REPORT ON THE UNITED NATIONS SEMINAR ON AERIAL SURVEY METHODS AND EQUIPMENT - BANGKOK, THAILAND

4 January to 5 February, 1960

By L. W. Morley

1. Introduction

A seminar on "Aerial Survey Methods and Equipment" was held at the Sala Santitham, headquarters of the Economic Commission for Asia and the Far East, from 4 January to 5 February, 1960, under the joint sponsorship of the United Nations and the Government of Thailand.

The aims and purposes of the seminar are outlined in the attached statement by Mr. U. Nyun, Executive Secretary of the ECAFE.

Mr. R. Brocklebank of Hunting Associates Limited, Toronto, and the writer, of the Geological Survey of Canada, were appointed by the Department of External Affairs as delegates. Mr. Brocklebank, who is in charge of the Canadian Colombo Plan Mekong River Survey in Indochina, was unfortunately only able to attend the meeting for two days due to the pressure of his work.

A complete list of participants is attached.

2. Seminar Program

Weeks 1 and 2 - Presentation and discussion of 63 prepared papers.

Week 3 - Discussion under the following topics:

(1) Aerial Photography

(2) Photogrammetry and Aerotriangulation

(3) Interpretation of Aerial Photographs

(4) Photogeology

(5) Airborne Geophysical Surveys

(6) Relationship between the Various Branches of Aerial Surveying

(7) Regional Problems and International Cooperation

Week 4 - This week was occupied in "demonstrations". In the case of photogrammetry, these consisted of the experts illustrating the use of photogrammetric equipment installed in the laboratories of the Royal Thai Survey Department. In the other cases, they consisted of informal question and answer sessions in small groups. The writer was not present during this last week.

3. Copies of Papers Presented

A complete list of papers presented at the meeting is attached. Copies of these papers have been stapled together according to the following categories and are available on loan from the Library of the Geological Survey of Canada, Department of Mines and Technical Surveys, 601 Booth Street Ottawa.

AS Aerial Surveying and Photogrammetry

PG Photogeologic Interpretation

AG Airborne Geophysical Surveying

PT Photo Interpretation (other than photogeology)

4. Report on Discussions

A draft report on the general discussions held during the third week is attached.

5. Recommendation for the Establishment of a Training Centre in Southeast Asia

The report of the working committee on training and information facilities, is attached. The recommendation that fellowships for trainees be established in countries advanced in the art of aerial surveying and that a training centre be established at a central location in S.E. Asia, was the only recommendation made at the seminar. It was explained that this recommendation will go forward to the ECAFE which, if it approves, will ask participating countries to contribute fellowships, technical assistance and equipment.

6. Recommendation re Future Meetings on Aerial Survey Methods Sponsored by the ECAFE

It is considered that Canadian technical representation is important at future meetings on this subject for the following reasons:

(a) Because of the attendance at these meetings of senior technical administrators from the U.S. and Europe, Canadian representatives can obtain important personal opinions of these men on developments in this field under conditions less hectic than on the usual 3-day conventions.

(b) It is a chance for Canadian commercial firms in this field to meet government officials of the ECAFE countries under ideal conditions, as American and European companies are doing. It is important, however, that the tone of these meetings not be too commercial. The U.N. officials guard against this as it does not leave a favourable impression with some of the ECAFE delegates.

(c) If the Canadian Colombo Plan continues to contribute some aid in the form of aerial surveys, it is useful to have technical representatives who have met the technical representatives from the ECAFE countries so that more effective planning and execution of these surveys can be accomplished.

7. Some Hearsay Information about Previous Colombo Plan Resource Surveys

Dr. Hari Narain, superintending geophysicist for the Indian Oil and Gas Commission, gave high praise to Mr. Agocs for his report on the interpretation of the Indian Aeromagnetic Survey sponsored by the Canadian Colombo Plan in 1956. He said that Indian seismic crews were following up this work and were finding it very useful.

It was understood from the director of the Thai Geological Survey that the Canadian Colombo Plan aeromagnetic survey in Malaya resulted in the discovery of a 200,000,000 ton iron orebody near the old Bukit Besi mine and that the ore was being successfully marketed in Japan, bringing about 8 million dollars a year royalty to the state.

STATEMENT BY MR. U. NYUN, EXECUTIVE SECRETARY
of the United Nations Economic Commission for Asia and the Far East

Your Excellencies, ladies and gentlemen,

On behalf of the Secretary-General of the United Nations and on my own behalf, I have great pleasure in welcoming you to this seminar on Aerial Survey Methods and Equipment, which is the first seminar of its kind to be held in the ECAFE region to review the status of aerial surveys carried out in Asia and the Far East and to examine modern aerial survey methods and equipment in regard to their applicability to the countries of the region.

In the first instance, I would like to express on behalf of all of us our grateful thanks to H. E. General Thamon Kittikachorn, Deputy Prime Minister of His Majesty's Government of Thailand for having kindly come here today to inaugurate this Seminar in the midst of his heavy duties. May I also express our gratitude to him for his warm and inspiring address.

It is also a great pleasure for me to express our deep appreciation for the co-operation and enthusiasm shown by the officials of the Government of Thailand, particularly those of the Royal Thai Survey Department, who have so efficiently assisted us in making the necessary arrangements for the Seminar and who have provided equipment and technical facilities for demonstration purposes in the Seminar.

His Excellency the Deputy Prime Minister has already mentioned to you in his address the importance of aerial surveys to the economic development of countries of the region. He has also outlined for us various aerial surveys carried out by the Government of Thailand and the results so far obtained from such surveys. In other countries of the region, there has also been a growing recognition of the usefulness of such surveys for compilation of geological, agricultural, forest resources inventory and for engineering and town planning; these surveys are essential for the formulation of integrated over-all development plans. In particular, aerial survey methods and equipment have been widely used in geological mapping and mineral exploration. In the British Territories in Borneo, the whole area has been covered by air survey. In Burma, a combined aero-geophysical survey and photo-geological study has

been undertaken with the object of delineating areas for detailed exploration for iron ores, radioactive minerals, and tin and associated mineral deposits. In Ceylon, aerial survey has been used in geological mapping of the country and in the study of water catchment areas and their potential land uses. Aeromagnetic and aero-radioactive surveys in the southwest part of Ceylon have been carried out in the search for iron and radioactive minerals. In India, air photographs have been used as base maps for plotting geological data in the field, and their value in accurate locations, tracing formations and interpreting other structural features has been fully recognized and utilized. The aeromagnetic survey for oil exploration has been carried out for a number of years, and the airborne scintillometer surveys for radioactive minerals have also been made. In Japan, air photography of shallow sea through the use of polarization filters has enabled some marine geological study and a proton magnetometer has been developed for various geological investigations. Airborne scintillometer survey has also been used for locating radioactive minerals. In the Republic of Korea, aeromagnetic surveys were carried out in 1958 and 1959 covering an area of over 15,000 square miles. In the Federation of Malaya, approximately one third of the country has now been covered by airborne magnetometer and scintillometer surveys. In Pakistan, in order to assist the economic development of the country, a team of Canadian experts were engaged under the Colombo Plan to carry out the aerial survey of the West Pakistan. In the Philippines, an aero-geophysical survey of some six areas considered likely to contain mineral deposits of commercial importance has also been undertaken.

In the context of the above mentioned developments in the countries of the ECAFE region, the convening of the Seminar at this time, therefore, assumes particular importance. It is my earnest hope that the Seminar will bring to light the problems common to many countries of the region, and recommendations may be made as to how they can be solved by means of co-ordinated effort between the countries. Discussions on the experience of countries where the status of development of aerial survey methods and equipment is in a more advanced stage may greatly assist the planning of exploration and development programmes in those countries where this important field of endeavour for

economic development has not yet received sufficient attention; this pooling of knowledge, which will be recorded in the final publication to be issued by the ECAFE secretariat, would also provide a means for broadening the outlook of those who are directly engaged in the field of aerial surveys in their respective countries.

In order to facilitate your discussions, it may perhaps be useful if I recall to you the terms of reference of this Seminar, the convening of which was originally recommended by the Subcommittee on Mineral Resources Development, and subsequently approved by the Committee on Industry and Natural Resources and the Commission. The main objectives of the Seminar, as outlined by the Subcommittee on Mineral Resources Development, are the dissemination of basic information and study on (a) techniques and equipment currently used with success; (b) their applicability and limitations; (c) organization of such surveys and (d) special problems encountered in the region.

Subject to your approval, it is proposed to divide the session of the Seminar into two main parts: Part I will deal with general questions of the application of aerial survey methods in the region, such, for instance, as planning and execution of the various survey methods and equipment, possibilities and shortcomings of current methods and equipment and organization of long range and short range projects. Part II will deal with the adaptation of technical methods to suit the needs and conditions in the region and other related questions. This part of the session will be conducted with practical demonstration of essential equipment in selected techniques.

You have a heavy programme of work before you and many important problems to consider, and I will not detain you longer from proceeding with the business of the meeting. I am confident that your deliberations will be fruitful, and that you will be able to make recommendations of practical value to the countries of the region. I may add a word about the procedure of this Seminar. This Seminar, being a meeting of experts, should be informal and flexible, and participants are expected to express their own views based on their special knowledge of the problems under discussion. The experts of the United Nations Bureau of Technical Assistance Operations as well as my colleagues from the United Nations Headquarters and the ECAFE secretariat and myself are available to this Seminar for participation in the discussions.

I wish the Seminar every success.

PROVISIONAL LIST OF PARTICIPANTS

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Mr. Anthony Peter Reginald Dias, Assistant Superintendent of Surveys, Chief Photogrammetrist, Survey Department

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Mr. Ching-Lu Lee, Advisor, Ministry of Economic Affairs

Mr. Pao-Lin Yang, Chief, Agricultural and Forestry Aerial Survey Team, Taiwan

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Mr. Roger Daniel, Ingenieur en chef, geographe de l'Institut geographique national

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Mr. F. I. Zenin, Engineer, Chief Department of Geodesy and Cartography, Ministry of Home Affairs

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Mr. William A. Fisher, Chief, Photogeology Section, US Geological Survey

Mr. Ben F. Dixon, US Liaison Officer to ECAFE, American Embassy, Bangkok

Mr. Shirley V. Griffith, Cartographer, Bureau of the Budget

Mr. Andrew Ness, Jr., Assistant US Liaison Officer to ECAFE, American Embassy, Bangkok

Mr. Albert L. Nowicki, Army Map Service, Corps of Engineers, U.S. Army

Capt. Lawrence W. Swanson, Chief, Photogrammetry Div., Coast and Geodetic Survey, Dept. of Commerce

Dr. William B. Agocs, Chief, Geophysical and Geological Department, Aero Service Corporation, Philadelphia, Penn.

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Mr. Bernhard Send, Zeiss-Aerotopograph, Munchen

Dr. Kiaus Volger, Aero Exploration

1/ Member of the United Nations, participating in a consultative capacity under paragraph 9 of the terms of reference of the Commission

2/ Participating in a consultative capacity under ECOSOC Resolution 617 (XXII) dated 27 July 1956

Switzerland 3/

Mr. Robert Scholl, Wild Heerbrugg Ltd.

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Mr. U Nyun, Executive Secretary

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United Nations Technical Assistance Board

Sir Alexander MadFarquhar, Regional Representative for Far East

Seminar Secretariat

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Mr. L. Imbert	Language Officer, UN E.C.A.F.E.

3/ Participating in the United Nations Expanded Technical Assistance Programme

CATEGORY	SYMBOL	TITLES	AUTHORS
AS	I&NR/AS/1	PLANNING OF AERIAL SURVEYS FOR THE OVERALL DEVELOPMENT OF THE NATURAL RESOURCES OF A COUNTRY	Dr. W. Schermerhorn, Dean, International Training Centre for Aerial Survey, Delft, the Netherlands
AS	I&NR/AS/9	COST OF AERIAL SURVEYS	Mr. J. Visser, United Nations Photogrammetric Expert in Teheran, Iran
AS	I&NR/AS/11	PRODUCTION OF LARGE-SCALE PHOTO-MOSAICS BASED ON SLOTTED TEMPLET CONTROL AT THE NATIONAL CARTOGRAPHIC CENTRE OF IRAN	Mr. J. Visser, United Nations Photogrammetric Expert in Teheran, Iran
AS	I&NR/AS/13	HORIZONTAL AND VERTICAL INSTRUMENT AEROTRIANGULATION	Captain L. W. Swanson, Chief, Photogrammetry Div., U.S. Coast and Geodetic Survey
AS	I&NR/AS/14	SUPPLEMENTAL CONTROL SURVEYS FOR PHOTOGRAMMETRIC MAPPING	Capt. L.W. Swanson, Chief, Photogrammetry Div., U.S. Coast and Geodetic Survey
AS	I&NR/AS/15	AERIAL SURVEYING AS CARRIED OUT AT THE U.S. ARMY MAP SERVICE	Mr. A. L. Nowicki, Chief, Dept. of Cartography, U.S. Army Map Service
AS	I&NR/AS/16	AEROTRIANGULATION ADJUSTMENT OF INSTRUMENT DATA BY COMPUTATIONAL METHODS	Mr. Wm. D. Harris, Photogrammetrist, General Engineer, U.S. Coast and Geodetic Survey
AS	I&NR/AS/17	VERTICAL ADJUSTMENT OF INSTRUMENT AEROTRIANGULATION BY COMPUTATIONAL METHODS	Mr. Wm. D. Harris, Photogrammetrist, U.S. Coast and Geodetic Survey
AS	I&NR/AS/18	PRACTICAL EXPOSURE DETERMINATION FOR AERIAL PHOTOGRAPHY	Mr. Wm. D. Harris, Photogrammetrist, U.S. Coast and Geodetic Survey
AS	I&NR/AS/19	PHOTO QUALITY ECONOMIZES AERIAL SURVEY	Mr. F.L. Corten, International Training Centre for Aerial Survey, Delft, Netherlands
AS	I&NR/AS/20	NOTE ON THE APPLICATION OF AIR SURVEY METHODS IN CEYLON	Ceylon Survey Department
AS	I&NR/AS/21	AERIAL SURVEY ACTIVITIES IN AFGHANISTAN	Mr. E. O. Dahle, Topographic Survey Expert, UNTAO

CATEGORY	SYMBOL	TITLES	AUTHORS
AS	I&NR/AS/23	AN APPRAISEMENT OF SOME QUESTIONS RELATING TO AERIAL PHOTOGRAPHY AND ITS PHOTOGRAMMETRIC ASPECTS	M. M. Volkert, Experts invited by UNTAO
AS	I&NR/AS/29	AERIAL SURVEY WORK PROGRESS IN THE REPUBLIC OF CHINA	Mr. C. L. Lee, Advisor of Ministry of Economic Affairs and President of the Chinese Society of Photogrammetry
AS	I&NR/AS/31	AERIAL SURVEY PROBLEMS IN SOUTHEAST ASIA	Leo V. Strees and C. W. Culkin, Photogrammetry Branch, Division of Chart Construction
AS	I&NR/AS/32	NOTES ON OBTAINING AERIAL PHOTOGRAPHY FOR TOPOGRAPHIC MAPPING	U.S. Geological Survey
AS	I&NR/AS/34	SUMMARY NOTE ON AERIAL SURVEY ACTIVITIES IN JAPAN	Dr. K. Sato, Geological Survey of Japan
AS	I&NR/AS/39	BRIEF REVIEW OF AERIAL PHOTOGRAPHY IN THE USSR	Soviet Delegation to the Seminar
AS	I&NR/AS/40	STEREOTOPOGRAPHIC METHODS OF CONSTRUCTING TOPOGRAPHIC MAPS IN THE USSR	Mr. F. I. Zenin, Engineer, Chief Dept. of Geology and Cartography, Ministry of Home Affairs
AS	I&NR/AS/43	TOPOGRAPHICAL SURVEYS BY PROGAMMETRIC METHODS IN PAKISTAN	Pakistan Delegation to the Seminar
AS	I&NR/AS/46	REPORT OF THE NATIONAL CARTOGRAPHIC CENTRE OF IRAN	Iranian Delegation
AS	I&NR/AS/51	L'AEROCHEMINEMENT A L'INSTITUT GEOGRAPHIQUE NATIONAL DE PARIS	M. Roger Daniel, Delegation of France to the Seminar
AS	I&NR/AS/53	COMMENT L'INSTITUT GEOGRAPHIQUE NATIONAL FRANCAIS A RESOLU LES PROBLEMES DE LEVE PHOTOGRAMMETRIQUE AUX DIFFERENTES ECHELLES	M.Roger Daniel, Delegate of France
AS	I&NR/AS/55	MAP MAKING FROM AERIAL PHOTOGRAPHS OF THAILAND	Thai Delegation of the Royal Thai Survey Dept.
AS	I&NR/AS/56	HELICOPTER OPERATION, CALVERT HILL-ROBINSON RIVER, 4-MILE SHEET AREAS, N.T., Sept.-Oct., 1957	
AS	I&NR/AS/58	INTERPRETATION OF AERIAL PHOTOGRAPHS	W.G. Agocs, Aero Service Corporation, Philadelphia

CATEGORY	SYMBOL	TITLES	AUTHORS
AS	I&NR/AS/59	RAPPORT CONCERNANT LES TRAVAUX ACCOMPLIS EN MATIERE DE LEVES AERIENS	The Lao delegation
AS	I&NR/AS/60	SERVICE GEOGRAPHIQUE DU ROYAUME DU CAMBODGE	The Cambodian delegation
AS	I&NR/AS/61	OBSERVATION DER SERVICE GEOGRAPHIQUE NATIONAL DU VIET-NAM SUR LES QUESTIONS INSCRITES A L'ORDRE DU JOUR DU CYCLE D'ETUDES SUR LES LEVES AERIENS	The Viet-Namese delegation
AS	I&NR/AS/62	AERIAL NATURAL RESOURCES EVALUATION PROCEDURES AND COSTS	W. B. Agocs, Aero Service Corporation, Philadelphia
AS	I&NR/AS/63	MEKONG RIVER AERIAL SURVEY PROJECT	R. A. Brocklebank, Hunting Associates Ltd., Toronto
PG	I&NR/AS/4	PHOTOGEOLOGICAL RECONNAISSANCE USING TRIMETROGON AIR PHOTOGRAPHY	Dr. H.Th. Verstappen, International Training Centre for Aerial Survey, Delft, Netherlands
PG	I&NR/AS/6	THE USE OF AIR PHOTOGRAPHS FOR GEOLOGICAL MAPPING IN BRITISH BORNEO	Geological Survey Department of the British Territories in Borneo
PG	I&NR/AS/7	UTILIZATION OF AIR-PHOTOGRAPHS BY THE GEOLOGICAL SURVEY OF JAPAN	Geological Survey of Japan
PG	I&NR/AS/22	INTERPRETATION OF GEOLOGY FROM AERIAL PHOTOGRAPHS	Mr. William A. Fisher, U.S.G.S.
PG	I&NR/AS/30	PLANNING AN AERIAL SURVEY FOR MINERAL RESOURCES BEARING IN MIND OTHER APPLICATIONS	Dr. K. Voelger, Frankfurt am Mein, Fed. Republic of Germany
PG	I&NR/AS/35	THE USE OF PHOTOGEOLOGY FOR PREPARATION OF GEOLOGICAL MAP OF IRAN	Mr. Rezer Kalhor, Geologist, National Iranian Oil Company
PG	I&NR/AS/37	THE PHOTOGRAMMETRIC CADASTRAL PROJECT IN THE PHILIPPINES	Mr. Amando A. Salvador
PG	I&NR/AS/42	AERIAL PHOTOGRAPHY IN GEOLOGICAL EXPLORATIONS IN THE USSR	Soviet Delegation to the Seminar

CATEGORY	SYMBOL	TITLES	AUTHORS
PG	I&NR/AS/45	USE OF AERIAL PHOTOGRAPHS BY THE OIL CONSORTIUM OF IRAN	Iranian Delegation
AG	I&NR/AS/8	BRIEF REVIEW OF AIRBORNE GEOPHYSICAL SURVEYS IN JAPAN	Geological Survey of Japan
AG	I&NR/NR/12	AIRBORNE GEOPHYSICAL SURVEYING IN THE REPUBLIC OF KOREA	Geological Survey of Korea
AG	I&NR/AS/24	PROBLEMS OF NAVIGATION AND POSITION PLOTTING IN AIRBORNE GEOPHYSICAL SURVEYS	R. M. Carter, Bureau of Mineral Resources, Australia
AG	I&NR/AS/25	SIMULTANEOUS MEASUREMENT BY TOWED AND INBOARD SCINTILLOGRAPHS IN AIRBORNE SURVEYING	R. M. Carter, Bureau of Mineral Resources, Australia
AG	I&NR/AS/26	THE REDUCTION OF AEROMAGNETIC SURVEY DATA	W.A.L. Forsyth, Bureau of Mineral Resources, Australia
AG	I&NR/AS/27	INSTRUMENTATION FOR AIRBORNE GEOPHYSICAL SURVEYS WITH D.C. 3 AIRCRAFT	J. K. Newman, Bureau of Mineral Resources Australia
AG	I&NR/AS/28	ELECTRONIC PROCESSING OF AEROMAGNETIC DATA	A. J. Barlow and K. Seers, Bureau of Mineral Resources, Australia
AG	I&NR/AS/36	A BRIEF REVIEW OF AEROMAGNETIC SURVEYING TECHNIQUES AND APPLICATION	Mr. Wm. J. Dempsey, United Nations Expert U.S.G.S.
AG	I&NR/AS/38	METHODS OF AEROGEOPHYSICAL EXPLORATION IN THE USSR	Mr. Yu. S. Glebovsky, Director, Leningrad Branch of All Union Research Institute of Methods and Techniques of Surveys
AG	I&NR/AS/41	AEROMAGNETIC SURVEY OF THE SOVIET ANTARCTIC EXPEDITION	Mr. Yu. S. Glebovsky, Director, Leningrad Branch of All Union Research Institute of Methods and Techniques of Surveys
AG	I&NR/AS/44	INTERPRETATION OF AEROMAGNETIC PROFILE FROM BANGKOK TO SINGAPORE	Dr. W. B. Agocs, U.S. delegation

CATEGORY	SYMBOL	TITLES	AUTHORS
AG	I&NR/AS/47	AERO-ELECTRIC PROSPECTING IN THE SOVIET UNION	Soviet Delegation
AG	I&NR/AS/48	THE INTERPRETATION OF AEROMAGNETIC SURVEY DATA	Mr. J. H. Quilty, Acting Senior Geophysicist Bureau of Mineral Resources, Australia
AG	I&NR/AS/49	RADIOMETRIC SURVEYS USING LIGHT AIRCRAFT	Mr. J. M. Mulder
AG	I&NR/AS/50	A BRIEF REVIEW OF AIRBORNE GEOPHYSICAL SURVEYING - RADIOMETRIC, ELECTROMAGNETIC AND GRAVIMETRIC	Mr. W. J. Dempsey, U.N. Expert, U.S.G.S.
AG	I&NR/AS/54	PROSPECTING FOR MASSIVE SULPHIDE DEPOSITS WITH AIRBORNE ELECTROMAGNETIC DEVICES	L. W. Morley, Geological Survey of Canada
PI	I&NR/AS/2	ON THE IMPORTANCE OF PHOTOGEOLOGICAL KEYS	Dr. C. Revertera, International Training Centre for Aerial Survey, Delft, Netherlands
PI	I&NR/AS/3	PRINCIPLES OF AERIAL PHOTO-INTERPRETATION	Staff of International Training Centre for Aerial Survey, Delft, Netherlands
PI	I&NR/AS/5	AERIAL PHOTOGRAPHY AND FORESTRY	Mr. D. A. Boon, International Training Centre for Aerial Survey, Delft, Netherlands
PI	I&NR/AS/10	THE APPLICATION AND COST OF NEW PHOTO-INTERPRETATION TECHNIQUES IN SOIL AND LAND CLASSIFICATION SURVEYS	Dr. P. Buringh and Dr. J. S. Veenenbos, International Training Centre for Aerial Survey, Delft, Netherlands
PI	I&NR/AS/33	PHOTOGRAMMETRIC INSTRUMENTS AS APPLIED TO INTERPRETATION AND SMALL SCALE MAPPING FOR GEOLOGY, FORESTRY AND SOIL SURVEY	Dr. B. Send, Munich, Germany
PI	I&NR/AS/52	BRIEF REVIEW ON THE USE OF AERIAL PHOTOGRAPHS FOR FORESTRY PURPOSES IN THAILAND	Mr. Dusit Banijbatana, Delegate of Thailand

REPORTS OF DISCUSSION GROUPS

1. Aerial photography

Group leader: Mr. Albert L. Nowicki

The discussions on aerial photography techniques were generally based upon the introductory paper prepared by Mr. M. M. Volkert (I&NR/AS23). Three main sessions were held at which questions raised in connection with other technical papers dealing with the subjects were also examined (I&NR/AS/23, I&NR/AS/39, I&NR/AS/32, I&NR/AS/19, I&NR/AS/18, I&NR/AS/1, I&NR/AS/30, I&NR/AS/31).

The subject matters dealt with in the introductory paper included aerial camera, photographic base material (film, glass plates) aerial survey flight, auxiliary instruments, current types of photography, quality of image, etc. Highlight of discussions are briefly given below:

Camera: modern cameras could provide photographs with better quality for various application.

Basic material for photographic emulsion. Reference was made to two articles published by Ahrend and Bruck locker on the subject. As interests were shown in the questions: film versus glass plate for precision photogrammetric measurements. It was noted that the effect of film shrinkage may reach ± 5 microns and that film image can be affected with age (2 weeks to 2 months time). The production of a very stable film (CRONAR) should reduce the gap between film and glass. Films up to 18 x 18 cms apparently is satisfactory for precision work.

Convergent photography and wide angle vertical photography. The advantages and disadvantages of convergent photography and wide angle (or super wide angle) vertical photography were mentioned in several papers. No concurred opinion was reached as to definite comparison of the two types of photography since the results of all research on this question were not yet available, and most of the agencies had only partial experience. It was reported that a study on this question has been carried out by the European Organization for Experimental Photogrammetric Research. Inquiry was made to Professor Schermerhorn who replied that at present stage of study it would not

be possible to give a definite evaluation of the two systems. The question should not be raised as one of the choice between two alternatives. Answer may be possible to question such as in which cases of map production convergent photography can have advantages.

With regard to the usefulness of convergent photography for interpretation purposes, a view was expressed that the increase in base-height ratio would be helpful for geological study because of the relief exageration. It was also pointed out that convergent photography has been primarily designed for large scale photogrammetric work (cadastral).

When no other material is available, unrectified convergent photographs can be used for recognition work. The determination of depths may encounter difficulty.

Vertical photographs are much easier to work with than rectified oblique photographs when viewing under mirror-stereoscope to say nothing of the time gap involved until rectified prints are available.

Aging of camera lenses. In France where the same type of lenses have been used both for photography and restitution,changes were noted, after 10 to 12 years, in distortion characteristics of the projecting lens. In spite of the fact that aerial cameras are subject to large variations of temperature, the change in the distortion characteristics was found to be small in comparison with that of projecting lens of restitution instrument which is in room of constant temperature. No other countries were able to report on this question since they did not use the same type of lens in camera and in plotting instruments.

It was further stressed that frequent calibration of cameras has been put into practice in many countries, by checking either at regular intervals(from 3 months to 1 year) or before and after each flight season.

Gyro-stabilized camera mounts. In order to reduce the tilt of air photographs, several countries have used stabilization devices for camera mounts to different extents, for instance, some on all mapping cameras, some only on vertical cameras excluding camera for convergent photography or for supplementary photography. It was noted that low tilt

angle photography facilitates the preparation of mosaics as well as the location of the nadirpoint in electronic flying and that better flight lines require less gap reflights. It was pointed out that, if the tilts could be reduced to 1 to 3 minutes of arc, the work of vertical aero-triangulation could be minimized. With regard to the possibility of stabilization equipment, reference was made to a gyro stabilized airborne magnetometer platform which maintained its direction within 2 minutes of arc[1]. Japan reported a magnetometer which maintained within 5 minutes of arc for an inclination of five degrees.

However, stabilized mount was not considered necessary when using first order plotting instruments. It would be of value in connection with the projection type of plotters which may be mechanically affected in cases of excessive tilt and/or excessive forward overlaps and excessive relief displacements. For light photographic aircraft, the use of stabilized mount may be restrictive. An alternate solution was to insist on rigid flying specifications in order to keep the average tilts to about 1^{o} and the maximum tilts to about 2^{o} or 3^{o}. Stabilized mounts may be objectionable if they tend to cause excessive vibrations, which may impair the photo image quality.

Infra-red photography and colour photography. During the discussion of the seminar, it appears that Infra-red photography and colour photography have been used in various studies and by several countries in their experimental work as well as in their operational work. But these techniques have not reached to the stage of routine operation. Infra-red has been successful in determining shore lines, their nearby rocks and other detailed features above water. Colour photography has been used with success in photo-geological studies, in the determination of the depth of shallow water (up to 70 feet) and provided additional details not recorded by conventional black-white photographs. Information was exchanged regarding the use of type of films: reversal colour films, colour negatives, spectrozonal camouflage - detection films, black-white prints from colour negatives;

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1. See: A Three-Component Airborne Magnetometer by P. Serson, et al. Publications of the Dominion Observatory, Vol. XIX, No. 2, 1957, Queen's Printer, Ottawa.

and from colour transparency. The cost, the possibilities and shortcomings of these two types of photography were also examined. While noting the promising possibility of these new techniques, their adoption for general use was not recommended pending results from further experiences.

As general remarks, the following views were expressed:

(a) The preparation of an introductory paper to be used as a guide for organizing discussions as followed in this group, proved to be highly useful. In future meetings of this kind, such an introductory paper should be prepared for each subject and be distributed far in advance to ensure maximum efficiency of the discussions.

(b) The procedure adopted by this seminar to space intermittently the programs of discussion of the various groups in order (i) to maintain the utmost interest of each group and (ii) to ensure a balanced progress of work in various fields, should also be followed in subsequent seminars. The time allowed between two discussions has enabled the participants to make better formulation of unsettled issues and to prepare well studied answers.

2. Photogrammetry and aerotriangulation

Group leader: Mr. Roger Daniel

A relatively large number of technical papers dealing with photogrammetric subjects was submitted to the seminar. The main discussions held by this study group were directly related to aerial photography. The following general conclusions may be drawn:

Generally speaking, photogrammetric methods are at present applied in all countries on the so-called "topographical" scales, such as 1:20,000, 1:25,000, 1:50,000 and 1:100,000. The equipment used has been developed to such a degree that the general methods, operational techniques and photogrammetric plotting do not, in themselves, raise any problems.

The important question which remains to be dealt with in this field relates to the intensive application of photogrammetric methods in cadastral surveys, in both numberical and graphical cadastral surveys; in this connection, it would be of interest to study the reports on the subject to the forthcoming

International Congress of Photogrammetry at London, and in particular the conclusions which may be reached.

The use of super wide-angle cameras is another subject deserving attention. This question is, in any event, connected with aerotriangulation. Indeed, it might be useful to exploit the possibilities of these super wide-angle cameras in processing, by means of analytical method, aerotriangulation in regions which subsequently will be plotted with photographs on a larger scale, taken with wide-angle cameras or with normal-angle cameras.

In any event, limites will have to be established for the use of super wide-angle cameras in rugged country.

With respect to aerotriangulation, several countries have developed methods which are applied at their current work. In general, first-class universal instruments are used and adjustments are carried out, either by strips or by blocks, with graphical, mechanical or numerical means.

Aerotriangulation by analytical methods is used in certain countries, and the methods adopted vary from one country to another. For example, in the USSR, analytical aero-triangulation is at present carried out with instrument of the stereocomparative or stereometric type, adjustment being subsequently computed by simple graphical methods.

In some other countries, however, efforts are being made to increase accuracy by combining a highly-precision stereocomparator with powerful electronic computers; these computers make it possible to effect the adjustment of large blocks of aerotriangulation, an operation which was not possible with simple calculating machines due to the very large number of equations to be solved. In this field too, the stage of development of experimentation varies with countries. The forthcoming International Congress of Photogrammetry may offer an opportunity for a better appraisal of the situation.

Mention should be made of the use in France, of the Air Profile Recorder to eliminate the need for aerotriangulation in so far as the altimetry is concerned. After the photographic flight, a second flight is made at a lower altitude, roughly along the axis of the lateral overlapping zones between

strips of photographs, and, if necessary, along lines perpendicular to the directions of the photographic strips.

Planimetric controls are provided by a classical slotted template triangulation using the principal points of the photographs.

3. Interpretation of aerial photographs

Group leader: Dr. H. Th. Verstappen

The subjects discussed by this group include photo-interpretation general principles and the application of photo-interpretation to various studies; forestry, soil water resource, urban development, engineering work, etc. Discussions on photo-geology were held in another group.

It was agreed that photo-interpretation was particularly suitable for reconnaissance work. With regards to the question of use of "keys" in photo-interpretation work, its local character was pointed out. USA and USSR reported that such keys were not used in survey work in their countries. As conditions change from one area to another, the use of universal "keys" would be detrimental to survey work. However, the "key systems" were used in universities in USSR for teaching purposes but their limitations were drawn to attention of the students. It was also pointed out that in interpreting vertically unknown areas, the availability of "keys" could be helpful.

The systematic approach by way of recognition-classification-deduction was accepted, although such methods should not be made too rigid. Possibilities for other lines of approach should be left open and the final decision should be based on the merit of each individual case. With regard to scale of photography for interpretation purposes, it was agreed that the ideal one would be that which enables the distinction of the smallest objects of importance to interpretation and which covers a sufficient large area to facilitate the delineation of interesting zones. Thus the requirements of photogrammetrists, geologists, foresters and soil scientists was not the same. When photographs at ideal scale were not available, scientists in photo-interpretation must try to draw maximum information from the existing mineral.

It was pointed out that while low quality photographs at large scale could still be used with some benefit, such photographs at small scale would be useless. Furthermore, photographs on large scale can always be reduced and studied stereoscopically as mosaics.

Detailed informations were given on the application of colour photography, infra-red photography and spectrozonal photography. Views were exchanged on the possibilities and shortcomings of these techniques. Mention was also made of experience with anaglyphs.

During the discussion of various items, information contained in technical papers was reviewed, in several cases explanation and further details on techniques and on results were submitted.

4. Photogeology

Group leader: Mr. William A. Fisher

The discussion is based on technical papers presented to the seminar, which covers the principal questions of photogeology, including techniques, procedures, usefulness, advantage and shortcomings. It must be borne in mind that photogeology which enables to carry out geological mapping, with increased economy and speed can not substitute all the field work.

During the discussions, information was supplied on instruments, methods, procedures used in various phases of geological mapping from aerial photography to map preparation. Some of the subjects studied are, to a great extent, of interest to aerial photography, photogrammetry and airborne geophysical survey. Information was supplied on the basis of experience and knowledge gained by various countries in recent years. Some conclusions reached by this group are also reported by other discussion groups under general headings.

The conclusions of the discussions dealing with photogeology are summarized below:

Geologic interpretation of aerial photographs can provide information that is helpful in geologic mapping of an area and will expedite such mapping. Such interpretations can also assist in the solution of engineering geology problems and in the search for minerals, petroleum and groundwater.

If speed of mapping is the paramount consideration photogeologic mapping should be done by a separate mapping group. The photogeologists, however, should participate in field checking. Better maps will result if the photogeologist participates as a member of an exploration team comprised of geologists, geophysicists, and other specialists as required.

Photographs of from 1:20,000 to 1:70,000 are in common use for photogeologic interpretation. Many factors must be considered in selecting the most suitable scale of photography. These factors include the character of the terrain, the complexity of the geology, and the objective of the study. Small scale photographs must be of good quality to be useful in photogeologic work. Further, the scale of the photographs must be large enough to permit recognition of discrete objects such as houses or trees if the photographs are to be used in the field.

Special types of photography such as colour camouflage detection and spectro-zonal photography hold much promise with respect to speeding and improving the reliability of photo-geologic mapping.

Photogeology is the logical first step in the geologic exploration of a country. If the area is completely unexplored, photogeological work should precede airborne geophysical surveys so that aeromagnetic flight lines may be properly oriented with respect to the geology.

Reconnaissance photogeologic mapping should be undertaken as soon as possible with the materials and instruments that are now in hand.

Noting the lack of sufficient photogeologists to fulfil the need for photogeological work in this region. The formation of technicians in this field remains an acute problem. Photogeologic training should be divided into two categories: (1) the training of specialists for purposes of training other geologists, research and special investigations and (2) the training of all geologists in the elements of photogeologic interpretation. This latter, general training should prepare all geologists to solve routine interpretative or measurement problems and to recognize problems that should be referred to specialists for solution.

All candidates for photogeologic training should be qualified geologists preferably with field experience. At the present state of

development the training of specialists should be done abroad until sufficient experience is gained in interpretation of southeast Asia areas to offset the current advantages of foreign training. In addition, a training centre should be established somewhere in the ECAFE region to assist in training large numbers of geologists in the elements of photogeology. This centre should be equipped with sufficient instruments to provide sound training.

5. Airborne geophysical surveys:

Group leaders: Dr. L. W. Morley
Dr. John H. Quilty

Items of discussion on airborne geophysical surveys fell under four headings:-

(a) Airborne magnetometer surveys

(b) Airborne radiometric surveys

(c) Airborne electromagnetic surveys

(d) Airborne gravimetric surveys

In the first three sections discussion covered aspects of operational procedure, interpretation of results and conclusions on the effectiveness of the method and its limitations. In section (d), new developments were described.

(a) Airborne magnetometer surveys

Operational procedure (and planning):

(i) Discussion took place as to whether geological mapping should precede airborne magnetometric surveying. It was agreed that some knowledge of general geology of an area was necessary to decide the applicability of the method and to plan the survey and that no general rule could be laid down as to the precedence of geological or photogeological mapping over airborne magnetometer surveys.

(ii) Where magnetometer profiles recorded as the low level were too complex, flying heights sometimes were increased and the equipment sensitivity lowered (USSR).

(iii) For broad reconnaissance surveys, regular spacing of flight lines were used. As a rule, supplementary lines were only used for small areas of interest (USSR). Groups of closely spaced lines were sometimes used in other countries.

(iv) Seasonal changes in surface features may be used for photo positioning by means of special aerial photo surveying along traverses just before aeromagnetic flights. Groups of indistinguishable features had sufficient dissimilarity to allow identification in difficult areas (USSR).

Interpretation:

(i) For qualitative interpretation, it was deemed necessary to compare known geology (making use of photogeology) with aeromagnetic data. "Blind" interpretation was difficult and often misleading.

(ii) For quantitative interpretation, "express" or "rule of thumb" methods for determining depths of dyke-like bodies were considered sufficiently accurate for many purposes. Vertical derivatives, residuals, continuations of observed fields to other levels are also used.

(iii) Interpretation differs in near-equatorial latitude from interpretation in high latitudes due to different inclination of magnetic field.

(iv) Remanent magnetism as well as induced magnetism had to be taken into account in interpretation of some areas.

(v) Aeromagnetic data could be interpreted to determine not only depths to magnetic basement but also to delineate magnetic intrusives in sedimentary sections. The presence of thick sill intrusives caused problems.

(b) Airborne radiometric surveys

Operational procedure:

(i) A method of simultaneous two-level radiometric observations was discussed. This method is in use in Australia, and is expected to yield more information from radiometric profiles.

(ii) The necessity of low-level flying and effective altitude control for interpretation purposes was stressed.

(iii) Radiometric surveying lacked depth penetration.

Interpretation

(i) The contrast in radioactive properties of shale with those of sandstone and limestone was useful in delineating sedimentary boundaries by

radiometric results.

(ii) Information was sought on the detection of radioactive halos associated with petroleum reservoir structures. Investigation had been made but the results were not conclusive. An explanation offered for such halos was that radioactive salts were carried by water up through fractures to the ground surface. Conclusions of AAPG bulletin 1958 were that radioactive anomalies supposedly associated with a petroleum reservoir could be accounted for on the difference on the radioactivity characteristics of the soils.

(c) Airborne electromagnetic surveys

Operational procedure:

(i) Basic systems of coil arrangements in use were outlined. Stability of coil orientations was essential.

(ii) Operational flying altitudes were stated to range from 3,000 feet to 300 feet.

(iii) In-phase and quadrature components of the secondary fields were measured, often at more than one frequency in the range 300 c.p.s. to 2300 c.p.s.

(iv) Depth of penetration below the ground surface varied with coil separation, but was also influenced by ground resistivity conditions and the effect of turbulence on coil orientations. For helicopter surveying, penetration was of the order of 50 feet, for aircraft with towed birds 400 feet to 500 feet. The A.B.E.M. system using two aircraft was claimed to have a penetration of 1000 feet. The AFMAG system using natural fields was also claimed to have a high penetration.

(v) A limitation of the method was the abundance of false anomalies recorded.

(vi) The method has been found highly successful in detection of massive sulphide ore deposits (Canada).

(d) Airborne gravimetric surveys

Interesting developments in airborne gravimetric techniques were reported:-

(i) In USA, two test flights were made at altitudes of 25,000 feet to 35,000 feet using Laceste-Remberg sea gravimeters. Errors in measurement were ± 5 milligals per 5 minute integrating period.

(ii) A successful test was carried out by Lundberg with a gravity gradiometer at an altitude between 1,000 feet and 2,000 feet. The equipment weighs 15 pounds and is considered to be a promising prospecting instrument.

General Conclusions

Airborne geophysical surveying can be expected to aid materially in the economic development of countries in the ECAFE region. In many areas, such surveying is essential for the detection of mineral deposits and potential petroleum reservoirs. Plans for these surveys should be formulated having regard to the known geology of the areas and in close relationship with other developmental systems.

Trained geologists and geophysicists would be needed in interpreting the results of these surveys.

The question whether the surveys should be carried out by the countries themselves or by contract with geophysical exploration companies could be decided in each case by considering the size of the survey area and the equipment, facilities and technicians available. Airborne geophysical surveys being usually costly operations compared to means available in newly developed countries. Adequate technical assistance to countries of the ECAFE region in carrying projects in the field was considered not only justified but also imperative.

Since airborne geophysical surveys constitute a continuing technical program, countries of the ECAFE region should take measure to provide competent staff and technical facility of their own to carry out the work.

6. Relationship between the various branches of aerial survey

Discussions on "relationship between the various branches of aerial survey" were focused on the following two questions: What aid one branch of survey could give to the other branches of survey; What aid one

branch of survey must depend on from other branches. On the basis of the discussions held in the Technical Groups as well as in the Seminar as a whole, the following conclusions were agreed upon:

(i) Aerial photographs constitute a basic tool, not only for the other branches of aerial survey but also for rarious topical mapping, development and construction work.

(ii) Photogrammetry provides economic means to prepare accurate topographic maps which are essential for study of resources development. Such maps are not only necessary for planning of flight and location of interesting areas for geological and geophysical studies, it provides also the base maps required for preparation of special subject maps, the final product of photo-interpretation studies and geophysical surveys.

(iii) In photogeological studies, photogrammetric procedures are required for (a) quantitative evaluation of interesting features such as thickness, slope and area; and (b) for location of position in field checking. Experience has proved that a short course of photogrammetry given to photogeologists has been beneficial. In turn, photogrammetrists have benefited from information given by photogeologists in handling difficult topographic conditions.

(iv) With regard to interdependence of photogeology and airborne geophysical survey, experience has proved that the knowledge of geological information on one area is helpful to interpreters of aeromagnetic anomalies of that area and the knowledge of airborne geophysical data is of great value to geologists in their photointerpretation work. Many scientists feel that airborne geophysics is essential in preparing geologic maps.

(v) In the various branches of airborne surveys, common techniques and common problems are numerous. For instance, method of stabilization of surveying instruments, positioning of aircraft, procedure of map compilation, etc., are of interest to all. The maintenance of a close contact among the various groups of scientists for exchange of information of mutual interest can be very fruitful.

7. Regional problems and international co-operation

Formation of technical staff

The seminar considered an acute problem confronted by most of the countries in the region, namely, the lack of sufficient technicians at various levels to carry out the aerial survey work required for efficient resources development. A Working Committee on Training and Information Facilities was set up. The report of the committee (I&NR/AS/57) which was reproduced as an annex to this document was accepted by the Seminar. The main conclusions read as follows:

It was agreed that:

(a) Existing training facilities in most parts of the region are inadequate;

(b) This situation could be remedied by provision of:

(i) Fellowships for advanced training in countries where the techniques have already been brought to a high level of development and where training facilities are recognized as excellent.

(ii) A Training Centre within the ECAFE region, primarily for the training of service investigators and qualified students about to undertake investigations. Secondary functions of the Centre would be to provide a specialist and research service, and to undertake the collection and redistribution of information on problems common to member countries.

Technical assistance

On the basis of discussions of possibilities of aerial survey method and of the reports received from participating countries, the Seminar recognized that aerial survey constitutes an efficient and rapid means of exploration and appraisal of natural resources of ECAFE region. Noting the lack of adequate technical facilities and financial means for such surveys in most parts of the region, the Seminar draws special attention to the need for substantive support from the United Nations (Technical Assistance Programme, Special Fund, etc.) to aerial survey projects for this region.

Further international exchange of information

During the appraisal of the work of the Seminar, it was pointed out that the intensive exchange of technical information has proved to be very beneficial to all participants. The assistance of the experts

from experienced countries in studying technical problems was highly appreciated In view of the great value of such a seminar to the participating countries, it was recommended that a second seminar on aerial surveying be organized for the ECAFE region in two or three years.

Regional Co-operation in Technical Work

Geophysical or geological maps of small areas cannot be prepared with accuracy if the geophysical or geological knowledge of large neighbouring areas are not known. International co-operation for exchange of the required geophysical or geological data must be strengthened to facilitate the compilation of the map with adequate information. For countries having small geographical areas, the undertaking of common projects with neighbouring countries to cover a large region would be highly desirable.

Knowledge of the magnetic field is essential for interpretation of aeromagnetic anomalies. The preparation of normal magnetic field charts and composite magnetic field charts of the ECAFE region is recommended so that they can be available to interested geophysicists.

REPORT OF THE WORKING COMMITTEE ON TRAINING AND INFORMATION FACILITIES UNITED NATIONS SEMINAR ON AERIAL SURVEY METHODS AND EQUIPMENT

Submitted by Dr. F. H. Fitch, rapporteur of the Committee

The Seminar met as a Working Committee of the whole at 1500 hours on 18th January 1960 to consider the position in regard to training and information facilities relating to aerial survey and interpretation techniques in the ECAFE region. The main conclusions, which are detailed below, were re-affirmed at a subsequent meeting of the Seminar at 1500 hours on 21st January.

IT WAS AGREED THAT:

(a) Existing training facilities in most parts of the region are inadequate.

(b) This situation could be remedied by provision of:

(i) Fellowships for advanced training in countries where the techniques have already been brought to a high level of development and where training facilities are recognized as excellent.

(ii) A Training Centre within the ECAFE region, primarily for the training of serving investigators and qualified students about to undertake investigations. Secondary functions of the Centre would be to provide a specialist and research service, and to undertake the collection and redistribution of information on problems common to member countries.

The employment of air survey methods is essential to modern exploration and development, not only for map making, but also in the assessment of natural resources. It invariably constitutes a saving of time and, in many branches, provides more accurate information than classical methods. Moreover, the methods provide a means of rapidly obtaining information from remote and inaccessible areas. It is therefore of primary importance that the techniques should be used to the full if the standard of living of the countries of the ECAFE region is to be raised as quickly as possible. This fact is recognized by the countries attending the Seminar, but there is at present no way of overcoming the serious scarcity of adequately trained personnel to apply the techniques. Thus the provision of additional and improved training facilities would constitute one of the most economical, valuable, and progressive means of assisting the rapid development of the countries of the ECAFE region.

The region's requirements in personnel fall into two categories, namely (i) specialists with a high standard of qualification, able to plan and direct projects; and (ii) a much larger number with a working knowledge of the techniques, able to carry out simple or reconnaissance work, and knowing when to submit more difficult or detailed problems to the specialists. Training of specialists would have to be done outside the region in one or more of the established organizations are available. Training of the second category could best be given within the region for two main reasons, namely: (a) economy in travelling and incidental expenses (particularly important as this type of training should be given to as many students as possible, but the courses would be of relatively short duration); and (b) so that practical work can be done in conditions related as closely as possible to those of the students' country of origin.

The Training Centre should be established in some place that can be easily reached from the countries sending students, and should provide for teaching and accommodation. The latter is considered important as an

opportunity for promoting international understanding by encouraging social contacts between students.

The Centre should consist of four departments, but students would receive elementary instruction in the three sections outside the one of immediate concern to them. The four sections would deal with:-

(a) Photography from the air

(b) Photogrammetry (map-making)

(c) Photo interpretation for geological, forestry, soil survey and related purposes

(d) Airborne geophysical surveys and interpretation

Working groups led by Mr. Saleh of Indonesia, Mr. Alam of Pakistan, Mr. Kalhor of Iran, and Dr. Sato of Japan prepared draft papers outlining the suggestions regarding the organization of these four departments. These draft papers[1] are given in Appendices I to IV. The availability of aerial survey material and data in ECAFE countries and details of their use can be found in reports submitted by participants on the activities of their respective countries.

At the adoption of this report, the Committee drew attention to the need for participants to report to their governments on this question so that the latter could be ready to consider the matter at the forthcoming meeting of the Subcommittee on Mineral Resources Development (Tokyo, April 1960) at which the report of the Seminar will be examined.

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1 As individual papers not reviewed by the Committee.

APPENDIX I

Photography from the Air

GENERAL

The accuracy and economy of photogrammetry depend upon the proper execution of the aerial flight. The quality of aerial photography, which closely affects the amount of use to which the photographs can be put, depends not only on a firstclass aerial camera, but also upon the choice of photographic material and careful work in the photographic laboratory. Due to the shortage of trained personnel in this branch, there is considered to be an urgent need for a training centre in the ECAFE region.

FELLOWSHIPS

It is considered that there is at present no scope for fellowships for instruction in aerial photography at any existing international centre, but (travelling) fellowships for study tour enabling experienced or semi-experienced personnel from the ECAFE region to see the latest developments in technique elsewhere would be of considerable value. The duration of these fellowships would be about 6 months.

TRAINING CENTRE

Subjects: Elementary optics, optics in photogrammetry, cameras, photography, photographic laboratory routines, and flight planning.

Duration of courses: About 6 months.

Personnel: One aerial photographic expert and two trained laboratory assistants.

Equipment: To include aerographic cameras, darkroom equipment, developing and printing machines, drying machine, rectifier, enlarger, stereoscopes, densitometers, diapositive printers and reductors, stereographic films and papers, chemicals, diapositive plates, transparent acetate and a full library of relevant textbooks and publications.

Standard of Students: Students would require a basic knowledge of physics, mathematics, and chemistry to certified secondary school standard, a knowledge of English and an interest in photography.

APPENDIX II

Photogrammetry

GENERAL

The desire for improved facilities for photogrammetric training in the ECAFE region is clearly illustrated by the unofficial figures assembled from participants. The following countries indicated that they would be glad to take advantage of fellowships:
Afghanistan, Cambodia, Ceylon, China, India, Indonesia, Iran, Japan, Laos, Pakistan, Philippines, Thailand, and Viet-Nam. The total number of fellowships immediately needed by these countries is 27, with suggested durations ranging from 3 months to 2 years. Preference as to location of study was given as I.T.C., Delft; U.S.A.; I.G.N., France; and Australia.

It was also considered by the working group that the proposed training centre would need to be capable of handling at least 20 students at a time in order to meet the urgency of the problems presented by the scarcity of personnel with a working knowledge of photogrammetry.

FELLOWSHIPS

Two main types of fellowship were envisaged by the working group, namely, general studies for durations of 3 to 6 months and full photogrammetric courses of 1 to 2 years.

TRAINING CENTRE

Subjects[1]: Basic principles of photogrammetry, elementary principles of aerial cameras and aerial photography, restitution of single vertical photographs, orientation of a pair of photographs (geometrical

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[1]/As it was generally agreed by the Working Comittee that geodesy should be included from the courses offered at the Training Centre, a sound knowledge of basic geodetic principles would also be required in students selected for training.

explanation and elementary explanation of various methods of orientation), elementary explanation of the principles of construction of stereoplotting instruments of various types, planimetric radial triangulation, principles and procedure of aerial triangulation, photo mosaics, and ground control for photogrammetric mapping.

These subjects and the accompanying practical exercises should be designed to bring a technician to the standard at which he could undertake all photogrammetric mapping independently, and be able to do cadastral mapping and aerial triangulation under guidance.

Duration of courses: About 6 months.

Personnel: Two experts to conduct theoretical courses and two experts to conduct practical exercises.

Equipment: For a class of 20 students:-

2 1st order instruments
6 2nd order instruments
4 3rd order instruments
3 stereoscopes with dove prisms and binoculars
12 stereoscopes with binoculars
1 slotted template equipment
1 radial triangulator
1 rectifier
12 stereometers / parallax bars
library of photogrammetric and geodetic textbooks and publications

Standard of students: Good educational background and preferably two to three years' ground survey experience.

APPENDIX III

Photo Interpretation

GENERAL

Generally, little use is made of photo interpretation in the ECAFE region as the large number of interpreters needed for the development of natural resources and allied purposes is not available. A regional training centre would offer the best means of training such large numbers. Students showing special aptitude at the centre could be selected for fellowships for more advanced training.

FELLOWSHIPS

Fellowships should be for about 6 months, with specialization in interpretation for mineral resources, geological, soil, forestry, engineering, and irrigation investigations, and more advanced training in aerial photography and photogrammetry.

TRAINING CENTRE

Subjects: As for fellowships, but at a more elementary level.

Duration of courses: Three months.

Personnel: For the full range of photo interpretation techniques at least 4 experts[1] covering between them the varied fields of interpretation. The photographic and photogrammetric training would be given by experts from the departments teaching those subjects.

Equipment: Pocket and mirror stereoscopes, Sketchmaster, Stereotope or equivalent, slotted template, parallax bars, library of general photo interpretation and regional geological, forestry and soil publications.

Standard of Students: B.Sc. or equivalent, in geology, forestry, etc.

1/ The Working Committee agreed that the experts could also usefully have a secondary function in the interpretation department by being responsible for the collection and redistribution of data (for example photogeological keys which, although not of regional value, would be of value to neighbouring countries).

APPENDIX IV

Airborne Geophysical Surveys

GENERAL

Provision of training facilities for airborne geophysical surveys in the ECAFE region would assist development by: (a) improving knowledge of the capabilities of the methods; (b) enabling countries to select the method most suited to their particular problem; and (c) permitting the continued useful interpretation of the results after the primary purpose has been achieved.

FELLOWSHIPS

Courses specifically directed to training in airborne geophysics are not yet available at any international training centre, but advanced training in geophysics as a whole could be given in some existing institutions, and experience of advanced techniques could perhaps be obtained by fellowships providing for attachment to organizations in which they are being developed. The probable duration of the fellowships, in either case, would be one year.

TRAINING CENTRE

Subjects: Academic study of all airborne geophysical methods[1], with a parallel technical course in operation and instrument maintenance.

Duration of courses: Six months.

Personnel: Experts on airborne geophysical survey methods and interpretation, instrument engineer.

Equipment: Aeroplane with radio altimeter, position camera, and radar; aeromagnetometer; aero-radioactivity instrument; aero-electromagnetic instrument; library of geophysical and mathematical textbooks and geological publications.

Standard of students: University graduates in geology, geophysics, or mining for the geophysical course. Qualified electronic technicians for the technical course.

1/ The participant from ITC gave it as his opinion, in Working Committee, that training in airborne geophysics was better given at a geological institution, but the participants from countries of the ECAFE region insisted that it should be included in the proposal training. Provided that students are already well

qualified in geology or mining, preferably with some knowledge of ground geophysical methods, there is no doubt that association of training in airborne methods with a Centre dealing also with photogrammetry and photogeologic interpretation, both of which are used in interpretation of airborne geophysical results, would have considerable advantages. The scope of the training that could or should be given at the Centre in this department was, however, not unanimously agreed to and is one of the main points requiring further clarification.

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