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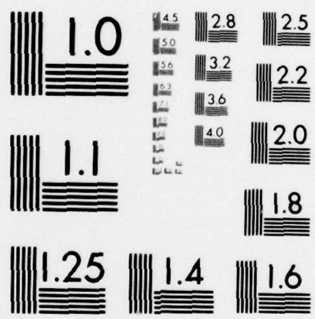

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the Four modernizations...

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FOREIGN TECHNOLOGY DIVISION

THE FOUR MODERNIZATIONS OF CHINA

EDITED TRANSLATION

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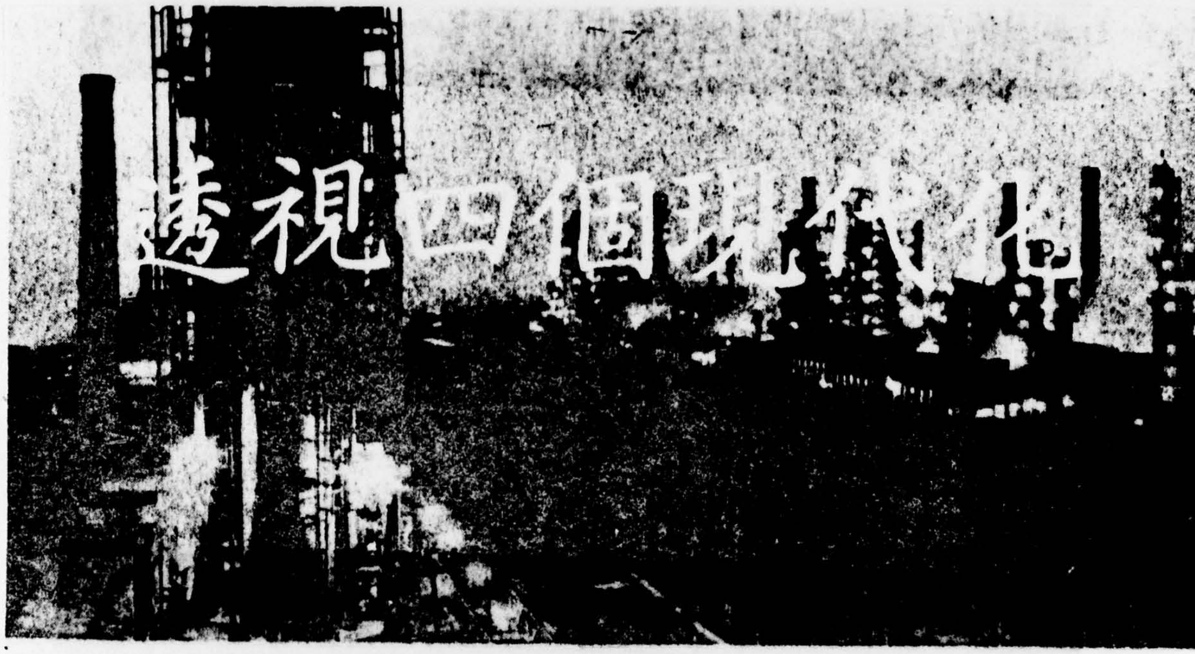

透視四個現代化

LOOKING INTO THE FOUR MODERNIZATIONS

China's Four Modernizations is a formidable task; it takes more than just talking to realize the goals. Do you know the current level of science and technology in China? and how far is it from the world standard? What are the assets and methods she will employ in carrying out her plans? This article will look into these questions.

* * *

The Chinese leaders announced, in the recent Fifth People's Congress, that China will achieve modernization in agriculture, industry, defense and science by the end of this century, and they presented a Ten Year Economy Plan. A National Conference of Science Delegations was called after the Fifth People's Congress, in which goals and proposals were presented. Everything seems to indicate great ambitions and confidence. But, can the Four Modernizations really be realized in time? Can the goals of the Ten Year Plan be met? What is the present science and technology level in China? and How far behind the advanced standards of the world is China? What are the resources and with what methods will China carry out her grand plans? Everybody seems to be focusing on these discussions recently. We have collected some information on this subject of concern and would like to share with the readers.

Will the check bounce?

We will first review the goals of the Chinese Ten Year Economy Plan. For the next ten years, the Chinese leaders are calling for a 4-5%

increase in agriculture production, 10% increase in industry, annual food production of 400 million tons and an annual crude steel production of 60 million tons.

Just consider the food production alone; the present annual production level is only around 280 million tons. Therefore, a cursory look indicates that the goals were set too high. Now the Chinese leaders have taken a high tone, will they be able to honor their promises? Economists at Hong Kong University have investigated the question and presented their findings in the following table:

	Average growth rate of the past ten years	Growth rate set in the Ten Year Plan
GNP	7%	8%
Agriculture	25%	4 - 5%
Industry	9%	10%
Steel	8%	15.7%

Based on the above table, experts think that the goals laid down by the Chinese leaders are sound and past growth has been taken into consideration. They also pointed out that China is fully capable of carrying out these plans. Just consider the fact that China elevated herself to today's achievements in a short twenty years plus, started from scratch and relied on herself; imagine what she can do with the preliminary foundation for modernization already there and plans to import foreign advanced technology. China also has extremely rich undeveloped resources and a great potential for production.

Chen Hsueh-Sen's opinion

Naturally, in order to achieve these goals, China will have to modernize rapidly. The key to the Four Modernizations is the modernization of science and the most advanced science and technology is essential in the realization of agriculture, industry and defense modernization. Among the various fields of science and technology, high energy physics is the peak of the frontier science and many nations are scrambling to reach the peak. Formerly, the atomic nuclear physics, high energy physics explores the microscopic world of matter and investigates the elementary particles of matter; any breakthrough in this field may lead to many new technologies.

The well-known Chinese rocket expert Chien Hsueh-Sen thinks that, as far as high energy research goes, China has more favorable conditions than the capitalistic nations because the task of high energy physics research is not to be accomplished by a few theoreticians working independently, rather it takes the coordinated planning and leadership of the mobilized manpower and resources of an entire nation. Chien emphasizes the importance of team effort in scientific research. In capitalistic nations, the scientists pay much attention to the patent right and monopolize one's individual research results. The advance of science is impeded and much time wasted by such guarding and lack of timely communication. For example, Chadwick discovered neutron in 1932. In 1934 another physicist, Fermi, started the experiment of neutron and uranium atom, but physicists do not understand enough analytical chemistry, and although they had found the clue were unable to interpret all the phenomena involved to draw any conclusion. Five years were wasted before two chemists Hahn and Strassmann discovered the fission of uranium 235 upon absorbing neutron in 1939 and revealed the answer to the puzzle. This example clearly shows that rapid advance of science cannot rely on individual's free research; instead, the manpower and resources of various branches of science must be pulled together according to a formulated plan and a central leadership.

<u>China can avoid the wrong track</u>

Science research needs centralized and overall planning, otherwise it is only a waste of time and money. Many nations have learned painful lessons in this regard. Chien named two other examples. When the United States decided to make an all-out effort in developing nuclear powered aircraft and rocket, there were no corresponding materials and technology for that purpose. The plan was forced to stop and wasted time and money. The Soviet Union has made a similar mistake. High energy physics research requires the progress on three fronts: building a large accelerator, sensitive detector and computer data processing facility. Russia suffered dearly due to its mismanagement. In 1959, Russia built a 10 Bev proton accelerator, the largest in the world at that time, but they neglected the development of supersensitive detectors and data processing computers and, as a result, nothing was accomplished for many years. Even today, they still have to take their data of high energy physics experiments to CERN for analysis and process.

<u>Chien San Ch'iang's composing words</u>

Another famous Chinese nuclear physicist summed up the development history of China's nuclear science: There has been nuclear research ever since the establishment of China, although only a handful of youths participated at the time. Chairman Mao, in 1955, decided on the policy to develop and build China's atomic energy industry and, since then, the number of people working in the atomic energy research institute has been increasing. A total of only 51 years was spent to the date of the successful test explosion of China's first atomic bomb. From the initiation of research to the launch of China's first satellite was again about 15 years. Only two years and eight months separated the atomic bomb and the hydrogen bomb. All these developments took China less time than other countries.

Although the current standards of Chinese science and technology fall behind the advanced countries by about 15 to 20 years in a majority of areas, as pointed out by Fang Yi, Chairman of the National Science and Technology Committee. In individual fields, the science research in China has actually caught up and surpassed the advanced standards of the world. Examples are the artificial synthesis of insulin, the shell model interpretation, the solution to the Goodbach paradox, a difficult problem in mathematics solved by Chen Chin-Jun, and the advanced understanding of the plate theory by geologist Li Sze-Kuang, all internationally recognized distinguished scientific achievements. Therefore, the prospects of China's closing in, catching up and surpassing the world's advanced level of science and technology by the end of this century are very bright indeed.

<u>What is supporting the modernization</u>

Although one can see the bright side, one can also see the difficulties expected. The difficulty lies in the capital. Where is the needed capital equivalent to the total capital investment of the past 28 years going to come from? The Japanese expert on Chinese economy pointed out that 90% of the Chinese revenue income is from the profits of government enterprises centered on consumer industry, the rest comes from tax.

In fact, the agriculture provides over one-half the national income, directly or indirectly. If large scale investment is to be made in such a financial structure, the surplus in agriculture will be extracted even more than ever before, an operation which has its own limit. It looks like capital will have to come from industrial areas like steel, oil, coal, agriculture machinery, chemical fertilizer and so on, by cutting production costs and increasing profits. In the meantime, step up the oil and coal export to boost income.

Oil export is already 10% of the total export of China. The major sources of foreign exchange are in the agriculture area, textile, food products and materials exports. Rapid developments in the agriculture areas are rather difficult, much faster advances can be made in oil, coal and natural gas resources. However, the oil production China is relying on has been in stagnation since 1975. In order to boost production, China will switch from its traditional land oil field-centered development to work on oil fields at the bottom of the ocean. China has begun exploration work in Pohai, East China Sea and South China Sea, but the real development needs American technology. It is not enough just to import some oil drilling gears, a development mode close to a cooperation with the American oil capitalists may be considered.

In addition, China will greatly exploit its tourist industry to increase its foreign exchange income. Recently, China sent people to investigate the hotel business in Hong Kong and to gain some experience for establishing modern hotel systems. There have also been plans for starting direct flights from Hong Kong to various tourist regions in China. Indications point to a first step toward the development of a tourist business. China no doubt has its very attractive natural capital in exploiting the tourist industry, with an all out effort, the prospects are very optimistic.

Concrete strategies of the Four Modernizations

What concrete policies has China laid down in carrying out its Four Modernizations? Explicit indications can be found in the report given to the National Science Conference by Fang Yi, Chairman of the National Science and Technology Committee:

(1) Establishing the System -- A national science and technology research system which is complete with all branches and fields, coordinated in development and combining individual and team effort will be established within 8 years. A series of topical science research institutes and the urgently needed fundamental science and new technology research institutes will be built.

(2) Popularization of Science -- Research facilities will be built at various regions of the country according to the natural environments. Research and development outfits for agriculture machines will be strengthened. R and D groups will be widely developed in factory and mine enterprises. A science loving atmosphere will spread over the entire nation through science publications, movies, museums, technical circulating teams, clubs, newspapers, broadcasting and television.

(3) Cultivating Specialists -- Stressing the education in elementary, high schools, and universities and specialty schools. Start television universities, correspondence universities, night schools, carry out science contests, and discover and select able technical personnel from all walks of profession.

(4) Learning foreign technology -- Selectively introduce key technologies from advanced nations. Invite foreign scientists to visit and lecture in China, carry out academic advising or cooperative research. Send students to study abroad.

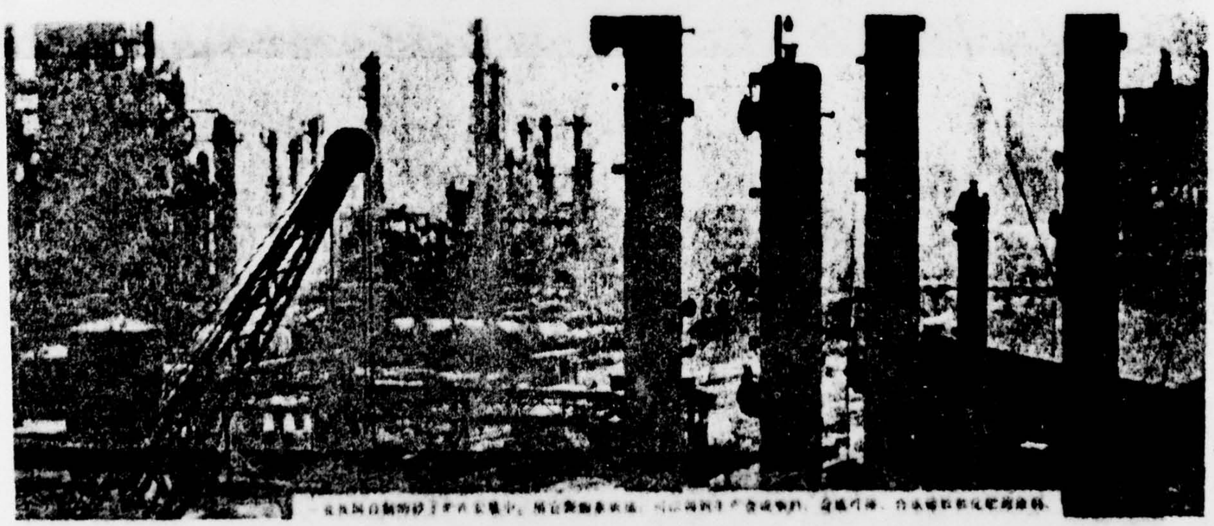
(5) Gather information -- Understand the international trend of science and technology, avoid repeating other people's work and wasted effort. A series of literature-cataloging centers and data banks will be established in 8 years.

(6) Reward -- In addition to spiritual encouragement, material rewards should be provided to technical personnel for major contributions.

The Chinese leaders have made broad and detailed disposition to make orderly leaps in the realm of science and technology. To these they have everything in mind. In the eyes of the readers, can China change her backward appearance rapidly and become a first rate strong nation?

Biologist Pei Shih-Chang introducing the coordinate structure of insulin to youths in Peking.

200,000 X electron microscope designed and built by the Chinese.



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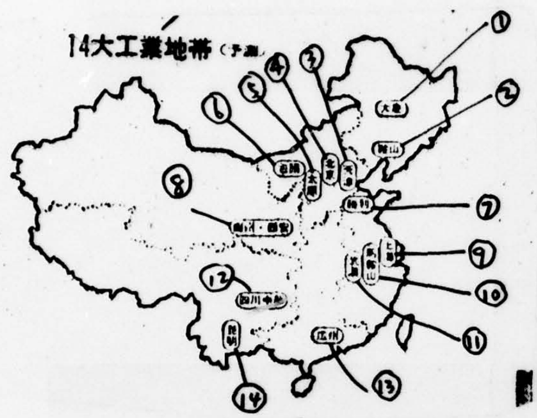
welding a large oil storage tank

LOOKING INTO CHINA'S EIGHT YEAR PLAN

International Trade Weekly (Japan)



1. Taching
2. Anshan
3. Tientsin
4. Peking
5. Taiyuan
6. Paotow
7. Shengli
8. Lanchow
9. Shanghai
10. Saddle Mountain
11. Wuhan
12. Central Szuchuan
13. Canton
14. Kunming

14 large industrial zones (predicted)

China plans to establish 10 industrial regions in the next eight years. These regions will be developed based on the existing fundamental industries, and the locations are believed to be the following: Northeast -- centered around Ta Chin, the crude oil production will be expanded and petroleum chemical industry will be added. Heilunkiang Ho Kang coal mine and Harbin heavy machine manufacture plant will also be expanded. Northeast -- Shen Yang is already an industrial base. The northeast industrial base will be centered at Shen Yang and involves the expansion of steel factories at An Shan and Ben Ch'i, the machine industry at Shen Yang, the coal mine at Fu Shung, and the petroleum chemical plants at Liao Yang.

North China -- Like the northeast, North China has already had some industrial foundation. Future projection includes the expansion of four areas: First, in the capital Peking, steel plants will be expanded. With the progress in North China oil fields, petroleum chemistry has ample room for expansion. Electronics industry and machine industry will also be major emphases in the development. Second, Tientsin, with its oil fields at Takang and Pohai, will become a major petrochemical industry center. The construction of Takang power generation station and chemical engineering projects is already underway. Third, Shansi will be developed into a large industry zone in northern China. The coal production at Tatung will be enlarged and, with the new discovery of iron, new steel industry is expected to develop in this area. Finally, in inner Mongolia, another industry zone will be developed with the steel plant at Paotow as the center. Non-ferrous metal factories and large coal powered electric generation plants will be built.

East China -- East China has several industrial bases also, principally Shanghai. Large coastal steel plants with peripherals such as harbor and electric power plants will be built near Shanghai. The production of Chinshan Petrochemical plant will be further expanded and modern ship building and electronics industries will also appear in this region. Next, the Saddle Mountain industry center will incorporate the steel industry at Saddle Mountain, the chemical industry at Nanking and Hofei, the coal mines at Huainan and the oil at Yencheng. The resources and industries in this region will be mutually complementary. Wuhan is also expected to become an industrial center and its steel factory expanded. With the coal resources at nearby Huinan and Onan, Wuhan is expected to grow in

Figure captions:

Middle:

Chinese young workers invented the advanced technique of petroleum dewaxing zymotechnics. Picture shows the zymosis tank.

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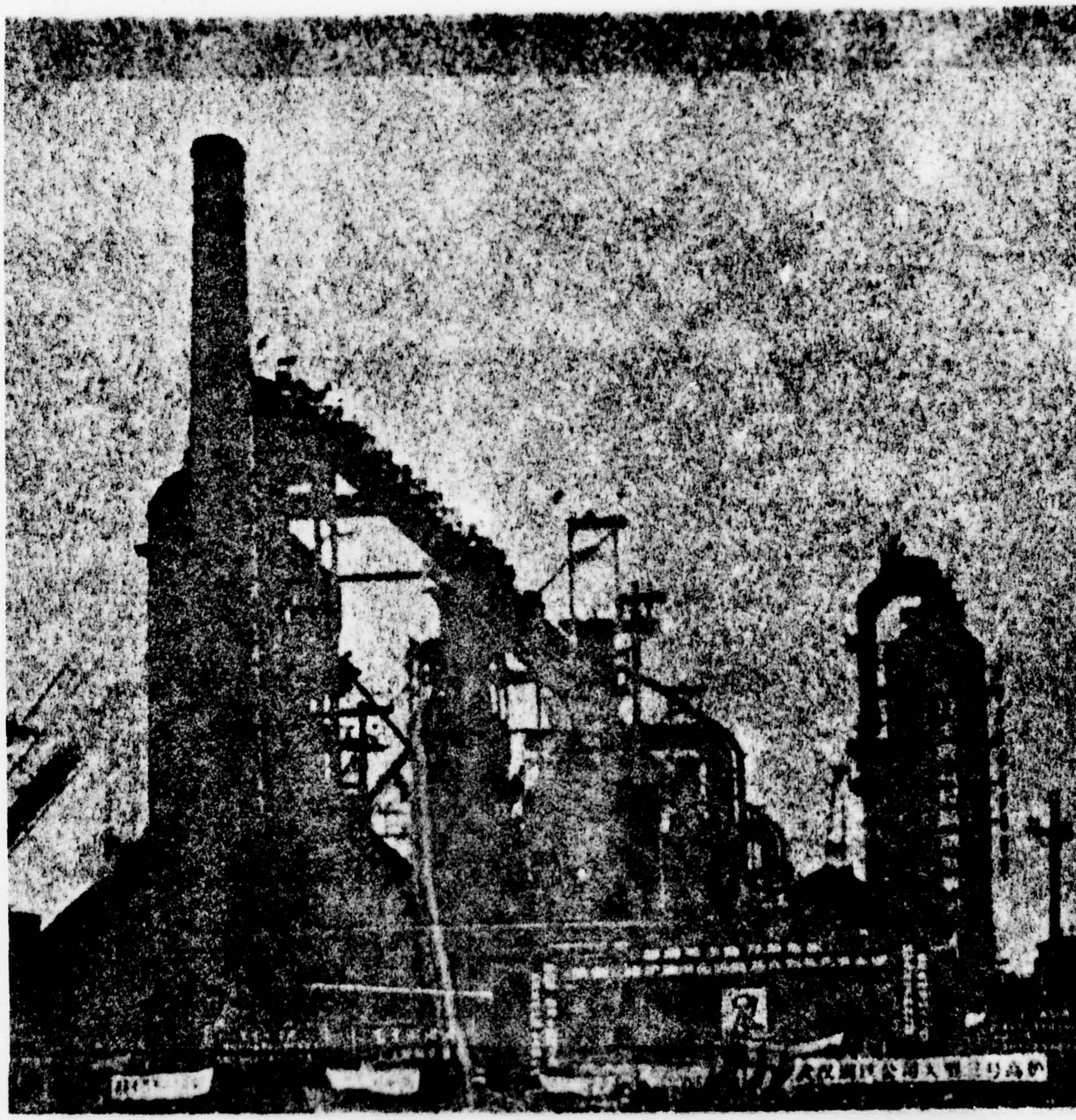
chemical, industrial and textile industries. Focused on the Victory oil fields, Shantung is expected to be a large industrial center with existing aluminium factory and machine industry and new steel plants and broad-based petroleum chemical enterprises.

South China -- The South China industrial zone will be developed around Canton. Major projects will be the oil production at Shanshui, new steel industry systems, and enlarged petroleum chemical industry. The petroleum chemical plant of Canton has been built and is under test operation. Nonferrous metals such as manganese, tungsten and antimony will be developed near Canton. A preliminary complete industrial system is expected to take shape in this region.

Northwest -- This is a vast territory suitable for medium scale industrial development. Expansions will be made at the Lanchow petroleum chemical plant and the Sian agriculture machine factory. Nonferrous metal industry is also expected.

Southwest - The conditions in this area are similar to the Northwest area. Chungking will become the center for developing the oil reserve of central Szuchuan and the chemical industry using local oil and natural gas. Other developments of this area will have to include coal and electric power generation. Another industrial center in southwest China will be Kunming. The Yunnan Province is rich in natural resources and has great industrial potential. The industries in the Kunming area will include nonferrous metals, machine industry, hydroelectric power plant, and the production of copper, aluminium, and tin.



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DISSECTING CHINA'S MILITARY POWER

Under the cause of scientific and technological modernization of China, defense modernization is an important branch. Before we start discussing the chances for the Chinese to realize their goal, we should first understand the current military power of China and how well are they equipped. We will now make a rudimentary introduction to this complex subject based on the book "Military Balance" published by the Britain Strategic Research Institute.

I. Army

a. Infantry -- main force, 120 divisions

b. Armored units - 12 divisions

Equipment: model 59 medium tanks, model 60 amphibious tanks, model 62 light tanks, and armored transportation vehicles.

II. Navy

a. Regular navy -- Approximately 170,000 men, more than the sum of British and French navies, only next to the United States and Soviet Union.

b. Marine Corps -- 28,000 men.

c. Navy air corps -- 25,000 men.

Equipment: Ten years ago, the Chinese navy was a "hodge podge" of ships made by Japan, U.S., Britain, and Canada. After years of efforts, the present Chinese navy consists of flotilla of self-produced ships.

1. Lüta guided-missile-destroyer, 3000 plus tons, equipped with Minho model 23 nautical mile ship-to-ship guided missile of reasonably

good quality. Compared to the guided missile destroyers of England, U.S. and France, the antiaircraft and antisubmarine powers of the Chinese ships fall far behind.

2. Chiang Tung type guided missile fast ship (16 ships in categories 1 and 2, capable of long cruise operation.)

3. Chiang Nan-type fast gun boat.

4. Hainan-type destroyer

5. Hai tao-type guided missile fast boat, with improved missile

6. Ho K'ou-type guided missile fast boat

7. Honan-type guided missile fast boat

   (A total of 140 guided missile fast boats, 420 missile launchers)

8. Huchuan-type hydrofoil torpedo boats, 200 plus

9. Gun boats, 400 plus

10. High speed patrol boats, 600 plus

11. Modern regular submarine, 40.

12. Liberation-type submarine } 30

13. B grade medium distance submarine } 30

(The Chinese submarines, although capable of 10,000 nautical miles range, are only equipped with unguided torpedoes; they lack the performances required in a modern naval war, i.e., silent cruise speed over 20 knots and ability to fire guided missiles under water.)

In addition, the Chinese navy also has several hundred airplanes and coastal guns. It is a respectable defensive navy force. However, the activity of the Chinese navy is restricted to its territorial waters and the inner seas, they are rarely seen in international waters. Their navy lacks the strategic philosophy of seeking the command of the sea, but rather, assumes only the defensive duties. The submarine development is slow, not to mention nuclear retaliation power under water. According to Western intelligence, Communist China still has no reliable antiaircraft and antisubmarine guided missiles on board their ships. The U. S. Navy claims that, by 1981, the Chinese may have the ability to place a limited number of nuclear powered ballistic missile submarines. A nuclear powered offensive-type submarine went through testing in recent years.

III. Air Force

Air Force accounts for 1/7 of the total armed forces.

Equipment:
1. MIG 17, 1500
2. MIG 19, 2000 (of the 1950's design, no all-weather fighters)
3. MIG 21, 75, modern type fighters, equipped for air combat
4. F 9, the best Chinese-made airplane, level flight speed is supersonic, about 200 in number.

FUTURE DIRECTION OF CHINA'S EFFORTS

Wakamatsu, a Japanese expert on China once said: "In the modernization of the Chinese armed forces, the Army will be strengthening its tank and antitank fire power in battle, and further expand its air task force including helicopters. Navy will be increasing its antisubmarine capability and the Air Force is expected to carry forward its all-weather ability, air-to-air guided missiles, air-to-ground attack force and to strengthen its antiaircraft force including land-to-air guided missiles. The most fundamental requirement in achieving these goals is naturally an advanced scientific technology. However, since the cultural revolution, the Chinese education system, the basis for advanced technology, is in disruption and the progress in science and technology has all but stopped. The pressing task of today's China in her striving for military modernization is to draw on the scientific technology of the advanced nations."

THE SECOND LONG MARCH HAS BEGUN

According to the data we have been able to accumulate, China is indeed going in that direction. While striving for self-reliance, China has also opened the door for communication. For instance, science and technology exchange treaties are signed more and more frequently with nations including Yugoslavia, the Phillipines, Thailand, West Germany, and even France and Japan. The increasingly active interaction between China and Western Europe countries, France, West Germany and England, is attracting the most attention. On September 15, 1977, a Chinese military delegation headed by Yang Chang-Wu, Deputy Chief of the General Staff, visited France. That was the largest military delegation to have visited the West by the Chinese since the establishment of the People's Republic in 1949. Members of the delegation included the deputy commanders of the army, the navy and the airforce, and experts in nuclear weapons and guided missiles. On April 1, 1978, the ultramodern escort destroyer "Trouin" of France visited China, the first visit to China by a NATO country warship since China became a communist country 30 years ago.

MODEL AFTER THE FRENCH NAVY

Although France is a member of NATO, she has been independently developing her navy and guided missile weapons in the past 10 years or so. France now has two offensive aircraft carriers, one helicopter carrier, three nuclear powered submarines equipped with guided missiles and three more under construction, fifteen regular power submarines, one guided missile cruiser and about twenty guided missile fast boats. The French ship Duguay-Trouin which visited Shanghai is a destroyer with the range and fire power of a light cruiser (5000 nautical miles nonstop at 18 knots speed). The ship is equipped with 3 dimensional high performance radar, 100 mm guns, antisubmarine guided missiles, guided torpedo, antiaircraft and ship-to-ship guided missiles. It is well equipped for antiaircraft and antisubmarine missions.

The outstanding features of the French navy are that its quality outweighs its quantity but it is fairly active in the Atlantic ocean, the Mediterranean and the Indian Ocean. The two nuclear submarines cruising in the Mediterranean keep close contact with the land-based nuclear attack force; once the French cities are under attack, the missiles from the submarine will be heading for Moscow. In fact, the French navy is an important link in the nuclear retaliation of France.

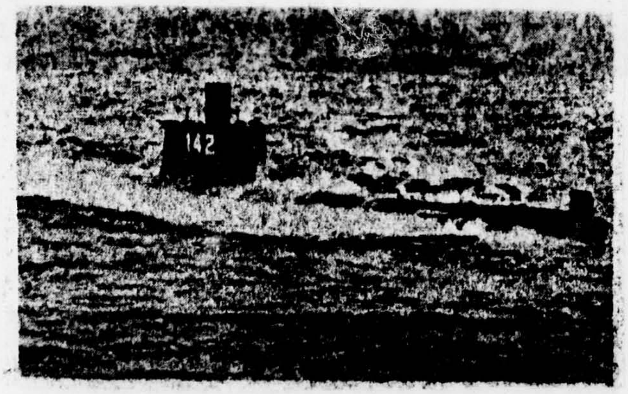
The Shanghai visit of the French ship gave the Chinese navy an opportunity for first hand observation of the advanced weapons systems of the West, such as the three dimensional radar on the Duguay-Trouin the "Exocet" ship-to-ship missiles, "Masurca" high altitude guided missiles, "Crotale" low altitude missiles, and the "Malafon" antisubmarine missiles, all are naval weapons which Communist China is very eager to obtain.

The Chinese navy will have to answer increasingly challenging tasks such as the development of resources at the bottom of the ocean, the sovereignty dispute of the islands in the South China Sea, and the control of the Taiwan Strait. None of these challenges can be met with torpedo boats and missile boats. Today, the Soviet navy is forcing its way into everywhere. The Western countries may aid the Chinese with advanced technology so that the Chinese navy is strong enough in containing the Soviet Pacific Ocean fleet. Under this new situation, the Chinese navy may expect some substantial improvement in the next 10 years.

DRAW ON FOREIGN ADVANCED TECHNOLOGY

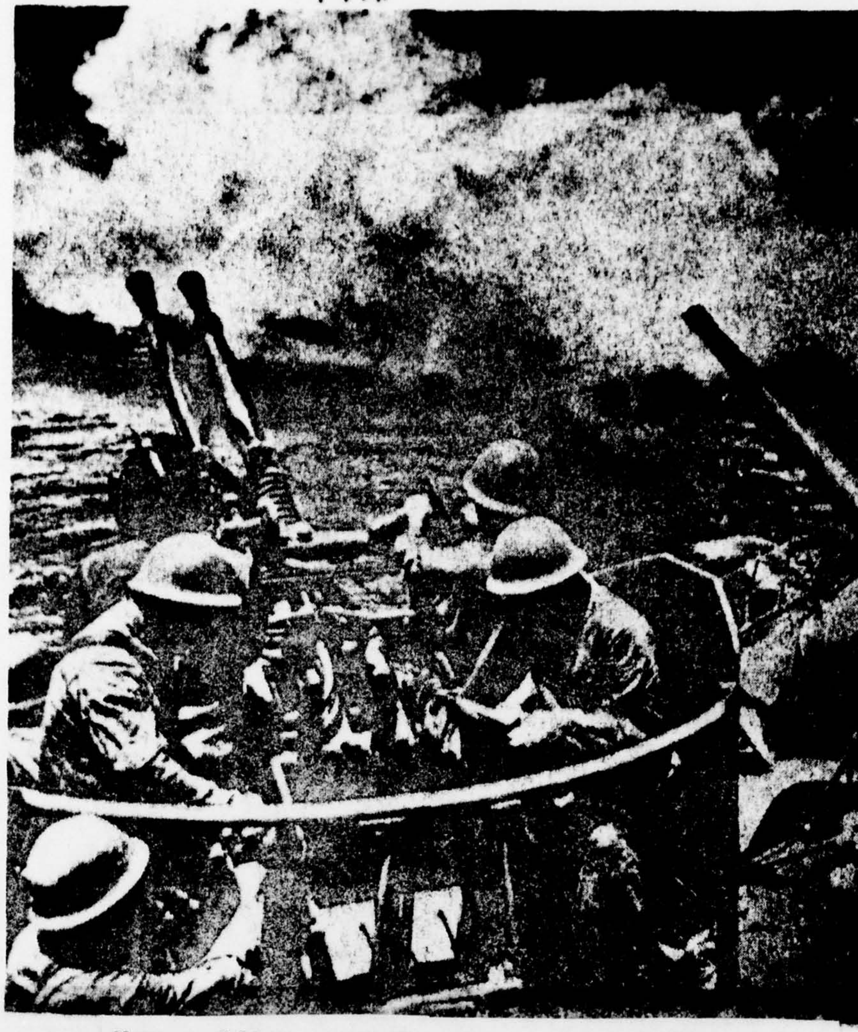
Currently the Chinese are not only exchanging academic and scientific knowledge with foreign nations, but they are also buying advanced weapons from these developed countries. The West Germany weapon manufacturer has provided China with the antitank, anti-guided missile helicopter BO-105. The Chinese and British governments have reached agreement in December 1975 regarding the production of Rolls Royce Spay engines *in China. This engine factory*, according to reports, is now located near Sian. Japan is prepared to export equipment meeting the Chinese needs, and Secretary of Defense Brown of the U.S. has also announced a partial lift of the embargo to China on strategic materials such as electron tubes, airplane engines, design and production know-how of electronic weaponry.

The most talked about subject these days seems to be the neutron bomb. Since the Soviet Union has been pushing hard in developing this type of weapon, the United States is also prepared to produce it. According to news reports, Chinese officials in London are closely watching the neutron bomb development and they claim that China has the ability to produce neutron bomb and will do so if the Soviet Union went ahead on the production. Foreign experts agree that the know-how of producing neutron bomb is known to nuclear powers. China, being one of the nuclear powers, naturally has the ability also. Let us wait and see.

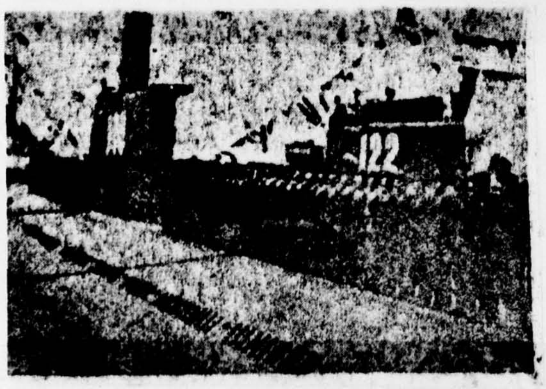


R ~~grade~~ class submarine of the Chinese navy

Model 59 tank

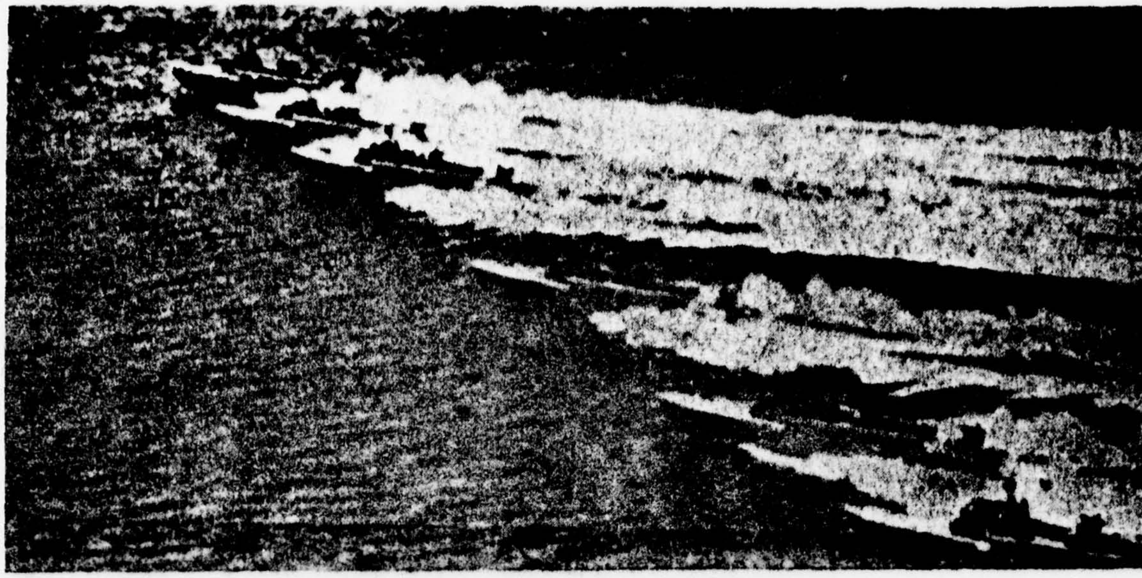


Navy soldiers carrying out antichemical training

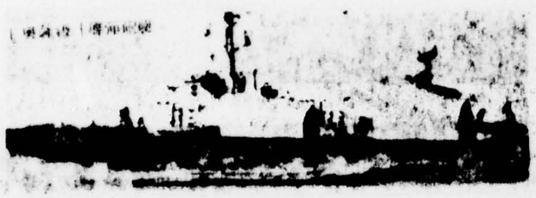


W class submarine of the Chinese North Sea fleet.

F-9 is an improved and modified version of the Soviet MIG-19. The major differences are the engine intake and the wing base.



Hydrofoil torpedo boat



Shanghai type gun boat cruising on the Chinese territorial sea.

CHINA'S WHO'S WHO IN SCIENCES

Wu Chung-hua

Born in Shanghai in 1917, studied mechanical engineering at Tsinhua University in Peking. In 1944, Wu went to study in America on a Tsinhua fellowship and received his Ph.D. degree. Afterwards he worked in an aerospace research unit, in the U. S. and challenged the difficult problem, "Three dimensional flow theory" which scientists from many nations failed to solve. After three years of persevering research, he accomplished unsurpassed achievements in 1950 in the three-dimensional flow theory and is regarded as the founder and initiator of the theory.

The three-dimensional flow theory was subsequently used widely in modern science and technology development and gained international recognition. It has become the theoretical foundation of contemporary impeller mechanical design and analysis. In the conclusions of the 1976 Third International Conference on Jet Engines, this theory was referred to as the Bible in that field. Wu's theory has been used in the design of many advanced modern aircraft, including: the British Trident civilian airliners, the engine of the "Phantom" fighter and the newly developed triaxis engine; the model 69 engine for unmanned aircraft of the United States, the engine of the world's largest airplane to date, the widebody Boeing 747; and the theory is used by West Germany, Japan, Switzerland and Belgium.

In August 1955, Wu returned to China with his wife. In 1956, the China Academy of Sciences and the Tsinhu University jointly built the Dynamics Research Laboratory and Wu served as the director. He published the paper "The design and analysis of impeller on arbitrary rotating surfaces" in the Review of Mechanical Engineering in 1956, and, in 1957, he published the book, "Thermodynamics Properties of Combustion Gas" in English and received international attention. When the electronics computer work was just starting in 1958, Wu participated actively and designed China's first program for mechanical computations of the impeller.

In 1976, the 59-year old scientist presented his paper "Three dimensional flow theory using arbitrary nonothogonal curvilinear coordinates" in the Ghird International Conference on Jet Engines held in West Germany. The conference regarded his theory highly and considered it to be a "Major development" to the original theory, "the highlight of the conference," and "only the inventor of the three dimensional flow theory is able to tackle a problem of such complexity."

Professor Wu Chung-hua is currently a committee member of the science branch in the China Science and Technology Committee and a director of the Mechanics Research Institut.

Ts'ai Tsu-ch'uan

Ts'ai is a high-vacuum electric light source expert in Shanghai, one of the inventors of the "Little Sun" (long-arc lamp). He is the director of the electric light source laboratory, Fu Tan University, Shanghai.

Ts'ai was an ordinary worker with only a third grade education. He started working in a factory at the age of 14. After the liberation, he became involved with scientific research work in the area of high vacuum and electric light source, under the encouragement and guidance of the government. He was qualified to enter the electric vacuum specialty of the Nanking Engineering College and later returned to glass work upon the call of duty. He learned and practiced while on his job and built relatively sophisticated high vacuum glass apparatus. He also created a medium size through-put glass oil diffusion pump. Ts'ai has developed a dozen or so new electric light sources including a hydrogen arc lamp.

Chen Yung-kang

A model national agriculture worker, Chen is a researcher of the Kiangsu Agriculture Research Institute. He was a common peasant and now has become a nationally recognized agriculture scientist. He is some 70 years old.

Chen was selected as the model seed-picker of his hometown, Sung Kiang Hsien, Kiangsu, in 1951. The same year, he was awarded the title national rice production model because of his record production of 1433 catty per acre of single season late planting rice. Chen was over 50 years old when he was transferred to scientific research units by the Kiangsu province committee in 1958. He worked with the experts in the experiment field, carried out research tests and unraveled the mystery of the "Three yellow, three black" high-yield rice. Gradually, his experience of rice planting advanced into sophisticated science theory and, in 1944, he entered the international science forum. In the science seminar with 44 countries participating, Chen presented his "three yellow, three black" theory and received wide attention of the attending scientists.

Hua Lo-keng

Sixty-eight years old and an eminent Chinese mathematician. He has conducted research and has made excellent achievements in the fields of mathematics, algebra, and theory of functions and is acclaimed as "one of the world's outstanding mathematicians".

Hua Lo-keng is from Jin Dan Xian (Chin T'an Hsien), Jiangsu (Kiangsu) Province. At 25 he had already become a world renowned mathematician. In 1936, he went to Cambridge University in England and within 2 years wrote more than 10 articles, conducted research and made contributions to difficult mathematical problems which were unresolved at that time. In 1938 he returned to China and held a post as Professor, Department of Mathematics, Southwestern Associated University in Kunming where he wrote his famous work "The Additive Theory of Prime Numbers"; was invited to lecture in the Soviet Union and the United States; wrote an analysis of number theories for an encyclopedia published in France; spent four years writing a major work, the 600,000 word "Introduction to Number Theory". In 1950 he resigned from the university of Illinois, where he had a promise of lifetime employment, and returned to his fatherland.

Because he did not use methods employed by his predecessors, his renowned scientific paper, "Theory of Complex Variables", represented a pioneering accomplishment in the field of mathematics and was honored by a "First Class Prize of the Science of China" in 1957. As a result of research in number theory, Hua and his students, Chen Ching-jun, Wang Yuan, and others received high appraisals from mathematics circles in China and abroad. Along with Wang Yuan, using the tool of algebraic number theory, he presented a new method for calculating numerical integration (abroad called the "Hua-Wang Method").

Reserach carried out during the period of the Great Vietnam Revolution was the basis of the theory of "Optimum Seeking Methods". He wrote a book, "The Study of Seeking Methods", and conducted research on mathematical methods for physics models. Again last year his research on the theory of algebraic numbers obtained gratifying results. His research in mathematical theory made creative contributions. His publications "Yang Hui Trigonometry", "Mathematical Induction Methods", "Plain Talk about Statistical Planning Methods", and "Plain Talk about Optimum Seeking Methods" have been disseminated to all parts of the country in order to bring mathematical theory in China more in touch with the reality of China's emergence on a new path and in order for China to make new contributions by applying developments in mathematics.

Chen Ching-jum

Chen Ching-jum is an eminent young mathematician who has made contributions to number theory research and has made notable accomplishments through intensive analysis and scientific calculations in regard to "Good-by conjectures" and, as a result, has gained world prominence. From 1956 to present he has published nearly 50 papers.

In 1953, Chen Ching-jun graduated from Amoy University in Fukien, being the first college graduate educated in the New China. After graduation he remained at the school and due to previous exposure to number theory research was assigned to work at the Mathematics Research Institute of the Chinese Academy of Sciences. His accomplishments in China and abroad have lead to his high esteem. The Chinese mathematicians, Professor Hua Lo-keng and the late Professor Min Szu-hao, have rated Chen Ching-jun's work highly. The English mathematician, Halberstam, and the West German mathematician, Richert, Wrote a book together, called "Sieve Methods", which orginally had 10 chapters. After it went to press, they then met with Chen Ching-jun in regard to his paper "1 + 2", which he then wrote especially to be added as Chapter 11, which was entitled "The Chen Theorem".

In 1977 the Cinese Academy of Sciences raised Chen Ching-jun from an Assistant Researcher to a Researcher.

Su Bu-qing

Su Bu-qing is an eminent mathematician, a Senior Professor at Fudan (Futan) University in Shanghai, and is 70 years old. He has been engaged in mathematical research for over 50 years.

In 1924 while studying in Japan he began research in the theory of numbers, specializing in differential geometry. He is honored as the founder of the "Classical Differential Geometry School of Thought" in China.

He has written and translated "Affine Differential Geometry", "Projective Differential Geometry", "K Expand Spatial Geometry", and "Riemann's Geometry". He has written more than 150 papers. He has gone on lecture tours on several occasions. As Chief of the Mathematics Research Institute, Fudan University in Shanghai, he was active in developing research in the basic theories of mathematics which allowed Differential Geometry in China to move into world leadership. His research success was a tool in the level of world developments in "Linear Smooth Order in Shipping".

Last year he wrote the paper, "Some Relatively Affine Invariants of High-Dimensional Spatial Parametric Curves", and organized associations for the research of mathematical theory. At present he is teaching the very latest mathematical courses and preparing lectures. He also conducts classes in a newly opened student research group at Fudan University.

T'ang O-Ching

Famous quantum chemist, professor of Kirin University. In 1976, he and his assistants, Kiang Yuan-Sheng, et al. published an important paper in China Science which is a study of quantum chemistry using graphical theory. This work established the graphical theory of molecular orbits and made quantum chemistry theory more concise and widely applicable. In 1977 T'ang again developed the graphical theory for eigen value problems which can be generalized in solving the energy levels and orbits of general molecular motion. T'ang has been doing research on the conservation principles of molecular orbit symmetry since 1973. This research is highly significant in the selection of catalysts and in the development of organic synthesis industry. He published new concepts concerning the molecular orbit symmetry conservation in 1974. Recently, T'ang and Hua Lo-keng cooperated in the compilation of the book "Introduction to Modern Science and Technology".

Chang Kwon-Tou

Chairman of the Hydraulics Department, Tsinhua University and well known hydraulics expert of China. Graduated from Chiaotung University in Shanghai in 1934 and entered Harvard University to study mechanics on a Tsinhua scholarship. After the Sino-Japanese War broke out, Professor Chang returned to China. In 1940, he designed the Szechow Taohua Ch'i hydraulic power station, the first power plant designed by a Chinese.

On the eve of the downfall of Chiang Kai-Shek government, Chang declined the recruitment of American experts working for the Kuomintang to go to the United States and refused the pressure of the Kuomintang to go to Taiwan. Later, the Kuomintang ordered him to pack and ship the hydraulic resources data of China to Taiwan. Chang secretly consulted with the Communist underground organization and decided to pack fake documents, with the invoice signed by Chang himself, for the shipment to Taiwan and the real documents were transferred to Shanghai through the party organization.

In 1958, the central government decided to reconstruct the Minyuan reservoir in order to reduce the flood and drought threats in the Ch'aopai river area and to improve the hydraulic power supply to the Peking-Tsientsin-Tanshan region. Chang was assigned as Chief design engineer and assumed the duty of designing the reservoir. After the devastating earthquake of Tanshan, he again participated in the reservoir reinforcement design.

In the early building stage of China, Chang has set foot on almost every part of China and participated in the design of numerous projects -- the People Victory Canal which draws the Yellow River water and feeds it to the Wei River; the flood control dike at Shihtowch'ung, Honon; the Yellow River project at Sanmen Canyon; the flood control at the mouth of the Dan River; and the dam at Liuchia Canyon. Chang is also a consultant for the two most important river management institutions of China -- the Yangtse Kiang Planning Office and the Yellow River Hydraulics Committee.

Lu Chia-Hsi

Director of the Fukien Material Structure Research Institute, China Academy of Sciences and famous material structure expert. Lu was born in Taiwan and was head of the Taiwanese Delegation to the National Science Conference. In 1956, Lu participated in the first work session on the scientific technology projects and has been carrying out material structure research at the atomic-molecular level. In 1962, he again participated in the planning of the second national science and technology session.

The Fukien Material Structure Research Institute, under Lu's leadership, employed structural chemistry and quantum chemistry in the research of chemical simulation of biology, solid nitrogen, laser and nonlinear optics' effects. In his fundamental research on microscopic structure, he has proposed revolutionary structure models followed by theoretical analysis and preliminary confirmation leading to meaningful results. They have planned to develop new solid nitrogen catalysts, laser, and frequency-doubling crystal material. Their work will establish the direction of our own in the important subjects of catalysis, crystal material new technology, molecular design and engineering.

Lu led the Chinese catalysis chemists delegation in its visit to Japan.

Chen Chung-wei

Chen Chung-wei is an eminent Chinese orthopedic surgeon and is Deputy Director of Shanghai Sixth People's Hospital, and Chief of Osteology. In 1963, he and another doctor performed the first successful reimplantation of a severed hand. Again in 1965 he succeeded in saving a severed finger. Chen Chung-wei leads the research group on orthopedics and severed limb reimplantation at Shanghai Sixth People's Hospital. This group has proposed new theories for eliminating limb swelling by splicing additional veins, and for preventing necrosis of the tissue at the point of cut-off by [means of] thoroughly cleaning the wound. This group has also pioneered technology for reimplanting severed fingers and toes, exchanged position reimplantation, free flesh transplanting, as well as the splicing of nerve endings in limbs after they are swelled.

Last year in successfully carrying out free fibula transplant surgery involving blood vessels on a 9 year old boy, he has obtained even newer developments in the field of osteology using Chinese microsurgical technology.

Kao Chih-Chi

Kao is a famous activist and author in the popularization of science. In the last 1920's, Kao was studying at Chicago University in the United States. While working in the laboratory, he fell victim to encephalitis virus and suffered serious damage. In the half a century since he returned to China, under the extreme conditions of having a body paralyzed, hands unable to hold a pen and his speech impaired, Kao continued to produce and publish with a strong will power. Since the beginning of the new China, he has published "Our Mother Earth," "Revealing the Secrets of Lilliput", "Autobiography of a Germ", "Catching the Little Devil", "My Atoms are Exploding" and many other science readings, essays on science popularization, science poems--a total of 700-800 publications amount to more than a million words.

Last July, he wrote Chairman Hua and Vice Chairman Yeh to propose his "four suggestions in science popularization", and in the part year or so, he met with youths of the capital on numerous occasions and encouraged them to love science, learn science and use science. He has published close to 40 poems and articles in newspapers and magazines since last September.

Tai-Wen-Sai

Tai is an astronomy professor at the Nanking University and a famous Chinese astronomer. He investigates the origin of the solar system and, having studied more than 40 different theories, proposed his new "nebula theory." According to his thesis, the solar system was formed from one single nebula. The nebula shrinks while spinning and the central portion forms the sun, and outer parts become the nebula disk. Planets and satellites are formed in the nebula disk. The new theory discussed and quantitatively analyzed the details of the formation process of the solar system and it interpreted the motion and structural characteristics of the solar system.

Tai taught at the Peking University in 1953 and attended the National Advanced Producer Conference in 1956. He served many terms as the vice president of the Chinese Astronomy Society. In 1962, he became the associate Chairman of the Astronomy Department at NanKing University.

Professor Tai's research on the origin of solar system goes back far in time. After studying the subject for more than twenty years, he has formed an independent and relatively complete theory concerning the origin and evolution of the solar system. He has proposed views totally different from any previous theories on many questions including the interpretation of the Teteus-Peter rule, the forming process of Jupiter, Saturn and their regular satellites, the appearance of the Jupiter corona, the satellite and belt of Uranus, and the distribution of angular momentum. He is currently working with young astronomers on the quantitative analysis concerning the origin of small planets, a pioneer work in this country. He is also working on new book, "The Evolution of the Solar System," which encompasses the entirety of his new theory. He writes for the Nature Magazine, discusses science popularization with editors of the pictorial Science magazine and participates in the correction of papers. He also meets with foreign visitors and conducts friendly academic exchanges.

In 1975, he initiated the weekly discussion seminar on astronomical physics, and within two short years, the discussion group finished 17 scientific papers and 10 investigative reports, raising the star system research work in China to a new level.

Yang Tin-Pao

A well-known architect, Yang Tin-Pao is 77 years old and has been practicing architecture design for over 50 years. He served as the department Chairman of Architecture and associate dean at the NanKing Engineering College. He was also the vice president of the Chinese Architecture Society. Yang studied in the United States in the early 1920's and taught at the architecture department of NanKing University. He participated in the design of the Yuhuatai Martyr's cemetery in NanKing, the Wangfuchin department store building in Peking; the Great Hall of the People and National Palace, both large buildings in the capital; the Yangtze River bridges at Wuhan and NanKing; the New Railroad Terminal in Canton and some other hotels in Canton; the Wutaishan ten-thousand people gymnasium in NanKing, and so on. Yang made numerous foreign visits and participated in international meetings. In 1955, Yang headed the Chinese Architecture Society delegation in a meeting in the Netherlands and he was elected an executive committee member of the International Architecture Association. Later, he was elected vice president of that organization in 1957. Yang led a delegation of Chinese colleges and universities in a 1977 visit to the United States.

Chien San-Ch'iang

Born in Wushin, Chekiang, 65 years ago, Chien San-Ch'iang is a famous physicist and has made major contributions to the nuclear science in China. Chien's father is Chien Shuan-Tung, a scholar in the late Tsing Dynasty. Chien graduated from Tsin Hua University in 1936 and, after a one year research tenure at the Peking Research Institute, he went to study at Curie college in Paris, France. While he was in France, he did nuclear research with Professor Curie. Chien returned in 1948 to become an atomic physics professor at Tsin Hua. Shortly after the Liberation, Chien started New China's nuclear research with a dozen young men and served as the director of the modern physics research institute, China Academy of Science. He also served as the secretary-general and committee member of the physics, mathematics and chemistry division of the China Academy of Sciences. When the atomic energy research institute was established in 1958, Chien became its director and he has been in that post since then. On many occasions, he visited foreign countries as the deputy secretary general of the China Academy of Sciences.

Chou Pei-Tuang

A well-known physicists, Chou is 75 years old. He came from south China and went to study in Peking in 1919. Later, he continued his work on fluid dynamics at the California Institute of Technology.

started his teaching at Tsin Hua University in 1929 and again went to the United States for research during the Sino-Japanese War. He continued to teach at Tsin Hua after the Liberation and later became the academic dean of Peking University. He was subsequently elected to the physics, mathematics and chemistry committee of the China Academy of Sciences. He has been the vice president of Peking University since 1956. In the past twenty years, has led delegations to international science and technology meetings on many occasions. His current positions are the associate director of the Chinese People-to-People Foreign Relations Society, chief officer of the Chinese Physical Society and of the Chinese Mechanics Society.

Huang Chia-Szu

Huang is the president of the China Academy of Sciences and a well known chest surgeon. He was a member of the Chinese delegation to the World Medicine Conference in May, 1953. In December 1953, he became the associate dean of the Shanghai First Medical College, and, in May 1955, a member of the Biology Association, China Academy of Sciences. In 1958, he served as a committee member and vice president of the Chinese Science and Technology Association, and in April 1960, he became president of the China Medical College, later president of the China Medical University. May 1965, he took charge of the village circulating medical team of the China Medical College in the Honan region. 1971, he was a representative of Peking area medical profession.

Wu Wen-Chun

Professor Wu Wen-Chun, research scientist of the Mathematics Research Institute, China Academy of Sciences, returned from France in 1951.

Going to be 60 years old, Professor Wu is continuing his research on topology which he has been investigating for many years. During the Great Cultural Revolution, he applied the imbedded indicator theory of numbers which he developed after he came back to China, to the application of large scale integrated circuits, and since 1974, he opened up the research on *I functions. He initiated a new research subject, machine proof, in late 1976.

Hsu K'o-Ch'in

A 70 year old geology professor, Hsu has been doing research on the geological formation of granite for over 40 years. One of the fruits of his long research is disputing the traditional belief in geology that the only granite in south China is the Yenshan granite formed about 100 million years ago. In a recent geological work session called for by the National Geological Service, the old professor of Nanking University was invited to give an academic report. In his talk, Hsu introduced the correlation of various metallic mineral resources in granites of different geological age and received wide attention by geologists.

Pei Shih-Chang

Came from Shanghai, Kiangsu. Pei is a 75 year old well-known biologist. He is the director of the Biophysics Research Institute of the China Academy of Sciences. Pei taught in the biology department of Chekiang University during the Sino-Japanese War. He served as deputy minister of higher education in the State Department and visited foreign countries with the Chinese Friendship Delegation. Recently, he introduced the coordinate structure of insulin to students in Peking and he is organizing a research group to investigate the rebuilding of cells.

Chang Wei

Mechanics professor at Peking University. January 18, 1978, at the invitation of the Sweden Royal Engineering College, Chang led a five member delegation of Tsin Hua University and visited Sweden.

Chu Fu-Tong

Chu is vice chairman of the Revolution Committee at Peking Children's Hospital. Chu is a well known pediatrician and he is 79 years old. "Practical Pediatrics", a book he has authored, is being revised for publication.

Chien Hsueh-Sen

(Translator's note: no vitae)

Yen Chi-T'zu

Yen is a well known physicist. He is from Tungyang, Chekiang, and is 78 years old. After graduating from Southeast University, he studied in France and received a Ph.D. from the University of Paris. His experiences after returning to China includes assistant professor of physics, Central University, Professor of Shanghai University, and director of the physics research institute, Academia Sinica. After the Liberation, he served as the director of applied physics research institute and administrative director of the China Academy of Sciences, secretary general of the National United Natural Sciences Specialists Society, director of the technical science division and committee member of the physics mathematics and chemistry division in the China Academy of Sciences, Secretariat of the National Science Association, vice president of the China Scientific Technology University.

T'ung Ti-chow

Born in Ningpo, Chekiang, 76 years old, T'ung is a respected biologist. In the early years, he obtained a degree in biology from Futan University in Shanghai and then he studied in Belgium and France and earned his Ph.D. degree. He returned to a teaching post in Shantung University, Tsingtao, in 1934. After the Sino-Japanese War broke out, he continued his teaching at T'ung Chi University near Chungking and concentrated on his research in cell biology under extremely difficult conditions. He returned to teaching at Shantung University after the Victory. On the eve of the Liberation, T'ung was on an invited lecture tour in the United States and he determined to return to his country. Shortly after the Liberation, T'ung served as the deputy director of the experimental biology research institute of the China Academy of Sciences and vice president of Shantung University. When the divisions were established in the Academy of Sciences in June, 1955, T'ung became the committee chairman of the biology and geology division, and later, was promoted to the posts of deputy director and director, and simultaneously, served as the director of Tsingtao Marine Biology Research Institute. T'ung is committed to long-term studies of experimental embryology and cell heredity in the search for regularities in biological growth. Recently, T'ung cooperated with Professor Niu Man-Kiang, a U.S. scientist, in the research of cells and heredity, and their achievements have already attracted interest and attention of scientists in and out of China.

T'ung has also studied the immunization of tumors. He tested the immunization against cancer, using cells hybridized from normal cells and tumor cells, and obtained some anti-cancer effect. This work is still under conceptualization and experimentation; further tests are needed in the future.

Chang Wen-Yu

Director of the high energy physics research at the China Academy of Sciences. Chang was educated in England and later taught at Princeton University in the United States. He returned to China in 1956.

Shen Shan-Chiung

Shen studied in the biology department of California Institute of Technology in the United States, and later came to Shanghai and started the research of biological synthesis of sozin. Shen made significant contributions to the initiation and growth of our country's antibiotic industry. Since 1974, Shen opened up the active research work in molecular biology with the young comrades in the Shanghai plant physiology research group. Under extremely difficult conditions, they started the work in an area which has been vacant for many years.

Mao Yi-Sheng

A famous bridge expert, Mao has been studying bridge building for over 50 years. Mao and his colleagues, after overcoming numerous difficulties with strenuous hard work in the 1930's, built the Chinese people's first railroad-highway bridge, the Chentang River Steel Bridge.

Wu Chi-Ch'iang

Wu, 69 years old, is a peasant scientist and model cotton grower. He felt his way through the cotton growing business and invented 9 new techniques including "cold bed seedling," "seedling transplanted," etc. In 1966, Wu was entrusted by Premier Chow to solve the problems of falling bud/and falling fruit in cotton growing. After spending days and nights at the cotton field, Wu finally figured out the nature of the cotton plant and realized the times of falling bud, bell and fruit and their relationship to water, fertilizer, light and temperature. He developed two plants which are top leaves and one-plant-double-stalk and obtained preliminary success. He was invited to participate in the National Symposium on Cotton Growing Techniques held in Shansi. In the meeting, Wu presented his one-plant-double-stalk cotton. Wu continued to climb new peaks in science in the past year and developed a new breed of cotton which is multiple-stalk-double-layer.

Huang K'un

Huang is a physics professor of Peking University and a famous physicist. He coauthored a book entitled "Crystal Dynamics" with Max Born, a world famous physicist and Nobel Prize winner. Huang went to study in England in 1945 and received his Ph.D. from Bristol University. He then taught and did research at Leeds University in Edinburgh. While he was in England, he published twenty scientific papers, and his unique understanding of the solid state physics research received attention from the British Scientific Community. He was regarded as a young and able physicist. Huang returned to China in 1951 and became the director of the solid state physics teaching and research laboratory at the physics department of Peking University.

Huang Hsi-Tsing

A geologist of the China Geological Science College, Huang is 74 years old and has been working in the field of geology for over 50 years. In the past twenty years, he did research and developed his theory on the multiple rotation of the earth crust. He is developing a multiple rotation model for the formation of trough. The theory of this school is preliminarily confirmed by the oil and iron survey data, especially by results of regional geological survey.

Shih Shaw-Hsi

Tientsin University professor, Shih studied internal combustion engines at Manchester University, England. He has been committed to the research and development of internal combustion engines ever since he returned to China. In 1975 and 1976, the internal combustion engine expert visited Austria and the United States.

Hou Kuang-Chiung

A 73-year old soil expert, Hou is a professor of the Southwestern Agriculture College and has been in the soil research for more than 40 years. Breaking away from the old concept in soil science that soil is never changing, he concluded that soil is really a parabiological entity undergoing periodic changes under the influence of natural and artificial conditions. He further concluded that the change in fertility of the soil is directly influenced by the weather in the form of radiation heat from the sun. Based on this concept, Hou proposed the combined water and heat stability in the vertical direction of the atmosphere, biosphere and the soil generation sphere (that is, the "big three") and the and structuralization of the soil itself (that is, the "small three"). His new theory strongly disputed the old thesis that the soil fertility is simply determined by the quantity and quality of its nitrogen, phosphorous and potassium content. In the old thinking about soil fertility, there is the so-called "return principle" that one must return to the soil the same amount consumed by the crop, otherwise the fertility of the soil will continuously decrease according to the law of "graduated depletion of soil fertility." Huo's theory disputed these and opened a new frontier for developing modern soil science. Some community teams in Szechuan used Huo's new theory in directing agriculture production and obtained good results and increased production. Huo is w king on his book "Introduction to Chinese Agriculture Soil" so that he can better serve the agriculture with his new theory.

Hsu Kuang-Hsien

Chemistry professor of Peking University, Hsu is a theoretical chemist engaged in long term research of the extraction technique of rare earth elements, and the theoretical work associated with this process. Rare earth is the collective name of 17 rare metallic elements. The rare earth resources of China are unsurpassed in the world. There are natural ores of more than 10 different elements and rare earth extraction is the means of separating and purifying these elements. After more than a hundred times of repeated experimentation and evaluation, Hsu proposed his series extraction theory characteristic of the situation in China. His optimization equation and purity logarithmic graphical solution method have solved the basic design problems of series extraction technique and generalized the method.

Lu Ru-King

Electronic computer expert. Lu has worked abroad before he returned to China. Since then, he has been doing research on fundamental theories in mathematics, in mathematics research institutes. In 1972, he switched his field to computer and made improvements to the computers currently used in China. He is working on a universal software compatible with all different models of computers. (Software are the programs for various systems in the computer. In order to have the computer carry out a certain operation, a machine "language" must be used to "tell" the machine what to do. Software assumes the task of communication.) This is also being developed in other nations. If Lu's research turns out to be successful, it will be a leap forward for the computer enterprise in China.

Wu Chung-hua

Ts'ai Tsu-ch'uan

Chen Yung-kang

Hua Lo-keng

Chen Ching-jum

Su Bu-qing

T'ang O-Ching

Chang Kwon-Tou

Lu Chia-Hsi

Chen Chung-wei

Kao Chih-Chi

Tai-Wen-Sai

Yang Tin-Pao

Chien San-Ch'iang

Chou Pei-Tuang

Huang Chia-Szu

Wu Wen-Chun

Hsu K'o-Ch'in

Pei Shih-Chang

Chang Wei

Chu Fu-Tong

Chien Hsueh-Sen

Yen Chi-T'zu

T'ung Ti-chow

Chang Wen-Yu

Shih Shaw-Hsi

Top left: Mao Yi-Sheng and young mathematician Chen ~~Chin-Jun~~ Ching-jun.

Top right: Kuo Mo-Jo, director of the China Academy of Sciences.

Biologist T'ung Ti-Chow and Professor Niu Man-Kiang of Temple University, Philadelphia, the United States, are doing scientific research together.

FIRST STEP TOWARD SPACE -- ARTIFICIAL SATELLITES

Chinese Vice Premier Fong Yi announced in the National Science Conference that China will launch space lab and space explorer in the next eight years, namely Communist China is developing manned spacecraft. Up to now, only the United States and the Soviet Union have this kind of technology. China will be the third country if the plan for sending astronauts to space materializes in eight years. However, this involves sophisticated and complex technology and the plan's feasibility is somewhat doubtful. Nevertheless, according to reports by U.S. scientists recently returned from a visit to China and the technical magazine "Aeronautical Knowledge," China is prepared to launch two communication satellites in 1979. Chinese magazines, for the first time, are discussing problems concerning human body in weightless state, crop and vegetable planting in space, and the like. These reports indicate that China is indeed preparing for launching spacecraft.

Searching through the Chinese research literature on space satellite technology, we found they have a short history, but fairly rapid progress in the research of this area. On April 24, 1970, they successfully launched their first earth satellite, and five years later, they were able to recover satellites. Two more recovery satellites were launched in 1976 and January 1978. These recoveries reflected the rapid development of the Chinese electronics industry to the capability of manufacturing tracking, guiding and control systems used in the launching and recovery of artificial earth satellites, and their aeronautical technology has entered a new stage.

After the development of analog satellite communication earth station in 1975, the Chinese built their digital communication earth station in 1977 to transmit People's Daily News and live radio and television programs to remote regions of that country.

According to recent reports, Professor Tai Wen-Tsai of the Astronomy Department, Nanking University, has analyzed and evaluated the current theories on the origin of the solar system and, based on various observation data, proposed his own theory which explains more phenomena. A young instructor, Liu Lin, in the Astronomy Department, made important contributions by proposing his perturbation calculations and the corresponding orbit modifications for arbitrary eccentricity and critical angle. Sixty researchers in the Nanking Engineering College, Chen Ching-Yao et al, finished a study at the end of 1977 on the generation of electricity by ferro fluid and the experiment quality of this group is at an advanced level in some aspects. The small helium refrigerator, also developed by this college, has been used in the communication satellite earth station with good results. From these tidbits of information, one can see the effort the Chinese are making to send spacecraft into the sky.

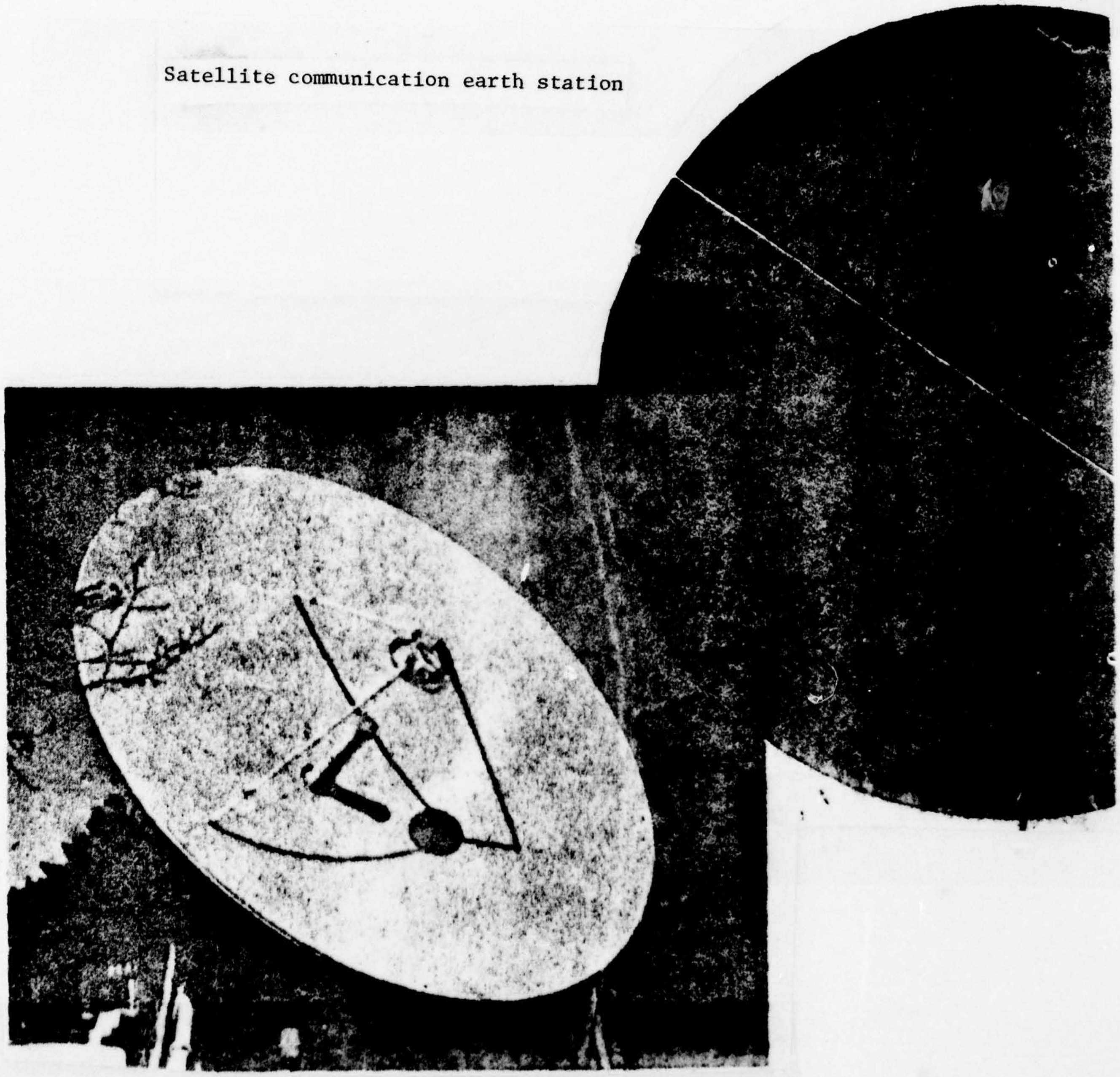
Launching dates of the eight Chinese earth satellites:

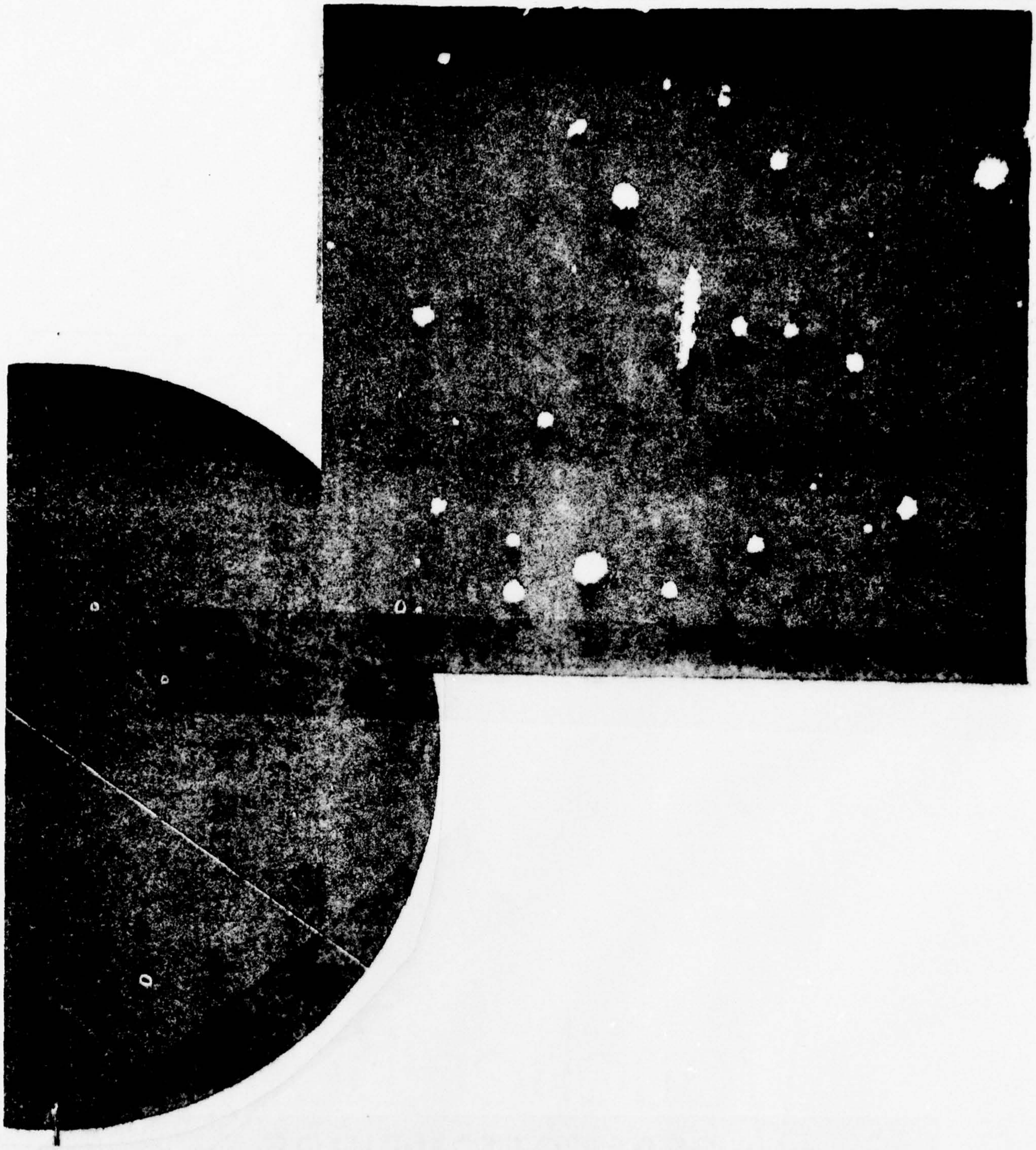
1. April 24, 1970
2. March 3, 1971
3. July 26, 1975
4. November 26, 1975 (returned to earth as scheduled)
5. December 16, 1975
6. August 30, 1976

7. December 7, 1976 (returned to earth as scheduled)

8. January 26, 1978 (returned to earth as scheduled)

Satellite communication earth station





Photograph (partial) showing the first Chinese artificial earth satellite flying over Nanking, taken with the astronomy telescope of the Tsu Chin Shan Observatory, China Academy of Science. The telescope is designed and manufactured in China. Photograph shows the orbit of the satellite on a background of stars in the sky. The satellite's trace is photographed as segments for the study of its orbit.

China's Potential in Nuclear Weapon Development

Generally speaking, China's strategic nuclear weapon development project has been highly successful and fast paced. The time elapsed from its first atomic bomb explosion test to the thermal nuclear explosion is shorter than any other nation with nuclear power. China has also made major developments in the area of nuclear warhead design; at one time, the weight and power were increased ten times within two years. The nuclear warheads produced by China can be carried by TU-116 bombers or by mid-range guided missiles as can be seen from the disposition of its mid- and short-range missiles. In fact, the development of strategic nuclear weapons in China has surpassed that of France and will soon leave Great Britain far behind.

Nuclear Installations: Before 1960, most of the nuclear facilities in China were provided by the Soviet Union. Now, Japan, Switzerland, Czechoslovakia, East and West Germany are constantly providing the instruments and machinery needed by China. Japan has provided facilities to China, including parts for guided missiles, and helped in the training of her technical staff. Electronic computers, guided missile tracking and monitoring devices and nuclear reactors were provided by West Germany. Switzerland also provided China with mechanical and measurement equipment of guided missiles. Electronic components seem to be a particular need of China, who imported 2000 million dollars (U.S.) worth of military and industrial electronic components between 1960 and 1966. The electronic industry in China today is still in the expanding stage.

At present, there are seven nuclear reactors in China. The most important one is the Lanchow gas diffusion plant which produces and processes six hundred pounds of U-235 per year. In the past twelve nuclear explosion tests, China used about four hundred pounds of U-235. That is to say, China should have six thousand pounds of U-235 in stock, enough to make one hundred and thirty three nuclear bombs.

The plutonium plant in Yumen can produce four hundred pounds of Pu-239 yearly, roughly enough for 40 nuclear bombs. The Yumen plant was built in 1967, therefore, 200 nuclear bombs at 20 kilograms each should have been stocked up. Another plutonium is in Paotow with a capacity of 100 kilograms of Pu-239 per year. In addition, another nuclear reactor of unknown capacity is in Haiyuan, Tsinghai.

According to one report, China has also established a gas diffusion facility in inner Mongolia, similar to the one in Lanchow. If this is true, China's production ability of U-235 will be doubled.

Rich Natural Resources: China has plenty of natural resources to support her development of strategic nuclear weapons. Large reserves of uranium ore are found in Sinkaing and Chunsha. Uranium mines have been in active operation since the 1950's, with a daily production of 2500 tons. China seems to be rich also in concentrated *. beryllium, boron tungsten, high pressure electronic quartz, mercury, tantalum, and molybdenum, all essential materials in the development of strategic nuclear weapons.

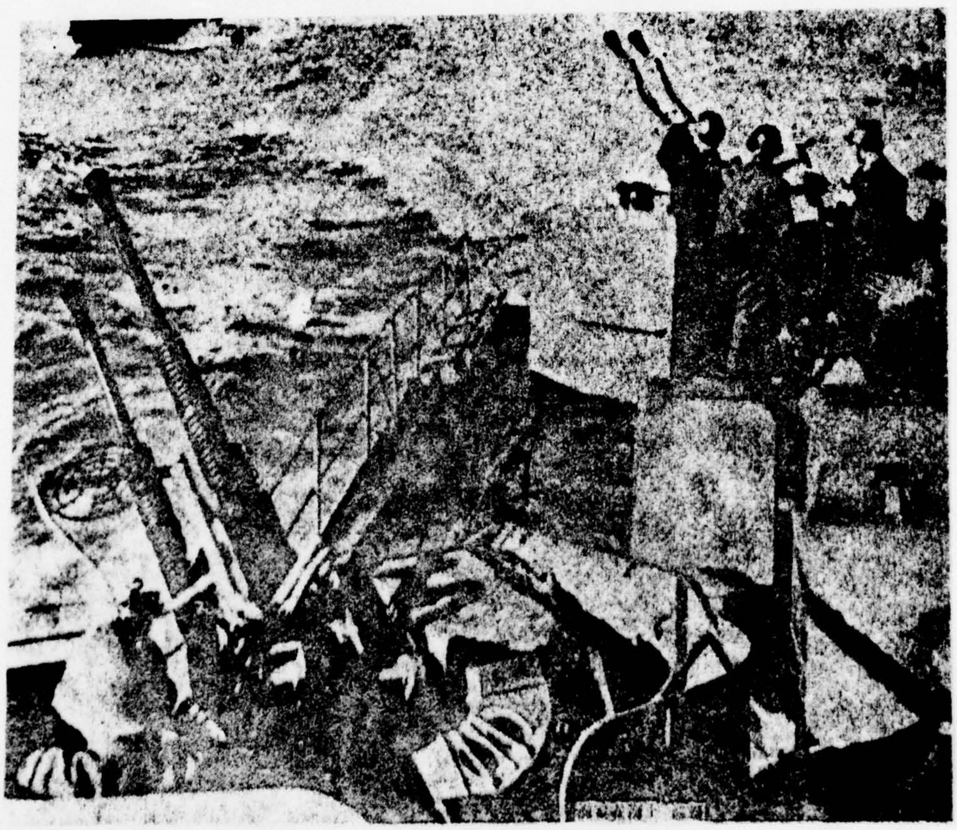
(*original missing one word.)

STRATEGIC NUCLEAR WEAPON DEVELOPMENT OF CHINA -- A CHRONICLE

Feb. 1955	Chemical separation plant built in Sinkiang with Soviet assistance for the production of U-235 and plutonium.
April 1955	Chanchun Atomic Science Academy established.
Mar. 21, 1956	China sent students to the Communist Country Joint Atomic Research Institute in Soviet Union
Apr. 20, 1956	China and Soviet Union signed the Nuclear Cooperation Pact, the Soviet Union provided China with a research nuclear reactor and a cyclotron, and also made necessary facilities available to the Chinese students studying and doing research in Russia.
Sept. 1956	Based on a Five Year Foreign Aid Plan, the Soviet Union provided facilities for the establishment of 39 Atomic Research Centers in China.
Feb. 1958	China proposed a twelve year scientific development plan and established the Shanghai Atomic Energy Research Institute.
Dec. 1958	Announced the "Twelve Year Science and Technology Development Plan" with atomic energy, electronics and jet propulsion as its main emphases.
June 1959	Soviet withdrew its experts from China. China started independent development of nuclear weapons. The Atomic Energy Research Institute of the China Academy of Science in Peking established branch offices in various provinces, cities and autonomous regions.
1961	Large atomic reactors capable of producing atomic bomb material are built in Sian and Chungking. Research on model atomic bomb and rocket system was carried out in Sinkiang.
1963	More than 40 chemical separation plants were built in the nation to extract uranium and produce radioactive materials, especially nuclear weapon materials. At a cost of 1.5 billion U.S. dollars, China built a 200 million watt nuclear reactor in Lan Chow for large scale gas diffusion operation.

Oct. 16, 1964	First atomic bomb test explosion detonated in Lop Nor. The bomb material used was U-235 instead of the normally used and more easily produced one The explosion method was implosion and not the commonly used scheme. This testified the accomplishments of China's development of strategic nuclear weapons.
May 14, 1965	Second atomic test explosion.
May 9, 1966	Test explosion of nuclear bomb containing thermal nuclear material.
Oct. 27, 1966	Launched guided missile nuclear weapon.
Dec. 28, 1966	Another nuclear explosion.
June 11, 1967	Test explosion of first hydrogen bomb.
Dec. 27, 1968	Test explosion of second hydrogen bomb.
Sept. 23, 1969	First underground nuclear explosion (weight has been reduced from 20,000 pounds to 2000 pounds with the same power, indicated the success of light nuclear warhead development).
Sept. 29, 1969	Test explosion of third hydrogen bomb.
Nov. 18, 1971	Another nuclear test.
Jan. 7, 1972	New nuclear test.
June 27, 1973	Test explosion of fourth hydrogen bomb.
June 17, 1974	Another nuclear test.
Oct. 27, 1975	Second underground nuclear test.
Jan. 23, 1976	New nuclear test.
Sept. 26, 1976	Another new nuclear test.
Oct. 17, 1976	Third underground nuclear test.
Nov. 17, 1976	Test explosion of fifth hydrogen bomb.
Sept. 17, 1977	Another new nuclear test.
Mar. 15, 1978	Yet another new nuclear test.

Mushroom cloud from China's first hydrogen bomb explosion



THE BACKBONE OF AIR DEFENSE -- GUIDED MISSILES

According to the 1977-1978 annual report "The Military Balance" issued by the British Strategic Research Institute, China now has a total number of atomic and hydrogen bombs approximately several hundred, and possibly increasing rapidly. Along the line of nuclear weapon delivery, China has five choices: bomber, medium-range guided missile, limited intercontinental missile, full-range intercontinental missile and under-sea launched guided missile. But China has obviously abandoned the bomber plan although a number of the Chinese bombers are capable of delivering strategic nuclear weapons, among them, the TU-16 bomber and the F-9 tactic fighter.

The main component of the Chinese air defense system is the radar controlled SAZ ground to air guided missile, a product of the 1950's, which was rendered useless by the electronically equipped U.S. airforce during the Vietnam War. However, China has made some preliminary new progresses in the area of guided missile research and has the following relatively new missiles:

1. MRBM -- medium range ballistic missile, range 600 to 700 miles, already in the battle-ready status.
2. IRBM intermedium range ballistic missiles, 1500 to 1750 miles developed to the stage of practical use.
3. ICBM -- Multistage intercontinental ballistic missile, 3000 to 3500 miles, will be battle worthy in the near future.
4. ICBM -- intercontinental ballistic missile, 8000 miles range

currently under development, probably will be battle ready in a few years. The number one enemy of China today is the Soviet Union, hence, this type of ballistic missile is drawing the most attention since it can hold Moscow as ransom. On November 23, 1977, China launched a nuclear warhead equipped medium distance ballistic missile from Chi Lin in northeast China and accurately hit the target in the Takla Makan Desert of the UIGUR Autonomous Region in the western part of Sinkiang, a flight distance of 3500 miles or 4500 kilometers. Full range tests of this type of missile, however, would require setting up a target zone in the Indian Ocean or the Pacific Ocean.

The Chinese missiles have been using liquid fuel propellant, and solid fuel is under development. The latter requires a much shorter time for launch. Guided missile production and assembly plants are located in Paotow, Sian, Shenyang and other places. Rocket body and mechanical components are manufactured in Shenyang, Harbin, Sian, and Chentu, whereas solid and liquid rocket fuel plants are in Liaonin, Taiyuan, Hsiangchin, and Yinchow. The missile test site in Paotow is for short range ground-to-ground missiles and the one west of Ninshia is for earth-to-air, air-to-air and ground-to-ground medium range guided missiles. The mechanical testings or rockets are carried out at Changhsintien.

The training institutions for rocket technical personnel include the Science Technology University (under the China Academy of Sciences), Chinhua University, Peking Aviation Mechanical Engineering College, Wuhan Upper Atmosphere Physics College, and the Automated Remote Control College and Mechanics Electronics College in Peking. One can conclude the following things about the Chinese launching system R and D:

1. Its development in launching technology has had a superior standing,
2. They have been quite successful in systems development; one notable fact is that it took China shorter time to launch a satellite than it did the U.S. and the Soviet Union,
3. Rocket system development is not as fast as people expected, at least somewhat slower than the U.S. expert's prediction; and in the area of guided missile equipment China is still one to two generations behind the Soviets.

Still, one thing is clear: China has made major accomplishments in the strategic and tactic weapon development, not only in nuclear weapons but also in guided missiles. In any case, their launching of an intercontinental ballistic missile can be expected any time now.

BLACK GOLD -- WORTH THE PRICE OF GOLD

The American petroleum expert Speers once said: "The land and the off-shore oil reserves in China are at least 45 billion barrels in each. With this reserve, China will become one of the largest oil producing countries of the world."

* * *

Oil is of the utmost importance in carrying out China's Four Modernizations movement. Oil provides not only the needs of domestic industrial development, it is also a major economic source in foreign trade. Therefore, we will spend some space to discuss it.

The Rich Oil Reserve in China

According to the American oil expert Speers, the oil reserve in China is at least 45 billion barrels in each of its land source and off-shore source. With these figures, China will become one of the largest oil producing nations in the world. The current Chinese annual oil production is 70 million tons. Experts of the Chinese Petroleum Chemical Engineering Department claim: Oil and natural gas have been discovered in almost every part of the country, from Heilungkiang to South China Sea, from Sinkiang in the west to Pohai Bay in the east. The oil and natural gas fields in China are also rich in variety. Large oil and natural gas reserves have not only been found in the sandstone strata but also in the neozoic third series strata. In addition, large oil reserves have also been found in the zoic Cathy series strata, a rare occurrance. It is estimated that the oil fields perambulated so far amount to only about 1/10 the national oil reserve.

Oil Fields Everywhere

Today China has about a dozen Tachin type oil fields with a total length of oil pipes approximately 3700 kilometers. (The oil pipe is a more economical mode of transportation as compared to railroad.)

1. Tachin fields -- located on the northeast plain, two oil pipes, one leading to Talian (the harbor can take 30,000 ton oil tankers) and Talian New Port (for 100,000 ton tankers). Additional oil pipes run from Chinhuang Island to the Fangshan Hsien East-is-red refinery south of Peking. The production of the Tachin field is more than ½ the national total.

2. Victory fields -- in the area of Pohai Bay, with a production of 20% national total, oil pipes leading to the port of Yellow Island (can take 70,000-ton oil tanker) and the refineries at Chinan, Linchin and Poshin.

3. TaKang fields -- the third largest oil field of the nation, runs from TaKang all the way to the bottom of Pohai. Refineries have been built in surrounding areas such as Tientsin and oil pipes are being installed to connect with the East-is-red refinery in Fangshan Hsien.

4. Panshan fields -- in the west part of Liaonin, stretching over 100 kilometers. Two oil pipes, one to Chinsi and the other to Anshan. Pipes are planned to connect Fushung and Shenyang.

5. Yumen field -- with oil pipe leading to the Lanchow refinery.

6. WU-ERH-MU field -- located southeast of the Ch'aitamu (Tsaidam) basin. Oil

pipes leading to Lhasa, Tibet are being installed.

7. K'O-LA-MA-I (KARAMAI) field -- located in Sinkaing, has two oil pipes, one leading south to Tushantze refinery and the other pipe leads to Wulumuchi (Urumchi) where connection is made to the refineries in the east by railways.

8. Nanch'ung field -- in the Szechuan province, with pipes leading to the oil field at Dragon Lady Temple.

9. 913 field -- in Shantung province.

10. Dragon Lady Temple field -- near the Nanch'ung field, has oil pipes to ChungKing where the oil from both fields are processed.

11. Ch'ienchiang field -- on the downstream of the River Han in Hopei, has pipes to Kingmen and waterway transportation to Shanghai, Nanking, and Linhsiang (in northern part of Honan) for refinery.

From Import to Export

China has always been regarded as an oil poor country although China is the first nation to own an oil well drilled in the early sixteenth century, more than 300 years earlier than those in North America and Europe. However, a real effort at oil development did not start until the 1950's, when China was relying mostly on imported crude oil and refined petroleum products. Along with the rapid development of oil industry in China, the oil import has been substantially reduced in 1965, and by 1968, the import had essentially dropped to zero. In the 1970's, China not only is self sufficient in oil but also exports oil to Korea, Vietnam, Phillipines, Japan and Thailand.

Does the prediction that China will become the largest oil producing nation imply there will be a large amount of crude oil export by China? Speers believes that, although the domestic crude oil production will continue to rise, China will not be a major oil export nation.

Mining Technique Needs Improving

"The United States will be our target for catching up and surpassing," said Kang Shih-En, Minister of the Department of Petrochemical Industry. China has never attempted to hide the fact that her oil industry started with very crude methods, and until now, her mining technique still has quite a distance to go, compared to the United States. As Speartz has pointed out, "China still needs specialized oil installations, particularly for its off-shore oil industry." However, the development technique used in Tachin field draws a fair amount of attention from the Japanese oil industry which has decided to invite a Chinese oil experts delegation to Japan to share their experiences and to assist the Japanese oil exploitation. The Japanese experts view the land phase oil development techniques used in China as superior, and in fact, the technical staff at Tachin did invent some new tricks, such as interior water injection at an early stage.

What is the technique of interior water injection at an early stage? The underground crude oil is under pressure and will gush out of the oil well, but this pressure eventually will wear off and the spontaneous gushing of an oil well stops after a number of years. The common practice in other nations is to drill water injection wells in the periphery of the old oil well in order to supply the underground pressure. This method is known as the "Late-state exterior water injection." In the Tachin oil fields, water injection wells were drilled in the oil field at the early phase of oil drilling so that the pressure loss due to spontaneous gushing is compensated from the very beginning and the pressure of the oil well is maintained constant. From this example, we can see that, with the Chinese ingenuity and the imported foreign technology, the Chinese oil industry will surely catch up and overtake the United States.

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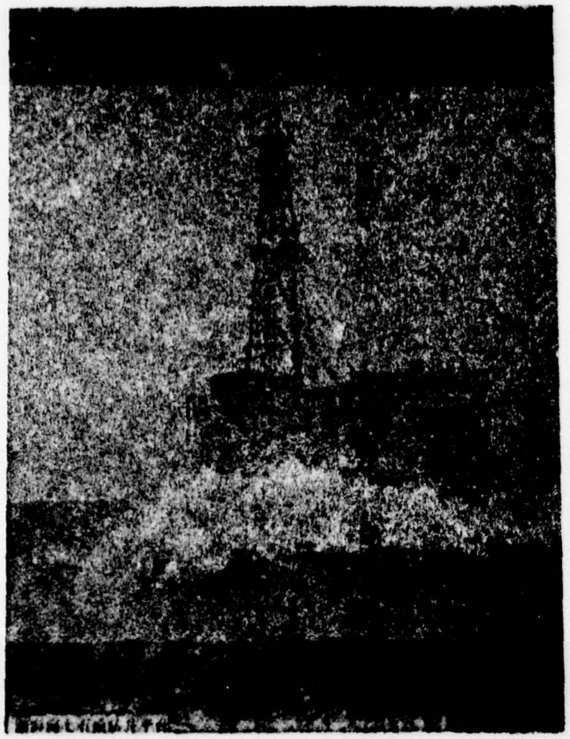

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STEEL -- THE FOUNDATION OF INDUSTRY

Steel is one of the vital part of industry. In analogy to a human body, petroleum is the blood and steel constitutes the bones. A human body needs strong bones to stand firmly and, similarly, the steel industry is essential to the industrial development. Unfortunately, steel has been a weak link of the Chinese industrial system. The China Metallurgy Department confessed frankly in an article published by its investigation group that flaws exist in all the small and medium scale steel enterprises in China: the biggest problem in the medium size enterprise is the lack of coordination in its production system and the biggest problem in small enterprise is the outdated technology and the high costs of production. Most of the steel mills in China are still manually operated, even the largest steel factory in China, Anshan, has only two turning furnaces. Compared with other advanced countries, China is more than 20 years behind.

The national steel production goals, according to the National Economic Plans, is an annual production of 100 million tons in 1990 and 200 million tons by the year 2000. The current annual steel production of China is 25 million tons, a mere 1/5 of the U.S. production. Today, the annual steel production of the United States is 113 million tons, the Soviet production is 140 million tons and Japan has an annual production of 100 million tons. Judging from these statistics, is it possible for China to become a first rate steel country in the last 22 or 23 years of this century?

High in Reserve and Low in Production

First we should realize that the iron resources of China, the magnitude and spread of the reserve, is unparalleled in the world, and the balanced and wide distribution of the steel industry in China is also unsurpassed in the world history. The article by the investigation group of the Metallurgical Industry Department has pointed out: China has more than 50 steel enterprises, distributed in 23 provinces and autonomous regions, which have an annual production exceeding the 50,000 ton level and are either operating or under construction. Small steel factories already in existence number more than 500 in some 400 counties and cities. One out of five counties and cities in the nation have their own steel industry. In addition, there are hundreds of independent small and medium mines, auxiliary material mines, iron works and small coke factories.

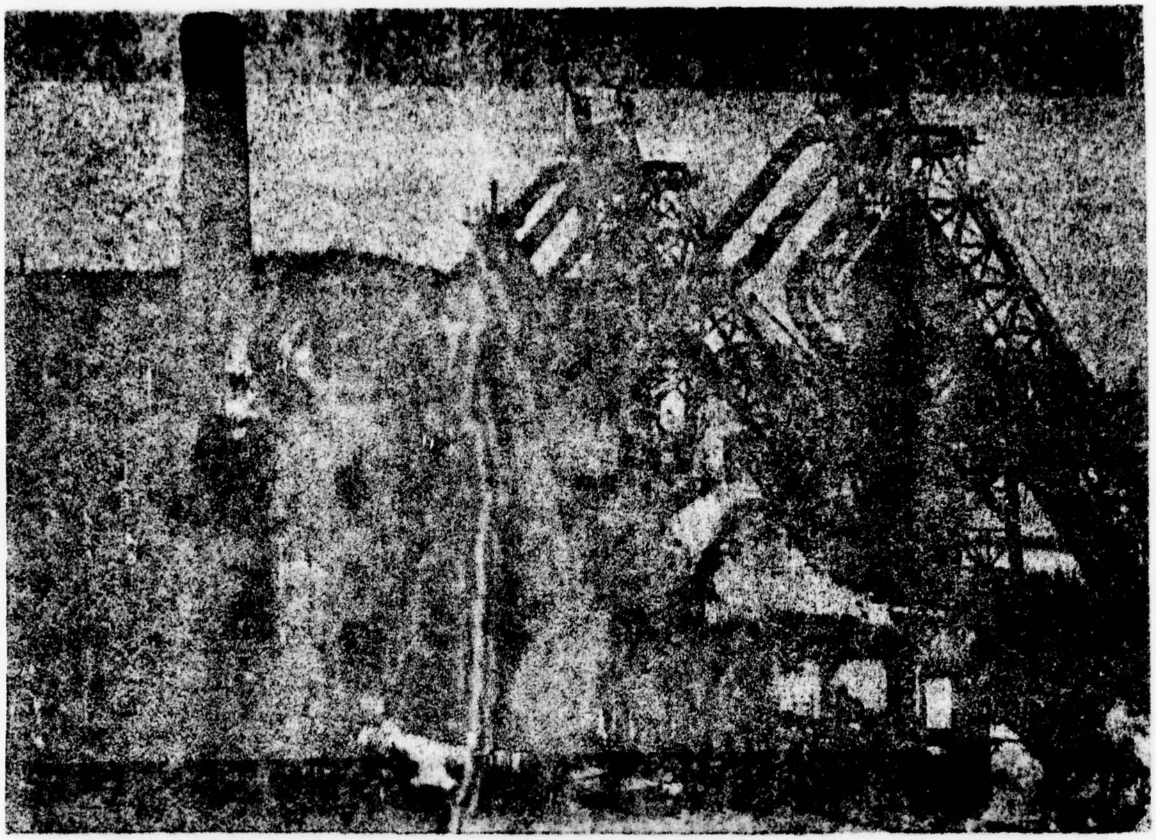
Small scale steel factories usually have an annual production of 10,000 tons or less, medium scale factories generally much more than 50,000 tons a year. Medium enterprises include Anyang, 200 - 300 thousand tons a year, and Tanshan, 800 - 900 thousand tons annually. Large enterprises with an annual yield of one million tons or more include Anshan, Wuhan, Shanghai, Peking, Penpin, Paotow, Taiyuan, Chunking and Saddle Mountain.

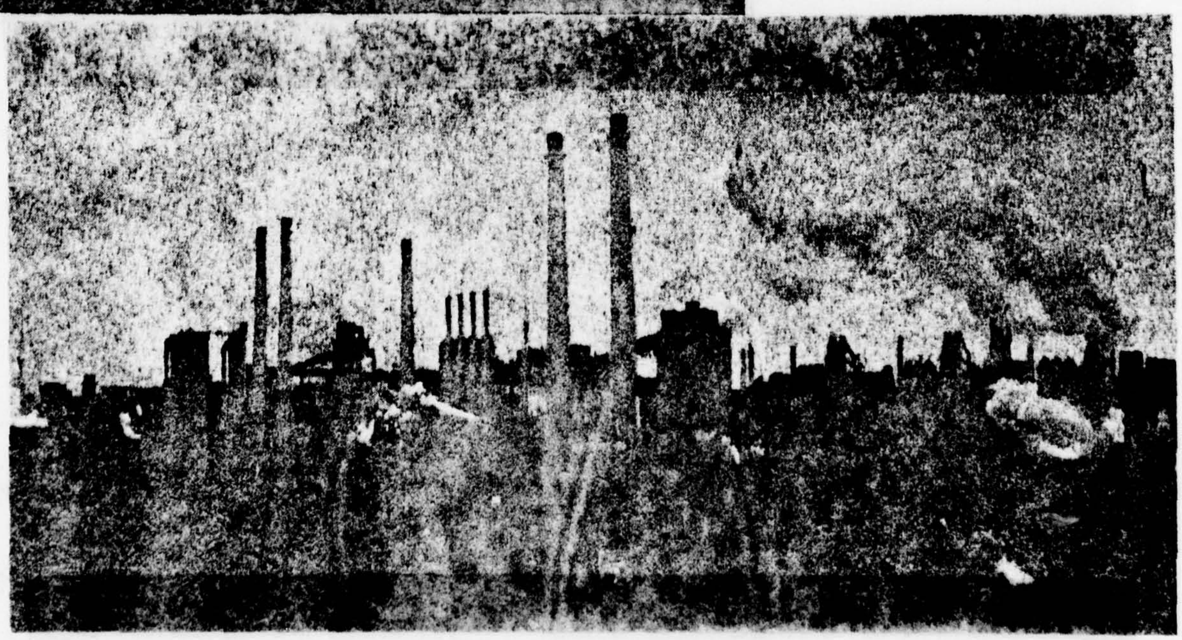
Japanese Help Needed in Catching Up With the U.S. and the Soviets

This question was discussed in an article by Ho Ping-Li, Thompson Professor in the Department of History, University of Chicago. He pointed out that the annual production of the several small steel factories in recent years account for a mere 11% of the national steel production in China, even with the medium enterprises included, the production is still probably less than 1/3 of the national total. If China is to achieve the goal of 100 million tons annual production by the end of this century, it takes a great amount of investment, a steady influx of the newest technology and equipment and trade from the Japanese advanced steel technology and facility with China's rapidly increasing oil production.

China has signed an eight year, 20 billion U.S. dollars Sino-Japanese Economy Trade Pact with Japan, in which Japan agreed to help build a steel factory of 6 million tons annual production in the suburb of Shanghai in 1980. Japan will also assist the improvement of China's large steel factories in Anshan, Peking, and Patow.

Arai, Kiake, a reporter of the Japanese newspaper Yomiuri Shinbun, thinks that China will need six steel factories of the size of the Shanghai factory in the Sino-Japanese Economy Trade Pact in order to reach the goal of 60 million tons annual production by 1985. He also thinks that it is not impossible for China to catch up with the U.S. in this centry provided the political situation in China continues its stability and production plans are followed through





Top: Large scale pure oxygen top blow rotating furnace designed and built by Shanghai steel workers.

Bottom: Paotow United Steel Company

THE BOOMING ELECTRONICS INDUSTRY

One indicator of the four modernization movements is the vitality of the electronics industry. What, then, is the status of today's electronic science in China? According to the report in the "Electronics" magazine by the U.S. electronic scientists delegation recently returned from a visit to China, there will be two breakthroughs in China's catching up with the advanced technology of the United States and the Soviet Union. First, China is scheduled to launch two communications satellites in 1979, and, second, China has developed the third generation new computer.

In their article, the electronics scientists delegation expressed their belief that, before the end of this century, China will catch up with the industrialized countries of the West in technology, and may even surpass the West. The delegation spent three weeks in China and its members included the Under Secretary in charge of science and technology in the Commerce Department, computer and satellite communication experts from IBM, Bell Telephone Company, Rolm Company, Mitre Company and universities like MIT, University of California and Harvard University. One of the members is the president of the IEEE Communication Society and the delegation also includes two former presidents of that society.

Launching Communication Satellites

Only two countries today, the United States and the Soviet Union, have the ability to manufacture, launch and maintain communication satellites. West Germany and France, although capable of manufacture and operation of the satellites, will not have the launching facilities until 1981. Ordinary artificial satellites can orbit around the earth with a rotation speed different from that of the earth at a distance of 100 miles or farther. The communication satellites, unlike other satellites, must orbit in space 23,000 miles from earth with the same speed as the self-rotation of the earth so that they appear fixed in space. Therefore, a launched communication satellite will stay above the Chinese territory to receive electric signals from earth, and send the signals back to every corner of China after they are processed by its computer. In view of the highly sophisticated technology involved in the altitude speed coordination and the signal processing by the satellite, the U.S. electronics expert delegation judge China's ability to launch communication satellites next year as evidence for the striking advancements in Chinese rockets, as well as the know-how in computer communication operation and the entire communication system from spaceship-to-earth control stations.

The U.S. delegation talked about the third generation 013 and TQ6 computers developed by the Chinese. The 013 computer handles 2 million instructions per second, equivalent to the third generation computers used in the U.S. in 1965. Tens of TQ6 have been produced with all parts and components made in China. Generally, the electrotechnology in China lags behind the West by about ten to fifteen years, indicated the delegation. Judging from the research facilities in China, the development of computers was carried out under difficult circumstances. However, if the Chinese can overcome some of the serious flaws, strengthen their education and emphasize the development efforts in this area, they will be able to equal or even surpass the West before the end of this century. They believe China has this potential because of the sound planning and administration, demonstrated solid technology base and the ability to draw from the advanced West.

A report by Tom Brooks, president of the Defense Electronic Computer Company in England, will help us realize the fast progress of the Chinese electronic computer industry. The report pointed out the truly amazing development pace of the computer industry in China where the research on electronics and computers started in 1953, the beginning of the first 5 year plan. At that time, the research center was in the China Academy of Science in Peking. Some parts and components were domestically manufactured while the data processing components were mostly provided by Russia who also supplied technical staff. By 1960, the Sino-Soviet relations had worsened and Khrushchev scrubbed the Soviet's aid program to China. The withdrawal of Soviet experts caused great difficulties but it also laid the foundation for the self-sufficient policy in China. In the mid-1960's, China bought computers from Britain, France and Japan, with her modest foreign exchange and initiated the early computer industry in China. In addition to the experts trained in Peking, many Chinese emigrated to the United States near the end of China's civil war were recruited back, and with them came the experience of American atomic energy and NASA. Subsequently, China joined the atomic club with her first atomic bomb explosion in 1964; and in 1967, China entered the computer world by exhibiting its first electronic computer.

The Singing Computer

The first computer was a huge crystal-tube machine of relatively simple structure. It was programmed* to play the song "The East is Red,"

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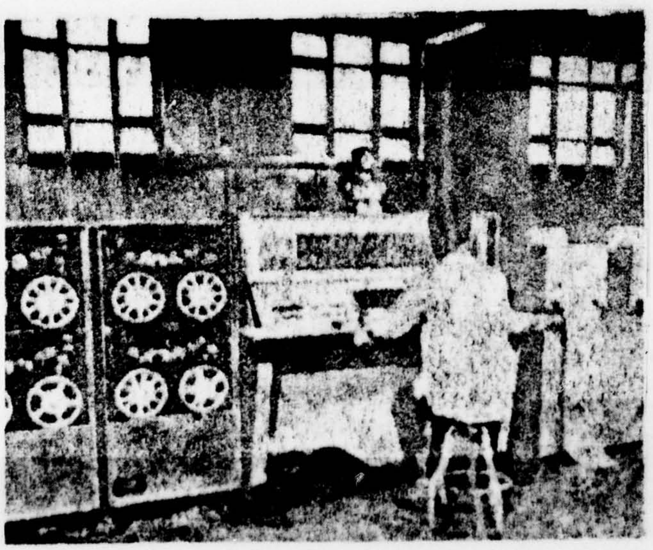
*Simply put, "program" is a set of instructions for the computer to solve a given problem.

then paint a Chairman Mao portrait and write the words "Serve the People" in Mao style before it began to compute. Only 9 years later, August 28, 1973, the New China News Agency announced the first integrated circuit computer made in China, which was capable of taking 1 million instructions per second. The computer was designed and built by Peking University with components from various places in China. The central processor used "Multiple printed circuit board and solid state integrated-circuit components." It had a storage capacity of 13K 48 bit words, and the peripherals included magnetic tape, magnetic disk, line printer, type writer and paper punch, a total of 22 devices. Some of the personnel involved in the development are fuel and chemical engineers, and the early stage computer applications are in the area of geological surveying in the petroleum industry.

Entering the Computer Era

China introduced the official Great Wall 203 computer in 1974. Designed by the Mathematics Research Institute of the China Academy of Science, the 203 computer was an independent mini-computer system complete with a printer and a magnetic tape unit. Its efficiency was three and one half times its foreign equivalent. The computer's storage space, high speed operation and procedure control allowed it to solve complex problems automatically. This was the time when the computer industry in China passed its rudimentary stage. Even though the quantity of usage was still far behind developed countries, various types of computers were finding general use.

Reports indicate that many major industries in China are now using the technique of "computer control." Computers are taking a major role, according to one early report, in the high speed automation in a petroleum composite factory near Peking. Ch'angchow steel factory uses computer facilities in its automated production of steel belts. Shih Ching Shan power plant, a major generating plant near Peking, uses computer to control its 100,000 kilowatt generator. Computers also serve other industries such as textile, ship building, and petroleum. All evidences indicate the rapid pace of the Chinese electronics industry. Although it is still behind other advanced countries by a long shot, there is reason to believe, however, the Chinese will reach their goal in the near future.



Chinese-made newest solid state digital computers. They are indispensable tools in the frontier technologies such as atomic energy, rocketry and space flights.

Integrated circuit digital computer takes 110,000 instructions per second.

Workers assembling transistor radios.

OVERVIEW OF THE CHINESE AGRICULTURE MODERNIZATION

China has always been built on agriculture, although the Ten Year Plan put emphasis on heavy industry, agriculture is still a vitally important foundation..The modernization of agriculture is mainly a question of general mechanization. The production of some of the Chinese Production Teams is comparable to that of other more advanced nations in the world, and in certain areas, even leads the world. The plan calls for 85% agriculture mechanized by 1985. (The current level is 20%).

The milling and shelling operation in China has already been mechanized on a national basis, and electric power or diesel water pumps has generally been used in irrigation. The most pressing, and most complex problem now is the use of machines for field work.

The former president of the U.S. China Friendship Association, Handing*, visited some villages in China in October 1977, and, at the invitiation of the Hong Kong College students Association, gave a talk on the subject of Chinese agriculture moderniation.

Handing believes that China will have no problem in producing enough tractors, the question is whether there will be enough farm implements for the tractors to pull. The number of tractors is not the measuring standard for agriculture production, but instead, it should be evaluated based on the production level per person per day.

He named a few examples for comparison: In Shansi, where the hoe is still the fundamental utensil and tractors are used only for digging, the quota of the Production Team is 10 catty.

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* Transliterated

tilling and planting and their quota is 30 catty per person per day; at Harbin, northeast China, where tractors are easy to operate in the vast and flat fields, the production is 40 catty; the agriculture in Peitahuang, near the China-Russia border, is generally mechanized and the quota per person reaches 300 catty per day. Compared to the United States, their usual production level (not the maximum) is 10,000 catty per person per day.

Mechanization Takes Time

Harding pointed out some unique factors causing the slow mechanization of the Chinese agriculture in the past twenty years. First of all, with the abundant labor, China did not have a pressing need for mechanization. It is also the Chinese tradition to divide the field into small sections, surrounded by ridges, which hinder the use of tractors as well as irrigation. To flatten out the fields would take much time, so the farmers simply prefer not to use tractors. Secondly, there are invariably two or three crops a year in China, and sometimes, even parallel crop and catch crop to use the growing time thoroughly. For instance, wheat is usually reaped before it is dried up, and there is no machine in the world to strip wet wheat. Thirdly, with the ever-improving planting methods and more sophisticated peasants, there are difficulties in designing the right machine. Finally, there is a lack of communication between the advanced agriculture machine colleges and the farmers. He mentioned one instance to show this lack of communication: he once visited a Production Team and the peasants told him that they needed a flail harvester. He showed them some pictures and they decided to build one. Later, when he was visiting an agriculture machinery display hall at a research institute, he noticed a similar machine was among the displays.

Favorable Conditions for Mechanization

However, Handing thinks there are favorable conditions as well in the mechanization of the Chinese agriculture. (1) The collective system means large acreage of cropland and concentrated capitol, enough money to buy necessary machineries; (2) There are a fair number of specialized people in the fields, self production of machines is possible; (3) Under the socialistic system, the farms are supported by the factories. When the communes run into problems with the repair, design or manufacturing of agriculture implements, they are not isolated small villages, and (4) The Chinese have an interest in inventing and making things. For example, he once talked with a team leader about the irrigation system of the U.S. and on the next day, the team leader decided to start to design and make the irrigation machine and it was made in 10 days. This spirit prevails in China. With the traditional hard working spirit and the enthusiasm about new design of the Chinese people and the wide spread quality agricultural research facilities, great development of the agriculture is expected.

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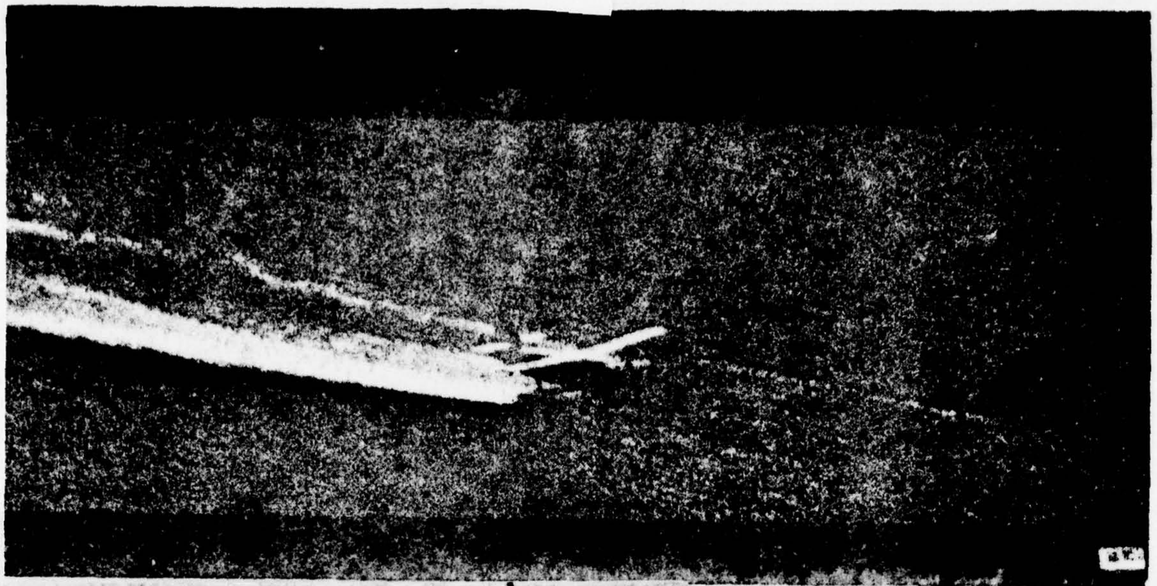

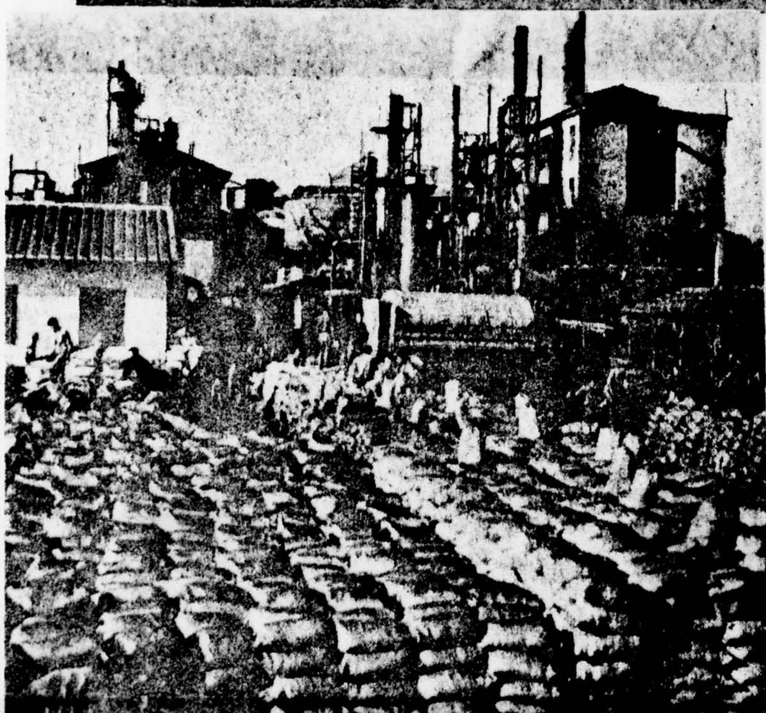

Chemical fertilizer plants are forming all over the nation. This will have an important effect on the agricultural development.

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FIRST STEP OF THE LONG MARCH

China is determined to realize the Four Modernizations in this century, a task calling for the collective effort of the whole nation and many hurdles to be overcome along the way. Any difficult journey starts with the first stride. The Chinese people have now made their first stride in the long journey referred to as the second Long March by the Chinese leaders.

Absorb advanced technology, hold book and journal exhibitions

A foreign science and technology book and journal exhibition was held at Peking Normal University in early April of this year (1978). The exhibition included 14,000 books from more than 1000 publishers all over the world, 5000 journals and 3000 special publications. More than 10 different fields were covered in the exhibition: general science and technology, natural sciences, technical sciences, agriculture and biological sciences, medical sciences, education, new book preview, journals, special publications, audio and visual material and equipment, books and journals on computer science, and so on. This exhibition was sponsored by the Chinese Book and Journal Import Company and supported by many countries and their publishers. The Toho Publishing Company and the Uchiyama Publishing Company in Japan initiated the organization of a "book exhibition progressing affairs office" and actively collected more than 4000 science and technology publications for the exhibition.

Blueprint for the publication business

The Chinese Science and Technology Literature Publisher has decided to publish no less than 41 journals on foreign technology in 1978.

I. Catalog and index: introductory publications providing information on various subjects.

1. Foreign science and technology data center catalog (13 categories)

   Monthly: Aviation; Chemistry and chemical engineering, petroleum; Radio electronics, automation technique.

   Bimonthly: Mining, metallurgy; Machine manufacturing, power engineering and electricity; Agriculture, forestry, and fishing; Mathematics, mechanics; Biology; Physics, Earth physics and astronomy; Medicine; Environmental pollution and protection.

   Quarterly: Light industry, textile.

2. Foreign science and technology catalog (8 categories)

   Monthly: Nuclear energy; Railroad transportaion; Highway transportation.

   Bimonthly: Architecture, hydraulics engineering; Measurement technique; Waterway engineering and transporation; Ship engineering; Giography, geology.

3. Book and journal catalog (9 categories, all quarterly)

   Aircraft material, electronics material; General mechanics; Plastics and polymers; Mechnaical reprocess, Chemical engineering and facility; Drugs; Leather and paper.

4. Foreign book and journal digest (2 categories, both quarterly)

   Petroleum, Foreign agriculture digest.

II. Translations: Publications of translated foreign data

Monthly: Standard translation; Foreign geology; Report of foreign standards data.

Bimonthly: Foreign earthquake; Foreign movie technology.

Biweekly: Reference news of science and technology.

Quarterly: Ophthalmology series; Ear, nose and throat series.

III. Research

Monthly: Activities in foreign science and technology

In addition, the Science and Technology Literature Publisher also publishes large amounts of information data on an irregular basis. These include: Reports of scientists toured and observed abroad, science and technology research reports, standard catalog of foreign nations, patent data of foreign nations, and translation and data of special topics.

Training scientists and technical personnel of the next generation

China has announced its first batch of selected higher education institutes, a total of 711 new students of high quality were admitted.

I. Universities: Peking University (and campuses), Futan University, Kirin University, Nankai University, Nanking University, Wuhan University, Chungshan University, Szechuan University, Shantung University, Lanchow University, Shiamen University, Yuanan University, Northwest University, Hsiangt'an University, Hsinkiang University, and Inner Mongolia University.

II. Colleges and institutes of technologies: TsinHua University (and campuses), Sian Transportation University, Tientsin University, Talien Engineering College, Nanking Engineering College, South China Engineering College, Canton Chemical Engineering College, Central China Engineering College, Chungking University, T'ungchi University, Shanghai Chemical Engineering College (and campuses), Chekiang University, China Science and Technology University, Changsha Engineering College, Peking Aviation School, Nanking Aviation School, Northwest Industrial University, Chengtu Electrical Communication Engineering College, Northwest Electrical Communication

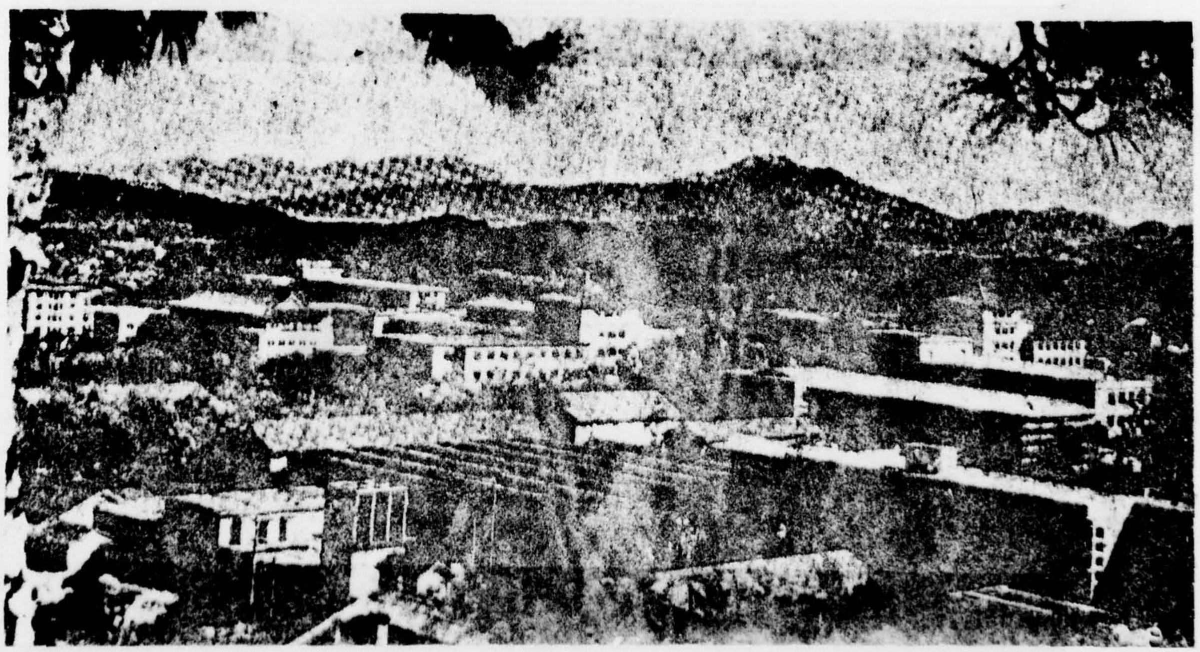
The Prodigy Class: 26 exceptionally gifted youths under the age of 16 were admitted to the Chinese Science and Technology University after rigorous tests. They were recommended by the mass and their admission was an exception to the regulation. Top picture shows the youth class, from right to left: Hsieh Yan-Po (age 11), Liang Chung-Chieh (12) Nin Po (13) and Tung Jui-T'ao (14) working on a calculus problem. Bottom picture shows the youth class talking to Professor Yang Chen-Tsung, Associate Chairman of the modern chemistry department.

Top: Chemistry professor Yang Shih-Lin directing experiment on ionic model polymerization.

Bottom: Associate professor of mechanical engineering Yu Ch'i-Tung received his Ph.D. from University of Iowa in the United States. For a long time, Yu has been doing research on alloy casting and special techniques in casting. He has distinguished accomplishments in his research on high speed steel.

Top: no caption

Bottom: The Chekiang University campus, a university of 80 years history.



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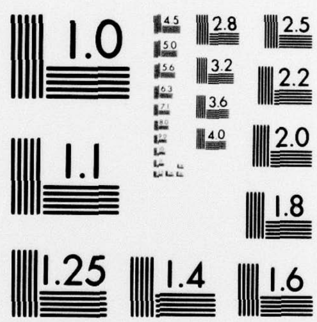

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CHINA WILL LAUNCH COMMUNICATION SATELLITE NEXT YEAR

A report by U.S. Scientist

The following in a digest of the Special Report entitled "Electrotechnology in China: Components, Computers, Telecommunications, and Power -- an inside look at the state of the art in the People's Republic" authored by Herbert Sherman, Harvard School of Public Health which appeared in the February issue of the scientific magazine "Spectrum" in the U.S.

The most striking aspect of the electric and electronic technology in the People's Republic of China is not its present level but where it is headed and how fast it is moving. Generally speaking, the Chinese are about 10 to 15 years behind the west in this area which started effectively in 1948. But the government has called upon the nation to equal or even surpass the industrial nations by the year 2000. Western visitors, including the recent delegation from IEEE, all seem to agree that the Chinese could do it if they resolve the problems of reconciling their ideology and their movement toward modernization and the problems of overcoming the serious shortcomings in their research, industry, and especially, their educational systems. What follows is a digest of the impressions expressed by a visiting group of IEEE members who recently spent three weeks in China.

Build factories to produce large-scale integrated circuits

Based on the impressions gotten from a single visit to an integrated circuit (IC) factory, the Chinese seem competent technically to produce almost anything that western IC manufacturers make. Research staffs over there are well aware of the more sophisticated IC production techniques. The products resulted from such knowledge are, however, of mixed quality. The yield of standard IC's is only 25 percent and the yield of simple large-scale integration (LSI) circuits is less than 10 percent.

The Shanghai IC factory is located in an old, dusty, and crowded alley. The building is converted from a school, not at all suitable for IC manufacture. In spite of the difficulties with environment, some real efforts have been made to create modern facilities. To keep the cleanliness of the room, air showers, changing cloth, and "bunny suits" are available to the workers at the entrance, but the cleanliness is still not up to standard. Engineers of the factory are well aware of this problem and they believe the low yield is related to this problem.

Five million telephones in the nation

Telecommunication:

Since there are only 5 million telephones serving a population close to one billion, China has plenty of room for growth in the telecommunication field. Even the country's capital and important city, Peking, has only 200,000 telephones serving the 9 million residents.

China's telephone equipment and facilities show a curious mixture of the old and the new. For instance, long distance telephone calls are still transmitted over open wires. (In the United States, open wire communication has all but disappeared except in some rural areas.) At the same time, a modern coaxial cable system connecting Peking and Shanghai is being extended to Canton and enlarged from 960 channels to 1800 channels.

Microwave radio links (960 channels) are in full production and extension to 1800 channels is currently underway.

Satellite system seems to be a natural solution to the problem of communicating with the isolated regions of the country. The Chinese have filed applications for the launching of two communication satellites in 1970; however, their actual plans for domestic applications are not known. No digital transmission or switching were observed, nor did the Chinese indicate any plans for developing or applying such devices. However, the Chinese have announced that they have built an earth station for digital satellite communication.

Motor Factories:

The Shanghai Motor Factory has a particularly well equipped electric plating shop. The design, materials and performance of the 300-MW, 18-KV, 3000 rpm generator are roughly equal to the western standards.

Electronic Computers have not found commercial uses

Computers:

Although the Chinese have had some success in two areas which are traditionally weak in socialist societies -- software and peripheral equipment -- the overall speed of progress must be judged as very slow. Operating systems are still in their rudimentary stage in the People's Republic. Programmers use paper tape instead of punched cards. The languages used are predominantly Chinese Algol (an algebra and logic programming language), although Fortran IV and Basic are catching on. Cobol (a business and commercial programming language) is not even mentioned -- indicating that big computers are used exclusively for scientific research and not for business. The Computer Technology Research

Institute in Peking has developed the 013 computer, a large scientific computer with the speed of 2 million 48 bit word computations per second. The 013 machine can be judged as the equivalent of the third generation computer of the U.S. used in 1965. But the visitors are impressed by the 013 machine since it was developed by a medium sized group (about 100 people) in a set of old buildings.

Potential to catch up and surpass western standards

Future prospects:

China is a vast country with great domestic needs in many areas including communication. China has several precious assets to help her meet these needs and achieve modernization by the year 2000. These assets are a skilled work force with lower wages compared with other countries, demonstrated skills in plan formulation and administration, *solic technical ability* in many areas, an economic system capable of technology transfer, and the benefit of drawing from the west the demonstrated technology through technical exchanges. Among the nation's flaws are the results of the disruptive education, production and production planning in the past 11 years. If the Chinese continue their present pragmatic course, they should make rapid progress in their catching up in the few years ahead.

Engineering College, Peking Industrial University, East China Engineering College, Shanghai Transportation University, Harbin Ship Engineering College, Harbin Industrial University, Chungking Architecture Engineering College, Peking Steel College, Northeast Engineering College, Central South Mining College, East China Hydraulics College, Wuhan Hydraulics Electric Power College, Hopei Electric Power College, East China Petroleum College, Peking Chemical Engineering College, Tachin Petroleum College, Szechuan Mining College, Fuhsin Coal Mining College, Hofei Industrial University, Kirin Industrial University, Northeast Heavy Machinery College, Talien Seaway College, Northern Transportation University, Southwest Transportation University, Shanghai Textile Engineering College, Northwest Light Industry College, Hopei Architecture Engineering College, Wuhan Geology College, Changchun Ceology College, Peking Post College, North China Agriculture Mechanization College, Nanking Mineralogy College, Wuhan Survey College, Shantung Oceanography College.

III. Other: Peking Normal University, Shanghai Teachers College, North China Agriculture University, Yuanan Forestry College, Kiangsi Communism Labor University, Tachia Agriculture College, Peking Chinese Medicine College, Peking Medical School, Shanghai First Medical School, Chungshan Medical School, Szechuan Medical School, Peking Foreign Languages College, Shanghai Foreign Languages College, Southwest Politics and Law College, Peking Foreign Trade College, Central Music College, Peking Athletics College, Central National College.

Science and technology activities have been widely instigated in colleges and universities. The Canton Province Science and Technology Association and its specialty societies are actively preparing for the reinstitution of activities including academic seminars, discussion sessions, and exchange sessions.

Frequent foreign trips of delegations

In addition to the work carried out in academic fields, China is also sending delegations to various countries for visits: A 19 member delegation will take off from Shanghai for a two week visit to Japan. They will meet with government officials and leaders in industry and commerce to discuss problems with enlarging mutual trade and inspection of industrial installations. Another delegation of 18 members, also from Shanghai, will visit Japan and investigate the import of textile, electronics, and urban planning techniques. An eleven member "Ocean exploratory ship research delegation" will visit the colleges in Japan and head for the United States in April. A 9 member Chinese Technology Import Corporation delegation will fly to Japan for business inspection. Another group is scheduled to visit Japan on April 4 to investigate the import of steel from Japan.

Besides, many other fields have also started practical action in the race with the clock to carry out the modernization of China. From the high spirit and hard work of the Chinese leaders, scientists and all the people, the prospects of realizing the Four Modernizations are indeed very bright.

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