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CHINESE SPACE AND AVIATION INDUSTRIES SCORE MAJOR BREAKTHROUGHS

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16. Abstract

This report presents an overview of the current status of China's aviation and aerospace industries, as well as planned future development and areas of importance for China's future space programs. The development of China's CZ-1, CZ-2 and CZ-3 rocket program is discussed, as well as China's satellite launch capabilities. China's first geostationary communications satellite STW-1 is also mentioned, and futher development of the second and third communications satellites to be launched in 1987 are shown. Other developments include a seventh low Earth orbiting photographic reconnaissance satellite, plans for an image transmitting remote sensing satellite to be launched in 1988-1990, and other satellite developments. The Chinese-designed Y-10 transport aircraft is discussed, as well as the TU-16 bomber aircraft and the co-production agreement with McDonnel Douglas for the MD-82 passenger aircraft.

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R. Hu

Last May, an American space delegation led by M. A. Silveira, chief engineer at NASA, visited China and toured space and aviation scientific research and production organizations in Beijing, Xian and Shanghai. They also published articles on what they saw and heard thus reflecting part of the present situation of developments in China's space and aviation industries. /88

Space Plans

China has successfully launched 16 satellites since the 1970's. The carrier rockets employed were the type-1, type-2 and type-3 "Chang Zheng" (i.e. CZ-1, CZ-2 and CZ-3). The CZ-2 can send a more than two ton payload into an earth synchronous orbit. The CZ-2 and CZ-3 use the same first and second stage liquid rockets; the CZ-3 uses the hydrogen-oxygen engine for the third stage. They have decided to develop a large-scale transport rocket at the latter part of the 1990's similar to the Saturn 1 of the United States to launch China's large-scale satellites. At present, China is researching the solid rocket bound-type booster to raise the capabilities of the CA-2 and CZ-3 carrier rockets. In the future, the CZ-2/3 series carrier rockets will use the new third stage solid rocket.

China's present policy is the comprehensive development of its national economy and therefore they have stressed improving production of energy resources and conditions of transportation. China thus hopes to launch satellites once or twice a year. It has also been announced that China will make the cost of the "Chang Zheng" series carrier rocket lower than the Ariane of Europe, American spacecraft and other single use carrier rockets and throw them into the international satellite launch market.

A certain joint company of Beijing, China has already reached an agreement with the Space Vector Company of California, United States to use the CZ-1 and CZ-3 to launch satellites. The launching costs of the CZ-1 are only 4.1 million American dollars; the costs for the CZ-3 have not been negotiated.

The reliability of China's carrier rockets is a question of great concern to users. According to statistics since 1975, CZ-2 and CZ-3 carrier rockets successfully launched payloads into orbit 12 times and there have been two or three failures. The reasons for the failures were all due to breakdowns which occurred in the guidance systems. On January 29, 1984, the CZ-3 made its first flight but because the third stage rocket was unable to successfully ignite twice there was partial failure. This caused the payload to be unable to enter the earth synchronous transfer orbit from the low orbit. A satellite launched during the middle of 1979 was a failure and so the payload dropped on to the Australian mainland or into the sea.

As regards the types of satellites launched, they have designed earth synchronous communication satellites, meteorological satellites as well as scientific satellites and direct transmitting satellites etc.

On April 8, 1984, China successfully launched its first communication satellite STW-1 into earth synchronous orbit. Although its design life is only one month, yet to date, it is still operating normally. This unexpected long life has caused Chinese to lengthen their real time television and telephone communication testing time. China uses two independent ground stations and communicates by means of this type of satellite four times a day to check the functions of each system. It is reported that when the satellite turned from the sun's shadow period to its period of shining, the attitude control system of the satellite broke down. From tracking measurement data it

was known that this type of communication satellite was possibly in a certain kind of drift orbit and was not fixed on a truly synchronous orbit with exact longitude.

The new communication satellite was fixed to be launched at the end of 1985 or the beginning of 1986. If the launch of this satellite is successful, it will be a back-up satellite of the STW-1. It also uses the CZ-3 for launching and the oxygen/hydrogen engine for the third stage. However, its difference with the STW-1 is that it is equipped with a 1.22 meter long and 0.76 meter wide graphite epoxy resin point beam antenna /89 which allows the transmitted signals to only cover Chinese territory.

The third communications satellite will be launched in 1987. This satellite will be designed and made by China and aside from being equipped with a point beam antenna, they will greatly raise the entire satellite's microwave communications capacity wherein it will use more sophisticated electronics technology than that of the first satellite and the back-up satellite.

The Chinese direct transmission satellite designed by RCA of the United States and MBB of West Germany is set to be launched in 1987 with spacecraft of the United States or the Ariane of Europe [Note: according to the latest information, this has already been cancelled].

The Shanghai Satellite Engineering Research Institute will launch a 675 kilogram polar orbit meteorological sattelite in 1987. This 1.4 meter square satellite has two large solar energy cell arrays on the sides and each array is composed of three solar energy cell plates. The main instrument of this satellite is two radiometers and each has three communicating channels which can provide visible light and infrared pictures. The maximum numerical resolving power is 0.97 kilometers and

the operating life is one year. However, the tape recorder and gyroscope have not yet reached predicted performance requirements and they hope to obtain technical assistance from the United States. The Chinese believe that they will continue to carry out meteorological satellite development plans so as to establish a continuously operating polar orbit meteorological satellite system and an earth synchronous orbit meteorological satellite system.

The seventh low orbiting camera satellite was successfully launched during the second half of last year. The film of this type of satellite was retrieved from a 1.5x1.8 meter re-entry recovery capsule. The film was able to be used for military reconnaissance and earth resources surveying. An American delegation saw multi-spectrum pictures retrieved from a 1984 launch and the resolving power of the small plots of farmland in the pictures was excellent. They could be used to predict the harvest of China's agriculture industry.

In order to fill in the deficiencies in the retrieval of multi-spectrum film in camera satellites, China is developing an image transmitting remote sensing satellite. Plans are to launch it in 1988-1990. Its performance will be very similar to that of France's SPOT remote sensing geodesic satellite. The Xian Radio Technology Research Institute is now developing the charge coupled device (CCD) sweep scanner and the quality of the pictures is very good. The Chinese have also used it to develop the remote controlled remote sensing spacecraft to make a battlefield monitoring system. The multi-spectrum pictures taken by the low orbiting remote sensing satellite are sent back to earth by radio signals. The diameter of the ground satellite picture receiving antenna is 3 meters.

China is now setting up new space industry installations. An American delegation saw the construction of a new solid engine

research institute in progress in Xian for the development of solid engines for intercontinental ballistic missiles and submarine launched ballistic missiles. A five storied building is being constructed in Beijing where they will develop a space optics system; they are also building a three storied building to be used for carrying out standard corrections in space technology; the foundation has already been laid for a satellite environmental experimental research center. The delegation observed a large anechoic chamber and water channel in Xian. The water channel provides simulation tests for aircraft and submarines and it is as large as similar American installations. Many organizations are also outfitted with new minicomputers. Some were imported from the United States and Europe.

However, the vast majority of space research and test facilities seen by delegations were out of date and backward. There was inadequate lighting in the buildings and the level of clarity was not high. China is lacking experience in the management and organization of a large-scale space program. China employs the strictly separated management method which has obstructed technical exchange between several space centers. The Chinese say that China has already made progress by cooperating with Western Europe and they have also reached cooperation agreements with Japan. China hopes to attain even greater developments through cooperation with the United States. At present, China is investigating the direct transmission satellite report plan of the MBB Company of West Germany and the RCA Company of the United States. China's position is important to the United States and Europe.

Aviation Plans

In the area of the aviation industry, an American delegation observed an aircraft manufacturing plant attached to the Shanghai Aviation Industry Company and an aircraft manufacturing plant of

the Xian Aircraft Company.

The delegates climbed aboard the Y-10 transport aircraft designed by the Shanghai Aircraft Plant while they were at the plant. The aim for this aircraft is research and development and there are no plans to put it into production. They have gained experience from designing, manufacturing and test flying it so as to make it convenient to assemble the MD-82 transport aircraft of the McDonald Douglas Company at this plant. The external appearance of the Y-10 is similar to that of the Boeing 707 but the designs of the wings, leading edge flaps /90 and empennage are noticeably different. The Y-10 uses the JT3D-7 turbofan engine of the Pratt and Whitney Company of the United States. These engines were provided when China purchased 10 Boeing 707. China strongly maintains that they did not copy the Boeing 707 in their design and manufacture of the Y-10. Its design features are:

(1) In the area of wing design, they eliminated the trailing edge camber of the Boeing 707's wing surface so as to reduce the pitching moment; they also used a relatively simple double channel folding wing layout;

(2) In the area of flap design, they used aluminum casted flaps which have outside fillet conical shapes on the entire wing;

(3) In the area of empennage design, the Y-10 has a larger vertical empennage than that of the Boeing 707 but the swept back empennage is smaller. This is done to prevent rolling/yawing, coupling or Dutch rolling;

(4) In the area of landing gear, the Y-10 uses the engine whereas the Boeing 707 uses an hydraulic system to lift the landing gear;

(5) The cockpit seats five crew members, that is, one flight engineer sits between two pilots and there is one radio operator and one navigator on the left and right. The Boeing 707

only seats three persons.

(6) The instrument panel arrangement is the same as standard four engine jet transport aircraft but the fuel level gauge and temperature gauge are placed directly in front of and above the pilot.

The Y-10 aircraft has 124 seats wherein there are two rows in the first class cabin and three rows in the second class cabin. The overhead baggage compartments are the same as in most American transport aircraft.

The Y-10 carried out its first test flight in 1980 and it has now completed its flight test plan. It has accumulated 200 hours of flight time in 120 flights.

The Shanghai Aircraft Plant has 6,000 workers and among these over 800 are engineers and technicians.

The Shanghai Aviation Industry Company and McDonald Douglas Company have just held discussions about a three year turbofan technical reserve agreement and yet one part will not necessarily be an agreement on the MD-82 aircraft. China is exploring a type of technically advanced medium and close range transport aircraft. Its propulsion system has still not been determined and they must investigate the marketplace. If they want to implement well the aircraft plans for the MD-82, the Shanghai Aviation Industry Company requires several hundred new engineers and workers. China has been enacting an open foreign policy and this company is welcoming more visits by foreign delegations. This company hopes to transform itself into a highly technical aviation organization with excellent products and facilities.

The Xian Aircraft Plant which is about 64 kilometers north of Xian has already built a Chinese model of the Soviet Tu-16 bomber. They have also produced a twin engine, upper single

wing, turbojet engine Chinese "Yun-7" transport aircraft which resembles the Soviet An-24 . This plant is also researching new twin engine supersonic bombers and other military aircraft (two person fighters or advanced trainers).

The American delegation observed a hangar with two Chinese Tu-16 type bombers. One of them had two new circular engine hanging compartments. This is a modification of the Tu-16 aircraft called the Tu-16/"Hong-6". When the Chinese use the Mikulin RD-3M (turbojet-8) engine, they do so based on the standard design of the Tu-16: there is a flat side surface and the air inlet of the engine and the fuselage are stuck together on this side surface. In the new design, the engine is moved towards the outside under the wing and the hanging compartments are circular so as to reduce the problem of the boundary layer around the air inlet.

After 1,000 hours of flight, the Tu-16 bomber had its first overhaul; after 3,000 hours of flight, it had its second /91 major overhaul. The other Tu-16 bomber in the hangar was produced in 1969. It has already been flown 3,000 hours by the Air Force and is now going through major overhaul. By opening the bomb hatch, one can see the bomb racks for the conventional bombs and atomic bombs.

Six Tu-16 bombers were lined up and being repaired in the maintenance area of the airfield and the bombers appeared especially clean. This aircraft is equipped with six 23mm machine guns and one 30mm machine gun. All of the modified Tu-16 are equipped with air-to-air missiles. Further, they also added a radar antenna radome on the nose and suspended two C-60 anti-submarine missiles under the wings.

The "Yun-7" transport aircraft produced by this plant has 48 seats. The cockpit can seat five persons. The KWX-58 color

display radar made by the King Company of the United States is a component part of the aviation electronics equipment of the "Yun-7." The Chinese are thinking of using the engine of the Pratt and Whitney Company of Canada or the Rolls Royce engine to replace the engine of the "Yun-7." They are also thinking of seeking American help and installing new aviation electronics equipment.

In the past, the Xian Aircraft Plant made certain parts of the wing's trailing edge for the Boeing 747. Since 1980, the Boeing Company signed a contract with this plant to make electronic cabin doors for the Boeing 737. Further, they will also deliver 100 vertical empennages for the Boeing 737. Last June, China delivered seven electronic cabin doors and some are now being transported. China will also deliver 70 doors and for the most part productivity is five doors per month. This is because this plant simultaneously wants to make much larger empennage modules. The Boeing Company considers that the quality is very high.

The Xian Aircraft Plant has 15,000 personnel and among these 3,000 are engineers and technicians. Several hundred personnel are researching design plans for a supersonic bomber. There is a 3,300 meter long aircraft runway near the plant.

This plant has 2,000 lathes and most of the larger lathes are Soviet made. There are two 90 meter wide and 180 meter long large factory buildings. They are equipped with lathes and yet the utilization rate of the equipment is only 30%. At present, they are producing the "Yun-7" transport aircraft and Tu-16 modified bomber. Further, there are also some aircraft which are being repaired.

This plant has jst set up a computer room and it is equipped with the Siemens 7356 computer of West Germany. This computer can carry out many types of design computations for the factory.

Further, when joined with the Siemens 7760 computer in Xian, it can be used to support many industrial users in this region. They will soon import a new IBM computer from the United States to carry out computer assisted design of aircraft structure. The other computer room in this plant has ten IBM PC computers which use Chinese characters to display data.

A relatively advanced piece of equipment in this plant is the contour tracker manufactured by the Digital Electronics Automation Company of Italy. Its precision is 6 mil.

This plant also has a very large engineering drafting room. Each of the large engineering drafting tables holds 20 sheets in a total of 20 rows. All of these sheets are manually drafted. Over the last two years, they have begun to use automatic drafting instruments.

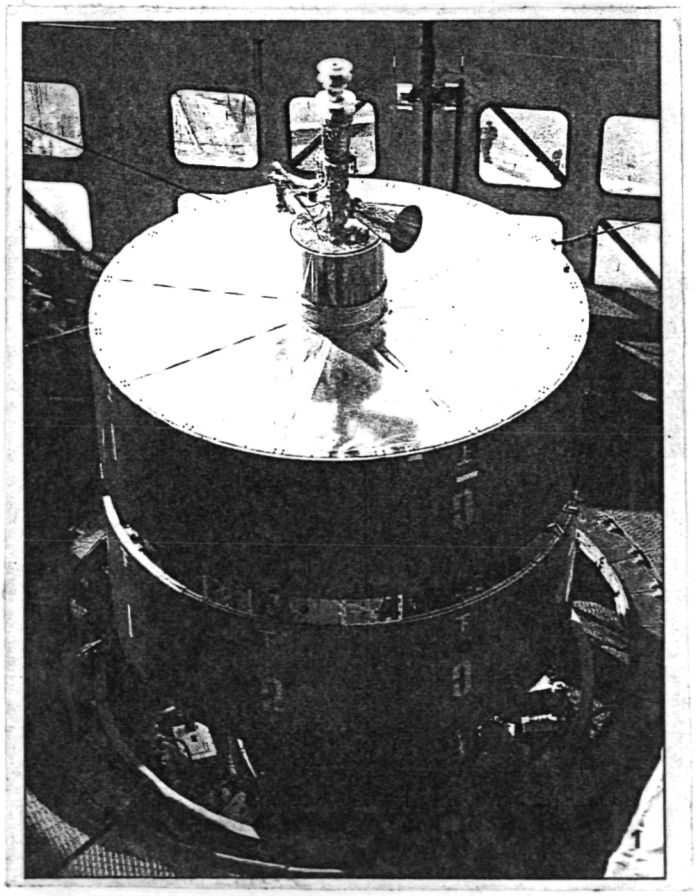


Fig. 1 A synchronous communication satellite developed and manufactured by China.

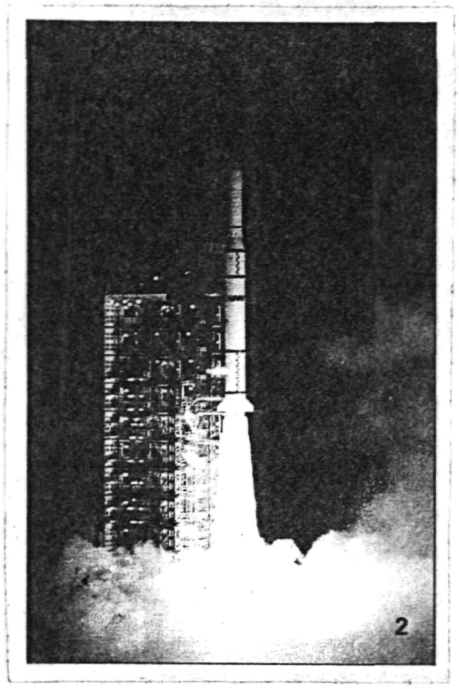


Fig. 2 On January 29, 1984, China used the "Chang Zheng" No. 3 carrier rocket to launch an experimental communication satellite.

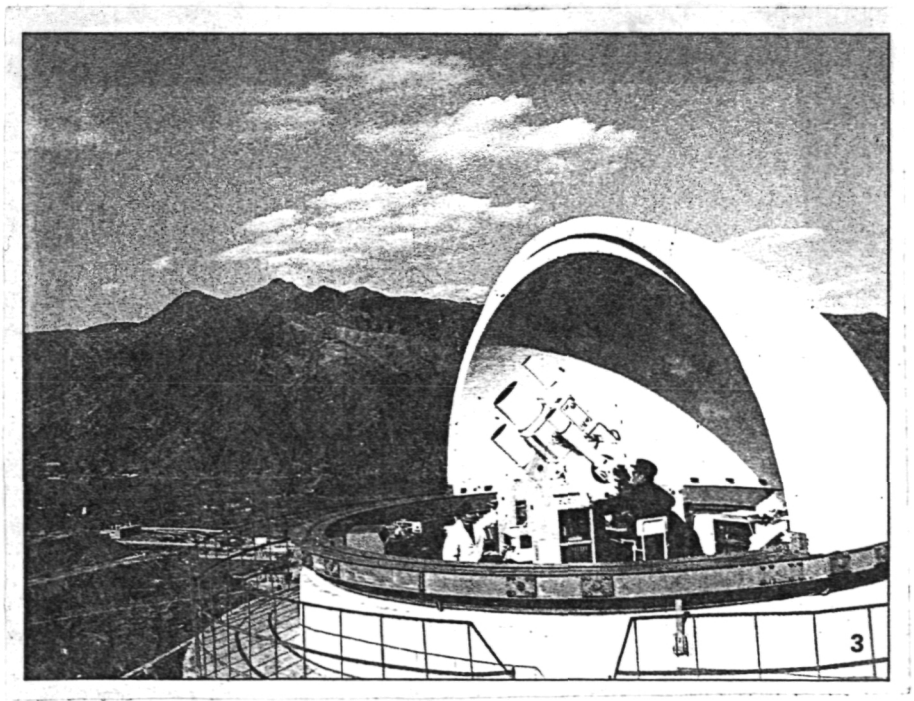
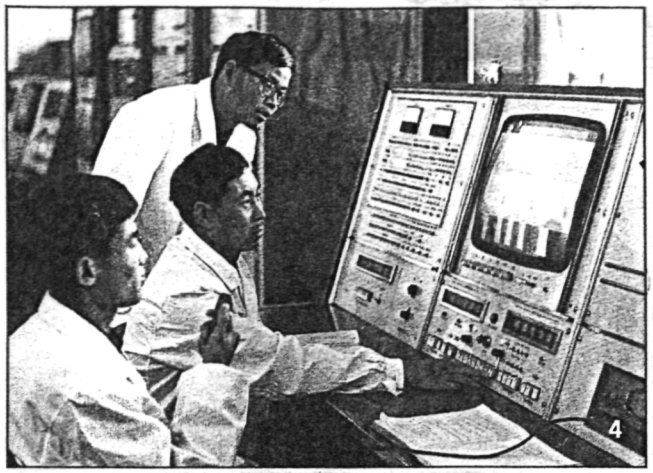
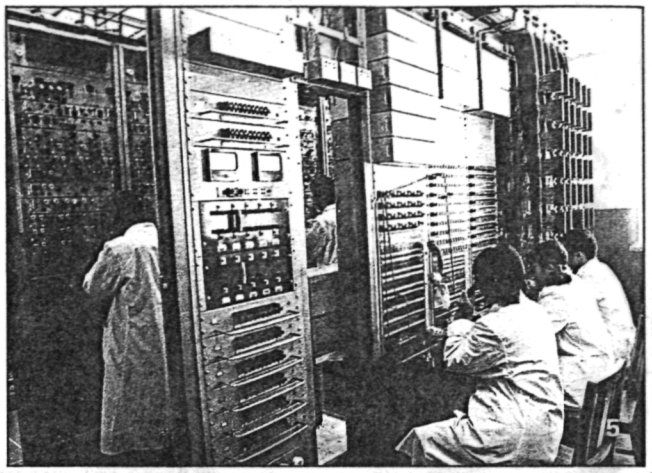


Fig. 3 The large laser movie transit used by China to track and measure experimental communication satellites.





Figs. 4,5,6 Three views of China's Monitoring Control Center

Fig. 7 The "Hong-6" bomber has two C-601 air-to-submarine missiles suspended under its two wings. The C-601 has anti-electronic interference and anti-sea wave interference capabilities.

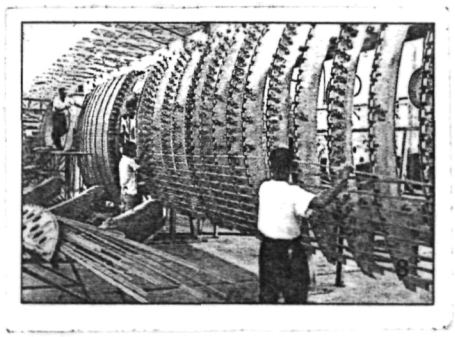


Fig. 8 Workers at the Xian Aircraft Plant assembling the frame of the "Yun-7" aircraft.

(Fig. 9 on next page)

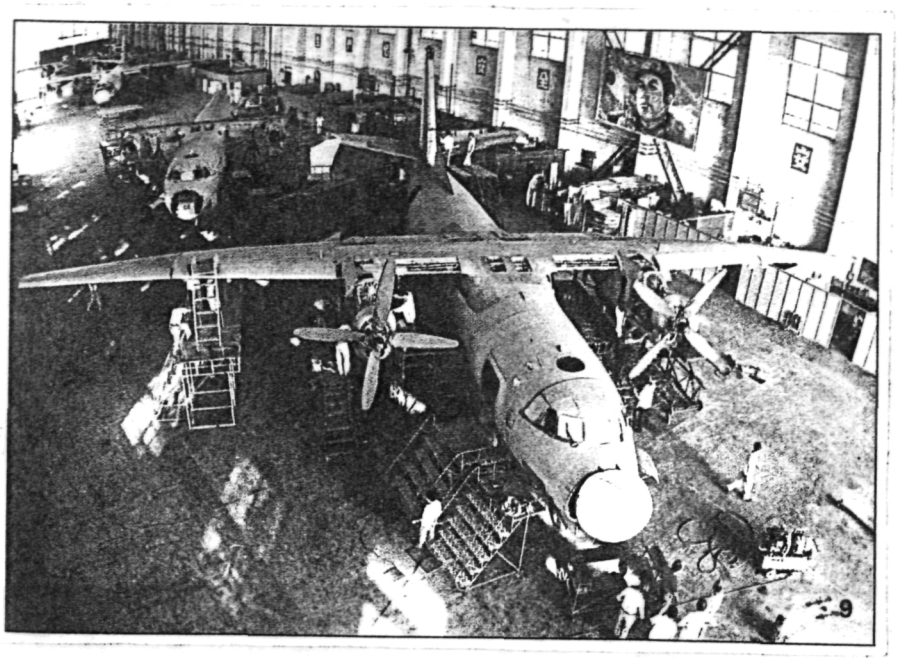


Fig. 9 The "Yun-7" transport aircraft main assembly workship of the Xian Aircraft Plant. The "Yun-7" which was designed by the Xian Aircraft Plant is the first Chinese made medium and short distance passenger plane used on domestic routes.