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DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

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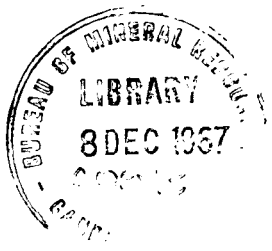

VISIT TO JAPAN

ELEVENTH
PACIFIC SCIENCE CONGRESS
1966

by

R.F. THYER

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SUMMARY

The Eleventh Pacivic Congress was held in the University of Tokyo from 22nd August to 4th September. The following week was devoted to Congress tours.

Over 2,000 overseas visitors attended the Congress and approximately 4,000 Japanese; about 2,000 papers were presented.

The remainder of the time (to 14th September) was used in visits to various mining companies, Government organizations and Universities.

INTRODUCTION

The purpose of the visit made to Japan on 15th August to 14th September, 1966, was to attend the Eleventh Pacific Science Congress as an official representative of the Bureau. The Chief Geologist, Dr. N.H. Fisher also attended the Congress in a private capacity.

The business of the Congress, including a post sessional tour, extended over the period 22nd August to 8th September. The remainder of the time was used in visits to various mining companies, Government organizations and Universities.

Notes on the Congress and on the more important of these visits is given below. A large number of publications and reprints was received during the visit and these have been lodged in the Bureau's Library.

ELEVENTH PACIFIC SCIENCE CONGRESS

The Eleventh Pacific Science Congress was held in the University of Tokyo from 22nd August to 4th September, and the following week was taken up with Congress tours. Over 2,000 overseas visitors attended the Congress and approximately 4,000 Japanese; about 2,000 papers were presented.

To cater for the vast field of science involved, proceedings of the Congress were divided into 12 Sections. Those of specific interest to the Bureau were Section II (Oceanography), Section III, (Geophysics) and Section IV, (Geology and Soil Science).

The programme for the first week of the Congress was devoted to Symposia on selected topics with invited papers and during the second week to Divisional meetings at which papers relating to chosen topics were presented. There were 60 Symposia held simultaneously covering the topics in the 12 Sections; (an average of 5 Symposia per Section). Symposium No. 10 concerned the "Upper Mantle Project in the Pacific Area" and Symposium No. 22 which dealt with "Pacific Arctic Science" contained many papers in Geophysics.

Symposium No. 23 dealt with "Mineralogenetic Provinces and Epochs in the Pacific Belt". I spent most of my time at Symposium No. 10 but attended papers at Symposia No. 22 and No. 23.

Divisional meetings were held during the second week and were sub-divided in the various Sections. In Section III there were two simultaneous sessions on "Solid Earth Geophysics"; one dealing with Geodesy and Seismology the other with "Geomagnetism, Geothermy and Volcanology and Geochemistry". There was of course a good deal of overlapping in the subject matter of the two sessions.

In Section IV (Geology), there were four simultaneous Divisional meetings on - (1) Major and Minor Geotectonics, (2) Palaeontology, (3) Petrology and (4) Sedimentology.

The proceedings, volume 13 (Guide Book) contained details of the programmes including titles of the papers presented. In addition there were separate volumes containing abstracts of papers for the respective Sections.

Those for Sections III and IV (Proceedings Volumes 3 and 4) have been lodged in the Library together with the Guide Book Volume 13.

There were many well known Geophysicists among the international visitors, including Bullard (U.S.), M. & G. Ewing (U.S.A.), Woollard (Hawaii), Bolt (U.S.A.), Hodgson (Canada), Vestine (U.S.A.), Vacquier (U.S.A.), Narain (India) and Beloussov (U.S.S.R.). In all fields there were very strong teams from the U.S.S.R. and the U.S.A.

It was interesting to note the very high regard with which Ringwood from Australia, was held by these international figures. He was obviously looked up as the international authority in his particular field of high pressure phase transformations in the mantle.

The papers given in Symposium No. 20 (Upper Mantle Project in the Pacific Area) were for the most part informative and well presented; all papers were presented and discussed in English.

They highlighted the considerable amount of geophysical work that has been done in the Northern Pacific Region, particularly by U.S.S.R., U.S.A. and Japan. On the surrounding land masses a great deal of work has been done on heat flow, crustal movement, earth tides and tilts, as well as deep refraction studies. By comparison, the picture in the Southern Pacific Region is not nearly so advanced although the U.S.A. (through Woollard, Ewing and the Scripps Institute) appear to have a fairly active forward programme.

A good deal of interest is centred around the Solomon Islands and the Coral Sea to the South West of the Solomons where, from satellite observations, there appears to be a large area of unusually high gravity anomaly over a deep ocean (4,000 meters). This has been confirmed in part by ship-board gravity observations carried out recently by the British Hydrographic vessel M.H.S. Dampier and by earlier results from R/V Argo (1960), H.M. Sub., Telemechus (1956), U.S. Subs., Bergall and Capitaine (1948-49).

Bouguer anomalies of the order of +400 mgls extending over large areas have been recorded. Bouguer anomalies are generally high over the Solomon Islands (in the order of +200 mgls). Deep reflection and refraction soundings are planned by Woollard's group in this area in the near future and Lamont (Ewing) are planning seismic reflection work in the Tasman Sea area early in 1967.

Many of the papers presented dealt with the problem of the transition zone from Oceanic to Continental type crust. A problem of special interest is the area in the centre of the Japan Sea with abnormal heat flow which appears to have a continental type crust.

Laudon of the University of Wisconsin, presented a paper which dealt with gravity measurements in the Solomons and New Britain. In Rabaul area there appears to be a Bouguer gravity high in the order of 100 mgls which occurs at the convergence of two high axes and which appear to coincide with lines of active volcanoes. Laudon's data is rather sparse however and this may be an area where the Bureau should do further work.

J. Milne presented a paper summarizing his recent studies of seismograph stations in S.E. Asia and Pacific Region and included a series of recommendations which will be indorporated in his report to S.E.A.T.O.

Under the chairmanship of Bruce Bolt (University of California) the Divisional meeting formed a sub-committee including myself to consider those recommendations and redraft them as a recommendation to the Pacific Science Council. This was done and they are included in the resolutions of Council. As far as Australia is concerned they included a recommendation that the attention of the B.M.R. be drawn to the desirability of a seismic station on Norfolk Island.

In presenting data on earth tides (mainly Japanese and Russian) the almost complete absence of data in the Southern Hemisphere was made abundantly clear. This is a field in which the Bureau should perhaps be making a substantial contribution to the international picture.

EXHIBITIONS ASSOCIATED WITH THE PACIFIC SCIENCE CONGRESS

Several exhibitions were held in conjunction with the Eleventh Pacific Science Congress and visits were made to those which had some relevance to our work.

These were:

1. Map exhibition held in the Library of the University of Tokyo at which maps were displayed representing 100 years of progress in mapping in Japan. A catalogue of exhibits has been handed to Publications and Information Section. A report on the preparation of Resources maps (prepared by the Geographical Survey Institute) has been handed to Water, Power & Geographics Branch.

2. An exhibition of instruments for oceanographic and fresh-water research held at the Hotel New Japan. It contained exhibits by 20 or more Japanese manufacturers and relevant catalogues were collected and passed on to the Geological Branch.

3. Exhibition of scientific instruments held in the Yasuda Hall of the University of Tokyo, organised by the Japan Scientific Instrument Association. Relevant catalogues and trade literature was collected and passed on to the Geophysical Branch.

4. Exhibition of scientific books held in the University of Tokyo Library. Catalogues of publications in English have been handed to the Publications and Information Section.

PACIFIC SCIENCE CONGRESS TOUR NO. 3 CHUBU

I took part in Tour No. 3 which started at Tokyo on 4th September and ended at Nagoya on 8th September.

There were 25 overseas visitors in the party, including 4 geologists from the U.S.S.R., several Americans as well as geologists or geographers from China, Formosa, Thailand, Malaya, Indonesia, Franch, New Caledonia and New Zealand.

The tour leader was Dr. Chikao Nishiwaki of the Mitsui Mining Company, but the logistics were organized by the Japan Travel Bureau. Transport was by electric railway and motor coach and accommodation was in part in western style and part in Japanese style hotels.

Chubu is the central part of the Japanese Alps and the scene of large hydroelectrical development.

The tour included a visit to the famous Kuro-Yon Arch Dam, the biggest in Japan and a series of smaller dams and power stations down the course of the Kurobe River. In essence the scheme is rather similar to the Tumut River Scheme of the Snowy Mountains, both in layout and size. As the Scheme has been developed in a national park area of outstanding beauty, great efforts were made to keep surface works to a minimum and indeed it is likely that the Japanese Government insisted on this.

Access to the Kuro-Yon Dam is via a huge tunnel through the Alps about 12 miles long and now serviced by electrical trolley buses. The whole of the construction materials for both the Dam and the adjacent underground power station (240,000 Kw) were transported to the site by this tunnel. The Valley of the Kurobe River andthe smaller dams and power stations along its course (about 8 in total) were serviced by a small electric tram way which, for a substantial part of its length is underground, but it emerges at intervals on the steep flanks of the Kurobe Valley. It terminates at the Town of Unazuki.

The valleys in the adjacent mountains are heavily timbered for the most part with planted forests of pines, the remainder with native forests which include a high percentage of Japanese maples. It is regarded as one of the outstanding beauty spots in Japan and must be very beautiful in Autumn when the maples are coloured.

Two days were spent at Kamioka, Japan's largest lead-zinc mine, operated by Mitsui Mining and Smelting Company. Underground workings and surface plant were inspected. The tour leader Dr. C. Nishiwaki had formerly been Manager of the Mine at Kamioka.

The geology of the mining area and details of the mining and milling practices are given in a number of pamphlets and maps distributed to tour members by the Mines staff and these have been lodged in the Bureau Library. The Mines, (there are three mines in the group), appear to be very efficiently (and I understand profitably), run although the total metal content of the ore is low by Australian standards. The ore reserved at the end of 1965 was 41

million tons averaging 0.54% Pb, 5.4% Zn & 28 gr/t Ag. Two factors which help in the efficient operation of the mine are that the country rock is very solid and needs very little support when the ore is mined and metal recoveries are exceptionally high.

Underground workings are highly mechanised and power is supplied by the Company's own hydro-electric plant. To make use of off-peak load in the power station a system of underground storage of compressed air has been developed. Air is pumped into an underground cavern and stored under an hydraulic head; the system was developed by Dr. Nishiwaki, after seeing a similar scheme in use in a mine in Sweden.

Social benefits for mine workers, and indeed for other industrial workers in Japan are highly developed. At Kamioka, low rent housing with free electricity and fire wood, free medical attention and amenities like recreation halls, libraries, gymnasiums and company operated supermarkets tend to keep the workers contented.

The Kamioka Mines have an authentic history dating back to the 16th century and the Mitsui Company or its predecessors have been operating them since about 1800. Kamioka is entirely a mining town (like Broken Hill and Mount Isa) with a population of about 20,000, many of the families having been there for several generations.

En route to the Kuro-Yon Dam visits were made to Suwa Lake near Omachi (fault angle basin) and to a camera works and a silk museum nearby. The city of Toyama was visited en route between Kuro-Yon and Kamioka and the local geology of the Toyama Plains was explained by local geologists, who also discussed problems arising from land slides which effected the terraced areas flanking the plains. The tour ended at Nagoya where a reception was held by the Nagoya University.

Visits in company with geologists from the Nagoya University were made to the famout pottery centre of Seto and the nearby clay pits. Clay from this area is used by the famous China works, Noritake at Nagoya.

Reprints and Publications

The following reprints and reports relating to the Chubu tour have been lodged in the library.

1. "Character of the Glaciers in the Japanese Alps at the time of the Glacial Age", by Kazuo Ogasahara.
2. "Snow Survey of Mount Tatyama and Mount Tsurugi of the Japanese North Alps", by Kazuo Ogasahara.
3. "The Formation of Murodo-Daira at Mount Tateyama", by Saburo Fukai.
4. "The Formation of High Erosion Surfaces in the North Japanese Alps and other Geomorphological Development", by S. Fukai.
5. "Study of Underground Water in Landslide Area at Kurumi, Himi City, Toyama Prefecture", by Sand Control Section, Department of Public Works, Toyama.
6. "Geology and Ore Deposits of Kamioka Mine".
7. "A Glimpse of Tochihora Pit at Kamioka".
8. "Summary of Kamioka Mine, Gufu Prefecture, Japan". (Including flow sheets of Shikama lead smelting plant, lead refinery, zinc roasting, sulphuric acid plant and electrolytic zinc plant).
9. "Kamioka Mine Smelting and Refinery Flow Sheet".
10. "Mining Methods, Tochihora and Kamioka Mines".
11. "Trip to a Potter's Town, Seto (near Nagoya) including notes on the geology of the Nagoya-Seto area and discussion of Clay and Glass Sand deposits".

UNIVERSITY OF TOKYO - GEOPHYSICAL INSTITUTE

The University of Tokyo is in effect divided into two separate universities in different parts of Tokyo; the main Hongo campus for specialist education and the Komaba campus of the College of General Education.

All under-graduate students must spend their first two years in the College of General Education. There they receive both general education and basic teaching in the various specialised courses which there are to pursue in their third and fourth year on the Hongo campus. Competition for entry to the University of Tokyo is very keen and it is claimed that this university has the cream of university under-graduates. I was unable to find out how many universities there are in Tokyo but the number must be large becuase in the whole of Japan there are 74 Government (public) universities and over 200 private universities.

Under-graduate enrolment at Tokyo University (Hongo and Komaba combined) is about 12,000. In addition there are over 3,000 post-graduate students at Hongo and a total teaching staff of about 4,200. Teaching in geophysics is done during the under-graduate's third and fourth year on the Hongo campus, in the Geophysical Institute attached to the Department of Physical Sciences. Professor Takesi Nagata is the head of the institute which has on its staff five professors and seven associate professors. At present it has about 15 graduate students.

Attached to the Geophysical Institute is the Geophysical Research Laboratory (formerly called the Kakioka Geophysical Observatory) and Professor Nagata is its Director. It is situated about 70 Km north-east of Tokyo. Studies in geo-magnetism, radio-wave geophysics and spectroscopic geophysics are carried out at the research laboratory. The high ratio of staff to students in geophysics indicates that the main emphasis is on research work.

Apart from geophysics in the Faculty of Science there is attached to the university a major geophysical research establishment, namely, the Earthquake Research Institute. This is situated in the Hongo campus and was established in 1925 after the great Tokyo earthquake. Although it is essentially a research institute, a small amount of teaching is done in specialised subjects. Its Director is Professor Takahire Hagiwara, a seismologist, and the Japanese Member of the S.C.A.R. Working Group on Solid Earch Geophysics. It has on its staff 16 professors, 9 associate professors and 3 lecturers.

In addition to research carried out in the two main buildings of the Earthquake Research Institute on the Hongo campus this Institute operates many observatories. They have seismological observatories at Tsukuba and Wakayama; volcanological observatories at Komoro, Mount Asama and Mount Kirshima; crustal deformation observatories at Aburatsubo, Maze, Nokogiriyama and Matsuyama; magnetic observatories at Momashi, and Izu Oshima, and Tsuamai observatories at Miyago-Enoshima and Izu Oshima.

The purpose of the Institute is to carry out scientific research on various phenomena related to earthquakes and to investigate methods of prevention and mitigation of disaster caused by earthquakes. The results of the research carried out by this Institute are published in the "Bulletin of the Earthquake Research Institute of the University of Tokyo" (issued quarterly) and supplementary volumes of the same Bulletin. Seismological reports of the

During my visit to the Geophysical Institute Professor Nagata was absent overseas and Professor Fukushima was acting head of the Department. His interest is in geo-magnetism and planetary physics. He showed me over the Institute's laboratories which were poorly housed and not particularly well equipped. The main lines of research are in palaeomagnetism, seismic (crustal) studies and age determination. As it was university vacations few of the staff were present and virtually no students.

Professor Fukushima gave me a copy of the University of Tokyo catalogue (calendar) 1964-65 which lists the staff and describes briefly the various courses available for under-graduates; this has been filed in the library. He also showed me a copy of the Annual Progress Report of the Rock Magnetism Research Group of Japan which if we do not already receive it, can be obtained if we need it.

The Secretary of Section III of the Palacif Science Congress - Professor Tsubokawa, formerly of the Geographical Survey Institute, is on the staff of the Earthquake Research Institute, and would be a particularly useful contact in any dealing with that Institute.

I obtained from Professor Fukushima a number of publications of interest and these have been lodged in the library; they are:

1. The University of Tokyo Catalogue 1964-5
2. Upper Mantle Project of Japan 65/66 - Second progress report
3. " " " (I.C.S.U.) - No. 3.
4. National Committee of Geophysics - Collected papers for C.R.C.M. - Japan Science Council & Geodetic Society of Japan
5. Magnetic Map - Japan (Mag. Latitudes?) - in Japanese

GEOLOGICAL SURVEY OF JAPAN

The Geological Survey of Japan is within the Ministry of International Trade and Industry (M.I.T.I.). This Ministry has nine individual Bureaus or Agencies including the Agency for Industrial Sciences and Technology. This Agency in turn is divided into 13 Research Institutes or Laboratories which cover many of the fields covered by our own C.S.I.R.O. The Geological Survey of Japan is one of these Institutes. These agencies are described in the booklet "Agency of Industrial Science and Technology, MITI" lodged in the library.

The head office of the Geological Survey is located at Hisamoto-Cho, Kawasaki City, which is about 15 kilometers south-west of the centre of Tokyo. It has a second office at Kawade-Cho, Shinjuku-Ku, Tokyo.

The Geological Survey has ten departments as follows - Geology Department (3 sections), Water Resources and Engineering Geology Department (2 sections) Mineral Deposits Department (4 sections), Fuel Department (2 sections), Geophysics Department (2 sections) Geochemistry and Technical Services Department (5 sections), Geological Information and Overseas Geology Office, Publications and Library Section, Planning Section and a General Affairs Section. It has a total staff of 481 (1966) of which about 300 are professional positions. It also has seven branch offices at various places throughout Japan.

The history, organisation and work of the Geological Survey of Japan is described in detail in a publication lodged in the library (in English). The budget for the Geological Survey in 1966 is approximately $US2.9 million. I was informed that the salary of the Director is 100,000 yen per month (£1,200 sterling per annum) and that the salary of a Chief of a Branch is approximately 70,000 yen per month. However the Director's salary is supplemented by tax free benefits such as the free use of a car and chauffeur and provision of housing at a nominal rental.

The Geological Survey publishes an annual report which is illustrated with numerous photographs depicting the work of the various branches. A copy of the report for 1966 (in Japanese with English legends) has been lodged in the library.

In many respects the work of the Geological Survey of Japan is similar to the Bureau's although more emphasis appears to be placed on fundamental research work. It differs in one important respect in that the G.S.J. does its own topographic surveying for geological and geophysical surveys. During the Pacific Science Congress members of Section IV were guests of the Director, Dr. Sato and delegates visited the various laboratories. The Geological Survey is very poorly housed in a concrete building which I was informed was built as an optical munitions factory during the war. I gained the impression that much of their work is done on a "shoestring" budget.

It has a fairly active geo-chemical group well equipped for spectroscopy and age determinations (potassium - argon and carbon dating). The research programme of this group for 1963-66 has been included in the loose folder at the back of the publication on the history etc. of the Geological

The chief of the Geophysics Department, Dr. Masami Hayakawa is a volatile little gentleman who seems to invoke a sense of intense interest, if not excitement into the work of his Department. He has a modest amount of geophysical equipment, some of which (e.g. sparker - seismic) has been made in the G.S.J. workshops. However improvision seems to be a key note of much of their efforts. A number of reprints and/or geological maps were represented by delegates of the Pacific Science Congress and these have been lodged with our library.

They are as follows:

1. Outline of the Geology of Japan
2. Geological Map of Japan
3. Map index of geological sheet maps
4. List of publications of the Geological Survey of Japan
5. Geological Survey of Japan, its history, organisation and work.
6. Bouguer anomaly maps of Japan
7. History and present status of geophysical prospecting in Japan
8. Hydrographical map of Japan
9. Agency of Industrial Sciences and Technology M.I.T.I. Japan Government June 1965
10. Annual report of G.S.J. (1966) in Japanese with illustrations and English titles

GEOGRAPHICAL SURVEY INSTITUTE

The Geographical Survey Institute of Japan is part of the Ministry of Construction and is located in the southern part of Tokyo. Its address is - No. 1,000-7 Kamimeguro, Meguro-Ku, Tokyo, Japan. It has a total staff of about 1,000 and the Director (who is not a technical man) is Mr. Motokiyo Aki.

The Geographical Survey Institute is divided into five main divisions, namely:

1. Administrative Division (Chief, Mr. Takeo Iba)
2. Geodetic Division (Chief, Dr. Yoshimichi Harada)
3. Topographic Division (Chief, Dr. Eiji Inoue)
4. Map Division (Chief, Dr. Kazuo Muraoka)
5. Reproduction Division (Chief Dr. Zyuhei Kobayashi)

In addition they have an Office of Planning and Inspection (Chief Dr. Takeshi Dambara).

The G.S.I. has eight regional survey divisions distributed throughout Japan and operate a Geodetic Observatory at Kanozan on the outskirts of Tokyo. The institute has an annual budget of 1,500 million yen ($A3.7 million). Its functions include those carried out by our Division of National Mapping and their Geographic Section of the Map Division prepares resources maps some of which correspond to similar maps prepared by our Department's Resources Information and Development Branch.

An interesting feature of the Geographical Survey Institute is that they have their own printing presses for map printing. They print and sell approximatley 5 million map sheets per year from which they receive an income of approximately 200 million yen. ($A450,000).

Administrative Division

The Administrative Division of the G.S.I. has five sections dealing respectively with general affairs, personnel, accounting, supply and welfare. This is the biggest of the five divisions and would correspond to the Bureau's Administrative Section.

Geodetic Division

The Geodetic Division has a total staff of 130 of whom 30 are professional officers. It is divided into five sections as follows:

1. Planning Section which is divided into sub sections for General Affiars, First Planning, Second Planning, Inspection, Data Maintenance and Public Surveys.
2. First Geodetic Section (Chief Dr. Hiromiti Suzuki) comprising the following sub sections - Research in Geomagnetics and Gravity Surveys, Geomagnetism (dealing with geomagnetic surveys and related studies), Gravity (dealing with gravity surveys and related studies) and a workshop for designing, trial production and repair of instruments.
3. Second Geodetic Section comprising the following sub sections - Triangulation Research, Base Line Measurements, Triangulation and Geodetic Astronomy.
4. Third Geodetic Section comprising thefollowing sub sections - Levelling Research, Geodetic Computations, Levelling and Tide Observations.

Topographic Division

This comprises four sections, namely -

1. Planning Section - general affairs, budget, progress control
2. Topographic Section - aerial photography, aerial triangulation - Topographic field work
3. National Large-Scale Mapping Section - contract aerial photography - map production
4. Inspection Section - aerial photos, triangulations and photo maps.

Map Division

This Division comprises four sections, namely -

1. Planning Section - of map compilations
2. Map Sources Section - search for source data - preparation of revisions
3. Geographic Section - Resources maps - data search and compilation
4. Drafting Section - preparation of base maps and scribing of compiled maps.

Reproduction Division

This Division also has four sections, namely -

1. Planning Section - budgets, machine repairs - photo and map libraries, proofing
2. Photographic Section - preparation of positive and negative plates - aerial photos
3. Plate Making Section - plate preparation and running proofs
4. Printing Section - printing and inspection of printed maps.

Office of Planning and Inspection

This group is concerned with the general planning for the G.S.I. as a whole, the adjustment of all technical works, the inspection of all business and of techniques and technical liaison affairs. In some respects it has similar functions to our Planning and Co-ordination Group.

The Division that is of most immediate interest to our Bureau is the Geodetic Division which is the principal authority in Japan for geomagnetism and gravity surveys. They have been particularly active in the field of designing and making protypes of various geophysical instruments including a three-string gravity pendulum which is used for ship borne gravity observations. Surveys have been carried out in the Japan Sea and in the Pacific Ocean to the east of Japan. An accuracy of about $\pm$ 10 mgls is claimed for it under good sea conditions. The equipment has been mounted in a Japanese oceanographic vessel which will shortly carry out surveys in the Antartic. The ship will call at Freemantle towards the end of December, 1966.

The Geodetic Division has also developed proton procession magnetometers which are in use at their observatories and in their field surveys.

The Institute has its own electronic computer, a N.E.A.C. 2206 made by the Nippon Electric Company of Tokyo. It has a memory capacity of 10,000 works (of 12 digits) and has an output to a line printer of 350 lines per minute by (120 characters). Input is by magnetic tape and they have a photo-electric reader for converting punch tapes to magnetic tapes at the rate of 200 characters per second (also made by Nippon Electric Company). The cost of this conversion instrument is approximately 1 million yen ($A2,500). The cost of the whole system, including three punch tape machines and verifiers, was about 200 million yen ($A500,000). The machine operates from 8.30 a.m. to 5.30 p.m. each day with about half a day for routine maintenance under contract by the suppliers of the equipment. Their magnetic observatory data is handled by this machine. Magnetic hourly values are scaled at Kanozan Observatory and are sent by radio teleprinter weekly directly on to a six-channel punch tape. About 80% of the machine's time is used in computing survey data and about 20% for administrative purposes. Operating staff comprises three tape punchers, one computer operator and two programmers.

Drafting Office

The Drafting Section of the G.S.I. is in the Map Division and is concerned primarily with the production of topographic maps. It is divided into a General Affairs Group and seven Working Groups. The output is approximately 90 topographical maps (46 cm by 58 cm at a scale of 1:50,000) as well as about 15-20 topographical maps at a scale of 1:200,000 and a few special purpose maps such as the recently published 1:1 million geographical map of Japan. There is approximately a 12 months' delay between compiling and scribing the maps and a further 6 months for printing. The Drafting Section has a staff of 52 with their work divided as follows - 18 on compiling 1:50,000 maps, 20 on scribing these maps, 7 in compiling and scribing 1:200,000 maps, 6 on supervising and checking and one surveyor. The recently completed 1:1 million series required 13 separate colour runs and 2,300 copies were produced.

Reproduction Division

This Division appears to be very well equipped with printing machines. It prints approximately 5 million copies per year with runs ranging from 200 copies to 60,000 copies. I was told that the reason for the very large sales of topographical maps in Japan was due to the demand from hikers and tourists who are evidently very map conscious.

Bureau Pendulum Equipment

The G.S.I. will be carrying out tests of the Bureau's quartz pendulum equipment prior to its return to Australia. It was expected that it would be ready for shipment towards the end of 1966. The Institute hopes to find sufficient funds to sent its own pendulum equipment to Melbourne early in 1967 to repeat the tie between Tokyo and Melbourne. Mr. Seto who is one of the two Japanese geophysicists that visited Australia previously, will be in charge of this. (Later advice indicates that the tie will be made to Brisbane).

The G.S.I. seaborne gravity meter will be used in the oceanographic ship being used to relieve the Antartic party and will call at Perth between 16th and 22nd December. Dr. M. Tazima will be the geophysicist in charge of this.

List of Reprints and Publications

The following reprints and publications were given to me by various officers in the G.S.I. and have been lodged in the Bureau library.

A. Bulletins of the Geographical Survey Institute as follows

1. Volume IV Part 2, March 1955.
   (a) Use of Aerial Photograph in Land Form Classification Survey in Japan
   (b) Gravity Survey in Hokkaido District
2. Volume V Part 3, July 1957
   Gravity Survey in Tohoku District
3. Volume IX, Parts 3-4, March 1964
   Gravity Survey in the Kanto and Chubu District
4. Volume X, Part 1, November 1964
   Various articles on geomagnetism, gravity, aerial triangulation, photo-interpretation, resources, maps and surveying and mapping programmes in Japan
5. Volume X, Parts 2-4, March 1965
   Gravity Survey in Chubu, Kinki and Chugoku Districts

B. Report of the Geodetic Works in Japan, January 1960 to December 1962

C. Adjustment of triangulation by automatic digital computer

D. Pendulum determinations of the gravity differences between Tokyo and Melbourne

E. Land deformation in Japan

F. New G.S.I. Pendulum Apparatus

G. Pendulum Determination of the Gravity Differences between Tokyo, Nowbray and Syowa Base

H. Second Order Gravity Survey in the Hakone District

I. Second Order Magnetic Survey of Japan (3)

J. Second Order Magnetic Survey of Japan (4)

K. Dynamic Sea Gravity Meter using three strings developed by G.S.I.

L. Gravity Survey in Niijima and Ooshima

M. Gravity Survey in Hachijo and Torishima Islands

N. G.S.I. Type Standard Magnetometer on the construction of standard coil of the G.S.I. type standard magnetometer

O. G.S.I. type standard magnetometer - on the G.S.I. type standard magnetometer

P. G.S.I. type standard magnetometer - on the measurement of gyromagnetic ratio using the G.S.I. type standard magnetometer

Q. Measurements of components of geomagnetic field with proton precession magnetometers

R. Gravity Survey in the Shikoku District

S. Magnetic Survey of Japan, 1951-1957

T. Observation of the vertical deflection in Japan

KYOTO UNIVERSITY

The Kyoto University is one of the oldest universities in Japan and is situated in a pleasant campus on thenorthern edge of the city. In the faculty of Science they have in addition to the normal Department of Physics, Institutes of Cosmophysics and Geophysics.

The Geophysical Institute is essentially a teaching institute for undergraduate and post-graduate students in Geophysics and is divided into five sections, each with its own Professor. There are:

1. Geodesy and Solid Earch Geophysics (Professor Ichinohe)
2. Oceanography (Professor Kunishi)
3. Meteorology (Professor Yamamoto)
4. Applied Geophysics (Professor Ozawa)
5. Geomagnetism and Electricity (Professor Tamura)

In addition to the faculty of Science there is attached to the University several research institutes including the "Disaster Prevention Research Institute of Kyoto University" and the university's geophysical staff appears to be common to both the Geophysical Institute and the Disaster Prevention Research Institute.

In the section dealing the geodesy and solid earth geophysics the Assistant Professor is Ichiro Nakagawa. Their main lines of research are:

1. crustal movements - measurement of tilt and secular variation of surface level. To this end they operate several remote stations equipped with tilt-meters and strain gauges
2. relation between seismicity and crustal movement
3. earth tides and free oscillations of the earth. They have continuously recording tidal meters; horizontal pendulums of their own design and a recording Askania Gravity Meter.
4. attempts to measure secular variation in gravity (Nakagawa's main interest).
5. various gravity surveys for specific purposes, e.g. the gravity survey of Aso Caldera in Kyushu to see if any changes in gravity are associated with volcanic activity (subterranean mass redistribution).
6. pendulum observations with a set of G.S.I. pendulums which the Kyoto University has.

A number of publications and/or reprints were handed to me and these have been lodged in the library. They are as follows:

Publications

Bulletin 53, Disaster Prevention Research Institute. Some Problems on Time Change of Gravity, Parts 1 and 2 (Nakagawa)

Bulletin 57, Disaster Prevention Research Institute. Some Problems on Time Change of Gravity, Parts 3, 4 and 5 (Nakagawa).

Reprints

1. "Relation Between Crustal and Sub-Crustal Earthquakes Inferred from the Mode of Crustal Movements" (Tanaka) - Special Contributions, Geophysical Institute Kyoto University No. 4 1964.
2. "On Peculiar Mode of Secular Ground Tilting Connected with a Sequence of Earthquakes in Some Restricted Areas" (Nishimura and Tanaka) - Reprint from Geophysical Papers dedicated to Professor Kenzo Sassa.

3. "Characteristic Movements of the Earth's Crust Related with the Activities of Earthquakes" (Ichinohe and Tanaka).
4. "Free Oscillations of the Earth observed by a Gravity Meter at Brussels" (Nakagawa, Melchior and Takeuchi) Royal Belgium Observatory, Geophysics Series No. 69. International Symposium on Earth Tides
5. "On the M1-Component obtained by Gravimetric Tidal Observations (Screening of Gravitational Forces" (Nakagawa). Special contributions, Geophysical Institute, Kyoto University No. 4 1964.
6. "A Gravity Survey on Aso Caldera, Kyushu District, Japan" (Kubotera and Sumifomo). Special contributions Geophysical Institute Kyoto University No. 5 1965.

JAPAN PETROLEUM EXPLORATION COMPANY (JAPEX)

This Company was formed in December, 1955 under an Act of Parliament to search for and develop petroleum reserves in or for Japan.

The Company's address is - No. 4-1 Chome, Ohtamachi, Chiyoda-Ku, Tokyo. It has a paid up capital of approximately $A37 million of which two-thirds has been provided by the Japanese Government.

At the Company's Office in Tokyo I met the following people - Dr. Hajime Hayashi, (Director), Dr. Ichiro Shishido (Deputy Manager, Overseas Department), Mr. Yoshikazu Hayashi (Geologist, who will be in New Guinea), Dr. Akira Kiyiraoka (Geologist, probably Company representative in Brisbane).

JAPEX has established an Australian subsidiary and proposes to establish an office in Brisbane. It had recently received from Aquitaine the terms under which the Commonwealth Government was prepared to allow JAPEX to join with Aquitaine in petroleum exploration in New Guinea. The Company was concerned about the restrictions on time allowed for their operator each year in New Guinea and conditions relating to a foreign company acquiring an interest in the permit in its own name. The problem was discussed in general terms but it was explained to Company officials that these were matters which concerned the Department of Territories and not our Bureau.

Since 1955 when the Company was first formed it has developed 10 small oil fields and 8 gas fields in Japan mostly along the western coast of the Island of Honsyu and in Hokkaido. JAPEX has at present an annual production of approximately 3 million barrels (U.S.) of oil and 435 million cubic meters of gas, worth at the well head approximatley $A9 million.

Visits were made to the Company's Seismic Playback Centre in Tokyo and to their laboratories on the outskirts of Tokyo. JAPEX places considerable emphasis on geophysics and operates six seismic crews as well as gravity crews and an aeromagnetic party. They have a very well equipped Playback Centre containing two sets of playback equipment, a Geo-Data MS32 type magnetic data processing equipment made by S.I.E. with an Omnitape transcriber purchased about five years ago and a Geo-Space Corporation model 1,000 seismic data processing system recently installed. Their playback-computing centre has a staff of about 50 including drafting staff.

At the laboratories in Kichijoji Musashino City, the scientific work is divided into five sections supported by a General Section for administrative matters.

No. 1 Section carries out chemical studies such as the methods of chemical treatment of reservoirs, research on drilling muds and cementing materials.

No. 2 Section carries out research on electrical methods used in oil prospecting such as gamma-ray spectroscopy, electrical logging, gun-perforators and control or tele-metering instruments.

No. 3 Section is concerned with studies on mechanical equipment such as weight indicators, pressure gauges, gravity recorders etc., drilling bits, the physical properties of drill strings and on metallic materials used for drilling machinery.

No. 4 Section is concerned with palaeontology and geo-chemical prospecting. They have a staff of four micro-palaeontologists. Their geo-chemical work is concerned mainly with the study of the organic contents and distribution of N-paraffins in source rocks and inorganic elements in the formation waters.

No. 5 Section is concerned with geophysical prospecting and carried out research in seismology as well as measurement of field samples for magnetic susceptibility, density and elasticity.

The laboratories are rather poorly housed but seem to be reasonably well equipped. One line of research which was interesting was seismic model studies. A re-print of a paper by Yoshinori Ishii on Seismic Model tests presented at the Third Petroleum Symposium (E.C.A.F.E.) November, 1965 has been lodged in the library.

My general impression on the visit to JAPEX was that they are a very efficient and energetic organisation as is amply demonstrated by their successful exploration in this country.

Publications

The following publications have been lodged in the library:

1. The Petroleum Industry in Japan 1965 - Jap. Nat. Con. of World Petroleum Congress
2. MITSUKE Oil and Gas Field - JAPEX 1962
3. A Seismic Model Study on Buried Focus - Yoshinori Ishii
4. Japan Petroleum Exploration Co. Ltd. - JAPEX - descriptive brochure 1963.

SUMITOMO METAL MINING COMPANY LTD.

This is one of the leading non-ferrous mining and smelting companies in Japan and was founded in 1590. It operates the famous Besshi Copper Mine. The Company's Tokyo address is 11-3, 5 Chome, Shimbashi, Minato-Ku, Tokyo.

In addition to mining and smelting the Company is involved in the refining and fabrication of metals and the manufacturing and marketing of construction materials. The Company purchases copper concentrates from Peko and Mount Morgan. The Company is a major investor in the Bethlehem Copper Mine in Canada from which it purchases the entire output of copper concentrates. It has also recently concluded an agreement with the Imperial Smelting Processes Limited in England for the simultaneous smelting of lead and zinc and a company (Sumiko I.S.P.) has been formed to construct and operate a smelter in Japan.

The mines which the Company operates in Japan are as follows:

Kohnomai (gold and silver)
Yaso (copper, lead and zinc)

Sazare and Besshi (copper - combined 2,700 tons of ore per day)
Taio and Oguchi (gold and silver)

It also operates two copper smelters (Kunitomi and Shisakajima) and has interests either directly or through subsidiary companies in three ferro-nickel smelters (Hyuga, Soyama and Shisakajima).

Discussions were held with the following officers of the Company:- Mr. B. Iizumi (Managing Director), F. Kurosu (Deputy Manager, Business Department) and S. Morinaga (Chief Geologist and Manager of the Geological Department). The Company is actively interested in Australia through its purchases of copper concentrates from Peko and Mount Morgan and appear to be interested in taking some active part in mining operations in Australia.

One of the Company's subsidiaries, Sumiko Consultants Co. Ltd. may be of interest to some of the smaller Australian mining companies. It offers a complete service of geological and geophysical surveys, analyses and laboratory tests of materials, planning, design, supervision and installation of mining and metallurgical plants as well as management consulting in the mining and mineral industries. It is actively engaged in programmes of international economic co-operation in developing countries and no doubt would be available for service in Australia if required.

MITSUI MINING AND SMELTING COMPANY

This Company owns and operates several mines in Japan including Kamioka, the largest of the base metal mines in Japan. It also has financial interest in mines overseas including the copper mine at Ravensthorp W.A.

The Company official with whom I had most to do was Mr. C. Nishiwaki, formerly Chief Geologist and a Director of the Company but who is now engaged in a consulting capacity. He has visited our Bureau on several occasions. He is Geologist whose special interest is in porphyry coppers and has been responsible for developing phophyry copper mines in the Philippines. Mr. Nishiwaki presented a paper in Symposium No. 23 of the Pacific Science Congress on the Distribution of Disseminated Copper Deposits in the Pacific Belt.

The Company was established in 1911 and in post war years has been very active in exploration, including geophysics; it has its own group of geophysicists. It is also an active participant in a Government supported scheme to assist in exploration for metalliferous deposits on a regional basis.

A visit was made to the Company's mines at Kamioka and this is discussed in the notes on the Congress tour.

NITTETSU MINING COMPANY

This Company owns and operates various mines in Japan including large dolomite mines on the outskirts of Tokyo.

I was informed that the Company is exporting limestone from Japan to Newcastle, New South Wales as backloading on ships bringing coal (?) to Japan. The Company's address is 20-1, 2-Chome, Marunouchi, Chiyoda-Ku, Tokyo, Japan.

The Company officers whom I met were Seiji Fukuchi, Manager of the Geological Department and Shiro Kimura, Chief Geologist whom I had met previously in Canberra.

The Company is very interested in mineral prospecting in Australia and is anxious to undertake exploration here.

RIOTINTO ZINC (JAPAN) LIMITED

This Company is a wholly owned subsidiary of Riotinto-Zinc and is concerned mainly with commercial arrangements in Japan for the disposal of Riotinto Zinc products, particularly iron ore and bauxite.

The Company's address in Tokyo is 413 New Tokyo Building, No. 2, 3-Chome, Marunouchi, Chiyoda-Ku, Tokyo, Japan.

Mr. N.W. Shudo is the Representative Director, Mr. T. Arakawa, Deputy Manager and Mr. N. Nishida, Mr. Shudo's General Assistant. The Company was particularly helpful to me in making contact with the various mining companies.