrode and the main discharge electrode is a serious problem. We made improvements

to the wiring of the preionization electrodes and obtained good results. The improved structure is simpler and more reliable and easier to mass produce.

To improve the life of the laser, improvements of the structure and the discharge loop are not enough. Since the TEA-CO_2 laser has discharges taking place under a high gaseous pressure, a large number of electrons accelerated by the electric field collide violently with the molecules of the gas medium in the discharge process. As a result, not only the ground state CO_2 and N_2 molecules are promoted to the excited state, a certain amount of CO_2 and N_2 molecules are also dissociated and produce NO and NO_2 which are very hazardous to the uniformity of the glow discharge. The process is as follows:

$$\begin{cases} CO_2 \rightarrow CO + O \\ N_2 \rightarrow 2N \\ N + O \rightarrow NO \\ NO + O \rightarrow NO_2 \end{cases}$$

In order to solve this problem, CO, H_2, or water vapor must be added to the laser. The addition of CO causes a combination between CO and the atomic oxygen and promotes the chemical reaction to proceed in the direction of CO_2 formation. In the meantime, since the collision cross section of CO is rather large, the probability of energy transfer between CO and CO_2 through collision is also great. Therefore, the addition of CO reduces the amount of N_2 in the gas and the likelihood for NO and NO_2 formation. H_2 is a reducing agent and the addition of H_2 may reduce the amount of atomic oxygen in the gas, improve the thermal conductivity of the gas and lower the gas temperature.

In addition, we have also explored the addition of a small amount of triethanolamine as a seed gas to reduce the ionization potential, improve the preionization, and increase the input energy density.

To determine the optimum operating parameters, we studied the mixing ratio of N_2:CO_2:He under a constant gas pressure. The results are shown in Fig. 3. As can be seen, a strong laser output was obtained when the CO_2:N_2 ratio is in the 7:8 to 10:8 range.

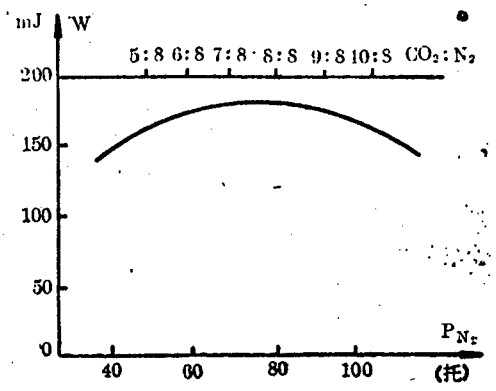

Fig. 3. Gas mixing ratio curve

It is generally desirable to raise the E/N value of the TEA-CO_2 laser for a greater power density and a greater output energy per pulse. However, more high speed electrons are produced at a higher voltage and the high speed electrons collide with the CO_2 and N_2 molecules, causing the molecules to dissociate rapidly and lowering the output energy. It also increases the probability for arcing. The E/N value of the laser should therefore be kept at an optimum value. Experiments showed that the optimum value is about 10^{-16} V·cm^2.

Figure 4 shows the discharge loop of the laser.

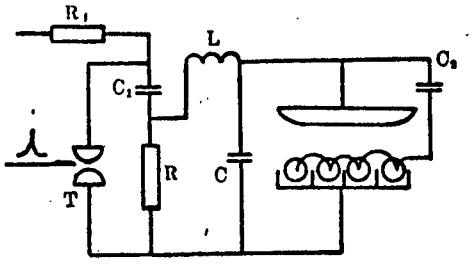

Fig. 4. Pulse discharge circuit

To study the plasma discharge process in the discharge circuit, we used an inductance free voltage divider and a Rogoviske coil to measure the discharge parameters of the entire loop. (The measured current and voltage waveforms are shown in Figs. 6(a) and 6(b).)

When the input trigger pulse breaks down the sphere gap, the storage capacitor discharges against the laser. The discharge characteristics may be described with the equivalent circuit shown in Fig. 5, where L_O is the total inductance, R_O is the parallel resistance of R and the gap resistance, L_S is the internal inductance of the laser, and R_L is the characteristic impedance of the laser plasma. In the discharge process, the characteristic impedance varies with the terminal voltage across the laser and the electron density:

$$R_L(l) = u_L(t)/n(t)\cdot v\cdot e \qquad (3)$$

where $u_L(t)$ is the terminal voltage, n(t) is the electron density, v is the drift velocity of the electron, and e is the electronic charge.

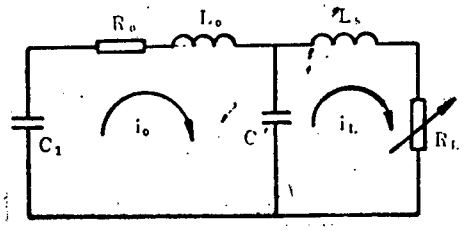

Fig. 5. Equivalent discharge circuit

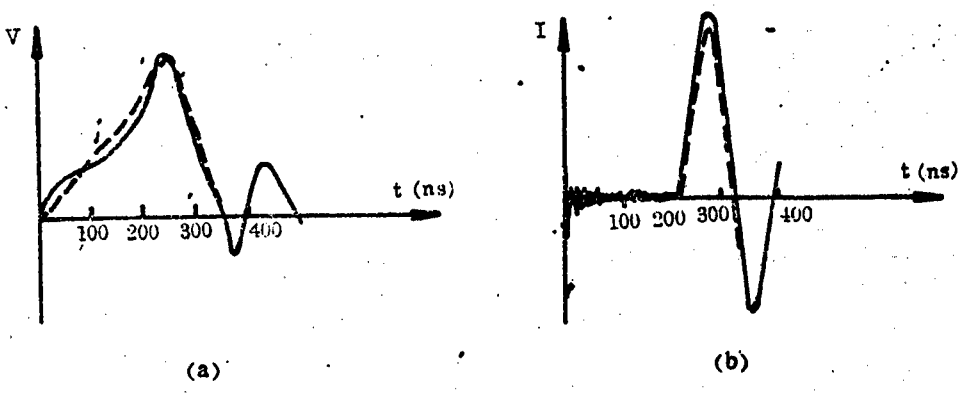

Fig. 6. (a) Voltage pulse waveform; (b) Current pulse waveform Solid line is experimental curve and dashed line is the theory

The time dependence of the current and voltage of the entire discharge circuit may be described by a set of differential equations:

$$\begin{cases} i_0 = -C_1 \dfrac{du_1(t)}{dt} & (4) \\ u_1(t) = L_0 \dfrac{di_0(t)}{dt} + R_0 i_0(t) + u_c & (5) \\ i_s(t) = i_0(t) - C \dfrac{du_C(t)}{dt} & (6) \\ u_C(t) = L_s \dfrac{di_1}{dt} + R_s i_s & (7) \end{cases}$$

During the glow discharge the time dependence of the electron density in the positive colume region is given by the following equation:[2]

$$\frac{dn(t)}{dt} = (\alpha - a)v\, n(t) - \gamma n(t^2)e \qquad (8)$$

where α is the ionization coefficient of the gas molecule, a is the additive coefficient, γ is the recombination coefficient, and v is the electron drift velocity in the electric field. Generally, α and a are functions of E/N and may be written as $\alpha/N = Ae^{-\beta N/E}$; $a/N = A'e^{-\beta' N/E}$. Equation (8) describes the time dependence of the electron density and determines the variation of the characteristic impedance of the discharging plasma.

Using an iteration method in the numerical model calculation and taking into account the charges of the characteristic impedance of the discharging plasma, we obtained the current and voltage waveforms in Figs. 6(a) and 6(b). As can be seen, the agreement between the experiment and the theory is good.

Theoretical analysis shows that the inductance of the discharge circuit is only 21 nf and the load impedance is 0.33 Ω.

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APPLIED SCIENCES

FREQUENCY SELECTION AND MODE LOCKING OF Nd:YAG LASER

Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese Vol 12, No 1, 20 Jan 85 pp 11-14

[Article by Tang Guichen [0781 6311 3819] and Qiu Peixia [5941 0160 7209] of the Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences: "Frequency-Selection and Mode-Locking of Nd:YAG Laser"]

[Text] Abstract

Using a prism as the dispersion element, we have achieved the mode locking of a Nd:YAG laser at four spectral lines (1.052, 1.061, 1.064, and 1.073 μm). The calculated output wavelength stability agreed with the experimental results result.

I. Introduction

A Nd:YAG crystal has ten transitional spectral lines between the $^4Fe_{3/2}$ and $^4I_{11/2}$ states, including the spectral lines at 1.05205, 1,06152, 1.06414, and 1.0738 micrometer[1]. The line at 1.05205 μm is very close to the peak wavelength (1.054 μm) of the phosphate neodymium glass. If this spectral line can be stably realized, it may be used as the main oscillator of the phosphate neodymium glass laser system. However, the stimulated emission cross section of the 1.052 μm line is small compared to those of the 1.061 μm, 1.064 μm and the 1.073 μm spectral lines[2]. Their relative cross sections for stimulated emission are respectively $3x10^{-19}$, $6.65x10^{-19}$, $8.8x10^{-19}$, and 4.10^{-19} cm^2. Under normal conditions a dispersion element must be used to supress other wavelengths in order to obtain the 1.052 μm oscillation. Using a dispersion prism together with a small aperture diaphragm and a special reflection film, we have successfully solved this problem. Compared with the polarization filter method[2], our method of frequency selection is simple and stable. We can continuously select any single spectral line or even have two spectral oscillations simultaneously.

II. Calculation of the Dispersion Prism Parameters

The index of refraction of ZF_6 heavy flint is 1.72791 at 1.05 μm and 1.72759 at 1.06 μm; by interpolation, the index of refraction at 1.052 μm is 1.72785. The index of refraction of ZF_7 is 1.77520 at 1.05 μm and 1.77476 at 1.06 μm; by interpolation, the index of refraction is 1.77511 at 1.052 μm. In order to minimize the loss in the cavity, the beam should impinge on the prism at the Brewster angle.

For ZF_6 $\quad \theta_B = \text{arc tg } n = 59.95°$

For ZF_7 $\quad \theta_B = \text{arc tg } n = 60.60°$

From the law of refraction, the angles of refraction are respectively 30.06° and 29.40°. Based on this calculation, the dispersion prism may be designed as in Figure 1.

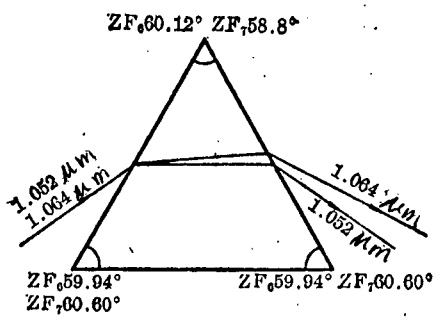

Figure 1. Dispersion prism design for 1.052 μm main beam

In the calculation of the prism loss, the ratio of the reflected wave energy flux W_1' and the incident wave energy flux W_1 is given by the following formula[3]:

$$\left(\frac{W_1'}{W_1}\right)_\perp = \frac{\text{tg}^2(i_1 - i_2)}{\text{tg}^2(i_1 + i_2)}$$

where i_1 and i_2 are respectively the incident angle and the refraction angle. The calculation results are listed in Table 1.

Table 1 shows that the loss is not large when the deviation from the Brewster angle is less than ±1°. For the convenience of fabrication, both the ZF_6 and the ZF_7 prisms may be fabricated as 60° equilateral triangles. Table 1 also shows that the loss is one order of magnitude greater when the deviation angle is increased from ±1° to ±3°. At a deviation of ±5°, the loss is as much as 6 percent and cannot be neglected. Table 1 further shows that the loss seems to be greater when the deviation from the Brewster angle is toward larger angles and the tuning should therefore be done intenionally toward smaller angles as one would think. Actually this is not necessary because the light beam must pass through both faces of the prism and the

incident angle and the emerging angle are interchangeable. The incident angle is large when the emerging angle is small, and vice versa. The deviation from the Brewster angle should be minimized in order to have a small loss.

Table 1. Loss due to the deviation of the incident beam from the Brewster angle

	Deviation in degrees					
Prism type	+1	+3	+5	-1	-3	-5
	Loss x 10^{-3}					
ZF_6	0.189	1.87	6.00	0.170	1.40	3.50
ZF_7	0.199	1.95	6.15	0.180	1.52	3.90

We now proceed to the calculation of the angular resolution. The dispersive angular difference of a single prism is given by[4]:

$$\Delta\delta_{min} = \frac{2}{\sqrt{4-\bar{n}^2}}\Delta n$$

and the dispersive angular difference of a set of prisms is

$$\Delta\delta = \sum_{i}^{N} \Delta\delta_i$$

where $\bar{n}$ is the average index of refraction for the two wavelengths, Δn is the difference in the refractive indices, and $\Delta\delta_i \equiv \Delta\delta_{min}$.

Table 2. Dispersion angular difference

Wavelength range (μm)	Single ZF_6 prism	Single ZF_7 prism	Two ZF_7 prisms and one ZF_6 prism
1.061-1.064	0.6'	0.9'	2.4'
1.052-1.064	2.68'	4.2'	11.08'
0.6238-1.064	2.595°	3.191°	8.977°

Whether a laser with a dispersion prism can separate two wavelength and allow one to oscillate while suppressing the other wavelength depends on the dispersion angular deviation, the cavity length, the aperture of the mode-selecting diaphragm and the divergence angle of the laser.

The experimental setup is shown in Figure 2. The diameter of the diaphragm aperture is D, the cavity length is L, and the rear cavity mirror subtends an

angle θ_1 - D/L at the small aperture diaphragm. Let the divergence angle of the laser beam be θ_2. then the dispersion angle difference and the two

$$\Delta\delta \geqslant \frac{1}{2}(\theta_1 + \theta_2) = \frac{1}{2}\left(\theta_2 + \frac{D}{L}\right),$$

corresponding wavelengths will be separated. If D = 2.5 mm, L = 1.5 m, and θ_2 = 1 milliradian, then we require $\Delta\delta \geqslant$ 2.7'. As can be seen from Table 2, a single prism is inadequate in the separation of the 1.061 μ m lines whether the prism is ZF_6 or ZF_7.

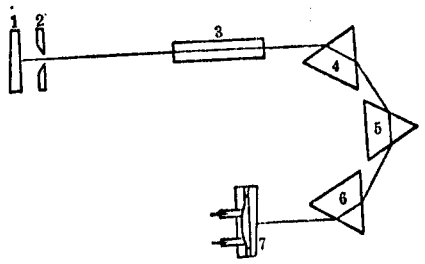

Figure 2. Schematic diagram of the experimental setup

KEY: 1. Wedge-shaped semitransparent lens
2. Mode-selecting small aperture diaphragm
3. Nd:YAG rod
4. ZF_7 dispersion prism
5. ZF_6 dispersion prism
6. ZF_7 dispersion prism
7. Dye cell

Taking into account the doubling effect of the reflecting mirror on the reflection angle, two ZF_7 prisms or three ZF_6 prisms are adequate to separate the 1.061 m line from the 1.064 μ m line. In order to have a stable wavelength, we used two ZF_7 prisms and one ZF_6 prism and the two wavelengths were stably separated.

III. Optical Path Adjustment

The tuning of the laser cavity is often done with the He-Ne prisms in the path and the dispersion of the 6328Å wavelength is quite different from that of the 1.052 μ m wavelength; therefore, the difference between the dispersion angles of the two wavelengths should be first computed and then the cavity mirror is adjusted to the position of the 1.052 μ m oscillation according to the calculated dispersion angle difference once the optical path is tuned with the He-Ne laser. Since the 1.064 μ m oscillation has the greatest gain, the system is allowed to oscillate first at 1.064 μm and then the cavity mirror angle is adjusted for oscillations at 1.052 μm and other wavelengths. The refractive indices of ZF_6 and ZF_7 at 6328 Å are respectively 1.74972 and 1.79992. The corresponding calculated dispersion angle differences are respectively 2.595° and 3.191°.

The above calculation shows that the correction of the dispersion angle is quite large when a He-Ne laser is used in the optical path adjustment. This

adjustment method is therefore difficult to implement and we did not succeed in using this method. We subsequently used a Nd:YAG laser for the path adjustment and avoided the dispersion angle difference difficulty.

IV. Laser Frequency-Selection and Mode-Locking

In our experimental setup we used two ZF_7 prisms and one ZF_6 prism. According to the formula given above, we have

$$\Delta\delta = 4.2' \times 2 + 2.68' = 11.08' \qquad \text{for } 1.052\ \mu\text{m and } 1.064\ \mu\text{m}$$

$$\Delta\delta = 0.9' \times 2 + 0.6 = 2.4' \qquad \text{for } 1.061\ \mu\text{m and } 1.064\ \mu\text{m}$$

The 2.5 mm diameter small aperture diaphragm is placed near the output cavity mirror and, with the doubling effect of the reflection angle, is capable to separate the 1.061 μm and the 1.064 μm lines. Even if the diaphragm is moved toward the center of the cavity by some distance, the angular resolution is still adequate.

Using a double lamp, double ellipsoidal pump cavity, the dimension of the rod is 5.1 mm diameter by 94 mm. A pentamethylidyne dichloroethane solution is used for the passive mode locking. The dye cell and the total reflection concave mirror have a unitary structure and the liquid layer is 1 mm thick.

After the frequency doubling by a KDP crystal, the spectral lines are examined with a 1 meter grating spectrometer. The spectrometer dispersion is 7.5 Å/mm and uses the 5461 Å line of a mercury lamp as a calibration standard.

The frequency tuning and selection are achieved by rotating the rear cavity mirror. Frequency-selected and mode-locked outputs at 1.052, 1.061, 1.064, and 1.073 μm are obtained.

Figure 3 shows the frequency doubled spectrum using a KDP crystal, the leftmost line is the 5461 Å mercury calibration line and the other lines are from left to right, the 1.052, 1.061, 1.064, and 1.073 μm spectral lines.

Figure 3. Frequency-selected and mode-locked double frequency spectrum of the Nd:YAG laser

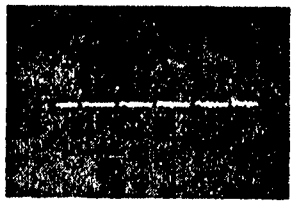

Figure 4. Mode-locking pulse sequence at 1.052 μm

Figure 4 an oscillograph of the 1.052 μm and 1.073 μm mode-locking pulse sequence. Similar pictures were obtained for the 1.061 μm and the 1.064 μm lines.

Experiments show that the output wavelength of the frequency selection component is stable enough. The output wavelength remained constant over 1 week and even when the cavity was intentionally tuned off ±1.7', it still only emitted the 1.052 μm line and not other wavelengths. In terms of threshold, again only the 1.052 μm radiation was emitted even when the source energy exceeded the threshold energy by 100 percent or more.

Double wavelength output is obtained when the rear cavity mirror is adjusted to a certain angle. When the angle is adjusted for a wavelength between 1.064 μm and 1.073 μm, then oscillations at both wavelengths appear, as shown in Figure 5. Simultaneous output at 1.061 μm and 1.064 μm has been observed, but not three spectral lines at the same time. Since the 1.052 μm and the 1.064 μm spectral lines are separated farther and have quite different gains, we did not observe simultaneous oscillations at 1.052 μm and 1.061 m or 1.052 μm and 1.064 μm.

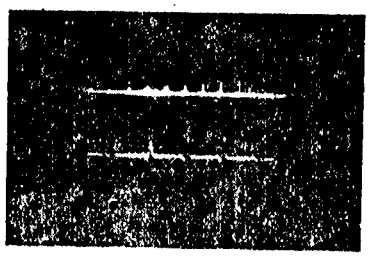

Figure 5. Mode-locking pulse sequence at 1.073 μm

It should be emphasized that since the cross section for stimulated emission at 1,052 μm is less than half of that at 1.064 μm, oscillation at 1.052 μm is difficult to get. In order to have uniform oscillations of the various spectral lines, special coating is used. We first used the ordinary 1.06 μm broadband reflection film as the output film and failed to achieve frequency selection. We later used the newly designed reflection film with a distribution of reflectivity with respect to wavelength and easily realized frequency selection. The reflectivity for a given wavelength may be deduced from the threshold condition. We derived the following equation for the wavelength dependent reflectivity:

$$\frac{\ln R_{1.064}}{\ln R_{\lambda_i}} = \frac{\sigma_{1.064}}{\sigma_{\lambda_i}}$$

where R is the reflectivity and the subscript refers to the wavelength λi = 1.052, 1.061, and 1.073 μm. Table 3 shows the calculated result using $R_{1.064}$ as a parameter. The actual film coating, of course, cannot completely satisfy the theoretical requirement in Table 3 and has exactly the same threshold at all wavelengths. It can only approximate the requirements in Table 3 and has roughly the same oscillation threshold at different wavelength.

Table 3. Reflectivity as a function of wavelength when the thresholds are equal.

λ (μm)	1.064	1.052	1.061	1.073
σ ($\times 10^{-19}$ cm^2)	8.8	3	6.65	4
R	0.5	0.79	0.59	0.73
R	0.8	0.93	0.84	0.89

Table 4. Thresholds at different wavelength and the threshold ratio (C 150 f)

λ (μm)	1.064	1.052	1.061	1.073
V_{th} (volt)	1050	1300	1200	1100
E_h (J)	82	123	106	98
$E_{th}^{1.064}/E_{th}^{\lambda i}$	1	1.5	1.3	1.2

Table 4 lists the experimental results using the dielectric film with a distribution of reflectivity ($R_{1.064} = 0.8$, $R_{1.052} \cong 0.88$). As can be seen, the thresholds at different wavelengths are quite close. After mode-locking, there was no obvious change in the pulse sequence and all the energies are of the order of a few millijoules.

Finally, it should be pointed out that each division of rotation of the cavity mirror rotation drum changes the mirror angle by 30". The angle for 1.061 μm is exactly 4 divisions or 2' from that of 1.064 μm. The calculated result is 2.4' and the agreement with experimental result is quite good.

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ROLE OF COMPUTER INDUSTRY IN CHINA'S MODERNIZATION

Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 13, 5 Jul 83 pp 3,2

[Article by Chen Liwei [7115 0500 3634]: "An Overview"]

[Text] During the National Electronic Computer and Integrated Circuit Planning Conference, Vice Premier Wan Li pointed out: "If we want to quadruple our industrial and agricultural output and achieve the goal of the four modernizations, we must accelerate our efforts in computer and integrated circuit development." The Vice Premier's comment was both an encouragement and a challenge to those of us working in the computer industry. We have a responsibility to present to the State a strategy for establishing a long range plan for the computer industry; we should identify the critical issues for reform and do our best to accelerate the reform.

In this article I shall present my own views for consideration by other members of the computer community.

1. Development of the Computer Industry Must Be Accelerated

In developed countries, the computer industry grows at an astonishing rate. In the U.S. for example, during the 20 years between 1958 and 1978, the gross national product (GNP) had generally been quadrupled, but the computer industry had grown by 40 times in hardware alone (50 times if software and services were also taken into account). In 1958, the production of computer hardware was approximately 0.1 percent of the GNP, which roughly corresponds to China's current situation. Twenty years later in 1978, the production increased to 1 percent of the GNP; its growth rate was 10 times that of the GNP. Compared with the overall electronics industry, the annual production of computer hardware had leaped from approximately 7 percent of the total production to approximately 50 percent; its growth rate was 7 times that of the electronics industry.

In other developed countries, the average growth rate of the computer industry is above 20 percent.

Let us now address the question of the growth rate of China's computer industry.

From the point of view of the society's needs, computers are needed in all business enterprises to achieve the four modernizations. There are currently more than 300,000 industrial enterprises in this country, which is a huge

potential market. As the business and management reforms expand in depth and in scope, the need for computers will undoubtedly increase at a rapid pace. By 1990, several thousand key enterprises will have the need for and probably will have installed general-purpose computers or minicomputers; by the end of this century, tens of thousands of enterprises will be equipped with computers. Furthermore, considering the needs of the financial, trade, commerce, and administrative offices, it is possible that the number of installed general-purpose computers and minicomputers will reach several hundred thousand units. The number of various types of microcomputers needed will be even more astonishing.

Therefore, as in developed coutnries, the growth rate of China's computer industry will also greatly exceed the growth rate of industrial and agricultural production; indeed, an increase by a factor of several decades within 20 years is to be expected.

2. Product Structure and Organization Structure Must Be Compatible With the Characteristics of "Compound Product"

The computer is a compound product, whereas other products such as television or radio are "singular products". This is one of the unique characteristics of computer. In order to satisfy the user's needs to solve problems in their work or business, the computer industry must provide not only the main frame and associated peripheral equipment, system and application software, but also services such as consulting, system design, maintenance and repair, and training. The above elements collectively constitute this "compound product" called computer; to an end user, every element is essential.

When an experienced user shops for a computer, he is concerned about price, performance and quality, but he is also interested in a product with a "high degree of compoundedness". Therefore, in future development of China's computer industry, we must pay attention to the degree of compoundedness and adjust the product structure to satisfy the user's needs. It must be pointed out that currently, particularly the magnetic disc; and maintenance and repair service is almost non-existent. For a compound product, a certain balance must be maintained among the various elements; otherwise, we will always be in a passive situation trying to cover the weakness of one element or another. This is an important problem that must be addressed in future development.

In conjunction with reforms in product structure, the organization structure and personnel structure of the computer industry must also be adjusted to establish a more balanced "compound system". In this system, the service departments which provide user consultation, system analysis, on-site maintenance, personnel training and product marketing are important departments which must have a large team of working staff to penetrate the various enterprises and businesses. Their feedback will provide the necessary basis for us to make our decisions. Without these people, the computer will lose its penetrability and initiative. At IBM and DEC, members of these departments account for one third of the total personnel; their number is 100,000 at IBM and 16,000 at DEC. But in this country, we have a very small number of people working in this field. This is one of the reasons for the slow development of China's computer industry.

Most service departments are supported by technical personnel; thus expanding service departments implies increasing the proportion of technical personnel. It is estimated that in the next 10 years, technical personnel will account for one half of the total personnel of the computer industry.

Having understood the compound characteristics of the computer, we shall find that the current management structure is much too loose. Our development needs cannot be met by small enterprises with individual management and diversed goals; therefore, it is essential to organize a unified body of the computer industry without delay.

3. The Problem of Developing Application Software Must Be Addressed

As a component of the "compound product", application software will be a key issue in the development of China's computer industry; without application software, the computer is just a piece of useless machine. Of course, the computer industry itself should devote more efforts in this area, but based on experience from home and abroad, the computer manufacturers (companies) can only provide the more general application software; the development of large and specialized software must rely on the users who are familiar with their particular field. This is called the user's secondary development. Quite often, the cost of secondary development exceeds the hardware cost, and the development time is generally very long. The software personnel of the user should be regarded as important members of the computer industry; without their labor, the computer cannot realize its full potential. Currently, the U.S. has approximately 500,000 software personnel, 80 percent of whom belong to user organizations. This number exceeds the total number of employees of the IBM Corporation. In the Soviet Union, approximately 200,000 application software personnel work in the ACY system (Soviet Automated Management System), but there are only 40,000 technical personnel serving in the ACY system to develop software and hardware of the EC series computer. The number of application software personnel is much greater than the total number of technical personnel (including both software and hardware personnel) engaged in product development. If we cannot solve the problem of supplying and training these personnel, proliferation of computer application will only be a pipe dream, not to mention the development of a computer industry.

To estimate the required number of application software personnel for this country, let us consider the management information systems used by ministries and various enterprises as an illustrative example. Suppose the total number of systems in use at the end of the century is 5,000, and the average number of software personnel per system is 40, then 200,000 people will be required in the whole country.

At present, the number of available application software personnel is clearly inadequate. But we have an abundant supply of human resources; in colleges alone there are over 1 million students. We can solve the problem of application software personnel by systematically offering courses in computer applications and providing on-the-job computer training to personnel in industries and businesses.

It should be pointed out that although from the practical point of view of large application software is mostly developed by users, in the long run the computer industry will be sharing an increasing amount of the development load. Indeed, a software industry is gradually being formed. With the accumulation of experiences in application software development and with the increasing degree of standardization of operating systems of various departments and businesses, the number of general software packages which can be developed by a central organization is also increasing. As a result, the amount of secondary development by the user will decrease accordingly and the computer will emerge as a total "compound product" for the user.

It is encouraging to note that several user organizations are already developing application software. But our society has not officially recognized software as a valuable commodity; there is no accepted method of evaluating software, and no established law to protect software. Consequently, software are not receiving the proper reward they deserve. We must establish a procedure for evaluating software, and persuade the government to establish laws for software protection, so that the current software development work may grow into a software industry.

4. Production Departments Must Regard "Reputation" As The Number One Priority

A user buys a computer to solve problems in his work or business, and to derive economic benefits from it. Once a user acquires a computer, it becomes an essential part of his business flow. If the computer develops trouble and cannot be repaired within a short period, the user must interrupt his daily activities and suffers a substantial loss. Members of the computer industry must fully and clearly understand this problem, and cannot treat it lightly. Not only must we insist on a high quality and reasonably priced product, but we must also provide reliable service in maintenance and repair, so that the user can be completely free of worries. This is what we mean by "reputation".

But to establish a reputation is not an easy task. It is built on the dedicated efforts of every individual. We must watch everything we say and every job we do; and we must be prepared to devote a large amount of time and effort to establish our reputation.

Some factories have already taken steps toward this goal and have been quite successful. But generally speaking, "Chinese-made machines" have not yet established a good reputation among the users. In particular, once a reputation is lost, it cannot be recovered by simply doing a few good jobs. One's reputation can only be recovered or established by performing thousands of good jobs over a period of many years.

It is not easy to establish reputation but very easy to lose it; to recover one's reputation is all the more difficult. Therefore, the computer industry must regard reputation as the number one priority; we must consider reputation as the life of our industry. The saying that without reputation there is no computer industry is not exaggerating.

5. Two Scenarios of The Development of China's Computer Industry

As part of the national economy, the computer industry must follow the rule of "planned and balanced" development. But what does "planned" development mean in the computer industry? This question is worth exploring.

It takes approximately 3 to 4 years to develop a medium size or mini-computer. Because of the nature of "compound product" , in conjunction with production preparation, setting production line and building a production force, it is also necessary to establish training programs for maintenance and repair personnel, and set up locations for maintenance and repair services. Therefore, the production cost of a new computer may be 5 to 7 times higher than the development cost; it is not uncommon to have production cost as high as several tens of millions of yuan.

However, this investment must eventually be recovered plus a certain profit; this is the only way to achieve economic growth. Therefore, once in production, a computer model must be continued for a certain period (e.g., 5 years) until a certain number of units are sold (e.g., 1,000 units). Beyond that time, this model will be replaced by a more advanced, newer model. This development approach, which proceeds rhythmically and systematically, is what we mean by "planned" development. Only by following this rule of development does the computer industry have a promising future.

But this ideal scenario does not necessarily agree with reality. For example, at the present tiem, we are developing computers which correspond to international standards of the late 1970's and early 1980's, and they will be in production after 3 to 4 years. But computer technology is advancing rapidly. During this period there will undoubtedly be more advanced computers with higher performance-to-price ratio invading the Chinese market. This will have an adverse impact on the computer model being produced, and cause nervousness among the domestic manufacturers. With the survival of the computer industry being threatened, there will be no room for "rhythmic and systematic" development. In fact, many organizations engaged in the development of new products are currently going through such a difficult period; they hardly have the determination or the courage to invest more money, more materials, or more manpower to build up a production capability or to establish maintenance and repair services. Under these circumstances, a new product may be terminated before it reaches the production line; even if it were being produced, the scale of production will be very limited. As a consequence, it will not be possible to lower its price, improve its quality or establish maintenance and repair services. Not only will it fail to establish a good reputation, its current reputation will be damaged. Also, the original investment cannot be recovered, and user interest cannot be protected. This is clearly a worrisome scenario.

Of course, in reality things are not so pessimistic. Considering that our computer industry is still in its infant stageand lacks competitive ability, the Government has established certain import policies to protect China's industry. However, these policies still have room for improvement. Specifically, unique features of the computer industry and its importance in the national economy should be considered in establishing technical and economic policies, so that

the computer industry can move forward according to Government plan and market needs without outside interference. Such policy will provide encouragement and motivation to those organizations engaged in new product development; it will give them a sense of direction and a sense of responsibility. Being free of worries, they will have the confidence to devote the necessary manpower, money, and material to the development of new products, to establish high-quality and large scale production capability, to train maintenance and repair teams and to install maintenance and repair service stations. Such a "compound product" will surely be well received on the market and its reputation will eventually be established. China's computer industry will then enjoy healthy growth, the user's interests will be protected, and the four modernizations will move forward at an accelerated pace.

What a beautiful scenario this will be!

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BRIGHT FUTURE SEEN FOR CHINA'S MINICOMPUTERS

Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 13, 5 Jul 83 p 2

[Article by Yi Shui [2496 3055]]

[Text] Due to the impact of imported computers in recent years, the Chinese minicomputer industry has suffered a decrease in production, thus creating a temporary difficult situation for a number of production factories. But the number of minicomputer installations increased substantially, which shows that there is still a great potential for China's minicomputer market. Therefore, the future of domestic minicomputer manufacturers is still quite promising as long as they make a concerted effort to produce machines with high reliability, good performance, and moderate price.

Currently, the mainframe of domestic minicomputers (particularly the DJS-100 series) can achieve an average trouble-free operation time of over 1,000 hours. Also, imported minicomputers are not necessarily trouble free. For example, a rough estimate shows that the 22 PDP 11/34 minicomputers used in the Huadong region had 128 breakdowns during a period of approximately 2 years; some of the computers had a series of malfunctions. Furthermore, imported computers also have problems with maintenance and spare parts. For example, some units must be shut down when a fuse is blown because the spare part is temporarily unavailable. Such problems are much easier to solve with domestic computers than with imported computers. The machines which are already in production today, i.e., the DJS-153, 142 and DJS-185, 186 are comparable to the PDP 11/34 in terms of both hardware and software capability. The S16 minicomputer which will appear on the market in the near future represents a new standard in performance, quality and reliability of domestic minicomputers. Therefore, we believe that it is entirely possible for domestic manufacturers to regain the minicomputer market if they continue to develop products with features superior to imported machines, and if they are supported by sound technical and economic policies.

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MICROCOMPUTER APPLICATIONS IN WATER QUALITY MANAGEMENT

Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 13, 5 Jul 83 p 8

[Text] The Nantong Computer Plant succeeded in using the DBJ-Z80 to build a microcomputer control system for water quality management. It was used in the chemical water treatment system of the Tiansheng Harbor Power Plant with noted improvements in economic results: lower investment and quick pay-off, stable system operation, reduced acid and alkali consumption, and savings in water and electricity.

Conventional industrial boilers tend to collect a thick layer of scale on the inner walls after long periods of use; this deposit not only increases the consumption of coal but also increases the danger of cracked pipes or boiler explosion. Therefore, most large boilers are equipped with a water quality treatment system which performs the functions of purification, and salt removal, as well as the removal of positive and negative ions. The control system consists of the following segments: the DBJ-Z80 microcomputer, the input/output interface, the A/D converters, the execution mechanisms and chemical instruments. The chemical water treatment system has two parallel units which include the following segments: water from Chang Jiang, the hydraulic accelerated sediment pool, valveless filter pool, the positive ion exchanger, the negative ion exchanger and the mixed positive and negatiive ion exchanger. During system operation, the microcomputer continuously monitors the water level in the salt removal tank. When the water level is low, the computer selects an optimum way of supplying water. The criterion of optimization is to maximize the water production in all the exchangers, minimize the number of regenerations, and at the same time ensure the quality of the salt-free water. When the water-treatment process is stabilized, the water parameters are checked periodically; if a defective exchanger is detected, it is automatically removed from the system for regeneration and reduction. But the form of the water-treatment process must change accordingly and will continue until the water level in the salt removal tank reaches a certain height, at which time the water-supply is automatically terminated.

This system is a linear, real-time control system equipped with protective measures such as screen isolation, arc-suppression relays, and redundant input/output structure so that the system can operate reliably in an environment with many interference sources. The computer-controlled water treatment system not only reduces the amount of labor required, but also improves the safety of the system. By operating under optimum regeneration conditions, the amount of acid

and alkali consumption can be reduced by 10 percent, and over 4,000 tons of salt-free water and more than 6,000 KWh of electricity can be saved annually. Also, the quality of water is improved, the rate of scale deposit along the walls is greatly reduced, which in turn improves the safety factor of system operation and increases the economic benefits of the overall system.

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MICROCOMPUTER APPLICATIONS IN HARBOR MANAGEMENT

Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 13, 5 Jul 83 p 8

[Article by Tao Lingsen [3447 7117 3932]]

[Text] In order to solve the problem of collecting and processing large amounts of data in conducting experimental research of harbor and hydraulic models, the Tianjin Industrial Automation Instrument Research Institute developed a wave motion and flow velocity data collection and real-time processing system by connecting a CROMEMCO-I microcomputer and its system module D+7 and TU-ART to an analog multi-channel cumulative counter-timer and a wave shaping device as well as to other on-site instruments. The development of this system greatly improves the level of automation of harbor and hydraulic model testing, and avoids the possibility of human errors introduced by manual computation.

In addition to the equipment mentioned above, the system also includes other instruments such as the KGY-2 wave height meter, the flow velocity sensor, and the photoelectric rotary type measuring rod. During system operation, the signal of the wave motion is transmitted from the KGY-2 wave height meter through a filter into a multi-channel gating switch; the gated signal is sent to the system module D+7A for A/D conversion, and the converted signal is sent to the CPU. The signal can have a maximum of 30 channels. The flow velocity signal is transmitted from the flow velocity sensor--photoelectric rotary type measuring rod through the amplifier and wave shaping device, and sent to the cumulative timer where cumulative counting is performed based on a pre-specified time. After counting, an interrupt request signal is transmitted through TU-ART to the CPU for real-time processing.

This system is developed specially for harbor and hydraulic model tests. It can be used to collect wave height data and estimate its statistical parameters, and to collect and process cumulative flow velocity data; it is now fully operational. It can also be used in similar industrial facilities or laboratories. Furthermore, the system is equipped with RS-232 standard serial communication interface; hence its application can be easily extended for remote operation by connecting it to the proper data communication equipment.

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MICROCOMPUTER APPLICATIONS IN STEEL MILL

Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 13, 5 Jul 83 p 8

[Article by Tao Jianyuan [3447 1696 8673]]

[Text] In order to satisfy the production needs of China's steel industry and to expand the applications of microcomputer, the Tianjin Electric Transmission Design and Research Institute and the Shanghai Metallurgical Instrument and Meter Plant have jointly developed a micro-computer-controlled SM4W-A high-precision X-ray pachymeter. This instrument was developed by connecting a WXK-01 microcomputer to the Factory's original digital SM2 X-ray pachymeter. Test operation shows that the new instrument has much improved performance indices over the SM-2 pachymeter. Indeed, they have reached a fairly advanced level.

Structurally, this pachymeter consists of two sections: the on-site measurement section and the instrument control cabinet. The on-site measurement section includes the C-shaped measuring frame, the X-ray generator and X-ray receiver; the instrument control cabinet contains the instrument operation control disc and the WXK-01 microcomputer. The measured signal of the steel plate thickness is converted into electric pulses and sent to the instrument control cabinet where discrimination and frequency demultiplexing are performed. The frequency measurement, filtering, logarithm calculation, and various compensation calculations are performed by a microcomputer, and then the thickness discrepancy is shown on a display unit. This instrument has four basic modes of operation: manual operation, automatic operation, automatic correction, and automatic diagnosis. The WXK-01 microcomputer contains four software modules: the main control program, the functional program, the subroutine module, and the keyboard interpreting program.

By replacing the original digital operation unit by a microcomputer, the SM4W-A high-precision X-ray pachymeter not only has greatly improved performance over the original instrument, it also provides several new functions. The use of a microcomputer eliminates the non-linear error introduced by the original digital circuits, and increases the measurement accuracy by an order of magnitude to $\pm$ 0.1 percent. The allowable measurement range is from 0.05 mm to 3.99 mm; and the statistical fluctuation index of the instrument is reduced from $\pm$ 1 percent to $\pm$ 0.1 percent. The instrument can be used on 10 different materials including low carbon steel, silicon steel, and stainless steel with a high degree of automation and reliability. The development of this instrument provides another effective measurement scheme for China's steel industry.

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APPLIED SCIENCES

SHENYANG TRANSFORMER PLANT USES COMPUTER IN PRODUCT DESIGN

Shenyang LIAONING RIBAO in Chinese 3 Mar 84 p 2

[Article: "Shenyang Transformer Plant Uses Computer-Aided Design in New Products; Design Turnaround Time Reduced by One-Fourth, Raw Materials Consumption Cut 3 Percent"]

[Text] The Shenyang Transformer Plant uses computers to help design new products so that the new product design turnaround time has been reduced on the average by one-fourth and consumption of raw materials has been cut by about 3 percent. Each of the 22 new products launched by this plant last year achieved advanced domestic levels.

The Shenyang Transformer Plant is one of China's major plants for producing large-scale transformers and the new product research and development projects it undertakes are mostly large-scale ultra-high voltage transmission transformer equipment for key national engineering projects. These products are structurally complex, technical performance demands are high, design difficulties are major, time is short, and without computer-assisted design some work would be hard to complete. Using computer-assisted design accelerated the development rate of new products, and the quality of the new products designed was also good. Relying on manual calculations to select product design proposals in the past generally required three months, but now with computers, it only takes a couple of hours to choose the best design. China's 500,000-volt AC mutual inductor which this plant designed was a piece of equipment for a key engineering project. Under normal circumstances, designing such a product would take six months, but after they started using computer-assisted design, it took only 3 months to complete the design task in a high quality way.

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APPLIED SCIENCES

ENGINEERS DEVELOP NEW COMPUTER APPLICATIONS

Shanghai WEN HUI RIBAO in Chinese 1 May 84 p 1

[Article by Wan Wenxuan [8001 2499 5503], Assistant Researcher, Shanghai Municipal Computing Technology Institute]

[Text] Since the 12th Party Congress the computer industry has been at the forefront of China's new technological revolution and has been the subject of serious attention by both the Party and the State. Motivated by a deep sense of the importance of our task, my colleagues and I at the Institute decided to direct our creative energies toward the development of new computer applications. During the past several years, while continuing to work unremittingly on traditional computer applications we have also been actively developing new applications in order to make computers more accessible and economically effective (these two aspects are closely related). We have been quite successful in this effort. Of the 45 large-scale computer applications that we completed in 1982, 94 percent were concerned directly with production; of these, 30 percent were involved with agriculture, communications, energy resources, and economics.

Laboratory No 2 at the Institute where I work develops software and new technical applications. At various times we have worked on and completed a Chinese-language data-processing system using a microcomputer, a large-screen microcomputer-based display system, a system for displaying train schedules, etc. Using the theory of stationary random process, we and our colleagues worked to combine digital signal processing, control theory, and signal discrimination techniques at the systems level with applied engineering considerations to develop a computer-based system for parametric analysis of signals from stabilization modules. This guidance system, which corrects for the factors that destabilize satellite trajectories during lift-off and in orbit, represents our contribution toward solving the difficult problems of space flight.

During my advanced studies in Canada, I was aware of the needs of China's modernization program, which would require advanced computing technology. I was thus motivated to work and study hard, and I published some papers which were favorably regarded by international specialists and scholars. My adviser and teacher contacted me cordially several times at the embassy in Canada, where I was staying shortly before my departure, and expressed the hope that

I might remain longer in Canada for extended study. However, I felt that I should apply what I had learned to serve China without delay and therefore returned on schedule.

My colleagues and I have been keenly aware of the recent new and revolutionary developments in technology and their vast implications for China's computer industry, and we recognize that a new era of computer applications is upon us (this is particularly true with regard to potential microcomputer applications). My colleagues and I are determined to work even harder to promote still deeper and more extensive applications of computer technology.

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APPLIED SCIENCES

HUAZHONG UNIVERSITY PROMOTES MICROCOMPUTER APPLICATIONS

Wuhan HUBEI RIBAO in Chinese 1 May 84 p 1

[Article reported by Zhang Bihui [1728 4310 6540]: "Huazhong University Actively Develops Technical Applications of Microcomputers; More than One Hundred Applications Give New Vigor to Economic Reconstruction"]

[Text] Huazhong (Central China) University of Science and Technology attaches great importance to research in the technical applications of microcomputers and the development of computer software. The results have been 30 new ideas for applying microcomputers, 150 successful research results on computer software, and 3 hardware innovations, all of which have enhanced the vitality of China's economic reconstruction program.

Since 1979, more than 400 professors and graduate students in over 10 departments at Huazhong University of Science and Technology have been engaged in research on the technical applications of microcomputers and the development of software for business management, process control, instrumentation and measurement, optimization, instructional aids, and graphics and data processing.

Some of the results on digital and computer control systems are already being applied in the engineering, electronics, and aviation industries and elsewhere, and product quality and worker productivity have been improved. The Laser Research Institute has developed a versatile computer-controlled laser device for welding very small metal components that cannot be welded using ordinary techniques. Since 1981, the University has developed numerous laser welders for use by clients throughout China. The unit installed at the University has been used to weld items received from all over China on more than 100 separate occasions; the welding quality is highly reproducible and technically superior to that achievable by other welding equipment in China. The Kaili Capacitor Plant in Guizhou has cut yearly costs by more than 300,000 yuan by employing the laser welder. Last year the Department of Radio Engineering designed a device for automatically testing balance wheels in wristwatches, which represents the first time that advanced laser, optical data processing, and computer methods have been successfully combined inside China to develop automatic equipment for testing watch components.

The Department of Computers and Automatic Control developed a data processing system for inputting, deleting, and storing data. The system is being used by the Wuhan Municipal Metals Company, which produces nearly 2,000 kinds of

products and must update its records daily. The entering, deleting, and storing of miscellaneous data for its various accounts can be completed in just 4 hours by using the computerized system.

Recognizing the profound future significance of microcomputers as instructional aids, Huazhong University has taken some preliminary steps in this direction which have met with gratifying success. Last year, professors in the Department of Electrical Power used their single-board prototype to begin "control theory" experiments in order to expose their students to the most advanced measurement techniques. The hardware costs were only 2 percent of the costs of the previous experiments, which were done by computer simulation, and the software was more plentiful and flexible. The graduate and undergraduate curricula of each department actively promote the applications of computers. Of the 13 graduate student projects last year in the Departments of Economics and Engineering Management, 6 involved using computers to monitor goods and materials. One student's graduate dissertation, entitled "A Model for Rational Coal Transport within the Municipality of Shanghai," proposed reforms that would reduce the number of ton-kilometers of coal transported in Shanghai by nearly one-half, thereby cutting transportation costs by 2,580,000 yuan a year.

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MEAN DENSITY SCALE HEIGHTS FROM ANALYSIS OF VARIATION IN PERIGEE HEIGHT OF CHINA'S SECOND SATELLITE

Beijing KONGJIAN KEXUE XUEBAO [CHINESE JOURNAL OF SPACE SCIENCE] in Chinese
Vol 4, No 1, 1984 pp 76-81

[Article by Feng Zhanliang [7458 0594 5328] of the Purple Mountain Observatory, the Chinese Academy of Sciences; "Mean Density Scale Heights from Analysis of Variation in Perigee Height of China's Second Satellite"]

[Text] Abstract: This paper discusses a method for computing the density scale height H. Four mean values of the density scale height H are determined from the analysis of variations in the perigee height of China's second satellite. The difference between the determined values and CIRA-1972 is less than 10 percent, the mean H is 5 percent greater than that given by CIRA-1972.

I. Introduction

Influenced by solar radiation and terrestial factors, the outer layer of the earth's atmosphere undergoes complicated and vigorous changes. Ever since the first artificial satellite was launched, researchers have been measuring the physical parameters of the outer atmosphere using satellite resistance data and the important laws governing the behavior of the outer atmosphere have been determined. One of the important laws regarding the atmosphere structure -- the atmosphere density as a function of altitude -- can be expressed as an exponential law:

$$\rho = \rho_0 \exp\left(-\frac{Z-Z_0}{H}\right) \tag{1}$$

where Z is the altitude, ρ is the density at Z, Z_0 is a reference altitude and ρ_0 is its corresponding density, and H, a function of Z, is defined by the following equation:

$$\frac{1}{H} = -\frac{1}{\rho}\frac{d\rho}{dZ} \tag{2}$$

In this paper we briefly describe the King-Hele method of determining the density scale heights using satellite resistance data and showed the results of density scale heights determined from visual data of China's second satellite (international code 1971-18A).

II. Method

Under the influence of a atmosphere resistance, the perigee height, the orbit eccentricity and the semi-major axis a (or the period) of artificial satellites (especially satellites orbiting close to the earth surface) gradually decrease. The perigee height of a satellite under atmospheric resistance can therefore be used in the determination of the density scale height.

1. Perigee height parameter Q

The changes of the perigee height r_p are mostly caused by the effect of the odd-order [dai xie] function of the earth gravitational field and the perturbation of the sun and the moon.

In order to obtain the change in the perigee height due to the atmospheric resistance alone, we define a perigee height parameter Q for a satellite. The influence of the solar and lunar perturbation is generally small and may be excluded. Perturbations may be computed according to the method given in Ref. 1. For China's second satellite, the perturbation is equivalent to $4.81 \sin\omega$ kilometers, here ω is the angular displacement of the perigee. The perigee height parameter Q can therefore be expressed as

$$Q = a(1-e)-R+ 4.81 \sin\omega \tag{3}$$

where $a(1-e) - R$ is the perigee height of a spherical earth and R is the average equitorial radius of the earth.

2. The equation for H measurement

In the King-Hele theory[2] of a contracting satellite orbit in an atmosphere, a relationship is given for the semi-major axis a and the eccentricity, e, Using $dQ/dt = (d\dot{Q}/da)a$, an equation for determining H is also given:

$$\frac{dQ}{dt} = \dot{Q} = -\frac{H\dot{n}}{3ne}\left(1 - 2e + \frac{H}{4ae} - \frac{2\varepsilon}{e}\sin^2 i \cos 2\omega\right) \tag{4}$$

where n and $\dot{n}$ are respectively the horizontal motion and the rate of the horizontal motion of the satellite, i is the inclination angle of the orbit and ε is the atmospheric eccentricity (taking as the earth eccentricity of 0.003353).

The value of H determined from Eq. (4) is the density scale height at an altitude of 3/2 H_p, here H_p is the density scale height at the perigee. $\dot{Q}$ is obtained from $\Delta Q/\Delta t$ and, to ensure accuracy of $\dot{Q}$, ΔQ must be large enough and the value of Δt is determined from this.

3. Selection of the observation data

In order to determine the value of H accurately, the altitude of the satellite perigee must be accurately measured. Therefore, the arc of observation should be long and preferably includes both ascending data and descending data, and other observation data (photographic, radar, etc) should also be integrated and used. On the other hand, one may also select the most favorable time for observation such as during the period just before the satellite falls back to earth when the effect of atmospheric resistance is the largest and the change in Q is the fastest.

III. The Measurement of the Mean Density Scale Heights

1. Orbit root

Visual observations of China's second satellite from May 1978 to January 1979 were used in the orbit calculation. The time accuracy of the data is $\pm$ 0.1 sec and the position accuracy is $\pm$ 0.05°. In the incremental iteration scheme, i, Ω, e, ω, M, $\dot{n}$, $\ddot{n}$, and n are treated as unknows. Here Ω is the direct ascent of the orbit, M is the flat perigee angle and $\dot{n}$ and $\ddot{n}$ are time derivatives of n. In the orbit calculation, since the change of the inclination angle i is very small, the perturbation value is used as the iterated value, and, when there is a lack of data, the second derivative $\ddot{n}$ of the horizontal motion is held constant. When only the ascending data or the descending data are available and the observation arc is short, the accuracy of the perigee height determination is poor. Then one or two sets of data are chosen from each segment of arc to be used as the root value. For observations covering both the ascending arc and the descending arc, the accuracy of orbit determination is good and the root values are chosen for an accuracy of the perigee height better than 0.5km. A total of 20 sets of data are selected and listed in Table 1, together with their standard deviation. In the last four columns of the table, U_1 and U_2 are respectively the smallest U and the largest U in the iteration, ε is an indicator for the degree of agreement between the root value and the observation data, N is the number of data points in the iteration and D is the number of days before and after the specified date. The agreement between the orbit root and the data is about 3 minutes of angle.

2. Determination of the mean density scale height

In order to improve the accuracy of Q, the Q values obtained from Eq. (3) are fitted to a polynomial, as shown in Fig. 1. The fitter curve and the measured value agree to approximately $\pm$ 0.33km.

Table 1 Orbit roots and standard deviation

Date Yr/Mo/Day	i (deg)	Ω (deg)	e	ω (deg)	M (deg)	n (rev/d)	$10^3\dot{n}$ (rev/d^2)	$10^4\ddot{n}$ (rev/d^3)	r_p (km)	U_1U_2 (deg)	ε_{min} (angle)	2N	D (day)
1978.5.6	69.859	132.270	0.05246	270.701	47.255	14.840110	1.015	−0.14	6627.91	28 154	3.1	120	6
	3	3	6	52	52	8	8	0					
7	69.861*	129.779	0.05241	269.297	347.462	14.841109	1.002	−0.11	6627.92	28 157	3.4	194	7
		7	5	33	33	5	1	0					
8	69.861*	127.284	0.05237	267.767	288.165	14.842104	0.991	−0.11	6627.95	28 157	3.3	204	7
		7	4	32	32	5	1						
9	69.859	124.789	0.05240	266.249	229.228	14.843080	0.971	−0.07	6627.46	28 157	3.3	178	6
	3	7	5	35	35	5	1	0					
7.9	69.863*	331.935	0.05043	174.711	158.666	14.911017	1.617	+0.07*	6621.01	9 66	2.8	176	7
		4	10	120	121	19	2						
10	69.863*	329.415	0.05039	173.213	124.571	14.912626	1.612	+0.07*	6620.79	9 66	2.8	176	6
		4	9	119	120	19	2						
11	69.863*	326.897	0.05034	171.712	90.972	14.914109	1.641	+0.40	6620.74	9 66	3.0	210	6
		4	8	98	99	4	1	0					
8.8	69.858*	256.050	0.04914	130.149	115.208	14.956106	1.100	−0.56	6616.65	23 52	3.0	58	4
		8	13	268	266	6	10	1					
9.26	69.859*	131.216	0.04688	57.095	61.589	15.019001	2.093	+0.05*	6614.43	128 164	1.8	44	4
		12	21	238	240	23	41						
11.25	69.866	336.078	0.04073	325.120	242.368	15.147852	2.186	+0.48	6618.76	37 163	3.6	160	5
	2	7	4	56	56	7	2	0					
1978.11.26	69.858	333.474	0.04062	323.778	293.332	15.150099	2.240	+0.26	6618.83	37 165	3.8	176	4
	2	2	3	43	43	6	3	0					
27	69.854	330.861	0.04053	322.220	345.344	15.152401	2.284	−0.24	6618.78	37 165	3.0	164	4
	2	2	0	0	5	7	6	0					
28	69.862	328.250	0.04043	320.651	38.190	15.154637	2.288	+0.19	6618.68	37 163	3.8	204	6
	2	1	2	33	33	4	1	0					
29	69.857	325.636	0.04027	319.133	91.801	15.156960	2.299	+0.02	6619.25	37 165	3.2	190	6
	2	2	3	41	41	8	1	0					
30	69.864	323.024	0.04027	317.425	146.412	15.159222	2.334	+0.30	6618.65	37 165	4.3	220	6
	2	2	3	35	35	3	1	0					
12.1	69.853	320.403	0.04023	316.074	210.503	15.161546	2.364	+0.37	6618.22	36 165	3.2	170	6
	2	2	3	34	34	3	1	0					
2	69.853	317.788	0.04012	315.500	257.668	15.163925	2.401	+0.36	6618.26	36 165	3.1	122	6
	4	4	3	45	45	3	1	0					
3	69.852	315.171	0.04009	312.920	314.698	15.166353	2.434	+0.30	6617.77	36 165	3.4	120	6
	5	5	4	53	54	4	3	0					
4	69.874	312.576	0.03993	311.351	12.598	15.168805	2.466	+0.30	6618.15	41 163	3.2	68	6
	11	13	6	83	84	4	19	0					
1979.1.21	69.851*	185.786	0.03602	235.044	114.715	15.271981	2.356	+0.93	6615.26	32 64	2.5	122	4
		9	13	184	185	11	8	1					

* perturbation calculation value

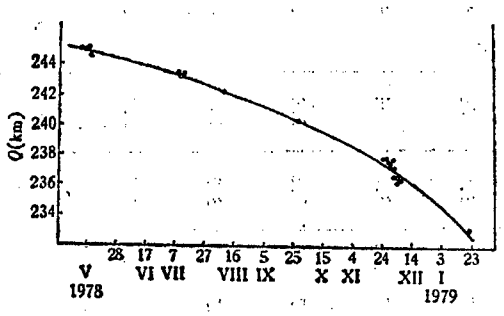

Fig. 1. Values of Q and the fitted curve

When Eq. (4) is used in the calculation of H, we used the Q values from the smooth curve in Fig. 1 and used $\Delta n/\Delta t$ for $\dot{n}$. The average values of roots were substituted into Eq. (r) and four mean density scale heights were obtained, as listed in Table 2. For comparison, Table 2 also shows the theoretical values[3] of H_{CIRA}-1972 and the average altitude Z and the outer atmosphere temperature T.

Table 2. Measured mean density scale height H

Time interval	Z (km)	T (K)	H (km)	H_{CIRA} (km)
1978 5 7 — 1978 7 11	325.6	1010	56.4	51.5
1978 7 11 — 1978 9 26	319.1	1010	54.9	51.0
1978 9 26 — 1978 11 30	310.7	1050	55.9	51.7
1978 11 30 — 1979 1 21	332.0	1160	56.3	57.5

(year, month, day)

IV. Discussion

As can be seen from Table 2, the deviation between the measured value and the theoretical value is less than 10 percent. The experimental value is higher than the theoretical value by only about 5 percent, similar to the results obtained by many other researchers. For example, the H value obtained from the 1009 rocket[4] (1978-50B) is usually greater than the theoretical value by almost 6 percent but can be as high as 16 percent during magnetic storms. The eleven H values obtained from the HEOS-2 satellite have seven values higher then the theoretical value by 4 percent and the other four values, obtained during a high solar activity period (average solar 10.7 cm radiation flux $F_{10.7} \simeq 165\times10^{-22}$ $Wm^{-2}Hz^{-1}$), are 10-15 percent higher then the theoretical value. These results are consistant with our observation.

The error in H is generally determined by errors in Q or r_p. In our work the value of Q is taken from the smooth fitted curve, we can therefore estimate the average error of H. The average standard deviation of 20 values of e shows an error of 0.41 km relative to the value of r_p, that is, Δ Q has 0.41km of error but the accuracy can be improved by fitting the data to a smooth curve. Since the value of Δ Q is usually 3.2km or so, the relative error in H is therefore approximately 13 percent. This accuracy is not as good as that of the photographic or radar methods but it is considered satisfactory for visual observation data.

The author thanks Liu Yaying [0491 0068 5391] for his assistance.

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CSO: 4008/181

NUMERICAL COMPUTATION OF FULL THREE-DIMENSIONAL FLOW IN TRANSONIC TURBINES

Beijing SHUZHI JISUAN YU JISUANJI YINGYONG [JOURNAL ON NUMERICAL METHODS AND COMPUTER APPLICATIONS] in Chinese No 2, Jun 84 pp 125-128

[Article* by Shen Mengyu [3088 1322 5148] and Zhang Yaoke [1728 5069 4430]]

[Text] Abstract: The scalar integral form of momentum equations in the cylindrical coordinate system is derived by a simple method. The derived equations can be applied to an arbitrary control volume. It is shown that all radial momentum equations in References 2, 3 and 4 miss a term $\iiint_{\tau} \frac{p}{r} d\tau$ or some equivalent term. The influence of the missing term on computational results is discussed by a numerical test. It is also shown that the discrete form (8) of the radial momentum equation in Reference 5 has a wrong sign and cannot be applied to an arbitrary control volume.

I. Introduction

Due to the urgent needs in engineering applications, there is great emphasis in recent years in the research, analysis, and computation of the three-dimensional transonic flow field of shock waves in turbine mechanics, some results have been obtained.

Reference 1 has used time-propelled [?] finite difference method to compute the full three-dimensional transonic flow of an array of blades in a compressor. Perhaps by using the fundamental equations of the differential type to construct the difference equations, 25,000 grid points must be used to insure the required precision, therefore, a large amount of computation time is required.

References 2-4 have used time-propelled [?] finite volume method to compute the full three-dimensional flow of the transonic turbines. Here, one begins with the integral type of fundamental equations to construct the difference equations, to insure that there is conservation property of the difference equation in each time-step. This is especially important in the transonic interval flow, it makes possible the use of a coarser grid and yet still achieving the same precision, consequently, it greatly reduces the required computation time.

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This paper derives the method of integral type of the momentum equations, and it is simpler. It also points out that in References 2-4 the term $\iiint_{\tau} \frac{p}{r} d\tau$ or its certain corresponding term is missing in the radial momentum equations. After numerical checking of the influence of that term on the final results, this paper also points out the errors of the discretized radial momentum equations used in References 5-6.

II. The Derivation of Integral Type Momentum Equations

We examine the constant angular velocity, ω, of the full three-dimensional transonic flow of an inviscid gas with constant specific heat in a turning rotor. We use a cylindrical coordinate system (z, r, θ) consolidated on a moving rotor, then the differential type of continuous equation and momentum equations are established[4]:

$$\frac{\partial \rho}{\partial t} + \frac{\partial(\rho w_z)}{\partial z} + \frac{\partial(\rho w_r)}{\partial r} + \frac{1}{r}\frac{\partial(\rho w_\theta)}{\partial \theta} + \frac{\rho w_r}{r} = 0, \tag{1}$$

$$\frac{\partial w_z}{\partial t} + w_z \frac{\partial w_z}{\partial z} + w_r \frac{\partial w_z}{\partial r} + \frac{w_\theta}{r}\frac{\partial w_z}{\partial \theta} = -\frac{1}{\rho}\frac{\partial p}{\partial z}, \tag{2}$$

$$\frac{\partial w_r}{\partial t} + w_z \frac{\partial w_r}{\partial z} + w_r \frac{\partial w_r}{\partial r} + \frac{w_\theta}{r}\frac{\partial w_r}{\partial \theta} - \frac{w_\theta^2}{r} - \omega^2 r - 2\omega w_\theta = -\frac{1}{\rho}\frac{\partial p}{\partial r}, \tag{3}$$

$$\frac{\partial w_\theta}{\partial t} + w_z \frac{\partial w_\theta}{\partial z} + w_r \frac{\partial w_\theta}{\partial r} + \frac{w_\theta}{r}\frac{\partial w_\theta}{\partial \theta} + \frac{w_r w_\theta}{r} + 2\omega w_r = -\frac{1}{\rho r}\frac{\partial p}{\partial \theta}. \tag{4}$$

Taking equations (2) through (4) individually to combine with equation (1), the following divergent momentum equations may be obtained:

$$\frac{\partial(\rho w_z)}{\partial t} + \operatorname{div}[(p + \rho w_z^2)\boldsymbol{i}_z + \rho w_z w_r \boldsymbol{i}_r + \rho w_z w_\theta \boldsymbol{i}_\theta] = 0, \tag{5}$$

$$\frac{\partial(\rho w_r)}{\partial t} + \operatorname{div}[\rho w_r w_z \boldsymbol{i}_z + (p + \rho w_r^2)\boldsymbol{i}_r + \rho w_r w_\theta \boldsymbol{i}_\theta] = \frac{1}{r}[p + \rho(w_\theta + \omega r)^2], \tag{6}$$

$$\frac{\partial(r\rho w_\theta)}{\partial t} + \operatorname{div}[r\rho w_\theta w_z \boldsymbol{i}_z + r\rho w_\theta w_r \boldsymbol{i}_r + r(p + \rho w_\theta^2)\boldsymbol{i}_\theta] = -2r\rho\omega w_r. \tag{7}$$

Integrating equations (5) through (7) with A as the sealing peripheral boundary of an arbitrary volume τ, and use the Gaussian formula we get the following integral type of momentum equations:

$$\frac{\partial}{\partial t}\iiint_{\tau}\rho w_z d\tau + \oiint_{A}[(p+\rho w_z^2)dA_z + \rho w_z w_r dA_r + \rho w_z w_\theta dA_\theta] = 0, \tag{8}$$

$$\frac{\partial}{\partial t}\iiint_{\tau}\rho w_r d\tau + \oiint_{A}[\rho w_r w_z dA_z + (p+\rho w_r^2)dA_r + \rho w_r w_\theta dA_\theta]$$
$$= \iiint_{\tau}\frac{1}{r}[p+\rho(w_\theta+\omega r)^2]d\tau, \tag{9}$$

$$\frac{\partial}{\partial t}\iiint_{\tau} r\rho w_\theta d\tau + \oiint_{A} r[\rho w_\theta w_z dA_z + \rho w_\theta w_r dA_r + (p+\rho w_\theta^2)dA_\theta]$$
$$= -\iiint_{\tau} 2r\rho\omega w_r d\tau, \tag{10}$$

where $dA_z = dA(\boldsymbol{n}\cdot\boldsymbol{i}_z)$, $dA_r = dA(\boldsymbol{n}\cdot\boldsymbol{i}_r)$, $dA_\theta = dA(\boldsymbol{n}\cdot\boldsymbol{i}_\theta)$, $\boldsymbol{n}$, and $\mathbf{n}$ is the exterior normal unit vector of the differential area element dA.

Comparing with equation (9), it can be known that the radial momentum equations in References 2-4 all lack the term $\iiint_{\tau}\frac{p}{r}d\tau$. The influence of this term in the computational results will be discussed later.

References 5 and 6 yield the discrete form of the integral momentum equations of the radial projection at the differential element control system center, this equation has one more term $\sum pA\cdot i_\theta \sin(\theta-\theta_{MID})$ than in the corresponding equation in Reference 2 (see equation (8) in Reference 5).

It is clearly pointed out in Reference 5 that A designates the interior normal plane element vector. Therefore, **A** corresponds to (-d**An**) of this paper, since d**An** is the exterior normal plane element vector. Hence, $\sum p\boldsymbol{A}\cdot\boldsymbol{i}_\theta\sin(\theta-\theta_{MID})$ should be the result of discretization of the surface integral.

$$-\oiint_{A} p\sin(\theta-\theta_{MID})(\boldsymbol{i}_\theta\cdot\boldsymbol{n})dA$$

Clearly

$$-\oiint_{A} p\sin(\theta-\theta_{MID})(\boldsymbol{i}_\theta\cdot\boldsymbol{n})dA \neq \iiint_{\tau}\frac{p}{r}\,d\tau.$$

Consequently, we know that the radial momentum equations used in References 5 and 6 are different from equation (9) of this paper.

It should be pointed out that the radial momentum equations used in References 5 and 6 contain errors, the explanation is given below: Apply the radial momentum equations of References 5 and 6 on the standard differential element volume as shown in Figure 1 (the volume is formed by the three pairs of coordinate surfaces of the cylindrical coordinate system). Examine only the term

$\sum pA \cdot i_\theta \sin(\theta - \theta_{MID})$: On surface $\overline{12}$, $\mathbf{i}_\theta$ and A have the same orientation (because $\mathbf{i}_\theta$ is pointing at the direction which θ increases, but A is along the internal normal of the surface element, therefore, $(\mathbf{A}\cdot\mathbf{i}_\theta)$ is positive, but $\sin(\theta - \theta_{MID})$ is negative. Since it is on surface $\overline{12}$, then the contribution of the aforementioned pressure effect term is negative. This is certainly not right, since it can be seen in Figure 1 that the projection on the $\mathbf{i}_{r_c}$ direction of the pressure on surface $\overline{12}$ should be positive.

Likewise, on surface $\overline{34}$, $(\mathbf{A}\cdot\mathbf{i}_\theta)$ is negative, but $\sin(\theta - \theta_{MID})$ is positive, hence, as it can be seen in Figure 1, on surface $\overline{34}$, the contribution of the aforementioned pressure effect term is negative, and is clearly incorrect. Besides, it should be pointed out that equation (8) in Reference 5 is not suitable for applications on an arbitrary control volume, but equation (9) of this paper is suitable for an arbitrary control volume.

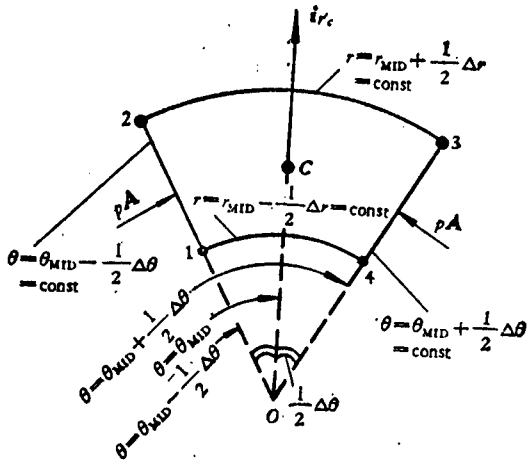

Figure 1.

3. Discretization

In considering the division of grid, the selection of computational elements, and the fundamental form and the amended form as well as the determining method of the flow parameter of the boundary computational points are all the same as in Reference 4. The only difference is the additional term $\left(\frac{p}{r}\right)_{i,j,k}\Delta\tau_{i,j}$ in the radial momentum equation of discretization.

4. Numerical Example

We choose as computational object a radial, vertical blade formed by the cross-section in the moving transonic rotor blade designed by Unit 624, and the objective is to observe the influence of this term ($\iiint_\tau \frac{p}{r}d\tau$) has on the computational results. In this computational example, the hub wall is a cylindrical surface with a semi-apical angle of 20°. The blade height h increases from $2.136L_0$ to $3.288L_0$, where L_0 is the axial width of the blade in the hub.

In order to examine the influence that the missing term $\iiint_{\tau} \frac{p}{r} d\tau$ has on the computational results, we utilize the program written for the aforementioned radial momentum equation and the program written for Reference 4 to individually compute this same example, and the obtained results are simultaneously plotted in Figure 2. It can be seen in Figure 2, in this example, the term $(\iiint_{\tau} \frac{p}{r} d\tau)$ has a larger influence on the Mach number distribution of the back half part of the apical cross-section of the blade.

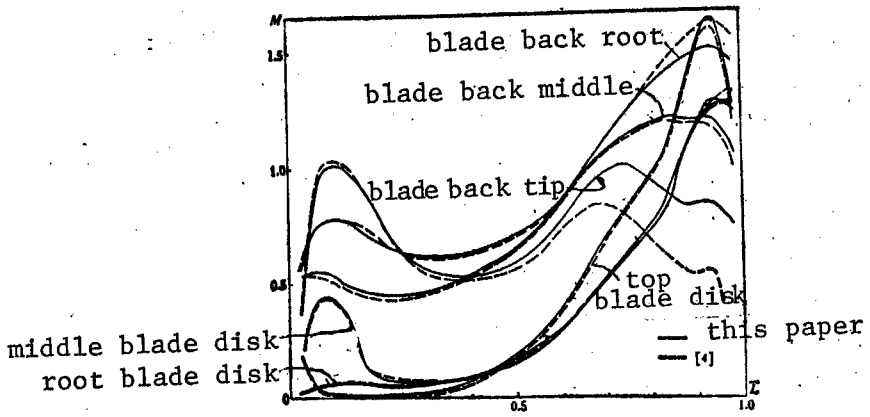

Figure 2. The Influence of $(\iiint_{\tau} \frac{p}{r} d\tau)$ on the Mach Distribution of the Blade Surface

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12744
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APPLIED SCIENCES

CODE OF FINITE ELEMENT ANALYSIS FOR THREE-DIMENSIONAL FLOW IN TURBOMACHINES

Beijing SHUZHI JISUAN YU JISUANJI YINGYONG [JOURNAL ON NUMERICAL METHODS AND COMPUTER APPLICATIONS] in Chinese No 1, Mar 84 pp 38-47

[Article* by Huang Aixiang [7806 1947 7449], Jiaotong University, Xi'an]

[Text] Abstract: The code of finite element analysis based on the arbitrary stream surface theory of three-dimensional flow in turbomachines is presented. The structure of the code and numerical examples using this code are also provided.

I. Fundamental Principles

The upstream function ψ of an arbitrary stream surface, in a turbomachine, obtained by using the semigeodesic coordinate system and tensor analysis tools should satisfy the differential equations[1]

$$\begin{cases} -\dfrac{\partial}{\partial x^{\alpha}}\left(\dfrac{\sqrt{a}}{b\rho}\, a^{\alpha\beta}\dfrac{\partial \psi}{\partial x^{\beta}}\right) + 2\sqrt{a}\,\omega^{3} - f = 0, \\ \dfrac{1}{b\rho}\, a^{\alpha\beta}\psi_{x^{\beta}} n_{\alpha}\big|_{\Gamma_0} = \tilde{g}, \\ \psi|_{\Gamma_s} = \psi_s, \\ \psi|_{\Gamma_{p_2}} = \psi|_{\Gamma_{p_1}} + \dot{G}, \ \dfrac{\partial \psi}{\partial n}\Big|_{\Gamma_{p_2}} = \dfrac{\partial \psi}{\partial n}\Big|_{\Gamma_{p_1}}, \end{cases} \tag{1.1}$$

where

$$f = -\left(\frac{\partial I}{\partial t} - T\frac{\partial S}{\partial t}\right)\Big/ W. \tag{1.2}$$

The stream surface boundary $\Gamma = \Gamma_0 \cup \Gamma_s \cup \Gamma_p$ is formed by flow region inlet/outlet Γ_0, the intersection of the stream and a wall Γ_s, and the artificial boundary Γ_p. And n_{α} is the unit vector covariant component of the exterior normal to the boundary, $a_{\alpha\beta}$ and $a^{\alpha\beta}$ are respectively the covariant component and contravariant component of the stream surface metric tensor, a is the metric tensor determinant, $\dot{G}$ is the internal fluid discharge of the runner, I, T, S are respectively the change in fluid enthalpy, temperature and entropy, γ is the

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unit normal vector of the internal streamline on the stream surface tangential plane, ω is the angular velocity of the revolution of the rotor, w^β is the contravariant component of the normal on its stream surface, W is magnitude of the relative velocity **W** of the fluid, and **W** and the flow function are related as

$$\nabla_\alpha \psi = b\rho\varepsilon_{\beta\alpha} w^\beta w^\alpha = \varepsilon^{\beta\alpha}\nabla_\alpha \psi / b\rho. \tag{1.3}$$

Here, $\varepsilon_{\alpha\beta}$, $\varepsilon^{\alpha\beta}$ are the stream surface determinant tensors, w^β is the contravariant component, and also

$$b\rho W = \sqrt{a^{\alpha\beta}\psi_{,\alpha}\psi_{,\beta}}\,, \tag{1.4}$$

where b is the flow laminar thickness, ρ is the fluid density, and it is related to $|\Delta\psi|$ as below

$$\tilde{\rho}^{\gamma+1} - \tilde{\rho}^2 + kq = 0,\ q \triangleq \nabla\psi \cdot \nabla\psi / b^2 = a^{\alpha\beta}\nabla_\alpha\psi \cdot \nabla_\beta\psi / b^2. \tag{1.5}$$

$\tilde{\rho} = \rho/\rho_t$, $k = (\gamma - 1)/2a_t^2\rho_t^2$, ρ_t and a_s are respectively the stagnant density and stagnant sonic velocity of the reference point.

According to (1.5), it is known that (1.1) is a nonlinear partial differential equation set, after using the discretization of the finite element method, a set of nonlinear algebraic equations is obtained

$$k_{ij}(v)v^j = f_i(v), \tag{1.6}$$

where ν is the parameter to be solved.

Solving the equation set (1.6), the discrete values can be obtained for the upstream function on the stream surface. Then the tensor components and densities of the fluid relative velocity may be obtained by solving (1.3) and (1.5).

II. Implementing the Technique

Since equations (1.1) are self-conjugating, it is beneficial to use the Galerkin procedure. Also, because the equations have uniform form, it is very beneficial to mutually iterate these two types of stream surfaces, and also, the s_1 stream surface is not limited to the surface of revolution.

Since the coefficient and the right-hand side term in differential equations (1.1) require to compute the metric tensors of the stream surface, consequently, according to the stream surface characteristics, the selection of Gaussian coordinate (x^α) is pivotal; we need to resolve the following problems:

1. How to select the surface Gaussian coordinate system, and then to determine the stream surface equations.

2. Due to using the semigeodesic coordinate system and tensor, then the flow function can only compute the tensor components of **W**, consequently it is

required to derive the relationship between the tensor component of **W** and ω are the physical components.

3. How to calculate the natural boundary.

4. How to mutually iterate for the flow solutions of the two kinds of stream surfaces.

In order to resolve the aforementioned four problems, we use the following several questions for discussion.

1) The physical components of **W** under a cylindrical coordinate system and the tensor components of ω under a semigeodesic coordinate system.

If u_i, u^i are the tensor components of a vector **u**, its physical component is designated by U_i, then

$$U_i = u_i / \sqrt{g_{ii}}, \tag{2.1}$$

where g_{ij} is a metric tensor in space. Taking the clindrical coordinate system formed by the angular velocity line ω revolving about z-axis of the cylindrical coordinate system, let $w^{i'}$ be the contravariant component of **W** under the cylindrical coordinate system, then from (2.1) we obtain

$$W_r = w^{1'}, \quad W_\varphi = r w^{2'}, \quad W_z = w^{3'}. \tag{2.2}$$

Set the stream surface equations as given by the following parametric form

$$r = r(x^1, x^2), \quad \varphi = \varphi(x^1, x^2), \quad z = z(x^1, x^2), \tag{2.3}$$

where (x^1, x^2) is the stream surface Gaussian coordinate system, then the semigeodesic coordinate system contravariant component w^i and $w^{i'}$ have the following relationship:

$$w^{1'} = \frac{\partial r}{\partial x^i} w^i, \quad w^{2'} = \frac{\partial \varphi}{\partial x^i} w^i, \quad w^{3'} = \frac{\partial z}{\partial x^i} w^i. \tag{2.4}$$

substituting (2.4) into (2.2), we can obtain

$$W_r = \frac{\partial r}{\partial x^i} w^i, \quad W_\varphi = r \frac{\partial \varphi}{\partial x^i} w^i, \quad W_z = \frac{\partial z}{\partial x^i} w^i. \tag{2.5}$$

and (2.5) is used to solve for physical components of the cylindrical coordinate system from the tensor components in the semigeodesic coordinate system.

It may be proved that the third contravariant of ω in the semigeodesic coordinate system is

$$\omega^3 = r \omega \varepsilon^{\alpha\beta} \nabla_\alpha \gamma \cdot \nabla_\beta \varphi. \tag{2.6}$$

2) The mutual iterations of the two types of stream surfaces.

In the mutual iterations of the two types of stream surfaces, how are the computational stream surfaces s_1, s_2 determined? Suppose that the streamlines are not too twisted in the rotor channels, and no shock waves have been formed, then a system of streamlines may be considered as sheets of stream surfaces. For example, the area bounded by the base to the top along the height of the rotor forms an array system of computational stream surface s_1; and from the blade positive pressure surface to the negative pressure surface forms a computational stream surface s_2.

In the actual computation, we use iteration on five sheets of s_1 stream surfaces and five sheets of s_2 stream surfaces.

1° First take the average of s_2 stream surfaces, using the central plane of the blade as the starting point. After computation choose five streamlines on s_2 to carry out computation, they are designated by the dimensionless net discharge functions $\tilde{G}_1 = \{0, 0.25, 0.5, 0.75, 1\}$. Make projection of these five streamlines on the meridian plane--taking the five meridian streamlines as the generatrix of the given sheets of the stream surfaces s_1, then the revolving surfaces of the initial stream surfaces s_1 are obtained.

2° After computing the flow-through on the initial five stream surfaces, each individually selects five streamlines, and they are designated as $\tilde{G}_2 = \{0, 0.25, 0.5, 0.75, 1\}$. On the five different stream surfaces s_1, the same $\tilde{G}_2$ streamlines form a stream surface s_2, so five stream surfaces of s_2 can be formed.

3° After computing the flow-through on the five s_2 stream surfaces, separately select, according to $\tilde{G}_1$, five streamlines. On the different s_2 stream surfaces, the same $\tilde{G}_1$ streamlines form a stream surface s_1, therefore, five stream surfaces s_1 can be formed.

Repeating such iterations, until the positions of the 25 streamlines are determined.

Each streamline has two functions, i.e., the corresponding discharge functions $\tilde{G}_1$ and $\tilde{G}_2$. The 25 streamlines are determined by $\tilde{G}_1 \otimes \tilde{G}_2$. When one junction is fixed, varying the other junction will form a stream surface. Then, how can stream surface equations be determined from streamlines?

The average stream surface s_2 is given, and the initial stream surface s_1 is a revolving surface, determined by the meridian streamlines. The stream surface equations of the later iteration process are

$$r = r(x^1, x^2), \quad \varphi = \varphi(x^1, x^2), \quad z = z(x^1, x^2)$$

where the parameters (x^α) are determined as below, and the stream surfaces s_1 are no longer revolving surfaces.

x^1. The streamline's corresponding arc length (dimensionless net), that is, the ratio of the arc length of the point on each streamline to the arc length of the entire streamline. Therefore, it is the position of the determining point on the streamline, and $0 \leqslant x^1 \leqslant 1$.

x^2. It is a dimensionless net discharge, and it is the determining function on the streamline on a stream surface. For example, the five streamlines on s_1 are determined by $\tilde{G}_1 = \{0, 0.25, 0.5, 0.75, 1\}$.

Consequently, for a certain determining x^2, there is a set of streamline equations

$$r = r(x^1), \quad \varphi = \varphi(x^1), \quad z = z(x^1).$$

While varying x^1, a suitable set of surface equations is formed:

$$r = r(x^1, x^2), \quad \varphi = \varphi(x^1, x^2), \quad z = z(x^1, x^2), \quad 0 \leqslant x^1, x^2 \leqslant 1.$$

For example: For the revolving surface s_1, take $(x^1, x^2) = (m, \varphi)$, where m is the generatrix arc length. For stream surface s_2, take $(x^1, x^2) = (z, r)$, and the stream surface equation of s_2 is expressed as $\varphi = \varphi(z,r)$.

We use a two-dimensional spline smooth-fit method to find stream surface equations.

3) Computation of natural boundary conditions

Let Q be the flow region of stream surface. Its peripheral boundary of the upstream flow that is sufficiently far away is called an inlet, and at its downstream is called its outlet. Then the inlet/outlet boundary $\Gamma_0 = \Gamma_{in} \cup \Gamma_{out}$, the peripheral flow region of the stream surface s_2 is also the inlet/outlet. The upper and lower boundaries of stream surface s_1 may be classified by two types, one is the rotor blade wall, and the other is the artificial dividing surface, and they satisfy the periodicity conditions. The upper and lower boundaries of stream surface s_2 are both walls, i.e., wheel disk lines and wheel lid lines, as shown in Figures 1 and 2.

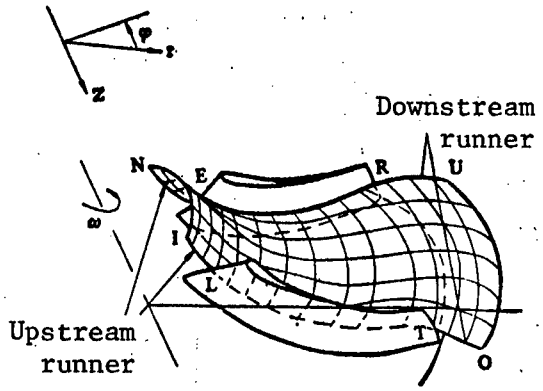

Figure 1. s_1 Corresponding Stream Surfaces

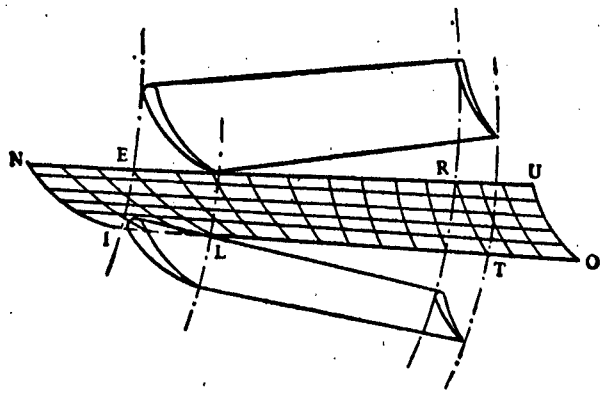

Figure 2. s_2 Corresponding Stream Surfaces

It is known from (1.1) that at inlet/outlet there is a natural boundary condition

$$\frac{1}{b\rho}\, a^{\alpha\beta}\frac{\partial\psi}{\partial x^{\beta}}\, n_{\alpha}|_{\Gamma_0} = \tilde{g},$$

where the $\tilde{g}$ of inlet is designed by g_{in}, and, for the outlet is at g_{out}.

Our task is to find g_{in} and g_{out} of the hypothesized inlet/outlet under homogeneous conditions. It should be pointed out that $\tilde{g}$ is an invariant,[3] that its value does not change in any coordinate system.

We get, utilizing $n_1 = \mp\sqrt{a/a_{22}}$, $n_2 = 0$[3],

$$\begin{cases} g_{in} = \dfrac{1}{\rho\sqrt{aa_{22}}}\dfrac{\dot{G}}{\Delta x_{in}}(a_{12}+a_{22}x)_{\Gamma_{in}}, \\ g_{out} = \dfrac{1}{\rho\sqrt{aa_{22}}}\dfrac{\dot{G}}{\Delta x_{out}}(a_{12}+a_{22}x)_{\Gamma_{in}}, \end{cases} \tag{2.6}$$

where $\Delta x_{in} = x_n^2 - x_i^2$, $\Delta x_{out} = x_u^2 - x_0^2$, $x = w^2/w^1$.

If the inclination α of the meridian streamline is known, then, using

$$\tan\alpha = \frac{W_r}{W_z} = \frac{r_{x^1}w^1 + r_{x^2}w^2}{z_{x^1}w^1 + z_{x^2}w^2} = \frac{r_{x^1} + r_{x^2}x}{z_{x^1} + z_{x^2}x}$$

we get

$$x = -\frac{r_{x^1} - z_{x^1}\tan\alpha}{r_{x^2} - z_{x^2}\tan\alpha}. \tag{2.7}$$

If the inlet-outlet flow angle β is known, then, from

$$\tan\beta = \frac{W_{\varphi}}{\sqrt{W_r^2 + W_z^2}}$$

we get

$$\begin{aligned} x = \{ & r^2\varphi_{x^1}\varphi_{x^2} - (r_{x^1}r_{x^2} + z_{x^1}z_{x^2})\tan^2\beta \\ & + \tan\beta[r^2(r_{x^2}\varphi_{x^1} - r_{x^1}\varphi_{x^2})^2 + (z_{x^2}\varphi_{x^1} - z_{x^1}\varphi_{x^2})^2] \\ & - \tan^2\beta(r_{x^2}z_{x^1} - r_{x^1}z_{x^2})^2\}^{1/2}/[r^2\varphi_{x^2}^2 - (r_{x^2}^2 + z_{x^2}^2)\tan^2\beta]. \end{aligned} \tag{2.8}$$

4) Using the flow function to solve for the magnitudes of density and velocity.

If the angular velocity ω, rotation λ, the universal constant R of the gas, the flow laminar thickness b, specific heat ratio γ, specific heat c_p under constant pressure, inlet stagnation temperature T_s, and inlet stagnation density ρ_s are

known, then ρ and W are both functions of W. Although the flow function ψ and, ρ and w^{β} are related by equation (1.3), but ρ and W cannot be directly obtained, after ψ is solved.

Under the condition of equal entropy flow we have

$$\begin{cases} \left(\frac{\rho}{\rho_s}\right)^{\gamma-1} = \frac{T}{T_s}, \\ \frac{T}{T_s} = 1 - \frac{W^2 + 2\omega\lambda - (\omega R)^2}{2c_p \cdot T_s}, \end{cases} \tag{2.9}$$

therefore,

$$\rho = \rho_s \left(1 - \frac{W_2 + 2\omega\lambda - (\omega R)^2}{2c_p \cdot T_s}\right)^{1/(\gamma-1)}. \tag{2.10}$$

It is known from (1.4) that $\rho W = \sqrt{a^{\alpha\beta}\psi_{x^\alpha}\psi_{x^\beta}}/b$, consequently ρW can be computed, designated as $\hat{\rho W}$, after ψ has been solved. Then, from (2.10), we get

$$\widehat{\rho W} = \rho_s W \left(1 - \frac{W^2 + 2\omega\lambda - (\omega R)^2}{2c_p \cdot T_s}\right)^{1/(\gamma-1)}. \tag{2.11}$$

Equation (2.11) is a nonlinear algebraic equation, we may use the Newton iteration method to solve for W, and its iterative form is

$$W_{n+1} = W_n + (\widehat{\rho W} - W_n \cdot \rho(W_n)) \Big/ \frac{d\widehat{\rho W}}{dW}\Big|_{W_n}, \tag{2.12}$$

where

$$\frac{d\widehat{\rho W}}{dW} = \rho_s \left(1 - \frac{W^2 + 2\omega\lambda - (\omega R)^2}{2c_p \cdot T_s}\right)^{1/(\gamma-1)} - \frac{\rho_s W^2}{(\gamma-1)c_p T_s}\left(1 - \frac{W^2 + 2\omega\lambda - (\omega R)^2}{2c_p \cdot T_s}\right)^{(2-\gamma)/(\gamma-1)}.$$

Usually $W_0 = \hat{\rho W}/\rho_s$ is taken as the initial value.

After using iterative form (2.12) to solve for W, and ρ may be obtained from (2.10).

III. The Capabilities and Structure of the Program

According to the above theory, we have coded a general program. The program is suitable for use with an arbitrary form of turbomachinery engine, be it radial flow, axial flow, mixed flow compressor or turbine engine.

This program applies finite element method to the differential equations (1.1), the elements used as parameters are the quadrilaterals with eight nodal points. The finite element grid information is automatically generated: the grid information including the total numbering of nodal points of the element and the partial coding reference table, the actual coordinates of the nodal points, the information on the boundary points, etc.

The program is written in both FORTRAN IV and in the 6912 programming languages.

The program is capable of computing the values for inviscid compressible and incompressible subsonic three-dimensional flow fields. It is suitable for use on arbitrary stream surfaces, whether they are s_1 or s_2 stream surfaces or neither s_1 nor s_2 arbitrary stream surfaces, including warped stream surfaces conditions. It can be used to compute for a system of s_1 stream surfaces and a system of s_2 stream surfaces.

The program has three major modules: 1) the preprocessing part, 2) the kernel, and 3) the post-processing part.

Preprocessing Part. This includes data input, such as inputting some gas constants, angular velocities, stagnation temperatures, stagnation densities, number of blades, the inter-blade intercepts, the dihedral angles formed by the stream surfaces and the meridian surface, the leading edge and trailing edge flow angles, etc. It also includes the required processing information for the various generated stream surface computations, and the required data for the "kernel" that is generated after various transformation processings.

Kernel. The matrix calculations of cell stiffness, the matrix superposition of the total stiffness, the solution for the system of nonlinear finite element equations, and the mutual iterations of the types of stream surfaces.

Post-processing Part. It uses the results obtained by the "kernel" to produce the required information for the process. For instance, the velocity distributions of the flow field, positions of the streamlines, density distributions, etc.; and simultaneously it needs to decide whether it is necessary to compute multistream surface conditions, and thus produce varied information exchange forming equations and metric tensors of a stream surface.

Due to the linearities of the differential equations, the system of finite element equations is a system of nonlinear algebraic equations, and its solution must use the iterative method of linear equations to approximate the nonlinear equations. Since the nonlinear term relates the densities and flow functions in (1.5), then the method and technique used to solve for densities have very profound influence on whether the iteration is convergent and on the speed of convergence.

IV. Input and Output Variables, and Program Segments

1. Table of Variables in the Program

Input Variables

GAM	γ	specific heat ratio of a gas
AR	R	universal constant of a gas
OMGA	ω	rotor rotational velocity, in arc degree/sec
TIP	T_s	inlet stagnation temperature, °K
RHOI	ρ_s	inlet stagnation density, kg/m^3
WTFL	$\dot{G}$	the flow rate in each layer between each two blades within the runner, kg/sec, m
BELE	B_{1e}	blade leading edge flow angle, in degrees
BETE	B_{te}	blade trailing edge flow angle, in degrees
NEL		number of blades
IML		number of grid stations from the inlet to the leading edge
IMR		number of grid stations from inlet to trailing edge
DO	$\Delta\varphi$	the intercept between the stream surface blades while computing for stream surface s_1, an arbitrary number may be taken in the computation of stream surface s_2
DRIN, DROU		the coordinate differences Δr_{in}; Δr_{out} of the inlet/outlet r while computing stream surface s_2, when computing for stream surface s_1 an arbitrary number may be taken
AIN, AOU		the respective dihedral angles α_{in}, α_{out} formed by the stream surface s_2 inlet and outlet with the meridian surface

For slewing surface s_1.

XU(2n + 1)	the nodal point coordinate of the generatrix of arc length m on the slewing surface
RM(2n + 1)	} respective generatrix equation for $r = r(m)$ } value of discrete point
ZM(2n + 1)	} for $z = z(m)$ }
BM(2n + 1)	flow laminar thickness, b = b(m) value of discrete point
YB(2n + 1), YU(2n + 1)	the φ coordinates of the upper and lower boundaries

For nonslewing surface s_1.

RR(NG)	} respective stream surface equation for $r = r(m, \varphi)$ } value of discrete point
ZZ(NG)	} $z = z(m, \varphi)$ }
BB(NG)	flow laminar thickness, b = b(m, φ) value of discrete point
QQ(2, 2n + 1), PP(2, 2n + 1)	the $(x^1, x^2) = (m, \varphi)$ coordinates of the upper and lower boundaries

For stream surface s_2.

ZTA(NG)	stream surface equation, $\varphi = \varphi(z, r)$ value of discrete point
BB(NG)	flow laminar thickness, b = b(z, r) value of discrete point
QQ(2, 2n + 1), PP(2, 2n + 1)	the $(x^1, x^2) = (z, r)$ coordinates of the upper and lower boundaries

The sets of data related to the application of finite element method.

IC(8), IE(8) the natural coordinates of parametric element nodal points of 8-nodal point quadrilaterals, etc.
HX(3), HG(3) the coordinates and exponential number of Gaussian integral point
FO(NG) initial discrete value of the flow function
ROQ(NG) initial discrete value of flow field density

Resultant Data

CPTIP $2c_p T_s$
EXPON $1/(\gamma - 1)$
GAMR $2\gamma R/(\gamma + 1)$
CP $\gamma R/(r - 1)$ gas specific heat under constant pressure
PITCH s expansion angle between blades, arc degree
LAMD λ gas inlet rotating degree
BEIN, BEOU β_{in}, β_{out} inlet/outlet flow angle, may be input data
WLE, WTE w_{le}, w_{te} average corresponding velocities of blade leading and trailing edge
WCRL, WCRT w_{CRle}, w_{CRte} boundary velocities of blade's leading, trailing edge average densities
ROI, ROT ρ_{in}, ρ_{out} inlet/outlet average densities
ROLE, ROTE ρ_{le}, ρ_{te} blade's leading, trailing edge average densities
RWLE, RWTE $\hat{\rho W}_{le}$, $\hat{\rho W}_{te}$ blade's leading, trailing edge average flow rates
RWMLE, RWMTE blade's leading, trailing edge maximum flow rates
PIN integral value of pressure along the blade surface

Resultant Arrays

II(8,LEE) partial coding of the element's nodal points and total coding reference tables
XY(2,NG) actual coordinates of finite element grid points
IBE(NE), AE(NE) coding of wall boundary points, and their functional values
IP(2,NE1) the coding (j,i) which satisfies the periodicity condition, $j < i$
AQ(2,NE1) the (α, Q) which satisfies the periodicity condition $\alpha x_i = x_j + Q$
SFM(2n + 1, NI), SFT(2n + 1, NI) } the respective m, φ coordinates of the spline points on the NI streamlines
SM(2n + 1, NI) spline arc length of the NI streamline
SFU(NI) value of the flow function on the NIth streamline
F(NG), AM(NG) value of the flow function at the finite element grid point, and relative velocity
RO(NG), WW(NG) finite element grid point density and relative velocity
PU(NG), TEM(NG) finite element grid point pressure and temperature
BET(NG), ARG(NG) grid point flow angles β, α of a finite element
ROS(2n + 1, NI) discrete points relative velocities on NI streamlines
WS(2n + 1, NI) relative velocity of discrete points on NI streamlines
PUS(2n + 1, NI) pressure of discrete points on NI streamlines
TEMS(2n + 1, NI) temperature of discrete points on NI streamlines

2. Subroutines and Their Functions

This program has 28 program segments, there is a main segment and the rest are subroutines, and the function of each subroutine is described below:

Preprocessor Subroutines

INPUT	the subroutine to input the original information
OUTPUT	the subroutine to output the resultant information
PRECAL	the subroutine to calculate constants such as s, λ, β_{in}, β_{out}, etc.
MTC	the subroutine to calculate stream surface metric tensors $a_{\alpha\beta}$ and $a^{\alpha\beta}$

Finite Element Method Subroutines

IFG	the subroutine automatically generated by the information of finite element grid
GKD	the subroutine of total stiffness matrix formed by one-dimensional determinant of main diagonal element addresses and the computation of the length of total staff matrix
QEB	the subroutine to solve differential equations by finite element method
SH	the subroutine to calculate the shape function and the single-value derivative of the shape function with respect to the natural coordinates
SHA	the subroutine to calculate the shape functions at integration points and their single-value derivatives
SHJA	the subroutine to calculate the values of Jacobi determinant at integration points
PXY	the subroutine to calculate the value of derivatives of the shape function with respect to actual coordinates
GF	the subroutine to calculate elements of an elementary array
GK	the subroutine to calculate elements of elementary stiffness matrix
COD	the subroutine to generate cell information
AK	the subroutine of total stiffness matrix formed by superposition of elementary stiffness determinants

Subroutines To Process Boundary Conditions and To Solve System of Equations

SLA	the subroutine to solve a system of linear algebraic equations with direct method
BDE	the subroutine to process the forced boundary conditions
PER	the subroutines to process the periodic boundary conditions
SPLine	interpolation subroutine
SPL	the subroutine with triple spline interpolations
SPI	the subroutine to use spline interpolation formula to solve the functions of interpolation points and the single-valued derivative
SPLI	the subroutine for block interpolation
SPLT	the subroutine to solve for spline point integral

Subroutines for Flow Field Analysis

DENSTY	the subroutine to solve for flow field densities
VELCAL	the subroutine to solve for flow field relative velocities
STLI	the subroutine to solve for densities, velocities, and streaming angles of all formed streamlines
THIN	the subroutine to calculate the thickness of the central runner, using the known streamline arc of the spline points

The Total Scheduling Subroutine

QEP	includes the categories of decision stream surfaces, and the required information of the types of stream surfaces formed by two kinds of recursive interacting stream surfaces

V. Computational Examples

This program was applied individually to a Gostelow cascade and a T1102 blade turbine cascade to carry out computations for logarithmic spiral compressor flow field, and the reverse twisted jetting ring shape rigidity center s_2 stream surface flow field, etc. The computational results and precision solution or experimental curves are comparatively very closely matched.

The T1102 cascade is formed by plane cascades made by an array of Model 1102 of a Siemens Industry steam turbine. The characteristics of those blades are: their leading edge radii are particularly large, the blades are thicker, the cascade parameters for computation are $\bar{t} = 0.7996$ and $\beta_y = 59.7$, and the computational conditions are $\beta_1' = 50°$ and $M_{2t} = 0.503$. Figure 3 shows the pressure distribution curve along the model surface, the surface loss function ξ_{np}, the computational result of the outlet air flow angle and the experimental results. The computational results show that at the region with comparatively large inlet angle of attack the degree of coincidence between the pressure distribution curve and the experimental points is quite satisfying.

The program has been used to calculate the A • R • C • N_0 • 3 blade model cascade. Figure 4 shows the results of computations, where the calculated values of gas discharge angles and the loss on the model surface also coincide with the experiment.

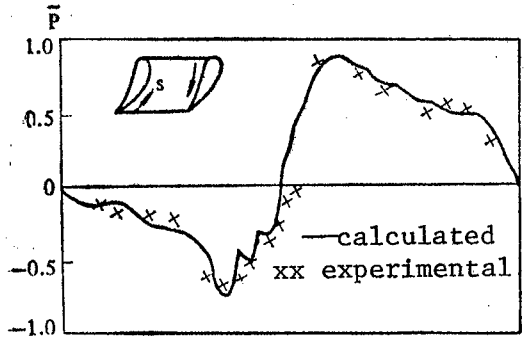

Figure 3. Plane Cascade Pressure Distribution Along Profile Surface for Profile 1102 $\bar{t}$ = 0.7996 $\beta_y = 59.7°$

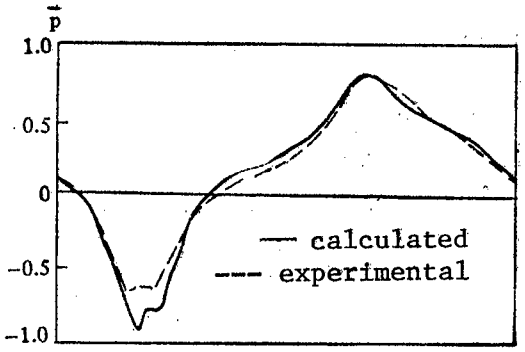

Figure 4. Pressure Distribution Along the Surface of an A • R • C • N_0 • 3 Profile

In the incompressible Gostelow cascade, we compare the results of theoretical solution with computations from this program and the calculations using difference method, Figure 5 shows the results of the leading and trailing edge finite element calculation are better than those obtained by difference method. The computed curves match well with the precision solutions.

Figure 6 shows the comparison between the finite element solution of logarithmic spiral compressor internal flow and the theoretical solutions under different Mach numbers. As seen in the figure, the error in solution increases with the increase in Mach number. This is the same with theoretical analyses.

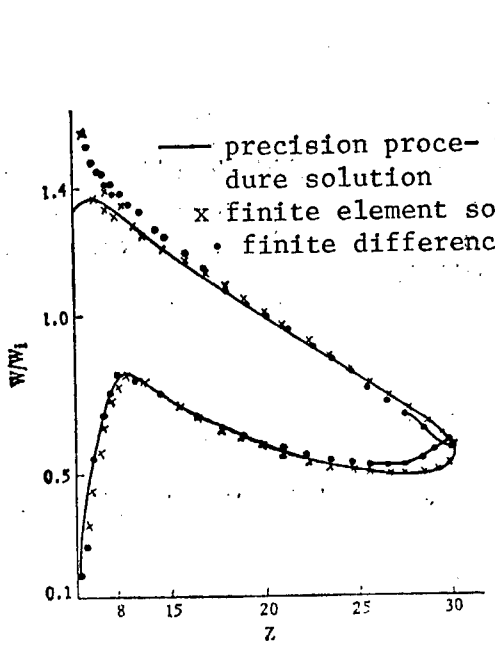

Figure 5. Profile Surface Pressure Distribution, Using Gostelow Precision

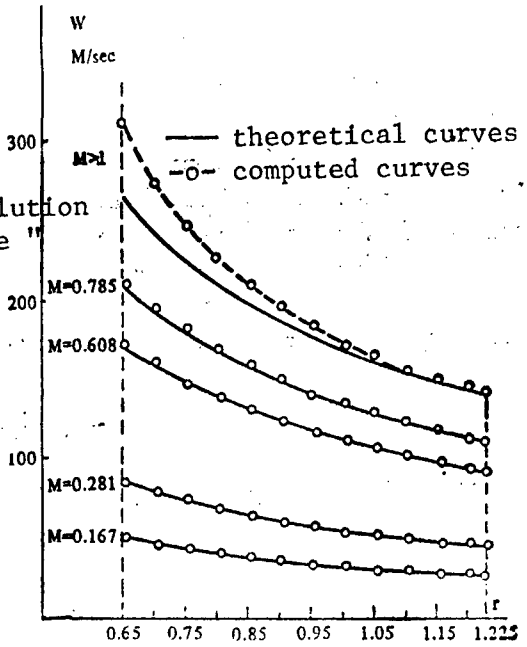

Figure 6. Flow Velocity Distribution in a Logarithmic Spiral Compressor

This program requires very little input information, it only needs to input a few simple geometrical measurements and physical parameters, and a large amount of finite element grid information are also generated by the program. The time required to calculate the flow field of a stream surface varies with Mach number. At low Mach number, 220 seconds of CPU time are required, and over 400 seconds of CPU time are required above 0.6 Mach.

Since the encoding in 1977, this program has been modified extensively three times, people inside and outside our school have been continuously using it on Siemens 7760 and DJS-18 computers. In 1980, training classes were conducted to broaden its use, and the source code had been supplied to related organizations.

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BRIEFS

COMPUTER TECHNOLOGY LEADING GROUP ESTABLISHED--In an effort to carry out the spirit of the National Computer and Integrated Circuit Planning Conference, the Party organization of the Ministry of Railways recently called a meeting to establish a computer technology leading group for the Ministry of Railways. The meeting also established a goal for the computer standards of China's railways to reach the current standards of advanced capitalist countries by the 1990's. The chairman of the computer technology leading group is Deputy Minister of the Ministry of Railways, Zhang Xintai [1728 6580 3141]. Under the direction of the Party organization of the Ministry of Railways, the group serves as a decision-making and guidance organization for developing computer applications. Its mission is to establish practical plans and implementation procedures for using computers in railways based on national policies, plans and regulations. It also provides guidance and encouragement, monitors the status of implementation, and coordinates the work of individual units. [Text] [Beijing JISUANJI SHIJIE [CHINA COMPUTER WORLD] in Chinese No 13, 5 Jul 83 p 1] 3012

TENTH ANNIVERSARY OF DJS-100 SERIES--The DJS-100 series is the first minicomputer series developed and produced in China. At the end of 1982, nearly 1,000 units had been installed and were in use by a wide range of financial organizations; the series had made important contributions to the development of the computer industry and to the growth of the national economy. In order to consolidate all the experiences and lessons learned, and to further promote the development of the DJS-100 series computers to meet the needs of the four modernizations, the Bureau of Computer Management of the Ministry of Electronics Industry decided to celebrate the 10th anniversary of the DJS-100 computer series in Beijing during November of this year. As part of the celebration, a variety of activities to provide exchange of technical experiences will be organized; future development of the DJS-100 series and suggestions for further improvements will also be discussed. The celebration activities are being prepared under the direction of the Bureau of Computer Management of the Ministry of Electronics Industry. The coordination unit of the organization is located in the office of the Chinese Computer Users' Association. [Text] [Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 13, 5 Jul 83 p 2] 3021

JIFS MICROCOMPUTER DATABASE--The research office of computer system structure of the Jinan University in Guangzhou recently developed a JIFS microcomputer data base which has been implemented and used on the IBM 5150 personal computer.

The JIFS database system is a small database system specially designed for microcomputers. It is written in the IBM 5150 BASIC language; it has a simple and compact structure, and is flexible to use and easy to expand. It can perform such functions as search, edit, and tabular output of data records based on the common requirements of many key words. It can also perform other functions such as searching for pictorial and written information in foreign languages, and data base management. It is a very practical data base system. [Text] [Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 13, 5 Jul 83 p 1] 3021

SUPER-86 MICROCOMPUTERS AT MAJOR PORTS--The Bureau of Statistics of the Ministry of Communications had installed SUPER-86 microcomputers at the harbor bureaus of China's major ports. Recently, the Bureau and the Computer Application Research Office of the Ministry jointly sponsored a SUPER-86 microcomputer training course. The course covered certain aspects of the hardware structure and the operating system; but the emphasis was on using the BASIC language to perform statistical analysis of harbor management information. A number of programs of various sizes were written and tested on the computer to provide a basis for calculating statistics on harbor shipping data. Currently, the Office of Computer Application of the Ministry is cooperating with the Dalian Harbor to install data processing systems on the WANG computer for processing cargo delivery papers and loading and unloading work orders. [Text] [Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 13, 5 Jul 83 p 8] 3021

SHIPYARD MICROCOMPUTER APPLICATIONS -- The Hudong Shipyard Research Institute in Shanghai employs a group of 12 recent university graduates in their mid-twenties who are responsible for developing computer applications. This group of "Communist Youth", who graduated in the 80s, has come up with 24 suggestions both large and small for improving plant productivity. Since joining the shipyard in 1982, they have seriously studied computer technology with the assistance of the management in order to come up with even better ways of using microcomputers. None of these students had majored in computer science, and they had only a rudimentary knowledge of this field. After hours they studied and used the reference manuals supplied with the three microcomputers imported by the Research Institute in order to master the techniques, and they wrote much software of very general utility. After Hou Fangyan [0186 2455 5888] in the Structural Laboratory got bitten by the computer "bug", he couldn't take himself away from the plant but remained working until late at night. Worker productivity was greatly increased by the five applications programs he worte. Zhang Hong [4545 3163] solved two problems concerning the construction of naval vessels by using a computer to exhaustively analyze an enormous amount of data and select the optimum solution in only roughly 10 hours, as opposed to the year of work that would have been required had the calculations been done by hand. [Text] [Shanghai WEN HUI BAO in Chinese 2 May 84 p 1] [Atricle by reporter Wang Baolai [3769 1405 0171] and correspondent Fan Guoyong [5400 0948 2837]: "Twelve University Students Recently Joined the Hudong Shipyard; Microcomputer Applications Strenuously Promoted"] 12617

SHANGHAI LASER INSTITUTE'S TEM_{00}-CO_2 LASER--The Shanghai Laser Institute recently developed a 100 watt continuous single mode TEM_{00}-CO_2 laser. The laser uses a sectional longitudinal discharge method and is totally sealed. The unique features of the laser include a high quality light beam and a high output power density. The divergence angle is 2mr and the power density may reach $3x10^5$ W/cm^2 after focusing by a 50 mm focal length lens. Such power density is difficult to achieve even in multimode 500 W CO_2 lasers. The new laser has good potential for industrial applications and may be used in the cutting and hole-making in wood, leather, glass, and other nonmetallic materials. It may also be used to cut and weld thin metal plates. The newly developed laser has a simple structure, is inexpensive to build and has a long service life; it should be exploited and promoted. [Text] [Shanghai YINGYONG JIGUANG [APPLIED LASER] in Chinese Vol 5, No 1, Feb 85 p 42] 9698

COMPUTERIZED CADRE FILES--Input a person's name in code into the computerized inquiry system and after a few seconds, detailed and accurate information concerning this person is printed out. This is the latest result of the Anshan Iron and Steel Company using the "WANG 2200 MVP" computer for managing technical cadre files. The Anshan Iron and Steel Company has over 10,000 technical cadres of middle specialist and above. In the past, each cadre status survey required a great deal of manpower and resources, took one or two months, and at that the survey results were not sufficiently precise. Last summer, to modernize file management, the Anshan Iron and Steel Company began research on using a computer to manage personnel files with preliminary success. The language-programming Chinese-character output program which this system uses can store, revise, add or subtract, do statistics, and print. The entire 13 types of report forms totalling 36 pages can be printed out in only 50 minutes. Statistics and classifications of 10,000 files can be completed in 3 hours. [Text] [Shenyang LIAONING RIBAO in Chinese 16 Jan 84 p 1] 8226

SMELTING RESULTS FROM USING COMPUTERS--The Anshan Iron and Steel Company actively spreads and applies the results of new technology. Forty-seven computers are being used in control of such production processes as steel smelting and rollng and in such tasks as enterprise management and scientific research with obvious results. The Anshan Iron and Steel Company's cold rolling plant has applied electronic computers to automatic control of bell-type furnaces so that the rate of first-grade product has gone from 94 percent to 97 percent; in that year the increased economic income made up for the 900,000 yuan investment in computers. The Anshan Iron and Steel Company's First Preliminary Rolling Plant applied computers to automatically control the temperature of 6 soaking furnaces which lowered the rate of waste by 40 percent and obtained clear results in energy saving and was praised as an advanced, energy-saving furnace. [Text] [Shenyang LIAONING RIBAO in Chinese 7 Feb 84 p 1]

COMPUTER USE IN ANSHAN CITY--There are 6 firms and 43 units in Anshan City which are actively using computers with excellent results. According to statistics from relevant departments, at present there are 164 computers in Anshan City applied to industrial control, scientific calculations, data processing, enterprise management, automatic plotting, medicine, and teaching. The 6 soaking furnaces of the Anshan Iron and Steel Company's

First Preliminary Rolling Plant use computers and have cut the rate of waste by more than 40 percent. In 1983, the 6 soaking furnaces reached advanced energy-saving furnace standards, and furnaces 3 and 4 were designated advanced furnaces by the Ministry of Metallurgical Industry. In February 1982 and October 1983, the Municipal People's Bank used microcomputers for accounting at its branch offices in Lishan and Tiexi and now 98-99 percent of the accounting (approximately 5,000 accounts daily) at these two branch offices are handled by computer. The Tiexi Hospital in Anshan Iron and Steel Company introduced the liver disease diagnostic and treatment process of Dr Guan Youlan [7070 1635 5695] of the Beijing College of Traditional Chinese Medicine, and in using the computer for diagnosis, the rate of accuracy reached 95 percent and over 2,200 patients have been treated. [Text] [Shenyang LIAONING RIBAO in Chinese 3 Mar 84 p 2] 8226

CSO: 4008/257

MINISTRY CALLS FOR IMPROVEMENT IN HEALTH WORK

OW050945 Beijing XINHUA in English 0852 GMT 5 May 85

[Text] Beijing, May 5 (XINHUA)--China has officially approved a policy of encouraging qualified medical practitioners to supplement government health services.

Individual practitioners, including retired medical workers and herbal doctors who have passed government examinations, will be encouraged.

These points are contained in a Public Health Ministry report which has been approved by the State Council.

The report, which appears in today's "JIAN KANG BAO" (HEALTH NEWS), calls for efforts of all quarters to improve the country's health work.

It stresses the need for both central and local authorities and government departments to set up medical and health institutions. Hospitals and clinics run by industrial and transport enterprises and other institutions should also be open to society at large, the report says.

Health institutions run by collective economic organizations and street committees in urban areas will continue receiving government subsidies, on condition that they fulfill the government-assigned tasks for prevention and treatment of diseases.

Such subsidies, the report adds, should be used mainly for personnel training.

Doctors, nurses and midwives in active service are now allowed to offer services in their spare time. Earnings from such services go entirely to the providers themselves, but deductions will be made if public medical apparatus are used.

The report calls attention to the fact that peasants are demanding better medical services along with improvement in living standards.

While doing a good job of running county and township hospitals and clinics, the report says, authorities should help rural collectives and individuals run medical services.

In more developed areas, the report says, local governments and people are encouraged to pool their financial resources to start hospitals or medical schools.

Students in such schools should go back to where they come from to serve their own folks, the report says.

CSO: 4010/135

MILITARY NAVIGATION MEDICINE'S ROLE IN MODERNIZATION OF PLA NAVY

Beijing JIEFANGJUN YIXUE ZAZHI /MEDICAL JOURNAL OF CHINESE PEOPLE'S LIBERATION ARMY/ in Chinese No 1, 20 Feb 85 pp 64-66

/Article by Liu Jingchang /0491 2529 2490/: "Tasks of Military Navigation Medicine and Its Role in the Modernization of Navy"/

/Text/ Military navigation medicine is an applied science, whose objectives are to ensure the personnel's safety, health and to maintain their good operating ability and efficiency while operating, training, fighting and living under the special circumstances of being at sea (including at sea surface, underwater, at sea bottom and on board). It clarifies the laws governing body's adaptive reactions to extraordinary environmental factors, looks for tolerable safety limit and formulates standards and regulations accordingly, provides measures for abolishing the effects harmful factors have on human body in order to maintain and raise the fighting ability of navy personnel. Military navigation medicine is established on the basis of theories and methodologies of general fundamental and clinical medicine. It applies these theories and technologies to the enclosed environment of ship and to the condition of submerged operation. It has become a new discipline and is playing an increasingly important role in the modernization construction of navy.

Naval soldiers and other personnel performing their duty at sea fight, train, operate and live under extraordinary environment with sophisticated equipment. The situation creates a series of problems that urgently need to be solved. Examples are the environmental medical hygiene of ship (including the control of high temperature, high humidity, noise, and toxic gas as well as nutrition, food and water supply during submerged or long-range navigation), diving medical protection, submarine medicine and sub personnel's escape to safety, hygienic logistical support and rescue and treatment at sea, navigation sickness and naval epidemics, radiation protection of nuclear-powered ships, chemical protection of navy troops and naval aviation medicine. With the rapid advancements of naval construction, more new materials, new technologies and new equipment will be employed in new ships and it is certain that there will be new problems in the area of naval military medicine. For example, the effects of microwave, electromagnetic radiation, laser, subsonics and material toxicity need to be studied and handled. The creation of new type nuclear-powered submarines and ships has greatly enhanced the self-sustaining capability of these ships. There is no doubt that the submerged

and long-range navigation of 30-90 days or even longer have become reality. This has added many complicated yet urgent problems in military navigation medicine.

As a result, the tasks of military navigation medicine are not only to guard the safety and health of personnel and to ensure the normal operation of ship personnel under extraordinary circumstances, but also to establish and maintain the advantage and high working efficiency of the overall man-machine-environment system, to raise troop's fighting ability and to realize the full potential of weapons and equipment. The latter is exactly the need of military operation at sea and is particularly essential under the conditions of long-range navigation at sea and inhabiting in the sophisticated-ly equipped ships. In summary, it shoulders the following tasks:

1. To study and formulate qualifications and special physical examination methodologies for the navy's specialized troops such as submarine personnel, divers, deep sea divers, amphibian troops and marines; to provide medical and hygienic protection measures for the above mentioned personnel during their training and operation at sea so as to meet the requirements that they are in good physical shape under this kind of extraordinary environment and to assure their safety.

2. To study and formulate medical protection measures during navigation. Examples are the study of food and water supply for long range navigation; monitor and elimination of toxic gases and materials; control of temperature, humidity, gas composition, and noise in enclosed environment in order to main-tain comfortable living condition for navigation.

3. To study and formulate ship's medical and hygienic standards. Examples are submarine's permissible concentration of toxic gas pollution and its hygienics standards; food nutrition and water supply sanitation standards; standards for temperature, humidity, illumination, noise and vibration hygienics, safety threshold value of shock wave pressure; safety standards of chronic low-dosage ionization radiation and microwave radiation; hygienic standards for ship habitation.

4. To study and formulate medical protection plans and safe decompression systems for divers undergoing various underwater operations; to supply prescrip-tion of physiologically compatible respiratory gas; to select various diving gears according to the diving depth and operational mode; to organize compression training under diving and high pressure environments; to carry out oxygen susceptibility test so as to assure the smooth implementation of under-water operations and diving rescues; to formulate medical protection measures for submarine personnel's underwater escape from submarines; and to provide medical protection for amphibious troop's underwater training.

5. To provide medical, physiological, hygienic and human engineering data for the construction of modern new model ships so as to maintain the optimal condition for man-machine-environment system engineering and to maximally utilize the potential of man power and equipment.

6. To study plans for the assurance of navigational hygienic logistics and rescue and medical treatment support at sea; to prevent and cure such sickness caused by navigational environment as motion sickness, various common ailments and frequently encountered diseases; to provide medical protection measures and emergency plans for ship personnel, bases and docks in case of nuclear, chemical and biological weapons attack.

7. To study various measures for enhancing navigation personnel's endurance and operational efficiency; to provide means, methods and parameters for monitoring the physiological and psychological functions of special task personnel. Examples are how to carry out fitness training during navigation; what kind of nutritious food and bioactive materials to be replenished; fabrication of various training simulators and special cabins; study and fabrication of instruments and devices for monitoring various physiological functions.

8. To study the application of basic principles of military medicine; to investigate extensively the theoretical mechanisms from real problems; and to develop new research projects for the advancement of the discipline in order to provide guidance for future practices.

To accomplish the above mentioned tasks, military navigation medicine has to include the following in terms of disciplinary category:

1. Ship Environmental Medicine: mainly to solve, by scientific methodologies of enclosed environment medicine, ship hygienics, pathophysiology, biochemistry, toxicology, nutrition, food and water supply hygienics, human engineering and biomedical engineering, the medical problems of habitation and operation under ship's special environment. Examples are the human body's functional change and operating ability in enclosed environment with restrained mobility for a long period of time (several weeks to several months); toxic effect of low concentration harmful gases on human body in ship's ambience; possible damages caused by various physical factors such as temperature, humidity, illumination, noise, vibration, shock wave, magnetic field and their protection measures; study of measures for improving a ship's environmental factors, nutritional requirement, work shift system and health protection measurements for all personnel of different combat positions.

2. Special Environment Physiology: mainly to study the human body's physiological function changes and its tolerance limit toward abnormal environmental factors when living and operating under the special environment of naval ship and underwater high-pressure environment in order to provide references for physiological parameters. Examples are problems of human body's functional changes and biorhythmic changes when navigating at sea for a long period of time; adaptation and de-adaptation of the human body while working; the body's reaction and freezing physiology in case of personnel's falling and soaking in sea water; changes of human sense organs, nerve and cardiovascular systems under special environment and their influences on operational efficiency; problem of high temperature heat stroke and its prevention.

3. Nutrition and Water Supply Hygienics: mainly to study nutrition requirement, food and water supply sanitation and standards for all navy personnel. Examples are caloric metabolism and nutrition requirement of submarine, diving, ship, marine and naval aviation personnel as well as special task operating personnel; handling of food for long-range navigation, emergency rations and food supplies; improvement of preservation methods for fresh vegetables and fruits; study of water supply standards; desalination and mineralization of desalinated water; exploration of simple, reliable water quality test and sterilization methods.

4. Diving (Submerged) Medical Physiology: mainly to study the human body's functional changes in underwater high-pressure environment, to clarify laws and causes of these changes, to provide medical protection measures for personnel undergoing underwater operations so as to maintain their normal physiological functions and effective operating state, to carry out prevention and treatment of diving sickness that are likely to occur and, through these measures and the clarification of diving physiology principles, to increase diver's diving depth, lengthen the time of underwater stay, have good operating ability and decompress and emerge quickly and safely. The study of various diving compression tables involves many specialized theories, and considerable attention has been attracted to the mechanisms of decompression sickness, oxygen toxicity and hyperbaric-neural syndrome. At present, there are more experiences with regard to non-saturation diving techniques and its medical protection such as air dive within 60-70m and helium-oxygen dive within 120 or 150m. They have been applied to a large number of actual operations and proved. There are concentrated research efforts to study saturation dive mode that allows large working depth, long underwater stay and high operation efficiency. Laboratory simulation depth of 686m has been achieved but only a few nations have tried in actual operation and it is not widely used. Most studies are concerning saturation dive respiration gas mix, living condition, compression and decompression methods, operation capacity, treatment of decompression sickness and elimination of hyperbaric-neural syndrome.

The medical protection in case of submarine personnel's emergence from the deep is an important problem that is related to submarine medicine and diving medicine. It is normal atmospheric environment within a submarine. But when personnel leave the submarine, they enter the underwater high-pressure environment. Since the 1970's, some nations have proposed collective rescue by using deep-diving life boat, whose actual diving depth reaches 1,562m. Other nations have proposed the rapid ascending escape by using floating suit and test has been carried out at the depth of 183m. Currently, many nations are developing floating escape method from the depth of 300m and necessary equipment.

Diving apparatus engineering, which is developing in tandem with diving medicine and has played a role in military navigation medicine, is mainly to perfect lightweight and heavyweight diving apparatus -- to match as much as possible breathing apparatus and diving suits with their corresponding monitor devices. It is possible to dive to a depth of several hundred meters and undergo ocean floor operation with the help of deep sea diving equipment and by breathing various gaseous media.

5. Navigation Sickness and Marine Clinical Medicine: mainly to solve, in the area of navigation sickness, problem of motion sickness occurred during navigation at sea -- sea sickness and sickness resulted from long-range navigation such as diving decompression sickness, vitamin C deficiency and waist and leg pains. For the treatment of other common ailments and frequently encountered diseases, principles therapeutics should be applied with ship's environment being taken into consideration. As to sea rescue, it is a more unusual subject. Things like search and lift of personnel fallen into water, emergency first aid, transport, treatment and retreat of the injured at sea all require special means and methods. All kinds of special equipments and rescue gears have to be studied and fabricated. The prevention of oral diseases and control of infectious diseases of fleet are medical problems that deserve special attention.

6. Marine Biology and Medicine: mainly to study medical protection measures against marine lives that cause injury to human, to study also the exploitation of marine lives. In the former area, examples are avoidance of attack by man-eating sharks, adoption of shark alert and shark repelling measures. Also caution has to be exercised to avoid injuries by sea snake and scorpion fish in the vicinity of dock and bay.

7. Ship's Three Preventions Medicine and Naval Epidemiology: mainly to study the special characteristics of these disciplines under naval and seaborne conditions and to implement prevention measures accordingly. Examples are health protection system and medical protection standards for nuclear-powered ship personnel; radiation dosage measurement, emergency treatment of radiation injuries and decontamination in case of accident; medical protection and emergency treatment of nuclear and chemical weapons caused injuries shipboard, at base and at dock; control of epidemics, treatment of the sick and epidemic investigation at coastal islands, dock and shipboard; study and fabrication of various high-speed detection instruments and devices.

8. Naval Hygienic Logistics: mainly to study peacetime and wartime hygienic logistical strategy at all levels of naval forces and the medical supply stock for all types of ship. Examples are providing ship's habitability hygienic standards; supply reliable data, information and anticipations with regard to plans concerning the organization, equipment, mode and methodology of marine rescue operation; logistics of organizing medical and all kinds of motorized capabilities to accomplish rescue missions. In order to accomplish the tasks described above, it ought to be clearly recognized that:

1. It is necessary to strengthen the naval military medicine research and it should be mainly applied research, and to actively carry out advanced research. In the meantime, emphasis should be directed toward the applications of fundamental research works because it is essential for development and advancement.

2. It is necessary to implement strictly and faithfully the training of specialized technologies, especially to emphasize the use of possible simulative environments and apparatus to carry out the training of living and

and operating under all kinds of special environments so as to raise the endurance and adaptability toward the effects of malignant factors during navigation.

3. It has become extremely important to study and solve the problems of how to optimize the man-machine-environment system engineering and how to maintain best structure, optimized mode and higher operational efficiency over the relationship among soldiers, weapons and equipment and operating environment in order to raise fighting capability.

4. Objectively, there exists the relative independency among the specialized disciplines of the military navigation medicine. They also have deep, sound theoretical basis. Therefore, they ought to explore new contents and theories. However, to solve practical problems, the help of general medical knowledge is needed. To have further impact, it is necessary to integrate with the closely related general medicine. Examples are that the integrated advancement of diving medicine and diving apparatus engineering accelerates the development in the direction of deep sea diving safety; environmental medicine and ship hygienics have supplied important data for ship building and new ships in turn create new problems that will force the advancements and deepening of the former. That is to say that we ought to develop disciplines and, at the same time, to emphasize the interconnection between theory and practice.

12922
CSO: 4008/281

BRIEFS

CORNEA-DONATING CAMPAIGN--Beijing, May 5 (XINHUA)--Over 60 national model workers have expressed willingness to donate posthumously their corneas for transplantation in response to an appeal by a Shandong ophthalmologist, the "Guangming Daily" reports today. Xie Lixin, deputy director of the ophthalmological department of the hospital affiliated with Changwei Medical College, initiated a cornea donation drive while participating in May Day celebrations in Beijing as a receiver of the "May 1 labor medal" from the All-China Federation of Trade Unions. More than 60 people, including union leaders and other national model workers, signed the appeal issued on May 2. About one million people in China lose their eyesight from cornea diseases every year, Xie said, and cornea transplantation operations can help up to 90 percent of them if enough corneas are available. More than 1,100 patients have registered at the Changwei Medical College Hospital for such operations, but the hospital can only perform 100 to 150 operations a year for lack of such materials. China has three "very small" cornea centers, in Guangzhou, Zhengzhou and Changwei, Doctor Xie said. [Text] [OW050837 Beijing XINHUA in English 0635 GMT 5 May 85]

HIGH QUALITY TETRODOTOXIN DEVELOPED--Qinhuangdao, April 28 (XINHUA)--Two research institutes in Hebei have succeeded in producing top quality tetrodotoxin, a biochemical substance much more expensive than gold, which only Japan could make previously. Tetrodotoxin is an extremely poisonous material extracted from the internal organs of globefish but it is an important reagent in studying neurobiology and physiology. It is extensively applied in research involving the excitable cell membranes of musculi skeleti, nerves and cardiac muscle. It is also an excellent pain killer, sedative and drug for controlling spasm, lowering blood pressure and regulating heart beat. Use of Chinese-made tetrodotoxin by more than 20 research and medical institutions in China and scientists from Belgium, Britain, the United States and France shows that it compares favorably with the Japanese product. An American professor of medicine recently wrote a paper for a British journal, evaluating the quality of the Chinese product as dependable and recommending its application. China had to import tetrodotoxin before. Its price stood at 67,000 U.S. dollars per gram last year and rose to 72,750 dollars lately. Research in isolating the toxin was started by the Hebei Aquatic Products Research Institute in cooperation with an army pharmaceutical chemistry institute in 1979. They succeeded in three years and then developed a process for its commercial production. [Text] [OW281128 Beijing XINHUA in English 0859 GMT 28 Apr 85]

SHANGHAI MEDICAL APPARATUS--Shanghai, 6 Apr (XINHUA)--The Medical Apparatus and Instruments Technology Development Center of Shanghai, China, was established on 6 April. This new organization, the first of its kind in China, will be responsible for formulating development plans for the medical apparatus and instruments industry, undertake major research programs, provide consultation and other services, and coordinate the introduction and popularization of new technologies. [Summary] [Beijing XINHUA Domestic Service in Chinese 1502 GMT 6 Apr 85 OW]

CSO: 4008/327

DIRECTION, TASK OF CHINA'S ENVIRONMENTAL RESEARCH DESCRIBED

Beijing ZHONGGUO HUANJING KEXUE /ENVIRONMENTAL SCIENCES IN CHINA/ in Chinese No 1, 21 Feb 85 pp 7-10

/Article by Qu Geping /2575 2706 1627/: "Direction and Task of Environmental Scientific Research in Our Country"/

/Text/ Let me first congratulate the successful opening of the annual meeting of the China Environmental Sciences Society! And welcome the foreign experts and scholars who come from afar to attend this meeting!

Along with the development of our country's socialist modernization construction, people become more and more aware of the importance of environmental protection. Environmental condition has overall and long-term effect on people's physique, on national economic construction, on social development, and on working condition of laboring people. Therefore, the protection and improvement of environment are listed as our basic national policy. To implement this policy requires the combined efforts of comrades from different fronts and quarters. In the past 5 years, the China Environmental Sciences Society has organized and united a large number of environmental scientists. It has not only obtained solid results in the areas of prevention and treatment of pollution and maintenance of ecological balance, but also macroscopically exerted positive influence in the economic decision-making and the developmental strategy of our country. These achievements are outstanding. Our country's environmental science is in the ascendant and shoulders heavy responsibility. To further prosper the environmental sciences, I want to discuss some opinions of mine.

I. On the Direction of Environmental Sciences Research

In our country, the large population has exerted great pressure on the environment, resources are not abundant, the economy is less developed, and pollution and destruction of the environment is relatively serious. We are far behind in paying our dues. For a rather long period of time in the future, the State is not likely to provide large amount of fund to solve the problem of environmental pollution. This situation is different from industrialized nations and is also different from some developing countries. To solve environmental problems, we have to chart our own course. We have to fully exploit the superiority of planned economy and to consider the

overall relationship among population, resource, environment and development when formulating our national economic policy, and to achieve overall balance. In developing energy sources and resources, the damage to natural ecological environment shall be avoided. In the areas of economic structure adjustment, technological transformation of enterprise and formulation of economic technological policy, environmental factors have to be considered so that they will help improve the environment.

Currently, there is a rising tide of worldwide new technological revolution. This presents new opportunities and challenges to our country's economic development. The magnificent goal to quadruple our gross annual national industrial and agricultural output value by the end of the century has been decided in the 12th Party Congress. In the recently held 3d Plenary Session of the 12th CPC Central Committee, decisions have been made regarding the reform of economic system. The economic system reform with emphasis on cities is in full swing. The situation is developing very fast. The new situation dictates that environmental sciences research must keep up with the pace of economic construction, with the situation of reform, and with the trend of world new technology revolution and serve the strategic goals and tasks of economic construction, serve the promotion of economic system reform, and serve the realization of the thorough improvement of our environmental condition by the end of the century. We ought to vigorously advance the research of such disciplines as environmental medicine and environmental economics, to strengthen the investigation of such environmental factors as natural resources and natural conditions, to understand the relationship between environmental quality and human health. We ought to analyze and keep abreast of economic and developmental trends, to propose ways to deal with environment, to prevent and treat pollution, to improve people's physique, to enhance the synchronized development of economic construction, town and village construction, and environmental construction. Aiming at the new situation and new problems surfaced in the reform of economic system, we ought to strengthen the study on environmental administration, to reform the environmental administration system, to raise the level of environmental administration sciences so that the reform will be helpful not only to the establishment of lively socialist economic system, but also to the protection and improvement of environment. Based on the current situation of environmental pollution, we ought to strengthen the study of environmental engineering and applied technology, to learn, digest, and absorb foreign accomplishments in environmental science and technology and to establish as quickly as possible the environmental technology structure that is reasonable and suitable for the conditions of our country. We also ought to strengthen the study of various basic theories of environmental sciences in order to make good preparation for environmental construction and technological innovation.

II. On the Tasks of Environmental Sciences Research

That environmental protection is one of our basic national policies is made clear in the 2nd National Conference on Environmental Protection. The general and specific environmental protection policies we formulated all reflect the spirit of our national policy. The policy of carrying out synchronized planning, implementation and development of economic construction,

town and village construction and environmental construction on the aspect of environmental protection strategy, the policy of carrying out prevention primarily, combining protection with treatment, and comprehensive remedy on the aspect of prevention and treatment of environmental pollution, the policy of laying equal stress on the exploitation of natural resources and protection and breeding on the aspect of prevention of damage to natural ecosystem, and the specific policies of "Three Simultaneities," "Whoever pollutes shall clean up" and "Whoever develops shall protect" are all proved through practice to be correct and suitable for the conditions of our country. Economic development depends first on policy and secondly on science. The development of environmental protection similarly depends on the policy and science. Now that we have general guiding principles on environmental protection, an urgent task is to advance environmental science and technology. At present, the major tasks facing our environmental scientists are:

1. To strengthen with great effort the research on multi-disciplinary sciences. We ought to be fully aware that environmental problems are often very complicated and can not be tackled by any single discipline. In fact, for many technical measures of prevention and treatment to be effective, research jointly carried out by scientific and technical staff from such disciplines as chemistry, physics, biology, environmental medicine, and geology are necessary. Studies on environmental planning, environmental management and environmental engineering not only are the domain of social sciences but also involve natural sciences, technological sciences and many others, and can be accomplished only through the close cooperation of sociologists, economists and natural scientists. To solve our country's environmental problems, comprehensive studies on the relationship between environment and human resource as well as population growth have to be carried out by viewing the situation as a whole and from the viewpoint of developmental strategy so that scientific basis are provided for economic and environmental decision-making.

2. To carry out extensively the study of applied sciences and technologies. At present, many commonly occurred problems in the area of applied technology of environmental protection are not resolved. For example, coal is the primary constitutent of our energy mix. Smoke pollution in large and medium-sized cities is generally serious. This involves the problem of technological economic policy on coal exploitation as well as the problem of technological measures of prevention and treatment. So far these problems are not solved satisfactorily. From short-term point of view, a series of problem in the areas of technological economic policy and technological measure regarding coal mining, washing and dressing, distribution, processing, centralized heating, residual heat recovery at factories and mines and improvement of combustion facility and combustion technology must be solved. From long-term point of view, efforts ought to be concentrated on coal's comprehensive utilization and thermal energy transformation toward the direction of coal-based industrial chemicals and coal gasification. Thermal power plants are big consumers of coal. To break the technological and economic barriers of desulfurization so that it becomes technologically feasible and economically reasonable requires the assembly of a group of

specialists to carry out research. An important measure to reduce air pollution and improve environment is to promote industrial and home use of coal. We ought to do research and development of coal combustion technology and sulfur-fixation technology and to get results as quickly as possible. Another example is the problem of industrial waste water. Each year, over 30 billion tons are dischaged, the majority of which are untreated and cause widespread pollution of rivers, lakes and seas to different degrees. This is a big problem in our country. In the prevention and treatment of water pollution, there are issues of reasonably developing water resource and of raising water recycling rate as well as the technical problems of comprehensive utilization and sanitation treatment of various kinds of industrial waste water. We ought to provide, through scientific research, the best applied technology of preventing and treating water pollution for all trades and professions, and even for all products. Having obsolete equipments, drawback technologies and large amount of waste water discharge, the majority of our industries and enterprises face the problem of technological transformation and equipments renewal. Aiming at these problems, they all need to study applied technologies for the prevention and treatment of pollution in order to raise the utilization ratio of resources and energy sources, and reduce the discharge of "three industrial wastes." Furthermore, we also have big problems in the areas of agricultural ecology and natural environment. For example, vegetation destruction, soil erosion, soil pulverization and alkalinization, and grassland regression are more serious and these are important factors restricting production development. To improve agricultural ecology and natural environment, it is also necessary to carry out the study of applied technology, to bring into full play the role of science and technology and continue to provide technological information and technical services.

3. To carry out seriously the study of basic theories. The basic theories of environmental sciences play important role in the development of modern environmental sciences. The studies of environmental economics and environmental management have to follow the basic principles of Marxism and laws of socialist economy and natural ecology and to find out the peculiar laws of environmental economy and environmental management. Currently, we ought to emphatically strengthen the study of environmental basic theories that are closely related to the development of national economy, and to raise the quality and effectiveness of the research works. We ought to work hard to investigate the laws of migration and transformation of pollutants in environment, and to study the mechanisms by which pollutants harm human health and environmental toxicology so as to provide scientific basis for the treatment of pollution and for setting standards. Basic theory research shoulders the task of providing theoretical basis and methodology for applied technology. In certain sense, the level of basic theory research represents the level of scientific advancement. Basic research usually is more long-term and ought to maintain stability and continuity. We ought to look farther and be willing to invest some brain power and money. This is the basic construction of environmental science research.

4. To work hard to study environmental forecast. Environmental problems follow economic development. It takes long-term and exploratory research

to answer the questions of what kind of influences our economic development will have on future environment and how to deal with them. It can be called futuristic study of environment. A correct environmental forecast is a prerequisite for making good environmental planning. We ought to carry out forecast study with regard to the influences such areas as economic development, population growth, resource exploitation, raising living standard, and new technology development have on the environment so as to give advices on the policy-making regarding economic and social development and environmental construction in order to avoid strategic mistakes.

The practice of environmental protection constantly poses large amount of problems for environmental sciences. Only through closely linking with environmental protection practice can environmental sciences get healthy advancement. Therefore, environmental scientific research should center on the goal and requirement of environmental protection planning, make overall arrangement, share out the work and cooperate with one another, formulate rigorous scientific research planning, and strengthen the management of scientific research. The Society has to do more on this aspect, to encourage discussion among experts and to play advisory role. The Society ought to promote the socialization and commercialization of scientific research results in order for the results to be widely applied as quickly as possible and to be transformed into productivity.

III. A Few Wishes

It has been pointed out in the 3d Plenary Session of the 12th CPC Central Committee that to carry out socialist modernization and construction, knowledge and talents have to be respected and struggles be waged against all thoughts and behaviors that despise science and technology, despise intelligence development, and despise intellectuals. It also was clearly pointed out that all reforms must be helpful to the advancement of science and technology. Thus, a vast vista is opened for our development of science and technology. The following are a few wishes of mine: First, strengthen contact among disciplines, fight and tackle problems in good coordination. Environmental problems are extremely complicated, the solution of which requires the close linkage of natural sciences and social sciences. Academy of Sciences, Academy of Social Sciences and their affiliated organizations, environmental protection system, institutions of higher learning, and all industrial departments, I hope, will strengthen their coordination, break barriers among professions and disciplines, and form an entity that share out work and cooperate with one another, and concentrate on solving a number of important scientific research problems. They ought to follow the principle of combining research, teaching and production, to go deep into the reality of production, and to produce as quickly as possible best applied science and technology in order to solve some notable pollution problems and to derive more benefits from the results of scientific research.

Second, pay attention to knowledge refreshment and intelligence development. Currently, world science and technology is advancing by leaps and bounds. There are many new areas within environmental sciences that need to be developed. The development of economic construction also will constantly

provide us with new tasks. All these demands that we keep abreast of new achievements in world science to avoid tortuous path. The development of the situation demands the training and bringing up of a new generation of environmental science and technology workers. Those senior experts and senior scholars in attendance shoulder this heavy yet honorable responsibility. Middle-aged and young scientists and technicians ought to broaden their knowledge and increase their competence through practicing science and technology. Facing the general tasks for the new period, you all have the problems of broadening with new knowledge, gaining new experience and relearning. And you all need to constantly renew your knowledge, whether you are experts and scholars of old generation or you are middle-aged and young scientists and technicians. I think all of you will have deeper understanding on this respect.

Third, broadly carry out academic exchange as well as technical consultation and service. Academic exchange is an important mode for the advancement of science and technology. It can stimulate new academic thinkings, and enhance the maturity of qualified scientists and technicians. We ought to develop academic democracy, implement the "Double-Hundred" principle, enhance the vigor of environmental sciences research. We ought to broaden the range of academic exchange, to carry out not only exchanges among different disciplines and among different professions but also international academic exchanges, to keep up-to-date with international scientific and technological information, to enlarge vision and to contantly raise the level of our environmental science and technology. Technical consultation is an important mode of the socialization of science and technology and the commercialization of technological achievements, and is a new area in which the service of economic construction by science and technology will be enhanced. We ought to constantly develop new approaches of technical consultation, to mobilize the great number of scientists and technicians to serve the economic construction and environmental construction.

Fourth, pay attention to the popularization of environmental science in order to continuously raise the environmental consciousness of the whole nation. It is the undeniable duty of environmental scientists to do well on popular knowledge education of environmental sciences. Aiming at the needs of different age groups and different situations, more and better popular environmental science books are to be compiled within every environmental science discipline. More popular science articles have to be written and environmental science knowledge have to be spreaded among people through TV, newspaper, broadcast, publication and lecture. Emphasis should be placed on the popular education of environmental sciences for teenagers. I wish the Society will closely cooperate with culture and education departments to hold more environmental science lectures, environmental sciences knowledge competition, to form extra-curricular teams for environmental science research, and to organize summer camp activity to learn environmental sciences. We ought to make environmental sciences popular education rich and interesting so that our new generation will have good environmental consciousness since childhood and a new habit of caring for environment and protecting environment can gradually be formed within the whole society.

Comrades! Environmental Sciences Society is the mass organization for the vast number of environmental scientists. I wish this organization is initiative, active, able to carry out its job distinctively and effectively, and able to fully exercise the role of "bonding" and "thinktank" so as to become high-level advisor and capable assistant to government departments and to make new contributions in bringing about prosperity of our environmental sciences.

Wish a complete success of the meeting!

12922
CSO: 4008/282

ENVIRONMENTAL QUALITY

URBAN POLLUTION REPORTED AT 'CRITICAL LEVELS'

HK260341 Beijing CHINA DAILY in English 16 Apr 85 p 3

[Article by staff reporter]

[Text] China's leading environmental planner has urged the state to take immediate measures against worsening urban pollution, which has reached "a critical level" in some cities.

Qu Geping, chief of the State Environmental Protection Administration said the air in Beijing now has an 840 micrograms of soot per cubic meter--a record level of atmospheric pollution for the capital.

Qu was quoted by the ECONOMIC INFORMATION newspaper as saying that pollution in 9 or 10 of China's major cities face the danger of being inundated one day by smog "if strict anti-pollution measures are not taken as soon as possible."

Earlier Xu Hongtao--another official of the Administration, told CHINA DAILY that the State Seventh Five-Year Plan (1986-1990) envisages a major programme to improve environmental protection across China.

Qu has urged the state to allocate 1.5 percent of the nation's gross national production instead of the present 0.5 percent to environmental protection, the EOCNOMIC DAILY said.

Acid Rain

A recent survey of the air in 52 of China's cities by computerized monitoring equipment revealed that the average amount of soot per cubic meter in the atmosphere of the northern cities had varied from 427 to 1,358 micrograms. The top figure is some four times higher than the 300 microgram upper level recommended by the state.

Monitoring has also revealed a serious acid rain problem, the bureau chief said. Areas in Sichuan, Guizhou and Jiangxi provinces have for the first time been affected by the problem, Qu revealed.

Water contamination is also a grave problem in cities, he said, and many lakes and parts of the Yangtze River and Yellow River that run through cities are among the most severely polluted.

The pollution of underground water near Beijing has already caused great strain on the city's water supply while Guan Ting Reservoir--the capital's main source of water--is running the risk of going completely dry.

Noise pollution, mostly from traffic and industry, is also on the increase, he said.

Modernization Drive

Although in some municipalities efforts to reduce noise levels have been fairly successful, the problem is still acute, he said. In Chengdu, Sichuan Province, traffic noise alone has reached 86 decibels.

The advance of the nation's modernization drive could be held back substantially by the pollution problem, he said.

He also warned that pollution is spreading rapidly to rural areas, and the lack of planning in the distribution of enterprises and residential quarters now means that much surface water is undrinkable in some areas.

But, he said, a recent meeting held by the Environmental Protection Committee of the State Council has approved proposals submitted by the Administration for concrete anti-pollution measures in 1985--the last year of the Sixth Five-Year Plan.

New environmental protection laws will be made and regular press conferences will be held to brief the media on progress in the fight against pollution, Qu added.

CSO: 4010/132

JOURNAL NOTES ENVIRONMENTAL IMPROVEMENTS IN SHANGHAI

HK200354 Beijing CHINA DAILY in English 20 Apr 85 p 3

[Article by CHINA DAILY staff reporter]

[Text] Shanghai--Half of Shanghai's 12 districts have become "fumeless zones" and the other six are also scheduled to be free from fumes by the end of this year, all thanks to the city's intensified environmental drive over the past years.

The drive, first launched in the late 1970s, focused on controlling air pollution from industrial sources. By 1982, the city's notorious 17 "yellow dragons"--dark fumes from 17 major industrial chimneys--were finally brought under control through a series of technical renovations plus administrative measures, CHINA ENVIRONMENT JOURNAL reported.

Since then the environmental authorities extended their scope of attention to fume sources in the residential areas, and succeeded in revamping them in the six districts in about 2 years, the journal said.

Now 16,000 of the 20,000 industrial or residential boilers, furnaces or ovens in Shanghai have been renovated to reduce their pollutant effects to a minimum. In the six fume-free districts, more than 97 percent of all such pollution sources are now under control. A latest survey indicates the falls of dust in the city are down to 24 tons per square kilometer from the 41 tons per month in 1979.

Shanghai's environmental control is guaranteed by a regular "check and approve system," which requires each pollution source to be inspected and approved every year. Any source found to have violated the fume-control standard will be penalized by a reduction or suspension in its fuel supply until the condition is improved, the journal said.

In some districts, environmental "sentry posts" have been placed on the major high-rise buildings to monitor air pollution. Any discovery of a fume source is immediately reported to the city's environmental authorities.

The environmental authorities have also organized the city's boiler and furnace workers to attend courses of fume-free operation techniques. They also give regular prizes to model workers or enterprises according to their contribution to pollution control, the journal added. Shanghai, China's biggest metropolis, banned the use of old-fashioned manually-operated boilers in the city.

CSO: 4010/132

CONFERENCE SETS RULES ON SOLID WASTE DISPOSAL

OW281248 Beijing XINHUA in English 1147 GMT 28 Apr 85

[Text] Beijing, 28 Apr (XINHUA)--China is working out a set of regulations for disposing of solid wastes, according to the State Environment Protection Bureau.

A national conference, which ended Saturday, was told that the regulations would go into effect next year. Experts attending the 4-day conference noted that the country had enacted a series of regulations for controlling water and air pollution but had paid little attention to the disposal of solid wastes. As a result, they said, it had become an increasingly serious problem and wasted a great deal of labor power and material resources.

China produces more than 400 million tons of industrial wastes and tailings a year, according to the experts. Only 20 percent of them have been treated for multiple utilization while the rest have been piled up on city outskirts or discharged into rivers, lakes or sea. Wastes and tailings, accumulated over the years, exceed 5.6 billion tons and mounds of them occupy about 60,000 hectares of land.

Only half of the rubbish and nightsoil could be treated before being disposed of, the experts said. The rest went to the dumping ground without any treatment, thus polluting soil, water and air to the detriment of people's health, they said.

Most organizations had not yet listed environmental protection as an absolute essential item in their construction programs, experts deplored.

They stressed that the new regulations must make installations for environmental protection an indispensable part of any construction project.

CSO: 4010/132

POLLUTION CONTROL OF XIAOQING HE

Beijing HUANJING KEXUE [JOURNAL OF ENVIRONMENTAL SCIENCE] in Chinese No 6, 30 Dec 84 pp 37-40

[Article by Sun Yulin [1327 3768 3829] of Research Institute of Environmental Protection Science, Jinan City, et al.: "An Approach to Pollution Control of the Jinan Section of Xiaoqing River"]

[Summary] The 216 km long Xiaoqing He is one of the major rivers of Shandong Province. During the dry season, the 67 km section in the city is basically for waste drainage only. Under current economic and technical conditions, it is, therefore, very difficult to restore it into a multifunction river. For the time being, the realistic goal is to improve the quality of the water to the extent of being used for irrigation. A mathematical model of such a goal is presented in the paper, accompanied with parameter calculations, a feasible plan, and technical and economic analyses, including the following tables.

Table 2. Current Data on Sections of the Xiaoqing He (Jinan Section)

Name of discharge system	Section number	Name of location at the beginning and end of each section	Length of section km	Average velocity of flow (m/sec)	Flow capacity (m^3/sec)	Effluent input q (m^3/sec)	Effluent input ℓ (mg/ℓ)	Effluent input O' (mg/ℓ)	L_0	O_0	L	O
Xingji He discharge system	1	Muli-Xijiao Paper Mill	8.59	0.29	1				2	10	1.738	9.88
	2	Xijiao Paper Mill-Xingji He	2.02	0.29	1.05	0.05	290	0	15.46	9.41	14.95	9.12
	3	Xingji He-Jiluoganguan	4.425	0.29	1.84	0.79	40	0	25.71	5.20	23.91	5.47
Gongshang He discharge system	4	Jiluoganguan-Gongshang He	1.22	0.36	2.29	0.45	28.36	0	24.78	4.4	24.39	4.59
	5	Gongshang He-Xiluo He	2.005	0.36	4.34	2.05	115	0	67.19	2.42	65.44	2.02
Xiluo He	6	Xiluo He-Dongluo He	1.275	0.36	4.50	0.16	18.35	0	63.77	1.95	62.68	1.73
Liuxingtou waste discharge system	7	Dongluo He-Liuxingtou	0.76	0.29	4.66	0.16	8.4	2.6	60.82	1.76	60.03	1.58
	8	Liuxingtou-Qilihe Plant	2.295	0.29	4.98	0.32	27.1	2.31	57.91	1.62	55.77	0.992
Qili He waste discharge system	9	Qili He Plant-Daxin He	4.235	0.29	5.30	0.32	230	0	66.29	0.932		
	10	Daxin He-Zhangma He	2.61	0.25	5.42	0.12	1.34	7.65	60.18		57.3	
Wangsherenzhuang waste discharge system	11	Zhangma He-waste discharge pipe	3.7	0.21	5.78	0.36	1.6	7.8	53.83		49.52	
	12	Waste discharge pipe-Hancang He	3.55	0.21	5.92	0.14	235.25	0	53.91		49.76	
	13	Hancang He-Yawang Kow	8.365	0.21	6.18	0.26	0.55	8.25	47.69		39.49	

Table 3. Pollution Load of Various Waste Discharge Systems Compared

Order of waste discharge system	Pollution load	Ratio of load (percent)
No 1 -- Xingji He	50.69	3.3
No 2 -- Gongshang He	651.35	42.42
No 3 -- Xiluo He	0.481	0.03
No 4 -- Liuxingtou	26.22	1.71
No 5 -- Qili He	125.093	8.15
No 6 -- Wangsherenzhuang	544.64	35.47

Table 4. Rate of Uneven Degradation (percent)

Plan / Rate of degradation of various waste discharge systems	Xingji He	Gongshang He	Qili He key plant	Shawu waste discharge pipe
1	80	90	70	80
2	70	90	70	80
3	40	70	40	70
4	40	70	40	60
5	30	70	30	60

Table 5. Feasibility Plan

Water quality goal	Treatment plan		
	1	2	3
1	Even degradation of 55 percent of all systems of waste discharge channels DO = 2.2 BOD = 17.97	Third plan of uneven degradation DO = 2.79 BOD = 16.25	Fourth plan of uneven degradation DO = 2.7 BOD = 16.66

6248
CSO: 4009/131

ENVIRONMENTAL QUALITY

ATCM USED TO PREDICT ATMOSPHERIC FLUORIDES

Beijing HUANJING KEXUE [JOURNAL OF ENVIRONMENTAL SCIENCE] in Chinese No 6, 30 Dec 84 pp 46-50

[Article by Yu Jinwen [0060 2417 2429] et al. of General Academy of Construction Research, Ministry of Metallurgy: "Application of ATCM (Model of Atmospheric Transport Climatology) To Predicting Ground Concentration of Atmospheric Fluorides in the Vicinity of the Baotou Iron and Steel Plant"]

[Summary] For the purpose of improving the local environment, the trend has been for factories to erect chimneys taller than 200 meters to discharge waste gas directly into the atmosphere without scrubbing. This measure may be suitable for North China with great winds and little rainfall. In South China, scrubbing should be preferred. Furthermore, it is well known that the effect of atmospheric fluorides on pastoral grass is long term and cumulative. In order to study the efficiency of purification under various rainfall and precipitation conditions, an ATCM model was established to study the effect of various environmental protection schemes for the Baotou Iron and Steel Mill and Baotou City. Observation data of Baotou Municipal Weather Station in 1976-1980 were used as meteorological parameters while the rate of uneven ground surface was used to revise the dispersion parameters. Calculations included 15 geographical points and 12 planes. In the meantime, a sulfur hexafluoride tracing experiment was carried out to compare and verify the prediction results of the model.

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INFLUENCE OF SOIL EROSION ON SOIL DEGRADATION STUDIED

Beijing HUANJING KEXUE [JOURNAL OF ENVIRONMENTAL SCIENCE] in Chinese No 6, 30 Dec 84 pp 5-10

[Article by Tang Keli [0781 0344 7787] et al. of the Northwest Institute of Water and Soil Conservation Research, Chinese Academy of Sciences: "A Preliminary Study on the Influence of Soil Loss on Soil Degradation in the Loessial Plateau"]

[Summary] According to related research data, about half of the 160 million tons of sand carried away in the Huang He every year come from erosion of the top soil of relatively fertile slope land. If the nitrogen content of the slope land is 0.05-0.10 percent, the yearly loss should be the equivalent of 1,739,000 to 3,478,000 million tons of urea. This figure is only an estimate, of course. Since 1982, the authors collected samples of sand from the major tributaries of the Huang He to proceed with analysis to determine the granular composition and the active nutrient contents of the silt in order to furnish a scientific basis for studying the effect of erosion on the loss of soil fertility as well as for ascertaining the source of the sand. Judging from the granular composition, about one-fifth of the grains are larger than 0.05 mm and their major origin should be the section from Hekouzhen to Longmen of the middle reaches, where erosion preventive measures should be immediately implemented. The nutrient contents of the sand in the tributaries of Huangfuchuan and Kuyehe are low; therefore, its source is likely to be mainly weathered matter of bedrock in the gullies. The sand of the tributaries of Dalihe, Yanhe, and Weihe is composed mainly of fine grains, with the level of organic matter and active nitrogen close to or slightly higher than ordinary top soils. It is, therefore, safe to assume that the sand of these rivers comes from fields on the slopes.

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JPRS-CST-85-016
23 May 1985

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TITLE: "The Preparation of Single Strand cDNA of Rat Serum Albumin"

SOURCE: Shanghai SHANGHAI DIYI YIXUEYUAN XUEBAO [ACTA ACADEMIAE MEDICINAE PRIMAE SHANGHAI] in Chinese No 1, Jan 85 pp 75-76

TEXT OF ENGLISH ABSTRACT: The phage RF M13mp7 was used as a vector to recombine with rat serum albumin gene fragment. The JM103 (E Coli K12 lac^- Strain) was transfected with the cloned inserted phage. From the positive infected plaques rat serum albumin cDNA was isolated. It hybridized with rat liver $poly^+$RNA to give a positive result.

9717
CSO: 4009/191

JPRS-CST-85-016
23 May 1985

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TITLE: "Study of Bronsted Acidic Strength for HZSM-5, H-Mordenite and HY Zeolites by Quantum Chemical Method"

SOURCE: Shanghai HUAXUE XUEBAO [ACTA CHIMICA SINICA] in Chinese Vol 42, No 12, Dec 84 pp 1244-1256

ABSTRACT: Using quantum chemical method, CNDO/2 scheme, the diagram of the potential energy surface for ammonia adsorption on O_{x1} site of straight channel was obtained by both adsorption distance and bond length of hydroxyl group. In diagram it was shown that a stable adsorption region is 2.80 Å>R_{ON}>2.45 Å and adsorption heat is 153.6 kJ/mol. On the other hand, when the NH_3 is adsorbed on the acidic OH group of sinusoidal channel of HZSM-5, and on the acidic OH group of straight pocket channel of H^+-Mordenite zeolite, and on the hydroxyl group of supercage of HY zeolite, the magnitude of adsorbion heats are 163.8, 138.8, 139 and 132 kJ/mol respectively. At the same time, the shifts of vibrational frequencies of acidic hydroxyl groups and the protonic degree of adsorbing NH_3 are also calculated when NH_3 is absorbed on these sites of acidic hydroxyl. All these results are in agreement with the change of acid strength and also in agreement with the experimental values published. For HY zeolite, the order of stability for protons on framework oxygen atoms has been obtained by calculation, it is $O_{(3)}H$ $O_{(1)}H>O_{(2)}H>O_{(4)}H$.

CSO: 4009/1005

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TITLE: "Ab initio Calculations of Vertical Ionization Potentials for H_2O"

SOURCE: Shanghai HUAXUE XUEBAO [ACTA CHIMICA SINICA] in Chinese Vol 42, No 12, Dec 84 pp 1302-1303

ABSTRACT: Ab initio Hartree-Fock SCF calculations have been performed on the ground states of the water molecule and its positive ions, using a Double Zeta CGTF plus polarized functions as a basis set. The vertical ionization potentials of inner- and valence-electrons are obtained, and the results are in agreement with experimental measurements.

CSO: 4009/1005

AUTHOR: SUN Jianxia [1327 1696 7209]
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TITLE: "Heterogeneous Catalytic Oxidation of Ammonia by Pulsed CO_2 Laser"

SOURCE: Shanghai HUAXUE XUEBAO [ACTA CHIMICA SINICA] in Chinese Vol 43, No 1, Jan 85 pp 19-23

ABSTRACT: A TEA CO_2 laser was used to induce the heterogeneous catalytic oxidation of ammonia. For 1:1 NH_3-O_2 gas mixture of 5 Torr, the reaction occurred only with the laser beam irradiating on the Pt (or Ni) surface in the fluence range of 3 to 8 $J \cdot cm^{-2}$. The main products were found to be H_2O and N_2 by mass spectroscopic analysis. The reaction yields have been measured as a function of the laser frequency, the fluence, the numbers of laser pulses and the partial pressure of NH_3 and O_2. A maximum reaction yield was observed at the laser frequency of 933 cm^{-1}, which coincided with the fundamental frequency of NH_3 molecule in the gas phase. The experimental results could be explained in term of the Eley-Rideal mechanism.
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TITLE: "Infrared Laser Sensitized Dissociation of UF_6 in the Presence of CO"

SOURCE: Shanghai HUAXUE XUEBAO [ACTA CHIMICA SINICA] in Chinese Vol 43, No 1, Jan 85 pp 24-29

ABSTRACT: The sensitized dissociation of UF_6 (supplied by Plant 504 of Ministry of Nuclear Industry) by SF_6 excited with a pulsed CO_2 laser has been investigated in the presence of CO as F atom scavenger. The dissociation yields were examined as a function of CO partial pressure, laser frequency, fluence and the number of laser pulses. The "laser snow" $(UF_5)_m$ and COF_2 were observed in the reaction products. The dissociation rate was first order with respect to the partial pressure of UF_6. The vibrational state densities of SF_6 and UF_6 molecules were calculated using the Whitten-Rabinovitch approximation. The intermolecular V-V energy transfer from excited SF_6 to UF_6 and the mechanism of IR photosensitization of UF_6 were discussed.
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CSO: 4009/1006

JPRS-CST-85-016
23 May 1985

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TITLE: "The Magnetic Properties of Unsupported Fe-Mo Catalysts"

SOURCE: Beijing CUIHUA XUEBAO [JOURNAL OF CATALYSIS] in Chinese No 2, Jun 84 pp 138-145

TEXT OF ENGLISH ABSTRACT: The precursors of the industrial Fe-Mo/Al_2O_3 hydrodesulfurization (HDS) catalyst, i.e., the precipitates prepared from ferrous sulfate and ammonium molybdate by the coprecipitation method without support on alumina, were characterized by the magnetic measurement and identified by the XRD method. The catalytic activity of the samples for the HDS of thiophene at 380°C was measured in a continuous flow type micro-reactor. The results are as follows:
(1) The phase component of the precursor is dependent on its atomic ratio of Fe/Mo. When Fe/Mo < 1.5, $Fe_2(MoO_4)_3$ is the principal component, with a negative Weiss constant of -53K, which implies there occurred antiferroparamagnetic interaction between neighboring Fe^{3+}. When Fe/Mo = 1.5-3.1, the samples reveal super paramagnetism for which the highly dispersed antiferromagnetic component α-FeOOH is responsible. Due to the high dispersivity of α-FeOOH as formed in the coprecipitation process, the component $Fe_2(MoO_4)_3$ formed in the same process is accordingly also highly dispersed. The average particle size evaluated by the Langevin function and the low field magnetization versus H/T plots for the superparamagnetic component is about 110Å.
(2) As a consequence of the difference in phase components and their different dispersivities, the catalytic activity for HDS of thiophene is found to be affected by both the surface area and Mo content of the samples. When Fe/Mo = 1.5, there appears maximum activity which is explained as the mutual effects of the surface area and the Mo content of the samples.
(3) The effects of aging and calcination on the activity of the samples are also examined. Under optimum conditions, the coprecipitation process may result in a highly dispersed Fe-Mo precursor available to the Fe-Mo/Al_2O_3 catalyst.

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TITLE: "The Effect of Ligands and Solvents on the Ethylene Polymerization and Oligomerization Catalyzed by $Ti(OR)_nCl_{4-n}$-AlEtCl System"

SOURCE: Beijing CUIHUA XUEBAO [JOURNAL OF CATALYSIS] in Chinese No 2, Jun 84 pp 168-173

TEXT OF ENGLISH ABSTRACT: Using $TiCl_4$, $(n\text{-}BuO)_2TiCl_2$ or $(n\text{-}BuO)_4Ti$ as catalyst and $AlEtCl_2$ as cocatalyst, the effects of the ligand around Ti on the molecular weight of ethylene polymer or oligomer and on the reduction rate of Ti(IV) were studied. At moderate polymerization temperatures, tri- and tetra-valent titanium coexist in these systems, and both polymer and oligomer are obtained simultaneously. If Ti is kept in the tetra-valent state, only oligomers are obtained at lower polymerization temperatures, and their average molecular weights are nearly the same no matter what ligand is coordinated on Ti. It is also observed that the reduction rate of (n-BuO) Ti is faster than that of $TiCl_4$. Considering the following views: (1) at moderate temperatures, two active species coexist in all of these catalyst systems, one which is formed from Ti(IV) and the other from Ti(III), (2) a polymeric chain grows on Ti(III) active species and an oligomeric chain grows on Ti(IV) active species, (3) the ratio of these two active species changes continuously during reaction, i.e., Ti(IV) is gradually reduced to Ti(III), and (4) the reduction rate of Ti(IV) varies with the catalyst system, it is suggested that the ligands studied mainly influence the reduction rate of Ti and hence the ratio of these two active species is different, leading to different ratios of polymer and oligomer in the product. Therefore, the major factor determining the ratio of chain propagation rate and chain transfer rate is still the valent state of the Ti catalyst.

The effects of solvents were studied as well. It is observed that solvents have considerable effects on the induction period of the reaction, the catalyst activity, the reduction rate of Ti(IV) and the activation energy of the reaction. A linear relationship between the catalyst activity and the Taft induction constant of various chloroalkane solvents has been noticed.

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TITLE: "Conversion of Methanol to Hydrocarbons with Heteropoly Compounds as Catalysts"

SOURCE: Beijing CUIHUA XUEBAO [JOURNAL OF CATALYSIS] in Chinese No 2, Jun 84 pp 180-184

TEXT OF ENGLISH ABSTRACT: The conversion of methanol to hydrocarbons over $H_3PW_{12}O_{40}$ and its salts was investigated. It was found that the activity of $H_3PW_{12}O_{40}$ gradually decreased as the reaction proceeded, while when using $Ag_3PW_{12}O_{40}$ as catalyst, the reaction showed an induction period, then the activity of this catalyst increased with the reaction time and reached a steady value after 3 hours. Only a few weakly acidic sites were observed on $Ag_3PW_{12}O_{40}$ by n-butylamine titration; nevertheless, new acid sites appeared during the induction period as shown by pyridine poisoning.

The activities of Ag(I), Cu(II) and Fe(III) salts of $H_3PW_{12}O_{40}$ were slightly higher than those of $H_3PW_{12}O_{40}$, while Mg, Ca, Sr, Ni, Co and La salts showed lower activity. The higher activity of Ag(I), Cu(II) and Fe(III) salts was probably caused by their reducibility.

It was reported in the literature that $Cs_3PW_{12}O_{40}$ had higher activity, but in our experiments Cs salt showed very low activity. It was found that as the x in $Cs_xH_{3-x}PW_{12}O_{40}$ changed from 0 to 1, 2 and 3, the surface area of the catalyst markedly increased, and the activity showed a maximum at $x \approx 2.5$ and dropped rapidly to nearly zero at $x = 3$. These phenomena might be explained by the difference in turnover frequency of the acid sites on the surface and of those in the bulk.

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TITLE: "IR Study of the Structure of the Catalyst ($MgCl_2/TiCl_4 \cdot THF/AlEt_3$) for the Gas-phase Polymerization to Produce Linear Low Density Polyethylene"

SOURCE: Beijing CUIHUA XUEBAO [JOURNAL OF CATALYSIS] in Chinese No 2, Jun 84 pp 185-189

TEXT OF ENGLISH ABSTRACT: Tetrahydrofuran (THF) as a modifier plays an important role in the catalyst ($MgCl_2/TiCl_4 \cdot THF/AlEt_3$) for the gas-phase polymerization to produce linear low density polyethylene. The complex forms of THF in the catalyst were studied by infrared spectroscopy.

Infrared spectrum of THF showed its ν_s and ν_{as} of C-O-C bond were at 910 and 1070 cm^{-1}. These bands were shifted to 810-820 and 985-990 cm^{-1} for the THF complexes with $TiCl_4$, and it was inferred that THF formed a co-valent coordination bond with the d-orbit of the Ti atom through its unshared electron pair on the oxygen atom. After grinding the $TiCl_4 \cdot THF$ with $MgCl_2$, the characteristic bands (810, 985 and 1040 cm^{-1}) of $TiCl_4 \cdot THF$ still remained, but there were some new bands (865, 1010 cm^{-1}) associated with the complex of $MgCl_2/THF$ which appeared. When the co-grinding material $MgCl_2/TiCl_4 \cdot THF$ was activated with $AlEt_3$, the $MgCl_2/THF$ complex was partly decomposed and the changes in the IR spectrum indicated that a new complex of $AlEt_3$ with THF was formed. Thus there were three kinds of THF complexes in the final catalyst, and only a part of THF combined directly with Ti was able to modify the catalytic properties.

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TITLE: "Studies of the Catalysts for the Alkylation of Ammonia by Thermal Analysis"

SOURCE: Beijing CUIHUA XUEBAO [JOURNAL OF CATALYSIS] in Chinese No 2, Jun 84 pp 190-194

TEXT OF ENGLISH ABSTRACT: The hydrogen reduction of Cu-Ni/clay catalysts for the alkylation of ammonia under atmospheric pressure has been studied by the thermal analysis technique. The exact composition of the active components of the catalyst was first determined by the thermal analysis and X-ray diffraction, and then by direct and indirect hydrogen reductions of the active components, basic carbonates, which were investigated by DTA and TG methods. The results indicate that the direct reduction is better than the indirect reduction and the appropriate direct reduction temperature is in the range of 160-220°C.

The selectivity of the catalysts reduced to the range of 180-350°C was evaluated by a small-scale test. Based on the experimental results, it is suggested that the reduction temperature of the catalyst adopted in the production facility be lowered from 300-320°C to 220-240°C, thereby, due to the lower reduction temperature, prolonging the life of the catalyst and reducing the energy consumption.

9717
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Chemistry

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TITLE: "The Synthesis and Crystal Structure Analysis of Two Binuclear Complexes $MO_2^{(V)}S_4[S_2P(OEt)_2]_2$ (I) and $W_2^{(V)}S_4[S_2P(OEt)_2]_2$ (II)"

SOURCE: Wuchang FENZI KEXUE YU HUAXUE YANJIU [JOURNAL OF MOLECULAR SCIENCE] in Chinese No 3, Sep 84 pp 345-352

ABSTRACT: Two binuclear complexes $MO_2^{(V)}S_4[S_2P(OEt)_2]_2$ (I), $W_2^{(V)}S_4[S_2P(OEt)_2]_2$ (II) are isomorphous, monoclinic crystals in the space group $P2_1/a$ with $a = 14.044(2)\text{Å}$, $b = 10.341(1)\text{Å}$, $c = 17.821(4)\text{Å}$, $\beta = 112.55(1)°$ in (I) and $a = 14.045(3)\text{Å}$, $b = 10.341(1)\text{Å}$, $c = 17.944(4)\text{Å}$, $\beta = 113.09(2)°$ in (II) respectively, $Z = 4$. The structures were solved by the usual Patterson method and Fourier techniques. The refinement of these two crystals using full-matrix least-squares methods led to a final deviation value R of 0.063 for (I) and 0.047 for (II) respectively. Each metal atom is bound to two bridging sulfur atoms (S_b), two sulfur donor atoms belong to one $[S_2P(OEt)_2]^-$ ligand (S_1) and one terminal sulfur atom (S_t), respectively, so that a square pyramidal coordination sphere is formed. The M-M distances are $2.826(1)\text{Å}$ and $2.824(0)\text{Å}$, respectively.

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TITLE: "Theoretical Study of the Structure and Formation of the Silicon Molecules $HOSi^+$ and $HSiO^+$"

SOURCE: Wuchang FENZI KEXUE YU HUAXUE YANJIU [JOURNAL OF MOLECULAR SCIENCE] in Chinese No 9, Sep 84 pp 309-318

ABSTRACT: The equilibrium geometries for $HOSi^+$ and $HSiO^+$ ions have been determined by ab initio (SCF + CI) calculations with a basis set of type double ζ + 1d: d(HO) = 1.80a.u., d(OSi) = 2.89a.u., $\angle$HOSi = 180° for $HOSi^+$; d(HSi) = 2.79 a.u., d(SiO) = 2.84a.u., $\angle$HSiO = 180° for $HSiO^+$. The predicted values for (J = 2←1) rotational transition frequencies of $HOSi^+$ and $HSiO^+$ are 73.2 GHz and 74.4 GHz, respectively, and for dipole moment $\mu(HOSi^+)$ = 0.02 D, $\mu(HSiO^+)$ = 6.48 D, respectively. The energy difference between the stable isomer $HOSi^+$ and the Metastable isomer $HSiO^+$ is 65 kcal/mol. The exothermicity of their formation reactions in the interstellar space is examined.

CSO: 4009/102

Computer Development and Applications

AUTHOR: Zhou Tiji [0719 1029 1015]

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TITLE: "A Multi-level Diagnostic System of a Large-Scale Computer"

SOURCE: Beijing JISUANJI YANJIU YU FAZHAN [COMPUTER RESEARCH AND DEVELOPMENT] in Chinese No 1 [Jan] 1984 pp 7-12

ABSTRACT: China's technology in computer systems availability and maintainability is still far from reaching the informational level. Recently the importance of the need for automatic diagnostic routines to locate computer malfunctions is recognized. The hardware design of a diagnostic system for a large-scale computer is discussed. The system, based on a powerful and highly reliable minicomputer is modular in structure and simple to control. A "snowballing" strategy was adopted to manually perform the diagnostic work. Based on the requirements for real-time monitoring, nonreal-time fault location and maintenance monitoring, the diagnostic system was divided into three levels: unit, card and chip. Each level corresponds to a subsystem which includes the system monitoring and detection subsystem, processor fault location subsystem and automatic card testing subsystem. The functions of these subsystems are described. In addition, a diagnostic documentation generation system based on this multi-level system and the DDL-D language is discussed. In more than 90 percent of the cases, the resolution has been found to be on the level of a single chip.

12553
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JPRS-CST-85-016
23 May 1985

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TITLE: "Experimental Study of the Intensification of Turbulence in Mixed Layer by Surface Waves"

SOURCE: Beijing HAIYANG YU HUZHAO [OCEANOLOGIA ET LIMNOLOGIA SINICA] in Chinese No 1, Jan 85 pp 28-34

TEXT OF ENGLISH ABSTRACT: Mixing-box experiments demonstrating grid-stirred turbulence can be significantly enhanced in the presence of finite amplitude surface waves which do not break. Interfacial entrainment speeds up to 80 percent larger than waveless values are measured. Enhancement decreases with increasing submergence of the grid. The experimental results obtained suggest the existence of certain physical processes in which the energy of the surface waves is transformed into the turbulence energy, or equivalently, the turbulence in mixed layer extracts some of the energy contained in surface waves.

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TITLE: "Application of the Complex Adsorbent $Al(OH)_3$-$Fe(OH)_3$ to the Uranium Extraction from Sea Water"*

SOURCE: Beijing HAIYANG YU HUZHAO [OCEANOLOGIA ET LIMNOLOGIA SINICA] in Chinese No 1, Jan 85 pp 74-77

TEXT OF ENGLISH ABSTRACT: $Al(OH)_3$-$Fe(OH)_3$ is a promising adsorbent in uranium extraction from sea water for its rich resource, low cost and pollution-free characteristics.

Uranium loading of the said adsorbent can be up to 459 μg/g, approximately to the upper loading of TiO_2 adsorbent (460 μg/g) under the same conditions (40-60 mesh under constant flow of sea water).

The authors have studied the optimal conditions for the preparation of $Al(OH)_3$-$Fe(OH)_3$, the appropriate pH at the completion of the precipitation under room temperature and certain concentrations. Comparison of $Al(OH)_3$-$Fe(OH)_3$ with pure $Fe(OH)_3$ has been made under similar conditions.

*Contribution No 1096 from the Institute of Oceanology, Chinese Academy of Sciences.

9717
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TITLE: "Transforming Activity of DNA from Primary Hepatocellular Carcinoma and 7402 Cell Line on NIH/3T3 Cells"

SOURCE: Beijing ZHONGHUA ZHONGLIU ZAZHI [CHINESE JOURNAL OF ONCOLOGY] in Chinese No 1, 23 Jan 85 pp 3-5

TEXT OF ENGLISH ABSTRACT: High molecular weight DNA was extracted from primary hepatocellular carcinoma (PHC) and 7402 cell line. The primary and secondary transfection experiments with PHC DNA were carried out on NIH/3T3 cell system. The transformation rates were 0.016 and 0.080 foci/μg DNA respectively, indicating a five-fold enrichment of putative transforming sequences. The primary, secondary and tertiary cycles of transfection with 7402 DNA were performed and the transforming efficiencies were 0.016, 0.160 and 1.0 foci/μg DNA respectively. The DNA of transformed cells from PHC and 7402 DNA transfection was analyzed by EcoRI restriction, agarose gel electrophoresis, Southern Blot and hybridization with ^{32}P labeled human Cot1 DNA or leukocyte DNA to prove the human repetitive sequences. Results indicate that bands of human sequences are present in DNA of both PHC and 7402 transfectants. This paper is the first report on the transforming activity of DNA from human liver cancer. These putative transforming sequences have been characterized as N-ras genes (to be published).

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23 May 1985

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TITLE: "Formation and Quenching Kinetics of Discharge Pumped Xe_2Cl^*"

SOURCE: Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 5 No 1, Jan 85 pp 11-14

TEXT OF ENGLISH ABSTRACT: By comparing the fluorescence intensity of XeCl (B-X), (C-A) and Xe_2Cl as a function of the total gas pressures, the formation and quenching kinetics of discharge pumped Xe_2Cl^* have been quantitatively studied and the HCl deexcitation rate constant for Xe_2Cl^* has been determined to be $K^0_{HCl} = 9.2 \times 10^{-10}$ cm^3/sec.

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TITLE: "Ablation Parameter Measurement of Plain Foil Target in Laser Produced Plasmas"

SOURCE: Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 5 No 1, Jan 85 pp 24-31

TEXT OF ENGLISH ABSTRACT: Experimental results are presented about specific mass ablation rate, ablation pressure, hydrodynamic efficiency and other parameters by using ion measurements in laser produced plasmas obtained at tilted plain mylar targets irradiated by Nd: glass high power laser with both P polarization and S polarization. Laser irradiance on the target surface ranges from 2×10^{12} to 10^{14} $W\cdot cm^{-2}$. The experimental scaling law is compared with theory. The difference in ablation parameters and temporal ion signals collected from the back of the thin foils produced by different polarizations of the incident light is preliminarily discussed.

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TITLE: "Microfabrication of Holographic Blazed Grating by Reactive Ion Beam Etching"

SOURCE: Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 5 No 1, Jan 85 pp 43-49

TEXT OF ENGLISH ABSTRACT: The SiO_2 holographic blazed grating of good quality and high diffraction efficiency has been developed by reactive ion beam etching and a holographic grating mask has been made by lensless Fourier transform holography recording.

We investigated the techniques of the photoresist coating, holographic exposure and development so that the mask pattern of the AZ1350 photoresist holographic grating could be made suitable for reactive ion beam etching. Then, the SiO_2 holographic blazed gratings with space frequency of 1000 lines/mm were microfabricated by CF_4 ion beam etching. The etching rate of SiO_2 and AZ1350 photoresist has been determined. The blazed angle of gratings can be controlled by varying the incident angle of the ion beam.

The advisable etching technology parameters have been chosen and the experimental results of the SiO_2 holographic blazed grating with 67 percent diffraction efficiency have been achieved.

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TITLE: "A New Approach to Investigating the Parameters of Surface Layer on Glasses"*

SOURCE: Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 5 No 1, Jan 85 pp 55-60

TEXT OF ENGLISH ABSTRACT: The relationship between the incident angle of a p-polarization beam and the reflectance ratio on both sides of glass or other transparent material is strongly sensitive to the surface layer parameters, such as refractive index, thickness and absorption, especially when the refractive indexes of the surface and the flat host are nearly the same. This paper gives the primary experimental results and the numerical simulation based on the theory of thin film optics. By means of data fitting, we are able to learn the physical state of the surface layer from the experimental curves of reflectance ratio versus incident angle. The method has the advantage of simplicity in equipment and ease of understanding.

*This work has been accepted by the 13th ICO (1984, Japan).

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TITLE: "GaAs Optoelectronic Switch with Continuous Variable Electric Pulse Width"

SOURCE: Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 5 No 1, Jan 85 pp 75-77

TEXT OF ENGLISH ABSTRACT: An optoelectronic switch, consisting of two GaAs cuboids and a resistance, operates in a high output resistance mode, and is directly connected to a pair of Pockls cell electrodes. kV electric pulses with continuous variable width in the ns region have been obtained. The output efficiency is as high as 84 percent.

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TITLE: "Effective Dose Equivalents for Internal Exposure to Mixed Fission Products"

SOURCE: Beijing ZHONGHUA FANGSHE YIXUE YU FANGHU ZAZHI [CHINESE JOURNAL OF RADIOLOGICAL MEDICINE AND PROTECTION] in Chinese No 1, 25 Feb 85 pp 1-5, 69

TEXT OF ENGLISH ABSTRACT: According to the method recommended by the ICRP, the effective dose equivalents were calculated for single or prolonged intake of mixed fission products. The following factors were considered in the calculation: the fission material, the solubility, the route of intake and the presence or absence of ^{239}Np. The contribution of individual radionuclides to the effective dose equivalent and the major risk organs or tissues were investigated.

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TITLE: "Antiradiation Effect of Thymus Transplantation in Mice"

SOURCE: Beijing ZHONGHUA FANGSHE YIXUE YU FANGHU ZAZHI [CHINESE JOURNAL OF RADIOLOGICAL MEDICINE AND PROTECTION] in Chinese no 1, 25 Feb 85 pp 11-13, 69-70

TEXT OF ENGLISH ABSTRACT: The thymus is an important organ of the immune system and is involved in the regulation of blood cell formation. Thymus transplantation can reconstitute the immune system to a certain extent in immunodeficiencies. The results of our primary experiment showed that thymus transplantation could increase the survival rate of lethally irradiated mice. The survival rate of the group with the thymus transplanted in the abdominal wall was higher than that of the group with the same organ transplanted in the peritoneum. During the recovery period, the labeling index of bone marrow cells in the former group was significantly higher than that in the controls.

After three months of transplantation, no significant immunologic rejection was observed histologically either in the mice with syngeneic thymic graft or in the mice with homograft.

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23 May 1985

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TITLE: "Intra-amniotic Injection of Crystal Trichosanthin for Induction of Labor in Second Trimester Pregnancy"

SOURCE: Shanghai SHENGZHI YU BIYUN [REPRODUCTION AND CONTRACEPTION] in Chinese No 1, Feb 85 pp 15-17, 20

TEXT OF ENGLISH ABSTRACT: Labor was induced in a group of 200 women during the second trimester of pregnancy by Crystal Trichosanthin injected into the amniotic cavity. It was effective and the success rate was 99.5 percent. The average abortion inducing interval was 4.69 days ± 1.15 days.

Blood loss was scanty during labor in 90.5 percent of the cases, being less than 100 ml. There was only one case of laceration of the cervix. The side effects of Crystal Trichosanthin were dramatically reduced with the simultaneous use of betamethason i.m. for three successive days. Side effects were reduced because the drug was concentrated in the cavity and only a little was present in the blood stream. Furthermore, the anti-allergenic action of betamethason was effective.

Trichosanthin is a kind of plant protein, so it may cause an allergic reaction which can induce the production of antibodies that will influence the effect of its re-injection.

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TITLE: "A Clinical Report of Norethisterone-3-Oxime-Acetate as a Contraceptive"

SOURCE: Shanghai SHENGZHI YU BIYUN [REPRODUCTION AND CONTRACEPTION] in Chinese No 1, Feb 85 pp 18-20

TEXT OF ENGLISH ABSTRACT: This paper reports the clinical application of Norethisterone-Oxime-Acetate used as a contraceptive. The results indicate that pregnancy can be prevented in women who receive this drug orally when they or their husbands come home on leave.

A dose of 2 mg was administered to women on the first day the couples lived together, followed by 1 mg daily successively. An additional pill was given on the morning following the end of the leave.

A contraception rate of 99.75 percent was achieved based on 825 treated cycles of 604 women. Of the two pregnancies which occurred, in one case the woman developed gastroenteritis while using the contraceptive, and was given chloramphenicol intravenously for three days. In the other case the contraceptive pills were improperly stored and got wet.

The changes in menstrual cycles, the duration of menstrual bleeding and the amount of flow after treatment were very slight. The incidence of intermenstrual bleeding and withdrawal bleeding was 2.16 percent.

Our observation showed that Norethisterone-Oxime-Acetate is an active contraceptive pill and possesses the advantages of high efficacy. few side effects and convenience.

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TITLE: "Effects of Dominant Lethal Mutation in Mice Induced by Irradiation with Microwaves"

SOURCE: Shanghai SHENGZHI YU BIYUN [REPRODUCTION AND CONTRACEPTION] in Chinese No 1, Feb 85 pp 41-44

TEXT OF ENGLISH ABSTRACT: When male mice were irradiated with microwaves of 2450 MHz, the induced dominant lethal mutation rate in the exposed animals was higher than that in the controls. The dominant lethal mutation rate of the meiotic stage spermatocyte was the highest (63.7 percent), and those of the post meiotic stages of spermatid and spermatozoa were 6.7 percent and 4.3 percent respectively. The mutation rates of spermatogonia were 0.8-1.3 percent, being the lowest among all germ cells.

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