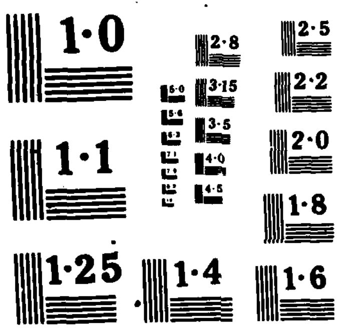
AD-A168 368 THE DEVELOPMENT OF SPACE SCIENCE AND TECHNOLOGY IN CHINA(U) FOREIGN TECHNOLOGY DIV WRIGHT-PATTERSON AFB OH Y LIU 22 MAY 86 FTD-ID(RS)T-0282-86 1/1

UNCLASSIFIED F/G 22/2 NL



NATIONAL BURFAU OF S
MICROCOPY RESOLU TEST

2

FTD-ID(RS)T-0282-86

FOREIGN TECHNOLOGY DIVISION

AIR FORCE SYSTEMS COMMAND

THE DEVELOPMENT OF SPACE SCIENCE AND TECHNOLOGY IN CHINA

by

Yung-An Liu

FOREIGN TECHNOLOGY DIVISION

HUMAN TRANSLATION

FTD-ID(RS)T-0282-86 22 May 1986

MICROFICHE NR: FTD-86-C-001864

THE DEVELOPMENT OF SPACE SCIENCE AND TECHNOLOGY IN CHINA

By: Yung-An Liu

English pages: 21

Source: Feiqing Yuebao, Vol. 27, Nr. 6, 1984, pp. 23-29

Country of origin: China
Translated by: SCITRAN
F33657-84-D-0165
Requester: FTD/SDBS
Approved for public release; Distribution unlimited.

THIS TRANSLATION IS A RENDITION OF THE ORIGINAL FOREIGN TEXT WITHOUT ANY ANALYTICAL OR EDITORIAL COMMENT. STATEMENTS OR THEORIES ADVOCATED OR IMPLIED ARE THOSE OF THE SOURCE AND DO NOT NECESSARILY REFLECT THE POSITION OR OPINION OF THE FOREIGN TECHNOLOGY DIVISION.	PREPARED BY: TRANSLATION DIVISION FOREIGN TECHNOLOGY DIVISION WPAFB, OHIO.

GRAPHICS DISCLAIMER

All figures, graphics, tables, equations, etc. merged into this translation were extracted from the best quality copy available.

THE DEVELOPMENT OF SPACE SCIENCE AND TECHNOLOGY IN CHINA

Yung-An Liu

1. INTRODUCTION

Science and technology are important for building a modernized country. They not only can improve a country's economic growth and living standard, they can also determine the victory or defeat in military combat and the success or failure of civil construction for that country. Recently, the rapid development of science and technology increased man's material progress greatly. After its invention, the computer gradually replaced people both in physical labor and intelligence. Because of the computer, we are able to extend our activity into space. In 1957, the Soviet Union successfully launched the first satellite "Sputnik". This was the beginning of man's space era.

Since satellites can be used for communication, electronic detecting, resource exploration, navigation and orientation and collecting meteorological information, most of the countries in the world have invested intensively in the development of satellites so that they can be used as military reconnaissance satellites as well as offensive and defensive weapons.

After the People's Republic of China took over the mainland, it founded the Academia Sinica and the other research institutes for the research and development in advanced science and technology. In 1968, the Research Institute of Space Science was founded in order to accelerate research and development in space technology. The first satellite of China was launched successfully on April 24, 1970. Since then, 16 satellites have been launched. It is important for us to investigate space program development in China.

II. THE MILITARY VALUE OF SATELLITES

(1) The basic principle of satellites

When the satellite is about one hundred miles above the Earth, it can take very clear pictures of the Earth's surface and send them back to the ground-receiving station. Right now, satellites can be divided roughly into two categories: One is the nonsynchronous satellite whose revolution period around the Earth is either larger or less than 24 hours which is the rotational period of the Earth; the other is the synchronous satellite whose revolution period around the Earth is equal to 24 hours. For synchronous satellites, there are three kinds of orbits:

1. Circular synchronous orbit: The satellite is 22,300 miles above the Equator. Its orbit is a circle with eccentricity less than 0.01. The initial velocity of this satellite must be exactly equal to the circular velocity (4.9 mile/sec). If the velocity is larger than the circular velocity, then the orbit becomes an elliptic orbit. If the velocity is less than the circular velocity, then the satellite will fall and be destroyed in the atmosphere.

2. Elliptic synchronous orbit: The average height of the satellite above the Equator is 25,200 miles. Its initial velocity must be larger than 4.9 mile/sec, but less than 6.9 mile/sec (escape velocity).

3. Tilt synchronous orbit: The surface of the orbit has a certain angle with the equatorial surface. This angle of inclination is related to the launching velocity of the satellite and will determine the covering area of the satellite. The smaller the angle of inclination, the less propellant energy of the booster rocket is needed in order to reach the required velocity. This is because the rotational velocity of the Earth can be utilized during the launch. The velocity of the Earth's rotation, which is from

west to east, is about 1000 mile/hour above the Equator. Since the latitude of China's current space launching center located at Shuangchengzi of Gansu Province, is high, a new space launching center is planned to be constructed in Xikang Province. It is better to launch a satellite eastward above the Equator so that the Earth's rotational velocity can be used; however, the disadvantage is that the satellite's covering area on Earth is small. On the other hand, if the angle of inclination is big, then the covering area is large. When the angle of inclination increases to 90° and the satellite passes over the poles which is the so-called "polar orbit", the covering area is the largest, but the required propellant energy of rocket is also the biggest. How to choose the optimal angle of inclination depends on the purpose of each particular mission.

(2) The variety of satellites

Due to the rapid progress in science and technology, satellites have been well developed and can explore and monitor the whole Earth through communication and photography. In fact, all developed countries in the world have developed their own satellites actively and use them for military purposes. According to different missions, satellites can be divided into the following four kinds:

1. Communication satellites: The early developed satellites are mainly used for communication. They are used for transferring data, files and information. They are also used as a relay station for long distance communication networks. In the military, they can be used for command and liaison between different combat units.

2. Meteorological satellites: Meteorology is closely related to our every day living. The recently developed meteorological satellites can be used for meteorology observation and weather forecasting. For the military, meteorological information is very important during wartime. It can quickly and accurately supply meteorological information and weather forecasts which are needed

for strategic purposes in every area of the world. There are two kinds of meteorological satellites: synchronous satellites and polar orbit satellites. They supply information every 30 minutes to every 6 hours.

3. Reconnaissance satellites: They are also called "spy satellites" and have the following applications:

(a) Photographic reconnaissance: TV and space cameras are used to obtain the enemy's intelligence information. So far, 40% of the military reconnaissance satellites in space are photographic reconnaissance satellites. The resolution of the picture on the Earth is less than 30 cm.

(b) Electronics detection: By using electronics, information about the working frequency, distance and the rotational speed of the enemy's radar antenna can be measured very accurately. This information is also very useful for anti-electronics detection.

(c) Geodesy: Satellites can supply accurate geodesic information which includes the gravitational and magnetic fields of the Earth. The measured geomorphic contour lines can be used for drawing military maps. They are also important data for cruise missiles and intercontinental ballistic missiles.

(d) Pre-warning: Reconnaissance satellites can detect an enemy's movement. They can forewarn a possible enemy attack so that there is enough time to prepare military defense and counter-attack.

4. Resources exploration satellites: Satellites used to explore the distribution and reserve of the Earth's resources are mainly used to explore underground mines, such as uranium, petroleum and rare metals which are strategic resources.

III. THE DEVELOPING HISTORY OF SPACE SCIENCE AND TECHNOLOGY IN CHINA

(1) Booster rockets for launching a satellite

A satellite is launched into space by the huge propellant of the booster rocket. The satellite usually sits on the top of the rocket. Below the satellite, there is a navigation system. When the direction of the rocket deviates from the predetermined direction, it can be corrected automatically by the navigation system. Without this navigation system, it is almost impossible for the satellite to be launched into a predetermined orbit. Below the navigation system is the propellant system. The strong propellant sends the satellite through the atmosphere into the predetermined orbit and maintains the velocity of the satellite slightly larger than the circular velocity (5 mile/sec). This velocity cannot be too high or too low. If the velocity is too low, the satellite may not stay on the orbit and will reenter the atmosphere and be destroyed. If the velocity is too high, the satellite may escape from the gravitation of the Earth. To launch a satellite, a single stage rocket is not enough. It requires at least a two-stage rocket, usually a three or four-stage rocket. At the bottom of the rocket is the stable and control system whose function it is to control the rocket engine and to stabilize the rocket during the flight through the troposphere and stratosphere before entering the ionosphere.

Since a satellite is launched by a booster rocket, its success in orbiting is thus determined by the rocket. It is much more difficult to build a rocket than to build a satellite. Therefore, most of aerospace engineering is mainly rocket engineering.

(2) Rocket development in China

Right after China founded the Academia Sinica in November 1949, it began research and development of rockets and missiles.

After more than three decades of research and development, China can build her own intercontinental ballistic missiles and has succeeded in launching missiles from submarines [1]. The overall development process can roughly be divided into the following four steps:

1. Assistance from the Soviet Union:

In 1950, China and the Soviet Union signed a Science and Technology Agreement. The Soviet Union agreed to help China establish research institutes and technical equipment related to rockets and missiles. The Soviet Union also supplied the blueprints and manufacturing techniques of rockets and missiles of China. In 1956, China under the assistance of Russian experts worked out a "12 Year Long Term Program for the Development of Science and Technology". This program established the base for China to develop rockets and missiles.

The initial research work in China was to copy Russian strategic rocket guns. At the end of 1955, a famous rocket and missile expert, Qian Xuesen, came back to China from the United States. He directed the research program of rockets and missiles and made many contributions to China's development of rockets and missiles.

2. Independent development

In July, 1960, the Soviet Union became an enemy to China. The Soviet Union recalled all of her scientists and technicians of rockets and missiles from China. China was forced to develop her own techniques; however, China had gained enough knowledge in short range missiles with liquid fuel and navigation systems so that one year after China became an enemy to the Soviet Union, she was able to test a short range missile launching.

3. Stealing foreign technology

In 1962, in order to continue developing rockets and missiles, China formulated a new "10 Year Program for the Development of Science and Technology" to replace the old "12 Year Long Term Program for the Development of Science and Technology". This new program was not only to compensate for the withdrawal of Russian experts, but to succeed in the launching of long range missiles by /2
1972, its main purpose. Since 1963, China had purchased many rockets, missiles and their accessories and related equipment which were used in research of inertia navigation and high energy "hydrogen atom" fuel, and for the development of optical tracking equipment. China also sent people to visit Japan while, at the same time, to steal important information and techniques of booster rockets and IC circuits.

4. Seeking cooperation from the United States of America

Since establishing diplomatic relations with the United States, China tried vigorously to obtain the United States' advanced technology in rockets and missiles. In fact, China collected the scientific and technological information needed through technological cooperation with the United States, purchasing and copying advanced equipment and sending people to study in the United States.

In February 1972, Nixon, then President of the United States, visited China for a week. During that time, America's three major TV broadcast companies employed three satellite-Earth communication stations and the Pacific no. 4 international communication satellite to televise Nixon's visit to the whole world. These three satellite-Earth receiving stations were set up at Beiging (one station) and Shanghai (two stations), respectively. In Shanghai, one station is a temporary satellite-Earth communication station; the other is a permanent, standard satellite-Earth communication station which was approved for construction by the Department of Commerce of the United States. This was the first time the United States supplied China with equipment related to space science and technology.

In a short time, China obtained three satellite-Earth communication stations, inducing China's interest in the development of space science and technology. China was then seeking more cooperation with the United States for the development of space science and technology..

(3) The variety of carrier rockets in China

China began development, manufacture and testing of her carrier rockets in 1958. She succeeded with a single stage booster rocket whose diameter was about 46 cm, weight about 60 kg, and launching height 60-200 km. Nitrobenzene was used as the fuel for this rocket.

At that time, since each research institute in China did its own projects without cooperating with each other, progress was very limited. In 1968, China founded the Research Institute of Space Technology to supervise all research institutes and direct research projects. Because of this institute plus the coordination of the Industry Department and factories, China's rocket projects progressed. In fact, China has succeeded in a series of tests on booster rockets since then. The carrier rockets which China had developed can be divided into the following three categories:

(a) CSL-1 carrier rocket: This is an imitation of the Russian SS-4 rocket. It is a two-stage, liquid fueled and inertia guided carrier rocket. Its range of fire is 2400 km. It was used to launch China's first and second satellites.

(b) FB-1 (CSL-2) carrier rocket: Since 1970, China had tried to improve CSL-1 carrier rockets. But it was not until 1975 when China succeeded in the FB-1 (called CSL-2 by Western countries) two-stage carrier rocket. This rocket can launch 2000 kg payloads into an orbit 2000 km above the Earth. The Chinese satellites from the 3rd to the 13th were all launched by this kind of carrier rocket.

(c) CSL-3 carrier rocket: This rocket consists of an FE-1 two-stage rocket propelled by liquid fuel, and a third stage of a rocket propelled by liquid hydrogen and liquid oxygen. The development of this carrier rocket is mainly for the long range intercontinental ballistic missile and the synchronous satellite. This kind of rocket is assembled in the Shanghai Machine Factory. It can carry a 700 kg warhead. The 16th satellite which was orbited in China was probably launched by this kind of rocket.

IV. A SURVEY OF SATELLITE LAUNCHING IN CHINA

Due to research efforts in rockets and missiles, China is able to develop its own carrier rockets and then launch satellites by itself. From April 24, 1970 to September 30, 1984, China had launched 16 satellites successfully. The general situation is briefly described as follows:

(1) On April 24, 1970, China succeeded in orbiting its first satellite. The perigee and apogee of this satellite's orbit were 439 km and 2384 km, respectively. The angle between the orbital surface and the equitorial surface was 68.5°. The period of revolving around the Earth was 114 minutes. The satellite was spherical, weighed 173 kg, used chemical batteries, and was equipped with a range finder and guiding instruments. It once broadcast the music of "The East is Red" [2]. The success of orbiting its first satellite indicates that China is good at carrier rocketry, computers, spacecraft, tracking radar and ground controlling and receiving.

(2) Less than a year after China's orbiting of her first satellite, the second satellite was launched. On March 16, 1971, the Xinhua News Agency of China announced that an experimental satellite for science had been launched on March 3, 1971. The satellite weighed 221 kg. The perigee and apogee of the satellite were 226 km and 1826 km, respectively. The angle between the orbital surface and the equatorial surface was 69.9°. The period of revolving the Earth was 106 minutes. During its traveling from

March 3 to March 15, this satellite with frequencies of 200009 and 19995 MHz, transmitted experimental data to the ground.

The carrier rocket that launched the second satellite was CSL-1, which was the same as that which launched the first satellite. Compared with the first satellite, the second satellite had better qualities, such as using solar cell batteries and two transmitters /25 with different frequencies. One of the transmitters sent out the tracking signal to the ground observation station. The other transmitter sent out observed experimental data and the operational information of that satellite to the ground. Since the second satellite was larger than the first in size and weight, it was speculated that China may have succeeded in the development of the means to launch intercontinental ballistic missiles.

(3) Due to the influence of the Great Cultural Revolution and without any breakthrough in the development of carrier rockets, satellite launching was suspended for four years in China at that time. It was not until July 26, 1975 that the third satellite was launched. The perigee and apogee of this satellite were 186 and 464 km, respectively. Compared with the last two satellites, this satellite was very close to the Earth, implying that China had obtained the technology of orbiting reconnaissance satellites. This satellite had the shape of a circular cylinder and was equipped with a TV camera and fine electronics. Its orbit passed over areas of underground nuclear tests, major armed forces and missile bases of the Soviet Union. It also passed over Mongolia. This knowledge suggests that this must have been the first reconnaissance satellite of China [3].

(4) On November 26, 1975, China launched her fourth satellite. This satellite was later recovered on the ground as planned. According to the judgment of some observers, this satellite was equipped with remote sensors and remote controls and its main mission was for experimental spacecraft recovery. This was the

first step for China in developing future man-controlled spacecraft flights. The success in satellite recovery indicates that China not only has its own multi-stage carrier rockets which are required for launching satellites, but also has overcome the most difficult problems usually encountered in satellite recovery: deceleration, heat shielding and landing [4].

(5) On December 16, 1975, China launched its 5th satellite which was recovered later. Unlike before, China did not disclose any information in detail. The reason why information such as the satellite's weight, etc., was classified may be that China had developed propelling power of carrier rockets. If so, then China might now have the capability of developing intercontinental ballistic missiles.

(6) On August 30, 1976, China launched its 6th satellite. The perigee and apogee of this rocket were 199 and 2157 km, respectively. The angle of inclination was 69.2°. The revolution period was 109 minutes. It weighed 1200 kg and carried a TV camera. Its main mission was to collect electronics intelligence and to test the communication system. This may have been a reconnaissance satellite.

(7) On December 7, 1976, China launched its 7th satellite. The perigee and apogee of this rocket were 167 and 489 km, respectively. The angle of inclination was 59°. The revolution period was 91 minutes. It weighed 1500 kg and carried remote sensing and remote controlling equipment. It was recovered on June 2, 1977. Its main mission was space photography and reconnaissance.

(8) On January 26, 1978, China launched her 8th satellite. The perigee and apogee of this satellite were 159 and 482 km, respectively. It had an angle of inclination of 57°, revolution period 91 minutes, weight 1500 kg and carried remote sensing and remote control equipment. It was recovered on February 8, 1978.

Its mission was to test the ability to collect reconnaissance information. An astrodog on this satellite was also recovered successfully [5,6].

(9). On September 20, 1981, China launched three satellites by one carrier rocket. This is the so-called "one rocket three satellites" (the 10th, 11th and 12th satellites). The perigee and apogee of these satellites were 240 and 1610 km, respectively. They had an angle of inclination 59.5° and revolution period of 103 minutes. The main mission was for the study of astrophysics which included the measurement of the Earth's magnetic field, the density of the atmosphere, UV and IR light intensity in atmosphere, and X-rays emitted from the sun and microparticles in the atmosphere. The techniques of "one rocket three satellites" can be used for the development of multi-warhead missiles. This technology combining the technique of electric rockets can also be used to develop synchronous satellites.

(10). On September 9, 1982, China launched its 12th satellite. The perigee and apogee of this satellite were 177 and 387 km, respectively. This probably was a reconnaissance satellite and its main mission was to reconnoiter the disposition of Russian SS-20 missiles.

(11). On August 19, 1983, China launched its 13th satellite. China called this satellite an experimental satellite for science. In fact, this may be the experimental satellite of the synchronous communication satellite.

(12). On January 29, 1984, China launched its 14th satellite, calling this an experimental satellite for science. The carrier rocket for this satellite probably was the CSL-3 rocket. Its main mission was to test the synchronous communication satellite and to test the newly developed CSL-3 carrier rocket [7].

(13). On April 8, 1984, China launched her 15th satellite which was a synchronous communication satellite. On April 16th at the time of 18:27:57, this satellite was at a fixed position of east longitude 125° and above the Equator. This satellite improved the communication and TV broadcast systems in China. The carrier rocket used to launch this satellite probably was the CSL-3.

The techniques required to orbit a synchronous satellite are more difficult than those for a reconnaissance satellite. The success in positioning a synchronous satellite indicates that China had achieved a major breakthrough in the technology of launching satellites [8-10].

(14). On September 12, 1984, China launched its 16th satellite which might be a meteorological satellite [11].

The main reason China tried so hard to develop space technology and the techniques of launching satellites is believed to be for /26 military purposes, such as setting up a space station for collecting military intelligence and a relay control station for guiding intercontinental ballistic missiles. The other reason may be for improving her international standing. In the future, China not only will rigorously develop reconnaissance satellites, launch meteorological satellites and develop intercontinental ballistic missiles guided by satellites, China will also construct pre-warning systems in order to prevent an enemy's first strike with nuclear weapons.

V. THE PROSPECT OF SPACE TECHNOLOGY IN CHINA

(1) Factors affecting the development of science and technology in China:

Due to the effect of the political system, economic strength and technological standards, China had difficulty in developing space technology.

1. The effect of the political system on the development of science and technology: Although China tried to carry out the program of the "Four Modernizations", due to the restraints of the "Four Persistences" policy, the normal development of science and technology was limited. Besides, due to bureaucracy in China, nonprofessional people always directed the experts in various research institutes. There were also too many rules and regulations. Therefore, the exchange of science and technology and the morale of research scientists in China were very poor.

2. Science and technology limited by economic strength: It has been more than three decades since China took over the mainland in 1949. But the economy of China has still fallen behind and remains economically an agricultural society with low income and poor living standards. The failure in the economic development certainly has some effect on the various developing programs of space technology in China.

Since Deng Xiaoping held his power in 1978, in order to implement the "Four Modernizations" effectively, he changed the government's policies to try to interest intellectuals and to give scientists and engineers preferential treatment so that they had better lives and morale. For economic purposes, China opened 14 coast cities where special economic areas were established in order to attract foreign capital, import Western countries' technology and then develop its own economy.

3. All the strategic missiles and carrier rockets in China use liquid fuel, but the stability of liquid fuel is hard to control. Besides, liquid fuel should be supplied a few hours before launching, which is very inconvenient. Since 1959, China continued the research of solid state fuel which could be used in long range rockets. A Research Institute of Applied Chemistry, under the supervision of Academia Sinica, was founded to develop solid state fuel. Because of the launching of an intercontinental ballistic missile from a submarine recently, China must have successfully developed solid-state fuel.

(2) The survey of space development by foreign assistance

On January 11, 1980, the first issue of Scientific Life in China reported the propaganda about astronauts who were trained for future space flights. It also showed five pictures of the astrodog which came back from the space flight and the astronauts under the training program. This report created international attention. But behind the propaganda is a fact people seldom pay attention to: the assistance from well developed Western countries and Japan plays a significant role in the success of China's space programs. How foreign countries assisted China to develop satellite programs is briefly described below:

1. The United States of America

On July 6, 1978, Dr. Robert A. Frosch, Chief of the National Aeronautics and Space Administration (NASA), accompanied by Dr. Frank Press, a member of the White House Science Council and Director of the Office of Science and Technology Policy, first visited Beijing [12]. The purpose of Dr. Frosch's trip was to understand the space programs in China and to seek possible cooperation between these two countries. In addition to being briefed and visiting some space programs, Dr. Frosch also was invited to visit the satellite launching site located at Shuangchengzi, Gansu Province. This was the first time China allowed visitors to see its classified space base. The visit laid a foundation for the Space Technology Cooperation Agreement which was signed later [13, 14].

On January 28, 1979, Deng Xiaoping visited the United States. On January 31 he signed the first agreement, General Agreement of Science and Technology Cooperation, after establishing diplomatic relations with the USA at Washington. D. C. [15]. Both countries agreed that the USA would help China build a meteorological satellite system, which included selling and launching two communication satellites, and build a receiving system on the ground which could receive information from the Earth resource exploration satellites of the USA. On May 19, 1979, Dr. Frosch visited Beijing again. In less than a year, he visited China twice. This indicates that the USA is willing to help China in the development of a space program. They are also seeking further cooperation.

2. Japan

On August 5, 1978, Ren Xinmin, then Director of the Research Institute of Space Technology, led 30 people of a Space Science and Technology Delegation to visit Japan. They visited a rocket launching center located at Nazepo on Deer Island, which belongs to the Research Institute of Space and Aeronautics of Tokyo University. Fourteen Chinese delegates stayed at Deer Island for four days in order to understand various equipment of the rocket launching center. At the center, Research Institute of Space and Aeronautics demonstrated launching of a solid-state fueled mini-rocket for the Chinese delegation. China was very interested in the manufacture of solid-state fuel. They had discussed details about this problem [16,17].

In June 1979, a space technology observation group led by group leader, Xu Ming, and vice leader, Chen Fangyan, went to Japan to see if there was any space technology which they could obtain. In Tokyo, Mr. Chen asked Japan's assistance in the following items [18]:

(a) high quality space camera, IR photography and highly sensitive film;

(b) computer image analysis techniques; /27

(c) high speed computer and digital manipulation system;

(d) analytical techniques for multi-color data system;

(e) optical image processing;

(f) determination of space photography.

After the visits of the Space Science and Technology Delegation and the Space Technology Observation Group by the Chinese on October 17, 1979, a Universal Science and Technology Visiting Group led by Mr. Hoya, President of the Space Development Promotion

Association of Japan, was invited by China to visit Beijing and the following organizations:

(a) the launching site of satellites and long range ballistic missiles which is located at Shuangchengzi, Gansu Province;

(b) tracking and control center of satellites at Xian Province;

c) satellite assembly plant at Shanghai.

This was the second foreign delegation after the delegation of the USA which was allowed to visit the space base and assembly plant in China [19-21].

3. Federal Republic of Germany

On April 17, 1978, China signed an agreement with the Department of Scientific Research and Technology of West Germany. Both sides agreed to do experiments of satellite communication and information transmission. China used the communication satellite of France-Germany to test the communication capability and the performance of its satellite ground station. This was for the purpose of developing its communication satellite [22]. The first experiment was in the afternoon of August 3, 1978. The technicians at the satellite ground station of Nanjing, China, communicated with the space technicians of West Germany through the communication satellite.

On October 9, 1979, Dr. Fang Yi, then Director of Academia Sinica, visited West Germany. He visited the Research Laboratory of Aeronautics and Space Aviation located at Bonn. He also signed a Science and Technology Cooperation Agreement with the Department of Scientific Research and Technology of West Germany. According to this agreement, West Germany sent a delegation of aeronautics and space research to visit Beijing on March 20, 1979. They discussed their cooperation in space technology. This was the beginning of the cooperation in space science and technology between China and West Germany [23].

In June 1979, the Research Institute of Measuring Science of China and the Research Institute of Physical Technology of West Germany co-sponsored a time synchronization experiment by using a satellite. Time synchronization means unifying the times of two separated places very accurately. This precise time synchronization experiment helped China in launching and tracking satellites and in orienting and guiding space aviation. This experiment also tested the equipment in the ground receiving stations, which was constructed by China itself. This laid a foundation for time standardization and broadcast systems which will be developed later in China [24].

On February 15, 1979, both countries again signed a Cooperation Agreement in TV Satellite Technology. West Germany agreed to help China set up a TV satellite system [25]. China also sent space technicians to West Germany for training. West Germany will transfer this technique to China gradually so that China can build her own TV satellite later.

4. France

On December 6, 1978, China and France signed a Space Technology Cooperation Memorandum at Beijing. This was the beginning of space cooperation between these two countries. The items for cooperation in this memorandum are:

(a) Direct and indirect broadcast TV satellite reception technology - the former is transmitted directly from the satellite to the TV receivers, the latter is received by a ground satellite receiving station and rebroadcast.
(b) Rockets and launching technology.
(c) Communications satellite technology
(d) Earth resources exploration technology using satellites.
(e) High altitude meteorological technology.

With this cooperation agreement, France transferred space technology to China. China was then able to use the TV broadcast satellite launched by the "Alian" rocket which belonged to the European Space Administration. In the spring of 1979, France sent a space technology delegation to visit Beijing and discussed the future cooperation in detail with China. They also introduced the "optical fiber communication" technology to China for future reference in the development of communication satellites [26-28].

5. Space Administration of Europe

The Space Administration of Europe is a space technology R&D organization whose members are from 11 West European countries. In September 1979, Dr. Gibson, Chief of Space Administration of Europe, led a nine-country delegation to visit China for a week. The main purpose of this visit was to discuss how to cooperate in developing satellite ground stations for receiving satellite information. The items for cooperation included:

(a) research and manufacture of communication satellites;

(b) reliability and quality control of accessories of the space system;

(c) design of efficient space engineering; /28

(d) manipulation of data transmitted from satellites scanning the Earth [29-30].

In September 1979, China sent a Space Science and Technology Delegation (10 people) to visit Europe for 40 days. During that time, they visited every plant related to space technology and tried to understand the space program activities in Europe [31].

From the above survey about space program cooperation between China and the Western countries and Japan, it is concluded that communication satellites are the first priority for the space program in China. It is expected that the communication system and the receiving capability of the TV network which fell behind the Western countries will be improved after 1985.

(3) The future space development program in China

The goal of the short term space technology development in China will emphasize the launch of the communication and direct broadcast communication satellites and the meteorological satellites.

China probably will orbit six satellites (direct broadcast satellites and meteorological satellites) between 1985 and 1987. The goal of her long term space program will be to launch communication or meteorological satellites into synchronous orbit of the Earth for the third world countries [32].

VI. CONCLUSION

In contemporary war, the new invention in military technology can have significant impact on international affairs. For example, the nuclear weapon in the 1940's; the intercontinental missile in the 1950's; the artificial satellite in the 1960's, and the computer in the 1970's, all have significant influence on the change of military affairs and the relative strength of the military. In the 1980's, due to the invention of warhead satellites, space may become another battlefield. It is believed that the country who controls space will have military superiority. Therefore, in order to raise its international standing and compete with other countries, China is very active in the development of space technology.

At present, Western countries and Japan argue that they only assist China to develop space technology in civil areas and not in military areas. But, in some sense, "civilian" and "military" areas are difficult to distinguish. For example, communication satellites will enhance the communication ability of the army and also can be used for military communication between airplanes, ships and command centers or for guiding missiles during a war; resource exploration satellites can be used for the purpose of military reconnaissance; the technology of carrier rockets can be used for the launch of intercontinental ballistic missiles. The success of "one rocket three satellites" in China can be used as the basis for the development of multi-nuclear warhead missiles.

The well developed countries in the world who assist China to obtain new technology without limit, not only will promote the modernization of China's civil technology, but also promote the modernization of her military. The carelessness of these countries may cause much trouble in the world.

REFERENCES

[1] Dagong News, 9/4/1984.
[2] Bulletin of Xinhua News Agency, 4/25/1970.
[3] Common News Agency of Japan, from Toyko, 7/30/1975.
[4] Dagong News, 12/18/1975.
[5] Liberation Army News, 3/14/1978.
[6] Dagong News, 9/2/1984.
[7] Dagong News, 1/31/1984.
[8] Wenhui News, 4/17/1984.
[9] Liberation Army News, 4/20/1984.
[10] Liberation Army News, 4/23/1984.
[11] Wenhui News, 8/17/1984.
[12] Aviation Week and Space Technology, USA, 5/21/1979.
[13] Xinhua News Agency, from Beijing, 7/9/1978.
[14] Xinhua News Agency, from Washington D.C. 1/31/1979.
[15] Dagong News, 8/26/1978.
[16] Dagong News, 8/6/1978.
[17] France News Agency, from Deer Island of Japan, 8/15/1978.
[18] Xinhua News Agency, from Beijing, 7/19/1979.
[19] Xinhua News Agency, from Beijing, 10/21/1979.
[20] Japanese broadcast, 10/22/1979.
[21] Broadcast by Voice of America, 10/22/1979.
[22] Weihui News, 8/7/1978.
[23] Xinhua News Agency, from Bonn, 10/9/1978.
[24] Xinhua News Agency, from Nanjing, 7/9/1979.
[25] United Press International, from Munich, 10/25/1979.
[26] Dagong News, 12/10/1978.
[27] Dagong News, 4/25/1979.
[28] Weihui News, 10/21/1979.

END

DTIC

7-86