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16 April 1980

China Report

SCIENCE AND TECHNOLOGY

(FOUO 1/80)

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APPLIED SCIENCES

PRESENT STATE OF CHINA'S SPACE DEVELOPMENT DISCUSSED

Tokyo KAGAKU in Japanese No 3, Mar 80 pp 170-172

[Article by Daikichiro Mori, Tokyo University Space Research Institute]

[Text] In the latter half of October last year (1979), at the invitation of the President of the China Aerospace Society, the Space Science Technical China Visit Association (headed by Osamu Nagano, with 17 subordinates) members had the opportunity of a visit for study of the present state of China's space development.

The objects of the study visit were satellite launching facilities, rocket engines, scientific and technical experimental satellites, and any facilities for these; since the mission of the abovementioned China Visit Association was entirely devoted to peaceful aims, it had absolutely no concern with anything of a military nature. There was no opportunity to see things related to general survey rockets.

Among the places we visited, the satellite launch site at Urumchi, in the Western region, was seen, as well as visits to Beijing, Xian, and Nanjing were the focal points of our visit. The field trip objectives amounted to twelve places in all. The names of the objectives of the field trip are recorded in Table 1, and the places visited are shown in Figure 1.

Urumchi Satellite Launch Site

The western region satellite launch site was the highlight, so to say. Urumchi, as shown in Figure 1, is in the interior of Nei Monggal, but the base, close to the Mongolian border, took a further 3 hours to reach by train and car. The visit, as mentioned above, was spread over the whole of China, including Urumqi. The China Aerospace Society was particularly attentive to our being able to make the tour of visitation in a brief period, and the exlusive use of an "Ilyushin 11-18" 4-enginer turboprop aircraft was allocated for the sequence Beijing - Urumqi - Xi'an - Namjing in 5 days, and also a special train of three observation cars from Urumqi to the base. We were met every day with a car; interpreters were provided, and arrangements were kindly made for our welcome, entertainment, etc in each

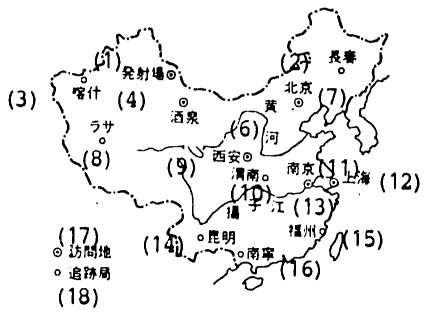

Figure 1. Places visited by the writer, and satellite tracking stations.

KEY:
1. Launch site
2. Changchun
3. Jungshih
4. Urumchi
5. (omitted)
6. Yellow River
7. Beijing
8. Lhasa
9. Xi'an
10. Weinan
11. Nanjing
12. Shanghai
13. Yangtze River
14. Kunming
15. Fuzhou
16. Nanning
17. Places visited
18. Tracking stations

Table 1. Places visited by the writer.

Toho Scientific Instrument Factory	Nanjing Satellite Geo-Bureau
Beijing Control Process Research Institute	Shanghai Huayin Machine Factory
Beijing Process Environment Test Center	Xin Xin Machine Factory
Beijing Aeronautical Research Institute	
Beijing Rocket Test Center	
Urumchi Satellite Launching Establishment	
Xi'an Satellite Tracking Establishment	
Xi'an Radio Electrotechnical Research Institute	

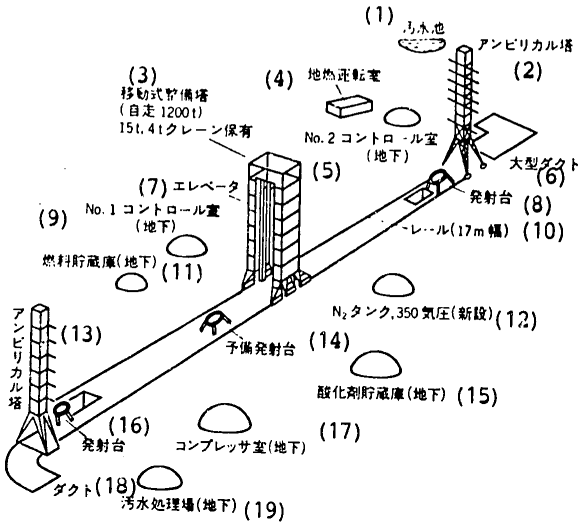

Figure 2. Sketch of Launch Establishment

KEY:
1. Waste water lagoon
2. Umbilical tower
3. Traveling-type equipment tower (self-propelled, 1,220 tons), with 15-ton, 14-ton cranes
4. Ground burn operations room
5. No. 2 Control room (underground)
6. Large duct
7. Elevator
8. Launch platform
9. No 1 control room (underground)
10. Rails (17 m width)
11. Fuel storage storehouse (underground)
12. Nitrogen tank, 350 atmospheres (newly constructed)
13. Umbilical tower
14. Spare launch platform
15. Oxidant storage storehouse (underground)
(16) Launch platform
(17) Compressor room (underground)
(18) Duct
(19) Waste water treatment plant (underground)

city. Once the invitation was given, an organization was set up for a thorough welcome, giving rise to admiration for the good customs of this courteous country, which can by no means be imitated in a Japanese government office or university. All these impressed us all. This might even give effect to fostering the "friends of China faction."

The launch site is in the middle of the Gobi desert, about an hour by car from from the base town (population 7,000, of which 2,500 are staff people). The central installation consists, as shown in Figure 2, of a traveling fully equipped tower between second phase launch platforms (attached to auxiliary towers). As described below, "Long March" type rockets are used; a second phase underground control room, fuel storehouse, nitrogen gas tanks, compressor rooms, etc, are disposed on the perimeter.

The installation is also for ground burn testing of first-stage engines.

All the facilities are simple and sturdy, and are sufficient for launching scientific and technical test satellites, in response to good building and management in this outlying region. Staff morale is extremely high. As regards environmental safety, the Gobi desert is really favorable. In future, dealing with high-altitude stationary and other satellites and with liquid hydrogen engines would require completeness of the electrical control apparatus, etc., of the facilities.

Satellite-launching rockets

Apart from the engines, there was no opportunity to see satellite launching rockets; explanations from others in the technical interchange societies of Peking and Shanghai, and inspection of engines, etc., at the Shanghai Huayin Machine Factory, led to the following conjectures.

Long March No 3 rocket: Three-stage liquid-fueled rockets are currently under development, equivalent to the American Arian class, a combination of Atlas and Europa. Their conjectured appearance is as shown in Figure 3.

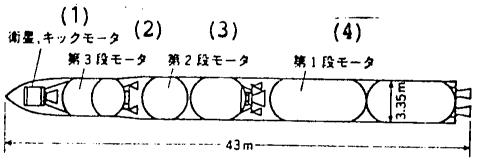

Figure 3. Chinese satellite launching rocket.

KEY: 1. Satellite, kick motor
2. Third stage motor
3. Second stage motor
4. First stage motor

Total length 43 m, diameter 3.35 m, total weight 200 t, fuel 180 t. First stage: four 70-t thrust engines, total thrust 200 t; fuel, asymmetrical dimethylhydrazine and N_2O_4 (nitrogen tetroxide); specific thrust on the ground 250 sec, in vacuum 290 sec. Second stage: one main engine, 73 t thrust; four vernier engines (gimbal) of 1.1 t; fuel same as first stage. Third stage: four liquid-oxygen-liquid hydrogen engines (thrust 1.1 t), gimbaled, one turbo-pump, specific thrust 425 seconds. Weight of satellite: stationary satellite 429 kg, to transition orbit 1.7 t, to low altitude circular orbit 5.

Development of the first and second stages is already completed. Among the 8 satellites launched by means of these so-called Long March #1 or #2 rockets at present made in China, satellites weighing 1-2 t are thought to have been launched with these rockets in and after 1975.

At the Shanghai Huayin Machine Factory, ten of the above-mentioned 70-t thrust engines were included in the semi-finished products. Though it is hard to say they were refined, the impression was of a stable, practical form, and there were signs of self-confidence about launching also.

In the construction of the four gimbal-type vernier engines (auxiliary control engines), 1.1 t thrust, used in the second stage, among five operatives, two were women.

During a visit, the third-stage liquid oxygen-liquid hydrogen engine, the Long March #3 main development product, was observed in a stationary test in an engine test stand in the suburbs of Peking. The thrust is 1.1 t, which is small in comparison with the 7-t and 10-t engines being developed at the present time in Japan; it should also be said that to avoid the technical difficulties in assembly and construction of the four-gimbal group familiarly used in the second stage vernier engine implies intelligent measures.

The main engine, of 70 t thrust, may be of the same class as the engine of the Chinese CSS-1 missile, similar to the Soviet Union's SANDAL rocket.

As against the N rocket engine of 90 t thrust received by Japan from America as a technical donation, China has developed by its own efforts this powerful booster of 280 t, giving a deep impression of extraordinary energy and planning devoted by China to space.

As regards normal liquid-fuel engines and liquid hydrogen engines, China is already in a way in possession of technology as mentioned above, and taking into account the case of the technical gift from America to Japan, hardly any questions were asked concerning liquid rockets. Questions to us were entirely concentrated on solid motors, electrical apparatus and computers.

Chinese Artificial Satellites

China's first artificial satellites are stored and exhibited in a clean state in the [Toryoku] Scientific Instrument Factory.

The back-up model of the technical experimental satellites launched in 1975 and 1976 was seen in the Shanghai Huayin Machine Factory. Its external appearance is shown in Figure 5; the diameter is 1.7 m, height 2.5 m, and weight 1.2 t.

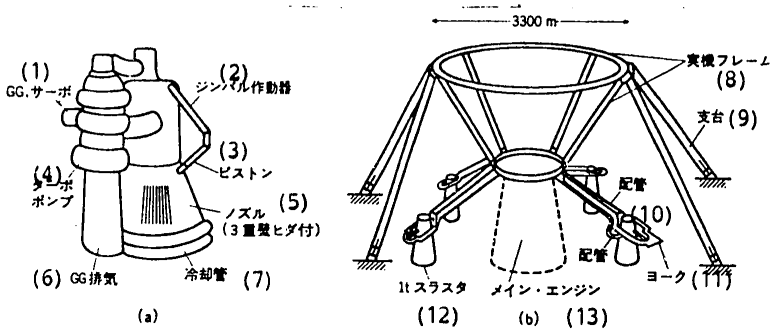

Figure 4. Chinese liquid-fueled rocket. (a) 70-t engine, (b) 2d stage vernier engine (in structure.) GG, gas generator.

KEY:
1. GG, servo
2. Gimbal operating device
3. Piston
4. Turbo-pump
5. Nozzle (attached to 3 heavy wall folds)
5. GG exhaust gas
7. Cooling pipe
8. Actual machine frame
9. Support stand
10. Piping
11. Yoke
12. 1-t thruster
13. Main engine

The attitude control, electronic instruments, measuring instruments, etc., of three satellites have already been successfully tested for about a month in orbits of altitude 200-400 km and angle of inclination 69°. It is said that recovery trials were carried out again in 1978, but these satellites were not present.

In future, 1981 and after, with the awaited completion of the above Long March #3 rocket, two kinds of large satellites should be launched, and their development is now being advanced. One of these is a 420 kg stationary communications satellite, the design of which is being worked on in Peking. The second is a weather satellite, and a full scale model of this was seen during the visit to the Shanghai Huayin Machine Factory.

As shown in Figure 5(b), this is a 1.5 m square cube; on three shelves are loaded a [hoiiru], nitrogen gas tanks, gas jets, infrared and visible light camera for weather use (resolving power 4 km), horizon and sun

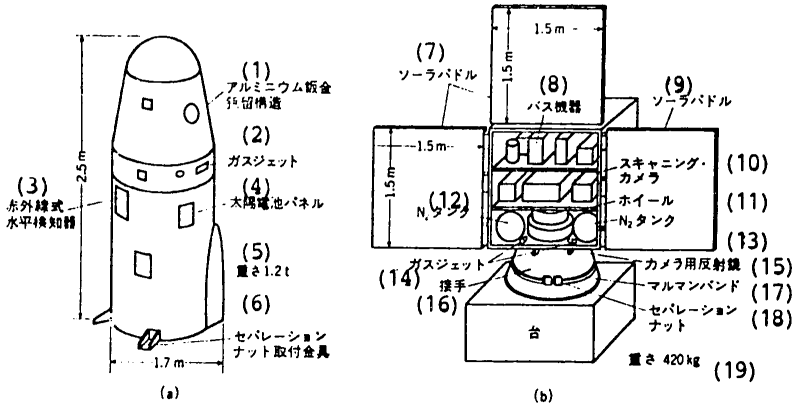

Figure 5. Two Chinese satellites. (a) technical test satellite, (b) weather satellite model

KEY:
1. Aluminum sheet metal
2. Gas jet
3. Infra-red type horizon detector
4. Solar cell panel
5. Weight 1.2 t
6. Separation nut mounted metal mounting
7. Solar paddle
8. Bus apparatus
9. Solar paddle
10. Scanning camera
11. [hoiiru]
12. Nitrogen tank
13. Nitrogen tank
14. Gas jet
15. Reflection mirror for camera
16. Joint
17. [Maruman] band
18. Separation nut
19. Weight 420 kg

detecting apparatus, communication devices, data recorder (recording time 40 min), etc. Three solar cell panels (output 260 W), 1.5 m square, open up in space and supply electric power. The weight is 650 kg, and the satellite will occupy a solar synchronous orbit of 98° angle of inclination and 900 km altitude; desired tests covering more than 6 months are said to be planned.

Our field trip was greeted by thorough cleaning and full equipment. However, for example at the Juchang space field, no scene of sultry fever, so to speak, was observed when people were seen at work at the [Utsunoura] experimental site, and slight doubts remain as to the level of performance in actual operations and practice. At any rate, favorable impressions were welcome of the manner in which preparations were being speeded up with renewed enthusiasm.

Tracking control of satellites

For tracking and command of rockets immediately after launching, a radar and command station is set up at Urumchi, but for tracking and control of satellites after reaching orbit a tracking network has been developed over the whole of China. Its tracking stations are at Changchung, Nanning, Kunming, Lhasa, Weinan, etc, shown in Figure 1, and furthermore 2 stations are newly established in Fukken, etc; it is said that ships are even planned for exclusive use as tracking stations.

The Xi'an satellite tracking center, 90 km north of Xi'an, has become the most important point of the network developed in this vast country. It has a large installation with the central role, for each station, of data transmission, copies of instructions, orbit analysis and prediction, time standards, etc. The number of staff is said to be 400, with a total staff of 2,000 for the entire network. Constructed and operated with great enthusiasm, they are absorbed in preparations for upcoming satellite launches.

The condition of this center, located half way up the Chinling mountain range and protected by a fair-sized garrison of the Liberation Army, appears to show the importance and great expectations attached by China to space.

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