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Reports on visits made to China in 1981

by J.A. Ewing and S. Rusby

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September 1981

NATURAL ENVIRONMENT RESEARCH COUNCIL
INSTITUTE OF OCEANOGRAPHIC SCIENCES

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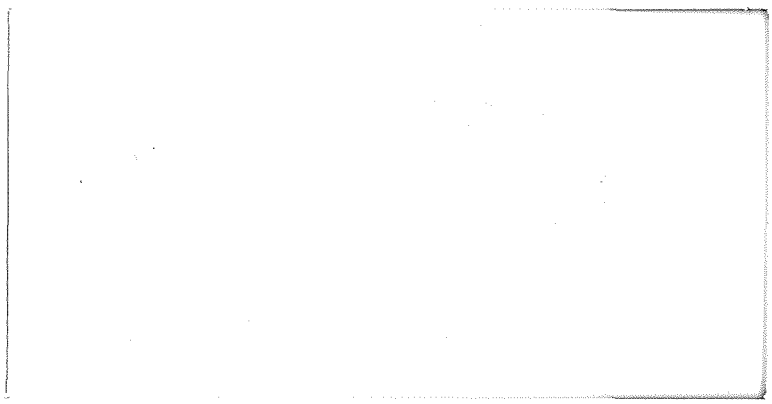

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During the summer of 1981 J.A. Ewing and S. Rusby were independently invited to visit China. These reports of their visits were made to the Director, IOS, who asked that the information contained should be filed as an Internal Report.

REPORT ON A VISIT TO CHINA: 17 JUNE - 2 JULY 1981

J.A. EWING

My visit to the People's Republic of China was arranged by Mr. Zeng Rong, Director of the First Institute of Oceanography in Qingdao. All my hotel and travelling expenses within China were generously met by the National Bureau of Oceanography, of which the First Institute is a component body. Mr. Pu, a visiting scientist (from Qingdao) at IOS, Wormley, had informed his Director that I would be in Hong Kong en route from South Korea, where I had a UNESCO contract to advise KORDI on certain wave matters. It was through Mr. Pu's initiative that I was invited to visit China.

I entered China by train from Hong Kong and arrived at Guangzhou (formerly known as Canton) station where I was met by Mr. Zhang Shumao. Mr. Zhang is an interpreter with the First Institute and he accompanied me throughout my stay in China. His English was excellent and he was furthermore a most helpful and pleasant companion. Customs and immigration formalities presented no problems and I was immediately taken to the airport at Guangzhou for a flight (by Trident aircraft) to Shanghai. I spent one day looking around Shanghai. The city had changed considerably from what I remember as a boy shortly after the war.

My interpreter and I travelled by train from Shanghai on the evening of 18 June and we arrived at Qingdao twenty-four hours later. That evening I was entertained by Director Zeng to a splendid dinner in the Huiquan Hotel, where I stayed during my visit to Qingdao.

The following day, I was shown around the Shandong College of Oceanography by Prof. Wen. This is a large teaching college, (established in 1952) with departments in Marine engineering, Mathematics and Physics, Physical Oceanography, Marine Geology and Biology, Fisheries and Chemistry. There are 1000 undergraduate sutdents and a large staff at this college. I was shown a film and then taken round some of the laboratories. A large outdoor wave tank with facilities for testing models of offshore structures was demonstrated to me by Prof. Hou. Most of the instrumentation was about 20 years behind present-day equipment available in the West.

Later that day, I was taken to the Institute of Oceanology and shown round by the Deputy-Director of the Division of Physical Oceanography, Mr. Guan. This is a multi-disciplinary institute operating under the Chinese Academy of Sciences. The total staff numbers about 500. It has a number of departments for Physical Oceanography, Marine Geology, Marine Biology, Marine Zoology and Marine Chemistry. In Physical Oceanography, most work was concerned with ocean circulation and air-sea interaction in shallow seas. The Institute has an excellent library with most of the well-known western journals and the collected reprints of major institutes like IOS. I was impressed by the calibre of staff at this Institute and their work on physical oceanography. Some modelling work was carried out on computers in Beijing (formerly known as Peking) as their in-house computer was not large or fast enough.

Finally, on my first day in Qingdao, I was shown round the First Institute of Oceanography by the Deputy-Director Mr. Chen. The Institute was established in 1964 and has about 300 research workers. It has a number of divisions in Marine Hydrology, Marine Meteorology, Marine Geology, Marine Physics, Marine Biology and Marine Chemistry. In addition, there is a Service Division for instrumentation and computing and a group concerned with Marine Information and Data. The emphasis of the Institute is on practical applications of oceanography to problems arising in the Yellow Sea and East China Sea. Work is sponsored by the Bureau of Oceanography and also local government agencies. Due to the cultural revolution (from about 1966-1976) real work has only been done since about 1977. I was shown round the instrumentation laboratory for wave studies. The Institute has developed a large wave staff, operating on the principle of discrete contacts shorted by the water, to measure waves in harbours and near the coasts. A pressure recorder for measuring waves was shown to me; it had an internal recording system within a sphere, with a one-week capacity for recording measurements. Upward-looking acoustic sounders were also used for nearshore work. Finally, I had a demonstration of real-time data acquisition using a Datawell waverider buoy located four miles offshore. Although a number of different instruments were available for use in this laboratory, there did not appear to be any work in progress to intercompare the measurements obtained from different instruments. Wave directional information was

estimated visually at nearshore positions, using powerful binoculars to site the alignment of wave crests.

Director Zeng asked me to give a series of talks on waves as a number of scientists in the Shandong College, the Institute of Oceanology of the Academy of Sciences and his own Institute were interested in hearing about recent work on waves. I gave seven seminars, starting on 21 June and spread over 6 days. The talks were concluded by a meeting for general discussion.

1. Outline of the work of IOS.
   Sea waves as a random process.
   Wave statistics and wave spectra.
2. Wave measurement techniques I (Non-directional).
3. The Joint North Sea Wave Project.
4. The energy balance equation and its use in numerical wave prediction.
5. Practical applications of numerical wave modelling with special reference to the estimation of extreme wave heights.
6. Wave measurement techniques II (Directional wave spectra).
7. Observations of wind-waves and swell at South Uist.
8. General discussion.

My talks, which, of course, had to be translated into Chinese, usually took about two hours. After a suitable interval, the meeting resumed and I received many questions from the audience who were especially interested in wave modelling and wave measurement systems. Chinese scientists were also glad to have an account of the Joint North Sea Wave Project (JONSWAP). A number of questions were asked about wave modelling in shallow water and on the dissipative mechanisms which occur under different conditions of the sea bed. My talks were recorded and I was asked for copies of all my slides.

At the final discussion session on 27 June, I was asked a number of questions on the future areas for wave research. I was also asked to comment critically on the programmes of work being carried out in Qingdao. Altogether, Chinese scientists are keen to learn about wave work in the West and how they can best contribute to the development of the subject.

I left Qingdao on 28 June for Beijing. There I met Mr. Liu of the Bureau of Oceanography and gave him my impressions of the work being carried out in Qingdao in waves. The Bureau very kindly

arranged for me to see the famous sights for which Beijing is famous and I returned by direct flight to London on 2 July.

CONCLUSIONS

Oceanography in China is ten to twenty years behind comparable work in the West. The main reasons for this appear to be:-

(a) Few Chinese scientists can converse in English or are able to fully comprehend articles published in western oceanographic journals. Due to the Cultural Revolution, there is a ten-year gap during which little useful work was done. However, with the teaching of English as a first language in the schools, it is likely that this deficiency can be made good in the future. Meanwhile, a number of able Chinese oceanographers are being sent abroad to improve their English and their knowledge of oceanography

(b) Instrumentation is generally very backward. Foreign currency is difficult to obtain for purchasing instruments from the West.

(c) Computers are scarce and, when available, are generally inadequate for modelling purposes.

I was made most welcome by all the people I met. Chinese scientists are very keen to learn about western work in oceanography and to exchange ideas and information; they would welcome further visits from IOS staff.

REPORT ON A VISIT TO CHINA - 3 JULY TO 18 JULY 1981

STUART RUSBY

Following the visit of the Chinese scientific delegation to IOS in June 1979 which was sponsored by the Royal Society and Academia Sinica, I kept in contact with Professor Ye Longfei of that delegation who was particularly interested in data buoy technology. In January 1981 Professor Ye, who is in charge of the New Technology Group at the South China Sea Institute of Oceanology at Kwangchow (Canton), invited me to make a visit to his and other Institutes in China to discuss data buoy technology, GLORIA and also new instrumentation. This was later agreed on the basis that China would pay my internal travelling and expenses and IOS the fare to, and expenses in, Hong Kong. Academia Sinica, in conjunction with the Royal Society, organised my visa and internal travel arrangements.

Due to delays in getting the visa on my arrival in Hong Kong, I did not enter China until the 3 July, when I arrived by train in Kwangchow from Hong Kong. During the subsequent two weeks I had the opportunity to visit a number of Institutes and speak with many people concerned with marine instrumentation and oceanography. This note attempts to summarise what I learnt from the visits made to the different centres.

When reading this report it should be borne in mind that China made good progress in modernisation from the Liberation in 1951 until 1966, the start of the 'Cultural Revolution', and then all scientific and cultural activities effectively ceased for 10 years until 1976. Many scientists were imprisoned and some died. It was clear that such damage cannot quickly be repaired.

SOUTH CHINA SEA INSTITUTE OF OCEANOLOGY, ACADEMIA SINICA, KWANGCHOW

This is the main centre for oceanography in South China and is particularly responsible for the South China Sea. The Sea is an enclosed deep oceanic basin with a maximum depth of 5500 metres bounded by an extensive Continental shelf to the north and west and by islands to the south and east, including the Phillipines. It includes ecology of the sub-tropical and tropical varieties.

The Institute was founded in 1959 and has a total staff of about 700, of whom 350 are scientifically trained. It runs three research vessels:

'Experiment No. 1' 1800T Ex-cargo built 1965 - Multidisciplinary

'Experiment No. 2' 1100T Purpose-built 1980 - Geophysics

'Experiment No. 3' 3000T Modified passenger vessel - built 1980 - Multidisciplinary

and I had the opportunity to see over No. 2 (see below).

The Groups and senior research staff are as follows (underlined names are family names):

Director - Zhan Chang

Scientific Secretary - Xu Bingzheng

GROUPS

1.	Tectonics	Xia Kanyuan, Liu Zhaoshu
2.	Sedimentation	Wang Wenyuan, Su Guangqing
3.	Estuaries and Coastal Oceanography	Huang Jinsen, Song Zhaojing
4.	Marine Biology	Chen Qingzhao, Zou Renlin
5.	Marine Applied Physics	Zhong Qijing, Tan Xianming
6.	Marine Chemistry	Ho Yueqiang, Cheng Jianlu
7.	New Technology	Ye Longfei
8.	Analysis	Wang Lichun
9.	Information Service Library	Liang Yuanbo
10.	Meteorology and Hydrology (Physical Oceanography)	Guo Zhongxin, Chen Junchang, Zhang Qingrong

In addition the Institute has three out-stations at

Swatow	- Marine plants and algae (East of Kwangdung Province)
Zhanjiang	- Marine animals (West of Kwangdung Province)
Hainan Island	- Tropical Activities (In South China Sea)

During my four days at Kwangchow I had the opportunity to see most of the above groups, and gave three lectures. One half-day was spent answering questions from a number of research staff selected from the different groups, mainly on the subject of my lectures on DBl, GLORIA and marine instrumentation. They were

very anxious to learn all they could, and considering the cultural Revolution only ended in 1976, they have done well in the intervening five years. After hearing their questions, and seeing some of the work they are doing, and visiting the research ship 'Experiment No. 2', I got the impression that the interest and enthusiasm is there but they still lack experience in science, in engineering and instrumentation and in the practicalities of sea-going. The Government has provided three ships plus, for instance, full sat-nav facilities, but they still seem very short of the right equipment to put in the vessels, including good handling gear and marine instrumentation.

I spent some time discussing the marine geophysics work of the South China Sea Institute with Xia Kanyuan, who was in the group that visited IOS in 1979 under the auspices of the Royal Society. They are developing an OBS system with the help of the Institutes of Acoustics and Geophysics, Beijing (Peking), which they hope to test further in the Spring of 1982. I suggested he got in touch with Dr. Francis on this, and Dr. Whitmarsh on PUBS. They are hoping to buy, later this year, reflection seismic gear from the USA, including air guns from Bolt and possibly a low-frequency hydrophone array and a TIMAP processing computer from Texas Instruments. A higher frequency array is already manufactured by a company in Shanghai. (China has a number of suppliers of PZT, including a local supplier at Foshan near Kwangchow, famous for its ceramics for a thousand years!). Mr. Xia hopes to start a program next year to investigate the deep structure of the South China Sea Basin and Margin, including gravitation and magnetic surveys (China makes both the necessary instruments, but I get the impression the sensitivity is poor).

I spent a short time discussing their Continental programme with Mr. Huang Jinsen. They are anxious to get the use of a side-scan sonar as soon as possible to study drainage and sediment transport in the neighbourhood of the Pearl River Estuary, and to generally study the geomorphology of the Shelf in that area (see my visit to Institute of Technology below). Dr. Stride asked me to find out about such activities in China, and I have suggested to Mr. Huang that he gets in contact with Dr. Stride. I believe they would greatly value his presence or that of one of his colleagues when they carry out the first shelf survey

cruise near the Pearl River Estuary in order to give them the benefit of their experience in interpreting shelf sonographs. This could be a relatively cheap and cost-effective way of helping their sedimentologists while at the same time adding to our own experience in sediment transport studies (see also below on my Shanghai visit).

It was also clear that there was considerable interest in air-sea interaction and I was asked about our instrumentation in this field by Zhang Qingrong. He was particularly interested in air temperature and wind gradient sensors, and near-surface current shear measurements. I mentioned Dr. Collar's work and suggested he got in touch with Dr. Pollard on JASIN experimental procedures and results.

The Institute appeared poorly supplied with sea-going and laboratory equipment, and none of it seemed up to date by our standards. Perhaps the most impressive bit of technology shown to me was a satellite receiver geared to a picture recorder, both built in China. This was routinely used to get pictures transmitted by a Japanese stationary orbit satellite of the weather systems approaching China. Very high quality pictures were recorded and I was given one to keep.

SOUTH CHINA INSTITUTE OF TECHNOLOGY, KWANGCHOW

Members of Professor Xu Bing-Zheng's Electronic Engineering Department of the South China Institute of Technology had been present at my talk on GLORIA and I was later invited back to see round their Department by Professor Xu. The Institute is on the old site of Chungshan University (the main University in this southern part of China) and has 7000 students, including considerable post-graduate research work. In his Department they are doing some interesting work on correlator development, both polarity-coincidence circuits and multi-level digital systems controlled by microprocessors. One valuable piece of research I saw involved using a microprocessor to enhance the signal/noise of the 'Heath wave' from a patient's ECG trace by gating out the high level P and Z waves and integrating the remainder. The Department is strong in underwater acoustics and they have recently made a 290 kHz side-scan sonar with a beam width of

only 0.75° and I saw some excellent sonographs taken from surveys with this in the Pearl River. They have also completed a 30 kHz side-scan array using a number of ring transducers in a line backed by a 'fire-bar' reflector. I was impressed by Professor Xu and the research in his Department. It appeared to be well directed and the laboratory equipment at his disposal was adequate. Again, all their PZT ceramic was locally manufactured at Foshan. I strongly advised Professor Ye to give up the idea of buying HF side-scan equipment from Kelvin Hughes or Kline and look to Professor Xu on his own doorstep for what he required for the South China Sea Institute. I believe he will act on this advice.

SOCIETY OF OCEANOGRAPHY AND LIMNOLOGY, SHANGHAI

In Shanghai I was invited to give two lectures on GLORIA and Marine Instrumentation at the City Scientific Hall by the Shanghai Society of Oceanography and Limnology. The President is Professor Chen Jiyu, Director of the Institute of Coastal Studies and the Chairman of the meeting was Yang Qiluan of the Bureau of Marine Geology. Professor Chen and his Institute have worked with Dr. Sternberg of the University of Washington on sediment transport at the mouth of the Yangtze River using the research ship 'Oceanographer'.

Professor Ye said Professor Chen was sorry that he was not able to be at the meeting as he had expressed a wish to co-operate with the UK in these sediment transport investigations in order to benefit from our side-scan sonar and sediment transport experience. I did not have the opportunity to visit any Institutes in Shanghai, but I understood that a significant amount of seismic survey work in the East China Sea was being carried out under the auspices of the Ministry of Geology.

During an afternoon discussion session, I met Xu Chengxia of the Institute of Acoustics, Shanghai (Donghe Marine Station) who had just spent a year with Orhan Berktay at Bath and he asked me questions on the development of our high resolution reflection seismic equipment (2 kHz) and on transducer design generally. After his stay with Orhan Berktay I am sure it will not be long before China has a non-linear narrow beam echo-sounder and a similar profiler! From the discussion there was considerable interest in the pros and cons of different wave-measuring techniques, STD systems and geophysical equipment.

Shanghai is China's major industrial city with a population of some 12 million; Institutes in the area are well-placed to benefit from this potential. They include:

1. Donghe (East China Sea) Marine Station. A department of the Institute of Acoustics, Academia Sinica. Mainly concerned with underwater acoustics. About 200 total staff.
2. Bureau of Marine Geology, Ministry of Geology. Yang Qiluan, Deputy Engineer in Chief (Vice President of Shanghai Society of Oceanography and Limnology) Yuan Zhongwen, Engineer (Secretary of same Society). Total staff about 1000, including ships' crews, admin. staff etc. Concerned with geophysical survey work for the Government in the East China Sea.
3. Donghe (East China Sea) Institute of Fisheries.
4. Survey Brigade of Marine Sciences.
5. First Brigade of Marine Sciences.

SHANDONG INSTITUTE OF MARINE INSTRUMENTATION (QINGDAO)

I spent some four days in Qingdao where my very hospitable hosts were members of the Shandong Institute of Marine Instrumentation. The port of Qingdao (sometimes spelt Tsingtao) with a population of about 1 million lies in Shandong Province, and has a number of marine institutes and laboratories. I had the opportunity to see round two departments of the Shandong Institute, concerned with the development of an STD and an ocean data buoy respectively. They had designed and constructed a portable STD with limited conductivity and temperature accuracy, somewhat analogous to the NBA Controls instrument. On the data buoy side, they completed a 10-metre discus buoy in 1979 and moored it in the entrance to the Yangtze River. This appeared to have had mooring problems and was withdrawn, and it seems now that they are about to put it back there after certain modifications have been made. Their interest in data buoy technology, and their concern for reliability, which has so far eluded them, was very clear throughout my stay and the discussions we had.

The Institute was founded in 1966 (a difficult year since the 'Cultural Revolution' started then) and now has a total staff of about 400. The people I met included:

Gu Jingshi)
Chen Beile) Assistant Directors
Wang Jingtian - Deputy Head, Data Buoy Laboratory
Cao Hongyang - Engineer, Data Buoy Laboratory.

Such an Institute is necessary (see also Tianjin below) since there are no manufacturing firms as such in China; these Institutes do the development, metrology and manufacturing and provide the Academia Sinica and Bureau of Oceanography with guidance on instrument standardisation.

INSTITUTE OF OCEANOLOGY, ACADEMIA SINICA (QINGDAO)

I spent half a day looking round this Institute in Qingdao, one of two in the city (the other comes under the control of the Bureau of Oceanography, see below). I was welcomed by Professor Mao Hanli, the Assistant Director, who gave me a summary of the Institute's history. It is a multidisciplinary Institute founded in 1959, but based on an older foundation concerned entirely with biology. It has a total staff of about 1000, including ships' crews and administrative staff (there is a very much higher ratio of admin. to scientific staff in China than in the UK). Like all such establishments, Professor Chen said that the Institute suffered great damage during the 10 years of the Cultural Revolution so that only now is it being strengthened again by newly qualified staff. He said as a result there is a complete gap in scientific staff in the important age-group from 30 to 40 years of age. (He had enjoyed meeting with Sir George Deacon recently at the Miami Conference on the remote sensing of waves).

The Director of this major Institute is Professor Tseng (Zeng) Chengkui. I have looked through the last three numbers of the Proceedings of Oceanography and Limnology, which largely publishes the Institute's output (now in the IOS Library) and about 70% of the papers are biological, the remainder being made up of papers on land or coastal geology, tidal theory, sediment transport and wave theory. There is one paper on the interpretation of Landsat

images of the Yellow Sea close to the coast. There do not appear to be any geophysics papers. Certainly the Institute seemed rather better equipped than the others I had seen. I saw a new Hitachi electron microscope which reportedly cost about £100K, and there was no lack of up to date Japanese and American test equipment in the laboratories, including a fine suite of Bruel and Kjaer laboratory acoustic instruments from Denmark, which is not cheap. They were developing a so-called 'stabilised' accelerometer sensor to measure waves (as per 'Waverider'), but I couldn't see the rationale behind it as they admitted the gymbal system had a natural period of 7 seconds. I was shown a 3 cm radar test rig for wave measurement which was about to be placed on a test platform; it certainly looked a useful piece of development. Like the South China Sea Institute, and Shandong Institute of Marine Instrumentation, they too were in the large data buoy business. They have made model studies of a discus buoy of about 8 metre-diameter which could be a successor to the Kwangchow buoy. Certainly the data buoy scene is a little confused at the moment and I understand there is to be a meeting in Qingdao in September to resolve the apparent triplication of effort. However, it does appear that China is very committed to the subject, mainly for the advance warning of Typhoons and offshore weather systems generally. The significant weather, like ours, is predominantly maritime.

There are a number of other Institutes in Qingdao concerned with the sea, including the:

First Institute of National Bureau of Oceanography, Director Zen Rong. Founded 1966. Multidisciplinary, but strong on physical oceanography. Total staff about 500.

Yellow Sea Institute of Fisheries. Director Lin Renchang.

Shandong College of Oceanography. The only such college in China training students directly in the various disciplines of oceanography. About 2000 students and 500 teaching staff.

Institute of Marine Geology, Ministry of Geology. Carries out geological and geophysical surveying of the Yellow Sea, including seismic work. (The East China and Yellow Seas are shelf seas, unlike the South China Sea which has a central deep basin). Founded 1978, about 200 staff.

Lest there be any confusion, I questioned a number of Chinese colleagues on the Chinese use of the titles 'oceanology' and 'oceanography'. They agreed their use of the terms was more akin to that of the Russians and French i.e. that 'Oceanology' referred to the science of the oceans whilst 'Oceanography' was more concerned with surveying, bathymetry, charts and 'techniques'. However, they also agreed that the distinction was not always evident.

During my stay in Qingdao I gave three lectures, on DBI, GLORIA and marine instrumentation. These were given in the hotel in which I stayed and were attended by about 200 people on each occasion. Half a day was devoted to discussion with a limited number of people, about 40, representing the major institutes in the city. The questions came thick and fast, and the majority were concerned with data buoy technology. There were also knowledgeable questions on GLORIA, particularly the signal processing, and considerable interest in Batfish and the IOS acoustic command and telemetry system. Again, I was able to give some contacts (poor IOS!) and distribute a few relevant papers.

INSTITUTE OF OCEANOGRAPHIC INSTRUMENTATION, TIANJIN (TIENTSIN), NATIONAL BUREAU OF OCEANOGRAPHY

I spent two days in Tianjin (Tientsin), the third largest city in China, at the Institute of Oceanographic Instrumentation which is the major such Institute in China. Like the Qingdao Institute, it is responsible for developing marine instrumentation for scientific research, marine surveying and environmental monitoring. It is also responsible for the metrology and standardisation of such instrumentation in China. There is a total staff of 680 with 290 involved in research. Some of the senior staff include:

Mr. Qian Zhihong - Director
Mr. Li Yunwu - Assistant Director and Engineer-in-Chief
Ms. Zhang Zhane - Deputy Head, STD.

The Institute is divided into six groups:

1. Optical Applications. Develops airbourne marine and underwater instruments using optical and microwave radiation techniques.
2. Acoustic Applications. Responsible for marine instrumentation using acoustic techniques.
3. Electromagnetic Applications. Responsible for developing an STD system and electromagnetic current meters.
4. Mechanical Structures. Designs mechanical instruments, pressure cases etc., and is concerned with corrosion and fouling.
5. Computer Applications. Concerned with data processing in situ and computer and terminal devices required for surveying.
6. Oceanographic Measurements Technology. Studies the technology and methods of marine surveying.

The Institute also has a metrology and standardisation group and I was shown their pressure and temperature-controlled tanks. Many of the above groups are small by our standards and their output may be limited, but on the whole I was rather impressed with their efforts. I was taken round and shown the following instruments which they had developed:

1. An airbourne infrared sea-surface thermometer which had taken 7 years to develop. It uses a thermistor sensor behind a germanium lens system to give a 2^{o} beam. It can be flown at a height of 300-3000 metres and has an accuracy of $\pm 0.2^{o}C$ in the range -2 to $35^{o}C$. Fully developed, and in production.
2. A ship-mounted acoustic doppler log/current meter for use in depths up to 200 metres and speeds up to 6 knots. 4 ms pulses at 200 kHz are transmitted simultaneously from four 100 mm diameter PZT discs mounted in an inverted bowl. They have successfully obtained current speeds from scattering layers when their depth has been < 100 metres.
3. Upward looking echo-sounder for wave measurement. 4^{o} beam at 200 kHz, and useful in depths from 5-40 metres. Fully developed and in production.
4. An STD for use to 1000 metres. Temperature from -2 to $32^{o}C$ with an accuracy of $\pm 0.05^{o}C$; salinity from 28-38‰ with an accuracy of ± 0.05‰; and depth to an accuracy of 0.5% of full scale reading.

5. Early stages in the development of an acoustic current meter, similar to that of Gytre at the Christian Michelsen Institute, Bergen. Uses the 'sing-around' principle at 1 MHz. Early days yet, I suggested they redesigned the acoustic probes and reflector to avoid 'shadowing'.
6. Boomerang corer. Uses their own glass spheres (not borosilicate glass), capable of withstanding a maximum pressure of 200 bar. A recovery radio is carried in one sphere. Fully developed. They would like to be able to obtain better quality glass.

The STD seemed a very useful bit of work, with its own small logger built in and with presentable sensor accuracies. Professor Ye has used it on the South China Sea data buoy and was very pleased with the results he obtained off Hainan Island. There seemed to be a good liaison between this important Institute and his home Institute in Kwangchow. (The Institute at Tianjin were not happy with the observed temperature performance of a number of InterOcean STD's imported to China from the States. In Qingdao I met two InterOcean service engineers who were trying to sort out the discrepancies).

I was impressed with the calibre of senior research staff. They were enthusiastic and concerned to have criticism of their work and to learn all they could about our activities in this field. During my two days' stay I gave my 'standard' three lectures on GLORIA, DBl and oceanographic instrumentation, and each was followed by a 1-2 hour discussion session - no lack of questions in each case. Again, their interest in data buoy technology was very evident. Apart from members of the Institute's staff, the lectures were also attended by research staff from the Ocean Engineering Department of the University of Tianjin and the Department of Radiotechnics and Acoustics of the University of Beijing (Peking).

CONCLUSIONS

The visits were well organised by Professor Ye and the Academia Sinica. I had the opportunity to see the instrumentation work of a number of the Institutes and during a tight schedule I gave some 12 lectures and had two full days of discussions.

The discussions were very valuable and lively, and were usually held in smaller, more informal, rooms than the lectures and were limited to about 40 people. All the lectures were recorded and all my slides copied - so I think they got their money's worth. I found the engineers and scientists I met very open and willing to learn from our experience and most friendly. Certainly overall staff numbers in the Institutes appear high but Chinese colleagues told me that there were many 'administrators' in the Institutes and Colleges of China. As I mentioned earlier, the effects of the 'Cultural Revolution' are very obvious - it is heart breaking to see the damage caused to research, education and people's aspirations and well-being by ten wasted years.

China has a great need for high quality reliable instrumentation if she is going to be able to conduct significant oceanographic and hydrographic research and survey work at sea. She has the research vessels but they are largely waiting for the right instruments. The purpose of my visit was not to act as a salesman for IOS equipment, but it soon became clear that there was interest in certain items. They were particularly taken with our acoustic command and telemetry system, with our development of batfish and with certain data buoy sensors. Because their industry is struggling to catch up the lost years, quality can suffer and this particularly applies to C-MOS circuitry. I think a lot of their problems in data buoy technology stem from this cause, where high quality components are essential. Whether they do come to us for some equipment will depend on decisions to be made, and on the availability of foreign currency. I personally would favour helping them if they do approach us, particularly on the acoustic command and telemetry side where I believe IOS has such a fine system which could be of very great value to China in marine physics, geophysics and biology. They are also interested in our many years' experience of side-scan sonar, and would value our help later in the interpretation of Shelf surveys, particularly near the Pearl and Yangtze Rivers.

Their committment to data buoys is considerable. At the moment they want to monitor the prevailing easterly weather systems, including tropical storms at this time of year, but later they may well require environmental data for offshore engineering in the South China Sea. I don't believe they will be successful in this very difficult field until their electronic industry has

improved the quality and reliability of components. I saw over the South China Sea buoy and found a couple of elementary errors in the use of aluminium and steel, and very poor glanding between electronic cases which may have been an additional cause of C-MOS component failure.

Professor Ye, and Mr. Xu - Scientific Secretary of the South China Sea Institute - accompanied me throughout the visits to Shanghai, Qingdao and Tianjin and were of great assistance. I was fortunate to have a fellow physicist as an interpreter who spoke English so fluently. We had some valuable discussions on our travels together.