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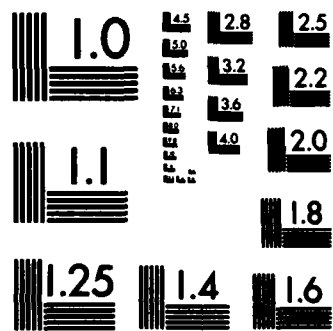
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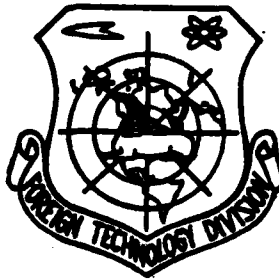
FOREIGN TECHNOLOGY DIVISION



THE OCEANGOING SPACE SURVEY SHIP, THE "WANG YUAN"

by

W. Jinzhong



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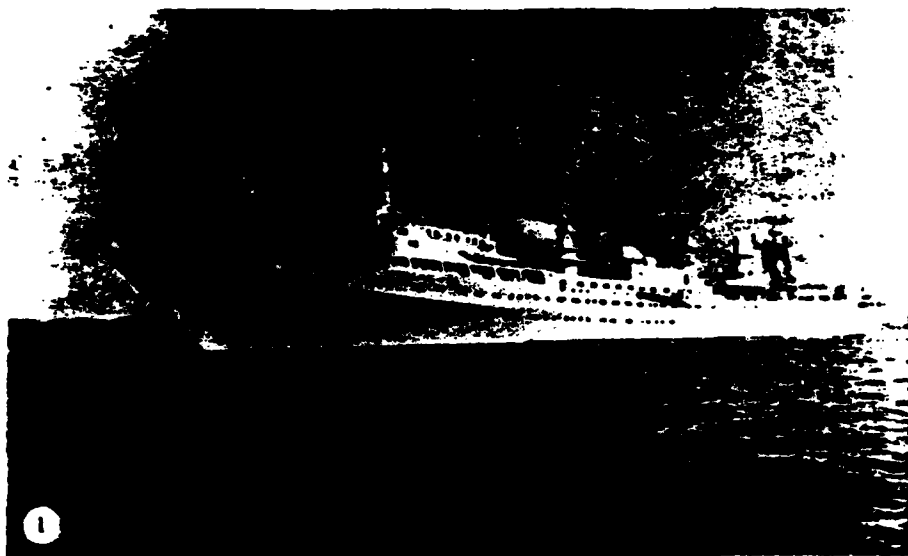


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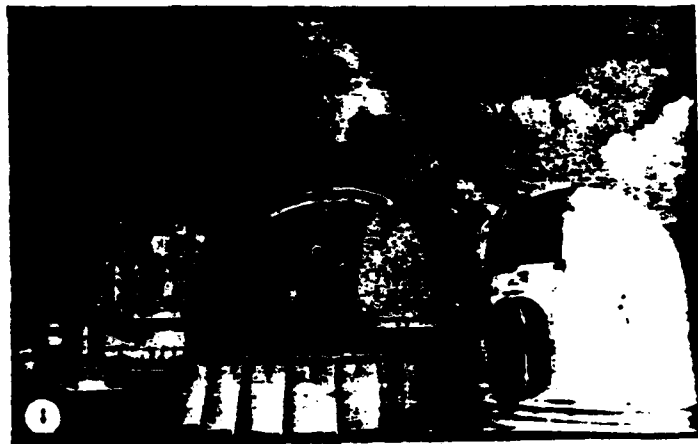
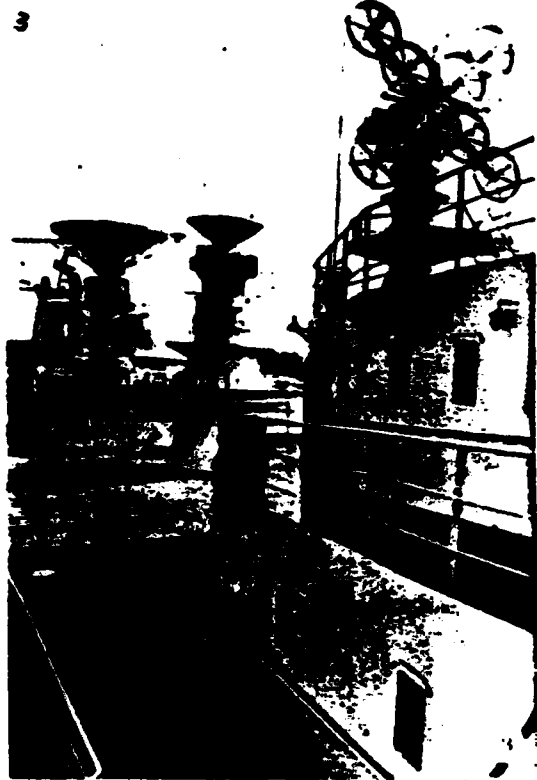
The Oceangoing Space Survey Ship - the "WANG YUAN"

Wan Jonzhong

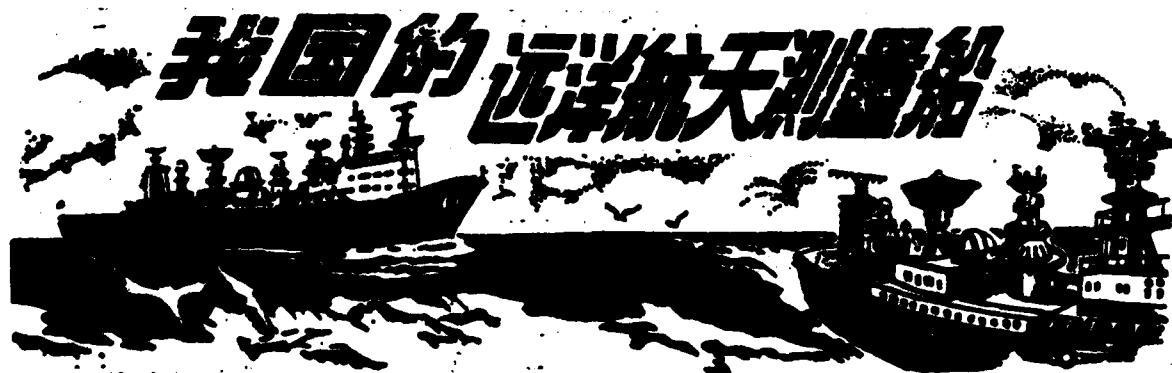
- 1) The entire view of the oceangoing space survey ship - the "Wang Yuan" (Photographed by Chen Zhonghua)
- 2) "Wang Yuan" - the oceangoing space survey ship on the South Pacific (Photographed by Deng Junzhao)



- 3) The vessel is full of antennas (Photographed by Chen Zhonghua)
4) Technicians are maintaining the optical theodolite (Photographed by Chen Zhonghua)



Our Own Oceangoing Space Survey Ship



OUR OWN OCEANGOING SPACE SURVEY SHIP

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Written by Wan Jinzhong - Plotted by Zhang Bozhi

The fall of last year was the season in which our space technology obtained consecutive "crops." In September, the twelfth scientific experimental satellite was successfully launched and recovered. In October, a carrier missile was successfully launched under water from a submarine. The head section accurately splashed in the pre-determined sea region. During the days when good news kept on coming, I was very proud to visit the oceangoing space survey ship which carries out the duties of tracking and surveying the satellites and the missiles.

During the day, I was riding on a high speed gun boat going towards the huge East Sea. Layers and layers of waves were generated by the bow. My mind was also agitated just like the waves: What does an oceangoing space survey ship look like? What are its functions and characteristics? How does it realize the complex technology of space survey? As I was thinking with my head hanging low, the famous ship building Chief Engineer in our country who accompanied me, patted my shoulder and said, "Look, that is the oceangoing space survey ship."

THE "SCIENCE CITY" FLOATING ON THE SEA

As I raised my head and looked, a milky white huge ship was sitting on the thousands of acres of waves. It looked like a small town floating on the sea. As the gun boat approached closer, I clearly saw the red five star flag hanging on the mast rising to the sky. On the bow which rose up high, two characters "WANG YUAN" have been gracefully written on it. There were rows and rows of portholes from the freeboard above the water all the way to the mast tower. The most attracting feature was the antennas standing like a forest. Some of them looked like a huge bowl. Some looked like a plum flow in full bloom. Some of them looked like a long whip. Some looked like a wooden xylophone which was able to play beautiful music. The center of the ship had a huge "dome." It looked like the planetarium in Beijing. As I was looking around, the gun boat had already stopped next to the side of the "Wang Yuan."

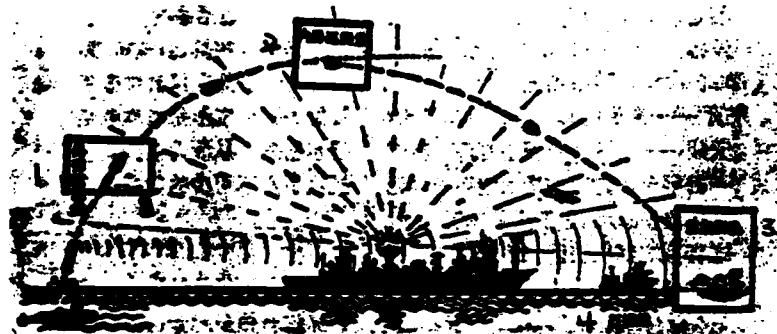
Under the lead of the Chief Engineer, I walked towards the tall control cabin along the semi-circular starcase. As we walked, I listened to his introduction that the "Wang Yuan" was an ocean-going space survey ship built by our workers and technical personnel in the late seventies. A space survey ship is also called a missile target survey ship or a satellite tracking survey ship abroad. Its mission is to track and measure the flight trajectory of a carrier missile and to observe and remotely control the operating orbit of a satellite. The total length of the "Wang Yuan" is more than one hundred ninety meters. It is over twenty meters wide. The full load displacement is more than twenty thousand tons. The maximum cruising speed is twenty knots. This survey vessel realized the state-of-the-art technological accomplishments. Its space corresponds to the total area of several multi-story buildings. The amounts of fuel and fresh water stored are more than enough to cruise around the world once. The electric power it uses is enough for the ordinary everyday use of a city with a population of several hundred thousand. The survey equipment it owns can "arm" over a dozen ground survey stations and offices ... People call it as the "Scientific City on the Sea." It is not exaggerating at all.

"NOT MOVING IN THE WIND AND RAIN LIKE A MOUNTAIN"

"Then, how does the space survey ship observe the missiles flying in the sky, and the satellites and spaceships in the space?" With regard to this urgent question of mine, the Chief Engineer did not answer directly. Instead, he first introduced the major duties of the space survey job. He said that space survey had an important position in the launching of satellites and testing of missiles because the various parameters observed at the time had extremely important effects on the analysis of the flight trajectory, the determination of the accuracy, the remote control and retrieval, and the study of the quality of the satellites and missiles. The space survey mainly includes the measurement of the external ballistics, which relies on optical and electronic equipment to observe the physical phenomena such as the flight state of the missile or satellite and the motion trajectory; the measurement of

the internal ballistics, which relies on means such as radio telemetry or retrieval to obtain the recorded data of the internal working status inside the missile or satellite during the flight; and the measurement of the dropping point, which is to determine the accurate coordinates of the dropping point of a missile or the retrieval of a satellite. In addition, there are other ancillary measurements. The "Wang Yuan" is an oceangoing giant vessel equipped with almost all the equipment necessary to survey the space.

Figure 1. Tracking and Surveying the Motion of a Carrier Missile.
1. External Ballistics Measurement; 2. Internal Ballistics Measurement; 3. Dropping Point Measurement; 4. Salvage Vessel.

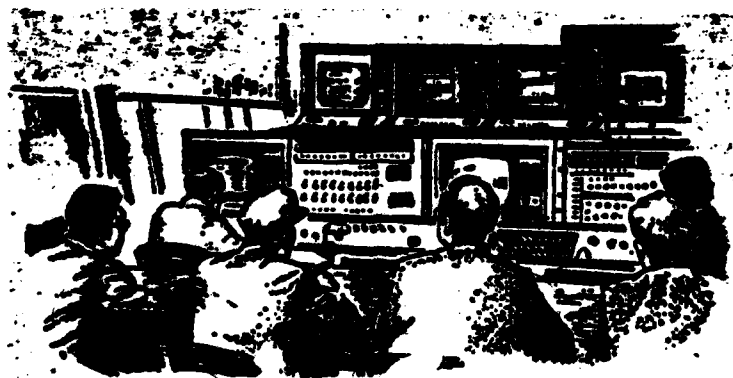


The Chief Engineer then told me that as a space survey ship, the first fundamental requirement is that it should "operate with stability," because the satellites and missiles under observation are very far away and the speed of motion is especially fast. Under the influence of the wind and wave, a slight rowing of the vessel may affect the accuracy of the observation. Targets may even be lost. In order to "move with stability," the "Wang Yuan" was built to be wide and large. This type of vessel itself has very good stability. Under the normal wind and wave, people would not feel anything onboard. /2

As we arrived in front of a control panel, the Chief Engineer said that the "Wang Yuan" was installed with two pairs of anti-rowing fins below its water line. The function is similar to

the fins of a fish. If high wind and heavy sea are encountered, the row-resistant fins are placed into operation by the control panel. An electronic computer is used to control the two pairs of fins to move to the opposite direction of the waves according to the frequency of the incoming waves. Thus, a stability moment in the opposite direction of the rowing direction is generated. Consequently, the extent of rowing of the ship is greatly reduced. As the Chief Engineer explained, he also motioned with his hands. He led me walking out of the control cabin and we stood on the highest deck. The entire view of the survey vessel was under our eyes. He followed up by saying that even though, it had not yet reached the stability requirement for a space survey vessel. Therefore, the various pieces of measuring equipment, such as the largest bowl shaped antenna - the single pulse precision tracking radar, the huge "dome" - the laser movie theodolite, and the plum flow shaped antenna - the telemetric receiving equipment, etc., have their own platform or servo balancing system. No matter how large the wind and wave are, and no matter how the vessel rows, these systems can maintain the huge antennas and lenses stable so that they are accurately aimed at the targets to be observed. This is truly "stationary in the wind and rain just like a mountain."

Figure 2. The Workers are Monitoring the Central Computer.



GUIDANCE AND LOCATION ARE ACCURATE AND FAST

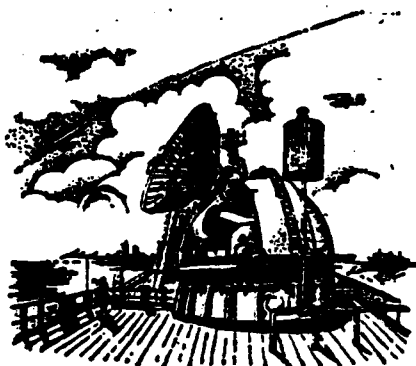
As we were talking, we walked in front of the guidance instrument cabin. I could see that it not only had the various navigation equipment necessary for a modern ship, but also had a number of pieces of special guidance and location equipment to be used in space measurements. The Chief Engineer said that, as a space survey ship, the second basic requirement is to "measure accurately." In order to attain this point, in addition to the extremely high accuracies of the various measuring instruments, the most important thing is to determine the accurate position of the vessel in the open ocean. This is quite different from being on land because the measuring point is fixed on land. Its position is relatively easier to determine. However, it is different on the sea. A ship can only keep on sailing in the ocean. It is very difficult to locate a fixed target as a reference. The error is very large using the ordinary navigation and location instrument. If the position of the ship is not clear, the entire measured data cannot be used. The navigation and location equipment onboard the "Wang Yuan" includes the astronomical guidance, satellite guidance, radio guidance, and inertia guidance systems. It is a very complete system. Using this system, it is possible to determine the coordinates of the survey ship at any instance on earth, including the longitude, the latitude, the course, the speed, the sway, and the yaw. Even the slightest plastic deformation of the survey vessel in the wind and wave can be accurately displayed. Consequently, it provides the necessary data for the space survey.

THE WELL-INFORMED EAR WHICH CAN'T BE INTERFERED WITH

As we came out of the guidance instrument cabin, we walked across an internal corridor of over one hundred meters long to enter the communications room. People always like to compare electronic communication as the "well-informed person in the Chinese novel who had a pair of sharp ears." The "sensitive ears" placed in the room include various domestically made receivers, transmitters, a coding machine, and a data transmitter. The parts used to form the instruments are mostly over a person high. However, some of

the small components can only be examined under the microscope to clearly see the "circuits." The Chief Engineer stood in front of the main control desk and introduced that, as a space survey vessel, the third basic requirement is to "be able to communicate." Because without communications, the space survey equipment becomes "deaf." The functions of command and guidance, as well as the transfer and operation of measured data are lost. The communications onboard the "Wang Yuan" not only include ship to shore contact, but also sea to air and sea to sea communications. It not only has short wave, ultra short wave, and microwave, but also has medium wave communications. It not only has the conventional command communications, but also the high quality data transmission. The various communications means and equipment are concentrated onboard of the same ship. They are used simultaneously. When they are operated, they are not susceptible to external interference. Furthermore, they are not interfering with one another. Moreover, they do not interfere with other measuring equipment. This is a complicated system engineering job.

Figure 3. Near the Drop-Off Point



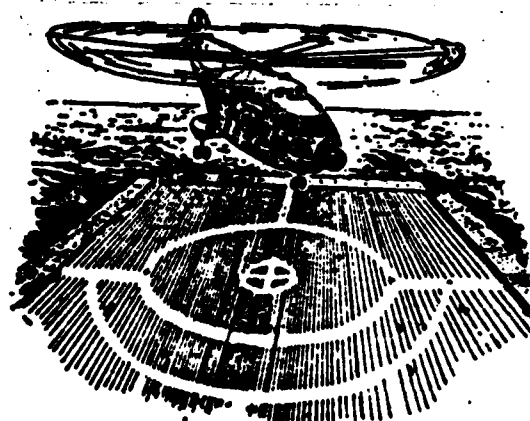
THE "COMPUTER" CONTROLS EVERYTHING

Afterwards, the Chief Engineer took me to the central computer room. He said that, as a space survey ship, the fourth basic requirement is "to calculate fast." From the navigation equipment to the power system, from the measuring equipment to the

communications system, the "Wang Yuan" has thousands and thousands of pieces of instruments and equipment to work accurately in the correct order without making any mistakes. It is impossible to operate it manually. Hence, it is necessary to use various electronic computers to control it. We may say that the "Wang Yuan" survey ship is a world of electronic computers. "Computers" are in charge of everything. The central computer we visited is one of the fastest large electronic computers in our country. It acts as the "brain" of the entire ship, which controls all the coordinating work among the instruments. As I changed into a pair of slippers and wore a white coat to walk into the central machine room, the first thing entering my eyes was the neatly arranged array of clean bins of hardware. Switches, buttons, red lights, and green lights are all over the machine. The technicians can monitor the various working states of the computer sitting in front of the television screen. The Chief Engineer told me that when it is executing the measurements, millions of pieces of information pass through the central computer in each second. On one hand, it drives all the measuring instruments to capture and track down the target. On the other hand, the observed results are recorded on magnetic tapes, punched on paper tapes, displayed on fluorescent screens and automatic recording apparatus. In the meantime, various kinds of data is transmitted back to the command post on land on a real time basis. Of course, these outstanding functions of the electronic computer are not "natural." It works according to the program compiled by people ahead of time.

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Figure 4. A Helicopter is Landing.



THERE ARE MANY ANCILLARY MEASUREMENTS

The Chief Engineer finally led me to the rear deck on the flight platform for helicopters to lift off and land. "As an oceangoing space survey ship, there are many ancillary measuring means and installations," he said as he pointed at the spirally shaped satellite cloud pattern receiving antenna and the circularly shaped weather radar antenna. He said that the weather observation equipment is approximately equivalent to a medium size weather station on land. It is capable of receiving the weather information transmitted from the shore, the weather patterns sent back by the satellites, and the meteorological plots distributed by various countries. In addition, it has an anemometer and a thermometer screen. It is able to launch exploration balloons at any time. Therefore, it is possible to accurately make short and intermediate term weather forecasts. In addition, the hydrological measurement instruments onboard are more or less the same as those on a small ocean survey vessel. It is possible to measure the depth, wave height, and sea current in the region at any moment. Furthermore, there is a unified service system, which controls the standard time on the entire ship. It is maintained synchronized with the standardized time on land. The accuracy of the time signal transmitted will not miss one second in three thousand years. After pausing for a moment, the Chief Engineer talked as if he was making a conclusion that "based on the information we have on hand, the survey vessels in the world are usually built with a single mission such as a communications vessel, a telemetric vessel, an electronic survey vessel, etc. A large scale comprehensive space survey vessel such as the "Wang Yuan" can only be built by a few countries in the world which are industrially advanced and technologically developed."

The completion of the space survey ship the "Wang Yuan" is really the crystallization of the wisdom of the Chinese people. It is really pride of the Chinese nation. I left the red long stairs with the feeling of hard to depart. The gunboat gradually moved away. The swanlike outlook of the survey ship gradually disappeared. However, the two letters "Wang Yuan" on the bow became ever clearer. This was the handwriting of Comrade Mao Tsetung.

The hope of the elder generation and the objectives of the new generation are realized on the lovely soil of this great land. I cannot stop thinking that, "Isn't the ship of our Socialist modernization sailing towards the infinitely beautiful future?"

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