Interim Progress Report for Commission VII International Society of Photogrammetry (Years 1956 to 1958)

CHARLES G. COLEMAN,
President, Commission VII

COMMISSION VII of the International Society of Photogrammetry is concerned with Photographic Interpretation, and its application in all parts of the world. It is the youngest of the commissions of the Society, having been activated in 1948.

At the International Congress of 1956, held in Stockholm, Sweden, it was decided that a number of working groups should be established under Commission VII, to cover the many different areas of activity in which the fast-growing science of photographic interpretation was operating. Therefore, in the months following this congress, an attempt was made to set up subject working groups, and to find qualified experts in each field to act as working group chairmen.

At the present writing, there are six such working groups active, each with a very able and experienced chairman at the helm. In the short period of operation these chairman have not only developed their own correspondents for the work of their groups, but are in some cases well along in planning for their participation in the 1960 Congress.

The six working groups, their field of interest, and their chairmen, are listed in Table A.

At the 1956 Congress, it was also decided that an effort should be made to report upon

TABLE A

Working Group		Chairman
No. 1	PHOTOGRAPHY AND PHOTO COVERAGE	*Dr. Kirk Stone* Department of Geography University of Wisconsin Madison, Wisconsin, U.S.A.
No. 2	PHOTO INTERPRETATION EQUIPMENT AND TECHNIQUES	*Mr. Harry L. Coggin* 1509 West Street Falls Church, Virginia, U.S.A.
No. 3	INTERPRETATION OF SURFACE CONFIGURATION, DRAINAGE, SOILS, GEOLOGY	*Mr. Page E. Truesdell* 7821 Gateway Boulevard Washington 28, D.C., U.S.A.
No. 4	INTERPRETATION OF VEGETATION	*Dr. A. Boone* International Training Centre for Aerial Survey Delft, Holland
No. 5	INTERPRETATION OF URBAN, RURAL AND INDUSTRIAL STRUCTURES	*Lt. Col. Norman E. Green* 79 N. Hancock Street Lexington, Massachusetts, U.S.A.
No. 6	INTERPRETATION OF ICE	*Captain Ragnar Thoren* R.Sw.N. 23 Kommendoersgatan Stockholm, Sweden

progress in photographic interpretation, at intervals of less than every four years. The present goal is to have an annual report. However this has not been possible during the 1956–1960 period, since much of 1957 and 1958 has been occupied with setting up the working groups. This report is therefore a biennial one, covering progress during 1957–1958. It has been broken into sections, corresponding with the working groups' fields of interest.

In general, the application of photographic interpretation techniques to military, commercial and academic problems is continually increasing, and may be expected to reach greater heights by 1960. The initiation of large highway programs in the United States, Sweden and elsewhere has brought with it a greater demand for photographic interpretation services. The number of photographic interpretation courses and photographic interpretation research programs at universities in the U. S. has increased during the past two years.

A particularly significant step forward in the documentation of photographic interpretation techniques is represented by the American Society's MANUAL OF PHOTOGRAPHIC INTERPRETATION, prepared under editorship of Dr. Robert N. Colwell, and soon to be published.

PLANS FOR THE 1960 CONGRESS

It is hoped that the schedule of the 1960 International Congress will provide time for holding a session for each of the six working groups of Commission VII, plus a general session. Comments received during and after the 1956 Congress indicated that more time for discussion was desirable, rather than a full program of papers. Hence it is planned to limit presentations to one or two representative papers from each working group, plus panel discussions. However an attempt will be made to publish a number of papers in addition to those chosen for presentation.

In order to ease the great publishing load which will result from submission of papers for the 1960 Commission VII program, it is planned to publish as many as possible of these papers in advance of the Congress. These papers will appear in various issues of PHOTOGRAMMETRIC ENGINEERING during 1959 and early 1960. Those desiring to contribute should therefore submit their material as soon as possible so that publication can be scheduled.

Working Group No. 1
Photography and Photo Coverage

KIRK H. STONE, *Chairman*

IN A previous paper the availability of world air photo coverage was presented to encourage the use of aerial photography in research and teaching.[1] Revision of that presentation is advisable because of numerous requests for data, new aerial photography, more complete information, changes in the availability of air photos, and the advisability of cartographic reclassification of world air photo coverage. However, there is need for still more information, to complete the revision. Aid is hereby invited.

Interest is limited to single and multiple-lens air photos which are available, at least to citizens of the country photographed, on permanent or temporary bases. In general availability should be through a local national office so that only primary diplomatic and military clearances, if any, will be necessary. No data are desired or published concerning classified military coverage, or any other air photography not generally available to at least the citizens of the nation of coverage.

By December 1957 more than half of the earth's land surface was known to have been photographed from the air at least once (Figure 1). Most of the photography was continuous coverage, that is, numbers of overlapping single or multiple-lens photos providing a complete and unbroken picture of a large area. This type of coverage is usually the more useful for interpretation and photogrammetry. Some world coverage, however, is discontinuous, where single-lens verti-

[1] Stone, K. H. "World Air Photo Coverage, 1953," PHOTOGRAMMETRIC ENGINEERING, v. *XX*, 1954, pp. 605–610. The map was also reproduced in V. C. Finch, G. T. Trewartha, A. H. Robinson, and E. H. Hammond, *Elements of Geography*, Fourth Edition, 1957 as Figure 1.13.

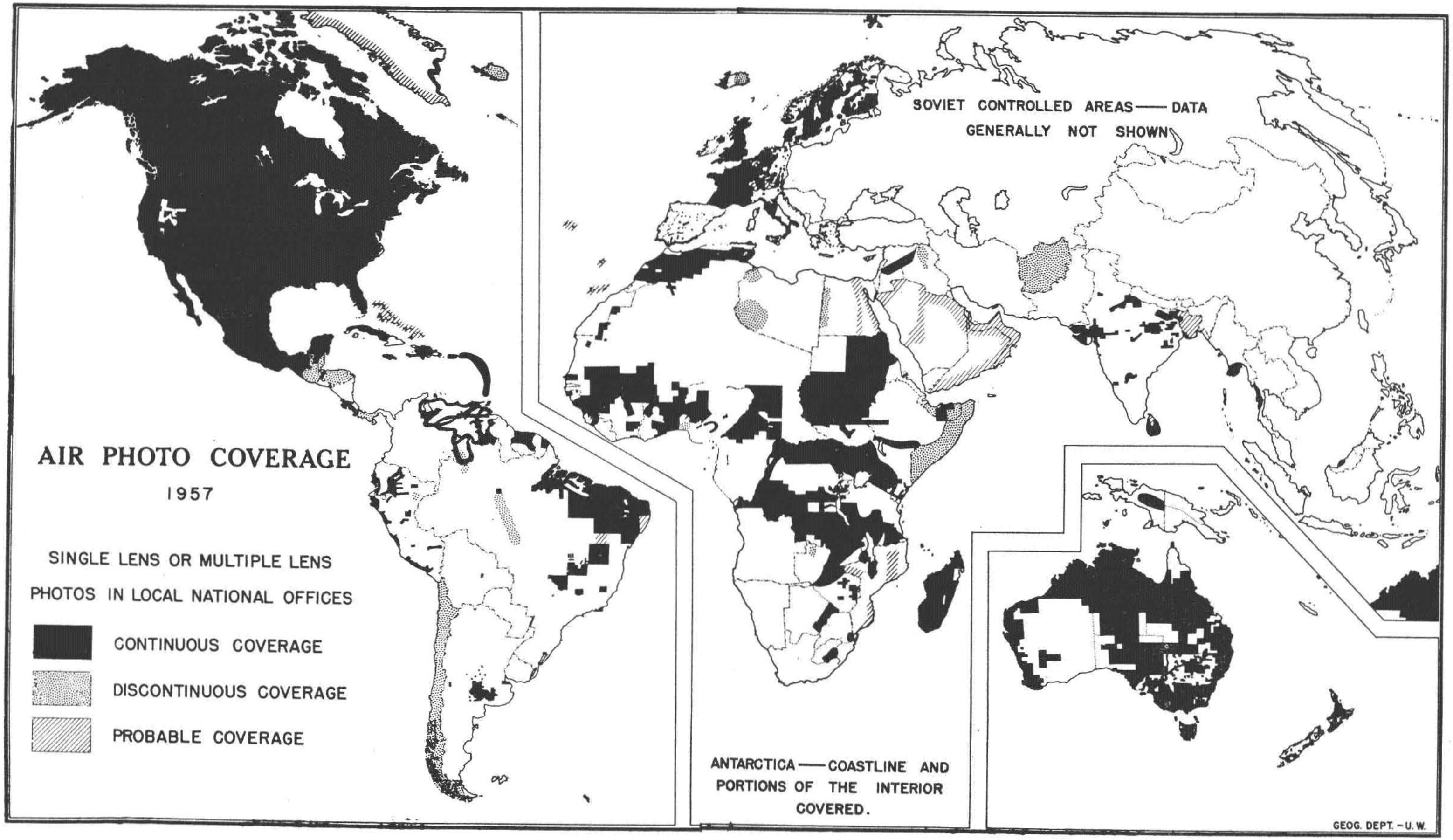
AIR PHOTO COVERAGE
1957
SINGLE LENS OR MULTIPLE LENS
PHOTOS IN LOCAL NATIONAL OFFICES
CONTINUOUS COVERAGE
DISCONTINUOUS COVERAGE
PROBABLE COVERAGE
SOVIET CONTROLLED AREAS—DATA
GENERALLY NOT SHOWN
ANTARCTICA—COASTLINE AND
PORTIONS OF THE INTERIOR
COVERED.
GEOG. DEPT.-U. W.

FIG. 1

cal or oblique pictures have been taken mostly as individual pictures; these have somewhat less value as source material for regional study but are useful for work on limited areas and as illustrations for publication. Also shown on Figure 1 are areas of probable coverage where photography of an unknown type, most likely discontinuous, has been taken. Specific information presented herein on all three of these classes of photography is supplementary to that previously published.[2]

Nearly all of North America has been photographed. Recent photography has eliminated spots of no coverage in Canada and has reduced them in the United States to a small area in the vicinity of Utah.[3] Least well known is Central American photographic availability where present information is that Costa Rica is largely covered by trimetrogon photography, and Panama, Honduras, Guatemala, and British Honduras have discontinuous coverage.

South American coverage data are more complete and accurate than previously. The existence of Brazilian and Argentinian photography of specific areas has been interpreted from maps[4] but undoubtedly there are areas of unclassified photography, additional to those shown on Figure 1. Specific locations are known now for the Peruvian, Ecuadorian, and Venezuelan flights which provide continuous coverage. However, only discontinuous coverage is known for Chile, and no data are available for air photos available in Colombia, Bolivia, Paraguay, and Uruguay. In general, South America remains the continent which is least well known with respect to aerial photographic coverage available.

The information about the availability of air photos in Europe has changed considerably since 1953. For Iceland, Norway, Sweden, and Finland there are recent data[5] on continuous coverage but it is most difficult for any foreigner to obtain Swedish and Finnish photography because of military restrictions. Similar controls are applied to both old and recent coverage of Denmark and the United Kingdom; in fact, it is often difficult for even local scientists to obtain coverage of U. K. areas. In the German Republic, much postwar coverage has been taken of western parts and the bigger cities[6] with much of the photography having scales larger than 1/15,000. So far as is known there are still large parts of Italy for which there is no unclassified photography, and the distribution of existing Iberian Peninsula coverage is so spotty that it could as well be mapped as discontinuous on the scale of Figure 1. For southeastern Europe no information on non-military photo coverage is available.

Less African coverage is available than was previously thought. There is continuous coverage,—taken largely for mapping purposes (therefore, small-scale photos—at the northwest coast and in a broken belt through the middle of the continent. However, there are large areas of no known coverage through central northern Africa and in the southwestern part. For these confirmation is needed regarding the lack of coverage available. Also for the remainder of Africa, excepting the Belgian Congo,[7] data are needed with respect to the recent coverage.

Knowledge of Near Eastern air photo coverage is very inadequate. This is partly a

[2] Stone, *op. cit.*

[3] Department of Mines and Technical Surveys, National Air Photographic Library, *Air Photographic Coverage, Dec. 1955*, scale about 1/8,000,000 Ottawa, 1955. U. S. Geological Survey, Map Information Office, *Status of Aerial Photography*, scale 1/5,000,000, Washington, January, 1958.

[4] Miss Mary Fortney compiled the data from: Instituto Geografico Militar, *Carta Topografica de la Republica Argentina*, scale 1/50,000, Buenos Aires, various dates; and American Geographical Society, *South America*, scale 1/1,000,000 New York various dates.

Since the preparation of Figure 1, newer and more complete data have been received for both Argentina and Brazil. We are indebted to Ing. Heliodoro Negri of the Pan American Institute of Geography and History in Buenos Aires for a photostat copy of Instituto Geografico Militar, *Vuelos Aerofotogrametricos*, scale 1/5,000,000, December, 1954, and to Mr. Orlando Valverde of the Pan American Institute of Geography and History in Rio de Janeiro for a blueprint copy of Conselho Nacional de Geografia, Divisao de Cartografia, *Recobrimento Aerofotografico do Territorio Brasileiro*, scale about 1/5,000,000, Rio de Janeiro, date probably 1956 or 1957.

[5] Steingrimur Hermannsson, The National Research Council of Iceland, letter and manuscript map, Reykjavik, Jan. 16, 1958; Wideröes Flyveselskap og Polarfly A/S, *Oversikt over Fotografisk Dekning* (mimeo.) with two maps with scales of 1/1,000,000, Oslo, 1958; Rikets Allmänna Kartverk, *Flygfotografering*, original scale 1/4,000,000 Stockholm, 1958; and R. R. Platt (ed.), *Finland and Its Geography*, New York, 1955, Fig. 53, and The Geographical Society of Finland, *Suomi, General Handbook on the Geography of Finland*, Helsinki, 1952, pp. 20–23, 27.

[6] We are indebted to C. G. Coleman, Jr. of Washington, D. C. for a photostat copy of Institut für Angewandte Geodäsie, *Zusammenstellung der Bildflüge*, 1955, with two maps with scales of 1/1 million, Frankfurt am Main, 1956.

[7] Institut Geographique du Congo Belge, *Carte des Regions Photographiques a la date du 31 Mars, 1955*, scale 1/3,000,000, Leopoldville, 1955.

result of most of the known air photography in this area being discontinuous and old, and partly because of strained political conditions in recent years. Additional information about air photos of the area including privately held coverage, such as photography for oil companies, is sorely needed for research purposes.

Coverage of Australia and New Zealand is generally the same as it was in 1953. Some additional photography has been taken in New Zealand[8] but details about recent coverage and rephotography in Australia are needed.

There is little air photo coverage available for that part of Asia outside of the Soviet Union and the area of its strong influence.[9] Actually large areas have been photographed but most of the work was by military agencies and many photos have been reclassified recently and are not available because of increased tension in southeastern Asia. Most of the non-military coverage known is of Afghanistan and India; the former is coverage to support the establishment of an accurate survey system while the known Indian coverage is largely of cities and is more than ten years old. Additional information is required for all of Asia, especially for research on the East Indies, the Philippines, and Japan.

It is realized that the data on world air photo coverage as shown on Figure 1 might be classified in different ways. Such classification might be for kinds of photography (verticals, near-vertical, and obliques, the number of multiple coverages, the scales of the photos, the dates (month and year), the availability to local or foreign scientists, and the types and locations of offices where coverage is available for study or purchase. However, maps showing these classifications can not be prepared until the appropriate information is more complete. Assembling these data at the University of Wisconsin[10] will be continued, but everyone's aid is needed. The help of all is invited in keeping world air photo coverage information current and complete.

[8] R. P. Hargreaves, *New Zealand Air Photo Coverage* (as at 1st June 1958) (ditto in color), scale about 1/5,275,000, Dunedin, 1958.

[9] The only unclassified information on Soviet Union air photo coverage is "An Aerial Photographic Survey of the Entire Arctic Land-mass has now been completed, . . . " from V. H. Burkhanov, *Achievements of Soviet Geographic Exploration and Research in the Arctic*, Canadian Defense Research Board, T 253 R, (translation by E. R. Hope), Ottawa, July, 1957, p. 22.

[10] The Department of Geography, University of Wisconsin, Madison 6, Wisconsin, U.S.A.

Working Group No. 2 Photo Interpretation Equipment and Techniques

HARRY L. COGGIN, *Chairman*

In the past, the equipment requirements of the photographic interpreter have tended to be very modest, the principal elements usually being a simple stereoscope, one or more magnifying devices, and a finely graduated measuring scale. These pieces were already available in the photogrammetrist's working kit. At the 1956 Congress however, a definite trend was noted toward (1) more complex pieces of equipment for photographic interpretation, and (2) a number of types of equipment designed specifically for interpretation rather than for photogrammetric work. This trend has continued during the two years since this Congress.

While the picture is still confused, it is hoped that by 1960, a more definitive estimate can be given as to the current level of photographic interpretation equipment requirements in the various subject fields. The study of photographic interpretation techniques will of course be closely related.

One or two examples will be given of current developments of interest to photographic interpreters.

The availability of electronic and fluorescent dodging printers has been of particular importance to both the photogrammetrist and the photographic interpreter. However while the photogrammetrist has been interested principally in clarifying the detail which he has to map or measure, the photographic interpreter has found his ability to use tone, texture and shadow in detailed analysis of photographic features increased manifold. It is anticipated that the use of these printers for photographic interpretation projects will become widespread within the next few years.

Closely allied with the above are the various image-enhancement devices now in development stage. These instruments permit the improvement (or diminishing) of various areas of contrast within a photographic image and have great future possibilities in special photographic interpretation tasks.

The photographic interpreter has been moving steadily into the field of stereoscopic plotting instruments. Here his requirement is not for the precise equipment used in many photogrammetric processes, but for the less expensive, simple devices which can be rapidly operated to determine spot heights or slopes. It is noted that during the past two years, instrument makers have begun issuing advertising literature describing the application of certain small, third-order stereoplotters to photographic interpretation problems.

A somewhat different problem faces the photographic interpreter who works in an organization where numbers of first or second-order plotters already exist. Here efforts have been made to adapt photographic interpretation techniques to this equipment. In some cases these efforts have led to the adoption of small modifications to the instruments. (See Wm. Fisher's U. S. Geological Survey report, under Working Group No. 3.)

Mention should also be made of the continuing design and use for photographic interpretation work, of plastic templates of all descriptions. Many interpretation tasks involve either sampling or repetitive measurement of a large number of small uniform objects. In this type of work, plastic templates scribed with sampling area sizes, or with standard measuring shapes or units are of great value. These pieces of equipment are simple, low in cost, and are often hand-made by the individual. It is believed however, that in many cases, mass production would be economically feasible.

Working Group No. 3
Interpretation of Surface Configuration Drainage, Soils, Geology

PAGE E. TRUESDELL, *Chairman*

Introduction

The use of aerial photography continues to be of major importance for interpreting the earth's surface. As techniques are developed throughout the world, and interesting papers are published, it is hoped that additional contributors from various countries will be stimulated to participate in the program of the working group.

Working Group No. 3 is concerned with all phases of photo interpretation of the earth's surface. Therefore, the subject matter to be covered by this group is extremely wide. Several papers have already been received for the 1960 program, and it is requested that each one who has previously indicated interest in or intention to write a paper, prepare it at the earliest convenient date so that such papers may be published in advance of the 1960 Congress.

The value and application of aerial photography for the interpretation of the earth's surface is indicated by the numerous uses in recent years.

Applications of Aerial Photography

A description of many of these applications has been contributed by various authors mentioned on the following pages.

Mr. Donald Lueder, formerly of Hunting Technical Services, Inc., and author of the recent publication "*The Principles and Applications of Aerial Photographic Interpretation.*"

Mr. Lueder indicates that the uses and applications, include not only the well-known location of sand, gravel, quarry rock and well-graded fill, but also the evaluation of foundation and abutment conditions at dam sites; the evaluation of materials surveys in tropical regions; the probable subaqueous conditions and regimen characteristics in river-valleys; route locations and analysis for highways, access roads and railways. Additional uses as reported by Mr. Lueder and others include the planning and extrapolation of ground geophysical and drilling surveys, airport foundations, surface drainage, flood control hydrology, depth of overburden, groundwater conditions, site analyses, agriculture and geological mapping, irrigation analyses and many others. In fact the uses of aerial photography are so numerous that it covers almost every field of natural resources and conditions.

Mr. Ta Liang, consultant, Ithaca New York.

Mr. Ta Liang writes that while associated with Tippetts-Abbett-McCarthy-Stratton of New York, his photographic interpretation activities included highway and railroad surveys; site and construction material investigations for the Shihmon Reservoir Project Taiwan (Formosa); and an agricultural soil mapping program for the Lower Tigris and Euphrates Rivers Project, Iraq. In the Iraq irrigation project airphotos were found to be very helpful to the engineers and agriculturists in classifying soils for irrigation use located in the large flat area south of Bagdad. In addition, many of the ancient irrigation systems, old river channels, and natural levees and backwater areas, related to present and past channels, were discernible on the airphotos.

Professor Charles L. Miller of the Massachusetts Institute of Technology.

The Photogrammetry Laboratory of M.I.T. is presently working on a project sponsored by the Mass. Dept. of Public Works, in cooperation with the U. S. Bureau of Public Roads. This project has as its mission "to explore new uses of photogrammetry in association with automatic instrumentation and electronic computers, for increasing engineering productivity and reducing construction costs on highway projects."

The project staff is currently working on two new concepts of highway location analysis which involve photo interpretation—the digital terrain model and the digital cost model. Under the concept for the former, strategic ground points (points of change) are represented by their three spatial coordinates and two classification criteria. These data can be stored in a digital computer and the various volumes of earth, rock, and peat can be computed for various trial alignments through the terrain model.

The digital cost model is similar to the terrain model in that its x and y coordinates are the same; however the z axis is in dollars and is the summation of the various costs to build a highway through that point, i.e. for right of way, clearing and grubbing, earthwork, etc. Through this model, the path of least cost can be computed and traced.

It is envisioned that air photo interpretation will be used in the digital terrain model to determine soil types, and where possible the depth of peat or the depth of rock, thus allowing this information to be used in the earthwork computations at the location stage.

Air photo interpretation will play a much greater part in the digital cost model. From aerial photographs of the area under consideration, overlays would be made for each factor influencing the cost per unit length of building a highway through any point. These factors include right of way, land preparation, earthwork, pavement foundations, and structures; and they are a function of land use, vegetation, soil type and extent, and natural man-made barriers, which may be identified through air photo interpretation with a minimum of fieldwork.

Thus it can be seen that air photo interpretation plays a vital role in the digital model concepts, allowing many trial lines to be evaluated from an earthwork or cost basis as compared with a very few using conventional methods.

Professor Jean Gandillot, University of Paris.

Prof. Gandillot in summarizing some of the recent technical progress in France in the interpretation of aerial photography states that in the Hoggar region, an area of 132,000 square kilometers—about a quarter of the area of France—was studied by the photo geologists of the Institute of Petroleum under the direction of Mr. Guyonnand. They analyzed 6,500 photographs of the mission, representing the areas studied, and traced the resulting stratigraphic and tectonic limits, the differences in morphology, and the outlines of the stratum, ruptures and anomalies on to the photogeological map. This study was completed in 14 months of which 7 were utilized in photogeology, 2 in contouring and 5 in verification of the terrain.

Professor Laurence H. Lattman of The Pennsylvania State University.

Prof. Lattman briefly summarized as follows his paper on "Techniques of Mapping Geologic Fracture Traces and Lineaments on Aerial Photographs" which was published in PHOTOGRAMMETRIC ENGINEERING, 24(4): pp. 568–576.

"Mapping of linear features consisting of soil tone, vegetation, and topographic (including drainage) alignments, on aerial photographs and mosaics has attracted much attention from photogeologists in the last few years. Contributions to the study of these features have been made by Blanchet (1957), Mollard (1957 a, b), Kupsch and Wild (1958), Lattman and Nickelsen (1958), and Lattman (1958).

"Various names, including fractures, lineaments, surficial lineaments, micro-fractures and macro-fractures, have been applied to these linear features. It is suggested (Lattman, 1958) that the term 'fracture trace' be applied to those linear features which have less than one mile of continuous expression on aerial photographs, and that the term 'lineament' be applied to those linear features which are expressed continuously for more than one mile on the photographs or mosiacs, but which may extend discontinuously for tens of miles. Fracture traces may constitute parts of lineaments.

"Fracture traces are best mapped by stereoscopic examination of aerial photographs whose scale is 1 to 20,000 or larger and lineaments are best studied on aerial mosaics (Lattman, 1958).

"It is suggested that fracture traces represent local joints or small faults (Blanchet, 1957; Lattman and Nickelsen, 1958), and lineaments represent major subsurface faulting (Kupsch and Wild, 1958) or zones of 'shatter.' All of the writers listed above include examples of fracture traces and lineaments in their articles, from which the interested reader may note the diversity of topographic and geologic provinces in which these features are found.

"In addition to speed and convenience in mapping, the aerial photograph allows joint and faults to be mapped which are not visible to the ground observer; for example, in areas of no bedrock outcrop."

Mr. W. A. Fischer, Chief Photogeology Section, Alaskan Geology Branch, U. S. Geological Survey, reported on the activities of the Photogeology Section.

Since 1956 the use of photogeologic techniques by the U. S. Geological Survey has continued to increase. This growth has been brought about primarily by training courses in photogeology and photogrammetry, and by a program of assigning to field projects, experienced geologists trained in photogeology. As a result a much broader understanding of the advantages and limitations of photogeology has been achieved; greater use is now being made of geologic data derived from aerial photographs than in previous years.

Most of the geologists in the Geological Survey who specialize in photogeology have been reassigned from projects involving reconnaissance-type photogeologic mapping to either photogeology research projects or detailed field mapping projects. These require geologists who are well trained and experienced in the techniques of photogeology and in the application of photogrammetry to the geology; there is a growing shortage of such personnel.

Several projects, which have been completed since 1956 or are currently active and which involve extensive use of photointerpretation, are listed in Table B. It is believed that these projects are representative of the general types of operational projects, involving photointerpretation, that have been or are being conducted.

In addition to the specific projects listed in Table B, a continually increasing number of field geologic projects are utilizing photogrammetric instruments for compilation of geologic maps, preparation of geologic cross-sections, determination of certain quantitative geologic data, and interpretation and mapping of geologic features having special significance, such as old lake beaches that locally are important aquifers.

The most significant trends, in addition to the closer integration of photogeology and field geology, probably have been the increasing use of small-scale photography (1/60,000 scale or smaller) and precision photogrammetric plotting instruments, and the increased interest in the use of color and other special types of photography to achieve certain geologic results.

Since 1956, training activities in photogeology and photogrammetry have been continued and expanded. Three separate courses are now given: 1) a photogeology course of 2 weeks duration, given in Denver, Colorado, and Menlo Park, California. This stresses the applications of photogrammetry to geology; 2) a photogrammetry course of 2 weeks duration, given in Denver, Colorado, and Washington, D.C.; this is an intensive course in the fundamentals of photogrammetry and includes demonstration of and brief training in the use of photogrammetric instruments used for both topographic and geologic mapping; 3) a photogeology course of seven months duration for foreign students. This includes study of both photogrammetry and photo interpretation and their applications to geology.

Thus far a total of more than 500 geologists have participated in one or more of these courses.

These formal training courses have been supplemented by assignment of photogeologists to training duties in British Guiana, Brazil, and Mexico under the ICA Point-4 program.

Photogeologic research is concentrated primarily in three fields: 1) analysis of the limitations of photogeology as applied to geologic mapping in various physiographic, climatic, and geologic terranes; 2) application of special photographic films and photographic tech-

TABLE B

Title	General Description	Objective	Scale and Type of Photography Used	Instruments Used
General geologic mapping, Colorado Plateaus	1/62,500-scale mapping of distribution of sedimentary and igneous rocks of the Colorado Plateaus, mapping all structures such as folds, faults and joints	To provide geologic information for use in the compilation of a 1/250,000 scale geologic map of the Colorado Plateaus	1/60,000 black-and-white supplemented locally by 1/20,000 black-and-white	Kelsh plotter, ER-55 Stereoscope, Radial planimetric plotter
Forty Mile Canyon area, Nevada	1/50,000-scale mapping of the distribution of volcanic rocks with emphasis on correlation of rock units and on mapping of structure	To provide geologic information to assist in studying possible ground water contamination resulting from underground bomb tests	1/60,000 black-and-white	Radial planimetric plotter, Stereometer, Stereoscope
Inyan Kara, Wyoming	1/24,000-scale mapping of the Inyan Kara group of rocks of Cretaceous age, emphasizing detailed mapping of sandstone beds within the group and detailed mapping of structure. A combination field and photogeologic project	To provide information for making stratigraphic correlations within the Inyan Kara group and to make detailed structure and isopachous maps to provide information pertaining to the search for uranium	1/37,000 black-and-white	Kelsh plotter, Profile plotter
Snake River area, Idaho	Preparation of preliminary maps showing distribution of volcanic and lacustrine rocks; also structure contour maps of selected horizons. A combination field and photogeologic project	To provide preliminary geologic information in advance of field investigations, and data for detailed structural analysis. Emphasis on water resource problems	1/37,000 and 1/60,000 black-and-white supplemented locally by 4″×5″ color photography	Kelsh plotter, Multiplex, Stereoscope
Orange Cliffs area, Utah	1/24,000-scale mapping of distribution and structure of sedimentary units. A combination field and photogeologic project	To provide geologic maps of a possible uraniferous area	1/20,000 and 1/60,000 black-and-white	Kelsh plotter
Goose Lake—Ebért Rim area, Oregon	1/125,000-scale mapping of volcanic and sedimentary terrane in Oregon, emphasizing correlation of lava flows	To provide information for use in compiling the state geologic map of Oregon	1/60,000 black-and-white	Stereoscope, Radial planimetric plotter, Stereometer
Southeastern Alaska mapping	1/250,000-scale mapping of igneous-metamorphic terrane primarily within the Juneau quadrangle, Alaska; also detailed mapping of selected areas at larger scales. A combination field and photogeologic project	To provide preliminary geologic information in advance of field studies, and detailed geologic maps of selected areas	1/40,000 black-and-white supplemented by 1/20,000 split vertical black-and-white	Stereoscope
Reconnaissance mapping, Alaska	1/250,000-scale mapping of much of Alaska, showing distribution and structure of major rock units	To provide geologic maps of areas in Alaska which are unmapped or covered by maps that are out of date or out of print	1/40,000 black-and-white	Stereoscope
Delaware River Basin, New Jersey Pennsylvania	1/24,000-scale mapping of parts of the Delaware River Basin. Current emphasis on the application of photointerpretation to the mapping of coastal plain sediments. This is a combination field and photogeologic project	To provide information pertaining to the mapping of the coastal plain sediments for the purpose of assisting water resource studies	1/20,000 and 1/55,000 black-and-white and 1/17,000 full color	Stereoscope, Kelsh plotter

niques to geologic studies, primarily the application of color photography to geologic mapping; 3) the development of instruments designed to facilitate the use of aerial photographs for geologic purposes.

To gain further understanding of the advantages and limitations of photogeologic techniques, the Geological Survey conducts a continuing project designed to provide specific information regarding geologic features that can and cannot be interpreted from aerial photographs taken under different conditions or with different types of film. Three areas are being currently studied as a part of this project. These are a complex igneous-sedimentary terrane in east-central New Mexico; an area in Wyoming underlain in part by Precambrian rocks and in part by sediments ranging in age from Cambrian through Triassic; and an area in the Piedmont physiographic province of North Carolina. These areas will be mapped in detail commensurate with 1/24,000 scale using several types and scales of photography. The results will be carefully evaluated by field methods from both quantitative and qualitative aspects. It is hoped that these projects will permit specific recommendations to be made to geologists mapping in similar terranes regarding the type of photography, procedures, and instruments most likely to give the best results from the standpoint of economy and geologic information. In addition to studies of these specific areas, a continuing effort is made to collect information regarding application of photogeologic techniques to other geologic problems in the United States and Alaska.

The second field of photogeologic research includes study of the value of color and other special types of photography, such as infrared, to specific geologic problems. Color photographs have been taken of the three areas previously discussed and of several other areas throughout the United States. Ektachrome, Eastman experimental color negative-type film, and Super Anscochrome film have been used. This photography is being evaluated both with respect to the additional information available from it as contrasted to conventional black and white photographs, and with respect to over-all economic and scientific value. In addition to the geologic analysis of color photographs of selected areas, continuing investigation is being made into new developments in the field of color and special photography including means of improving specifications for procurement.

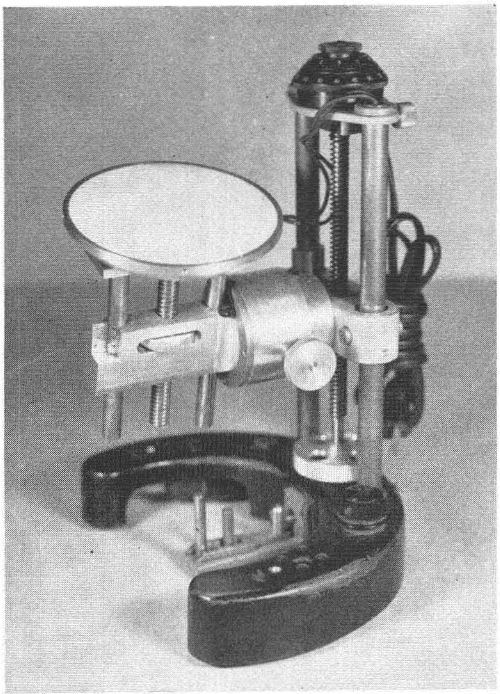

FIG. 1. Combination tilting platen.

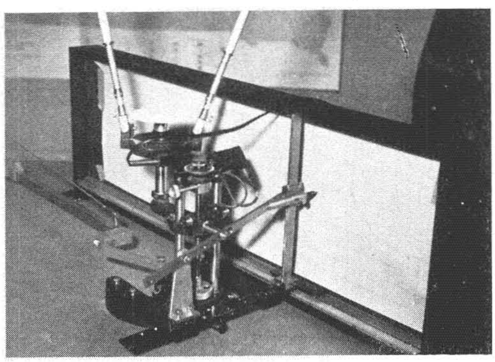

FIG. 2a. Exaggerated-profile plotter based on lever and fulcrum principle.

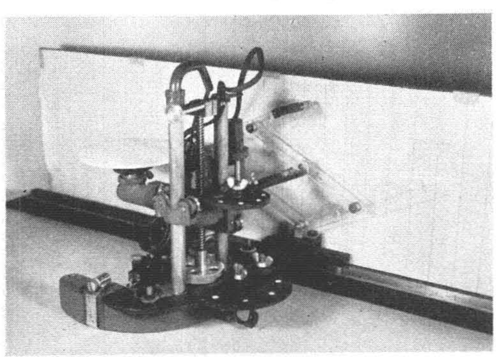

FIG. 2b. Exaggerated-profile plotter based on pantograph principle.

TABLE C

INSTRUMENTS

INSTRUMENT	DESCRIPTION	GEOLOGIC APPLICATION	REFERENCE
Combination tilting platen	Consists of a multiplex tracing table modified so that platen and underlying assembly can be tilted as much as 40 degrees. A separate worm-screw drive on the tilted assembly permits movement of the platen in an inclined direction perpendicular to the surface of the platen. The platen has two rows of illuminated dots at right angles to each other and passing through the center of the platen	For direct measurement of angles of slope and direct measurement of inclined distances (such as stratigraphic thickness of dipping beds) from stereoscopic models in double-projection instruments	Fig. 1
Variable-exaggeration profile plotter	A mechanical assembly based on the lever and fulcrum principle attached to double-projection tracing table. A pencil attachment plots profile on a vertical tracing board as tracing table is moved and floating dot kept on ground. The assembly also designed as a vertically mounted pantograph that can be attached to any tracing table. Profiles may be exaggerated up to 5 times by adjusting the assembly	Provides accurate terrain profiles for use in developing geologic cross-sections. Plots bedding in proper attitude with respect to direction of cross-section. Exaggerated profiles used for correlating thin stratigraphic units	Fig. 2a Fig. 2b
"*Isopachometer*"	Consists of two circular disks mounted in a frame on which there are thumb screws for separating the disks in the x-direction and for rotating the disks equally but in opposite directions. Nine dots, evenly spaced, are arranged in a straight line through the center of each disk. The amount of separation of any two conjugate dots, whether a result of separation by the x-motion screw or by rotation of disks, can be determined to the nearest 0.01 millimeter. Rotation of disks results in two diverging rows of dots that form a short parallax ladder	In addition to use for specific measurements of elevation difference, the "isopachometer" can be pre-set to specific elevation intervals, using different pairs of dots on the two disks, usually the center dot and one other dot. Design of instrument permits measurement of elevation differences in shorter time than many stereometers because differential parallax can be read directly. Instrument designed for use with paper prints	Fig. 3
Stereoscopic grid	Consists of two plastic grid plates mounted in a metal frame. A half-inch-square grid on each plate is composed of inscribed lines, alternately red and blue, oriented in the x- and y-directions. Thumb screw adjustments permits movement of the grid plates in the x- and y-directions. A vernier records movement in the x-direction in millimeters	Forms a stereoscopic grid that can be superimposed on stereoscopic models of paper prints, thus providing a horizontal plane of reference that can be raised or lowered within the model. The instrument is useful in estimating strikes and dips, in correlating geologic features across the model and in drawing approximate topographic and structure form lines. The grid is also useful as an aid in recognizing tilt in a stereoscopic model	PHOTOGRAMMETRIC ENGINEERING, Vol. 23, No. 3, pp. 593–594

A number of new instruments have been developed to facilitate the use of aerial photographs for geologic study. Some of these instruments have wide application; others were developed to assist solution of specific problems arising in conjunction with certain photogeologic studies. A brief description of these instruments is given in Table C.

In addition to the instruments described above improvements in existing instruments have been made and several photogeologic aids have been devised. Improved perforated targets have been made for the stereo slope comparator. (See original description in PHOTOGRAMMETRIC ENGINEERING, 1956, vol. 22, No. 5, pp. 893–898.) A photo holder for black-and-white photographs has been devised (see PHOTOGRAMMETRIC ENGINEERING, 1957, vol. 23, No. 4, pp. 790–791) and a device to hold color transparencies has been constructed. (See Figure 4.) As a training aid a "Ready-to-view" holder for stereoscopic pairs of prints has been devised. (See PHOTOGRAMMETRIC ENGINEERING, 1957, vol. 23, No. 1, p. 189.) A photogrammetric aid based on trigonometric principles has also been designed that allows rapid determination of slope angles and stratigraphic thicknesses from measurements taken from paper prints or double-projection stereoscopic models. (See

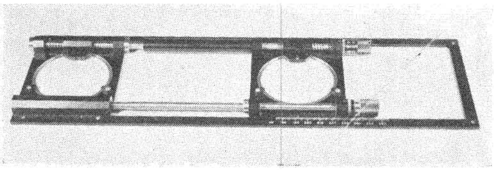

FIG. 3. "Isopachometer."

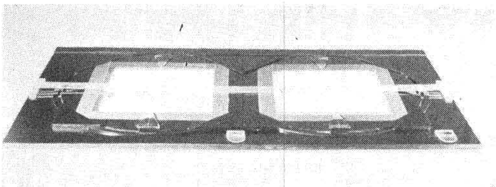

FIG. 4. Photo holder for color transparencies.

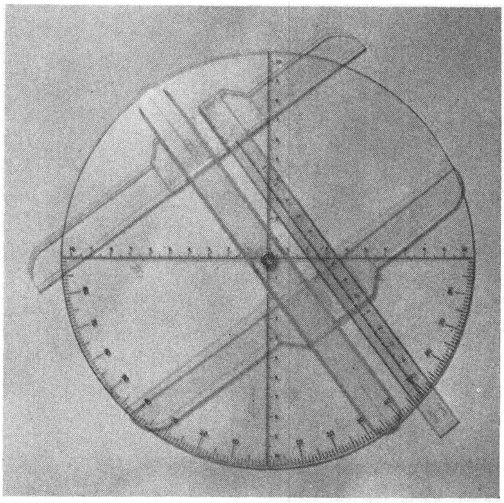

FIG. 5. Photogrammetric aid for determining slopes and thickness measurements.

FIG. 6. Flip-down lenses attached to a visor-type cap.

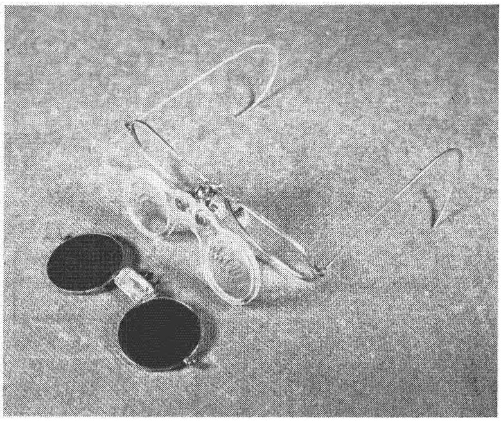

FIG. 7. Viewing double-projection stereoscopic models in the offices.

Figure 5.) Flip-down lenses have been attached to visor-type caps for stereoscopic viewing in the field (Figure 6); similar flip-down lenses have been attached to spectacle frames for viewing paper prints and for viewing double-projection stereoscopic models in the office (Figure 7). Most of the instruments and photogeologic aids described above have been devised by Robert J. Hackman of the Geological Survey.

Working Group No. 4 Interpretation of Vegetation

The report of Working Group No. 4 was printed in the September 1958 issue of PHOTOGRAMMETRIC ENGINEERING. (Vol. XXIV, No. 4, pp. 603–616.)

Working Group No. 5 Interpretation of Urban, Rural, and Industrial Structures

LT. COL. NORMAN E. GREEN, *Chairman*
and
ROBERT B. MONIER

OF THE many ongoing activities in urban and industrial photo interpretation, there are four particular studies which can now be reported, at least in brief form. They are selected especially because they indicate the wide diversity of interest and technical specialization which now exists in this field of P.I., and also because each study reflects considerable originality of approach as well as novelty of focus and application. In Paris, aerial photographic studies of urban traffic flow have revealed new possibilities for analysis of critical problems of vehicular movement. At the University of North Carolina, photo interpretation has been successfully utilized in an extended study of a regional network of cities. On still another aspect of urban structure, work has continued on methods of photographic analysis of certain sociological and demographic features of metropolitan areas. Finally, there is a special photo interpretation study relating nuclear bomb effects on human populations to urban building types and densities.

The following paragraphs summarize these four representative photo interpretation projects above described. Forthcoming reports and publications will contain further detail on this and similar work on urban area analysis of interest to Commission VII.

AERIAL PHOTOGRAPHIC ANALYSIS OF URBAN TRAFFIC PROBLEMS

Concerned with growing problems of vehicular congestion on city streets, the Ministry of Construction in Paris, France, has undertaken a series of experimental studies using aerial photography as the basis for detailed analyses of traffic flow. The project has been reported by Dr. B. L. Y. Dubuisson, who is the Director and Chief Engineer.

Each study begins with an aerial photographic mission flown over the city at a designated hour when traffic problems are at a peak. The first investigations which took place in late 1956 utilized 1:1,500 vertical coverage of the Place de l'Etoile area of Paris. As the investigators developed the method, two sequential phases evolved.

The analysis phase includes the detailed photo interpretation study of traffic flow into each street in the area. Stereo pairs, overlapping about 55% in line of flight, are used for measuring the speed of each vehicle. The average speed of the traffic movement is then calculated. With an overlap of about 66%, a longer path or trajectory for each vehicle can be drawn. When this is superimposed on the trajectory drawn on the 55% overlap pair, three points can be identified on the path for each individual vehicle. Since the time interval between exposures is known and ground distances can be measured to scale, the variations in distance between points along the trajectory can be used to determine accelerations and decelerations of the vehicles. In addition, estimates are made of the number of vehicles per hour and the spatial utilization of the streets and parking areas.

In the synthesis phase, all the information is organized and summarized for comprehensive presentation. Graphs are used to plot curves characterizing the changing flow of traffic. Urban base maps with conventional signs and symbols portray spatial utilization information and density data.

Thus, the photo interpretation method of study, employing newly developed techniques, has served to locate and describe specific trouble spots in surface transportation routes. It then becomes possible to foresee just what remedial steps need to be considered, whether it concerns changing or establishing certain traffic regulations or whether certain public works projects may be involved. Furthermore, in a general sense, such a study permits an interpretation of the human behavior of the city—in ecological terms—at the time of the photographic mission. For example, at a certain hour an average of so many vehicles is leaving District A, while such and such a quantity of traffic is flowing into District B.

Naturally, the information on traffic conditions derived from this type of study is valid only for the particular time of the photography. However, the investigators indicate that generalizations for a longer period of time may be proposed if one assumes certain local factors. On the more positive side, Dr. Dubuisson and his assistant, M. Burger, state that the data obtained by their method are definitely more meaningful and varied in nature than could be expected from any conventional system of traffic survey. As the method was developed, they were genuinely surprised at the emerging possibilities it offered, with the validity of the interpretations and with the significance of the conclusions drawn from the data.

Since the original studies of Paris districts, the method has been extended for use with standard photo coverage of 1:5,000 of other French cities. The studies have been made in the Paris office by the two investigators alone and no visits to the actual scenes have been necessary. Dr. Dubuisson has estimated the cost of this technical service, of unusual value to any municipality, to be on the order of only $750.00 per square mile.

Aerial Photography in the Study of a Regional Network of Cities

The Institute for Research in Social Science at the University of North Carolina has furnished information on a new social science application of aerial photography. Under the newly established Urban Studies Program, the Institute is embarked upon a study of "Emerging Forms of Metropolitanism in the South," and in this connection has selected as a laboratory the "Piedmont Industrial Crescent." This is the industrial heart of the Piedmont area of North and South Carolina, and consists of clusters of small cities extending along the railroad and superhighway system which forms the corridor through the Piedmont connecting the Washington-Baltimore area with Atlanta.

In a very general sense, the research is concerned with the economic growth potential of the Crescent, the political and institutional factors affecting this growth, the problems this growth portends and the alternatives open to the area in solving these problems. Pursuant to this general theme, one of the seven related projects under way in the Program has been concerned with the amount and rate of urbanization in the Crescent in the past as measured from land development patterns. Using U. S. Department of Agriculture photography for the years 1935–1937 and coverage for 1955–1957, the extent of change in urban settlement patterns is being determined. The recent photography is being coordinated with ground surveys of urban land uses, carried out by local planning agencies or the University. The work is under the direction of Professor F. Stuart Chapin, Jr., of the Department of City and Regional Planning. When it is completed, it is expected that some facts on the amount of urbanization, and the changing trends in industrial and residential densities, will be available for use in land development projections under various growth assumptions.

Aerial Photographic Interpretation and the Human Ecology of the City

Work has been continued, and the over-all results have been summarized in report form, on this specialized social science application of photo interpretation previously reported in part at the 1956 Stockholm meetings. As a result of several studies of United States cities, a methodology was developed for utilizing aerial photography in research concerned with the ecological foundations of urban social and demographic structure. The main conclusions offered are: (1) aerial photographic interpretation studies of urban areas can produce accurate data on physical-structural-spatial items such as residential housing types, numbers and densities, ecological location and distances, and land use characteristics; (2) these physical structural data are systematically related to many elements of urban social and demographic structure; (3) the Guttman scale analysis technique is an excellent method for deriving maximum predictive power from the photographic data categories in multiple correlation with social data categories.

The results of the photographic interpretation and data analysis may be translated into information relevant to the human ecology and social structure of the city, including rankings of sub-areas on population size and density and on socio-economic status indices. The work has been under the direction of Dr. Norman E. Green, Air Force Cambridge Research Center, and Mr. Robert B. Monier, Plymouth State College, Plymouth, New Hampshire. A bibliography of published technical reports is available.

Photo Interpretation in Radiation Studies of Urban Areas

During the past ten years, the Atomic Bomb Casualty Commission has collected a large amount of medical data on the survivors of the Nagasaki and Hiroshima bombings. The objective of this "Ichiban Project" is to determine just how much radiation was received by the different survivor groups. As explained by Mr. Robert B. Monier, a consultant to the Health Physics Division of the Oak Ridge National Laboratory, a most critical requirement is that the exact position of each survivor be accurately located in the urban area at the time of the bombing. Theoretically, at least, it is then possible to estimate dosages received by studying the shielding effects of various types of materials and structures in each of the locations.

The specific problem of getting accurate information on the physical structural characteristics of each neighborhood was most difficult to solve. There were no satisfactory maps for this purpose. Survivor interviews and field visits attempting to reconstruct the existing conditions, block by block, were of very limited value, since the project demanded accurate horizontal and vertical scaling of all forms and structures in the immediate vicinity of each survivor. Finally, it was decided that it would be feasible to develop large-scale block maps from pre-strike aerial photographs of the cities.

Stereo-pairs covering the selected pilot study area were found to be satisfactory for contour and physical structural information. Vertical and horizontal-control were obtained by referring to Army Map Service Japan City Plan Maps, 1:12,500 scale. The completed pilot map, scale 1:700, is currently being field tested. Preliminary reports indicate that it will meet the Project requirements. In a practical sense, this means that photogrammetric and photo interpretation techniques may provide the key information needed for completing a highly important medical research undertaking.

Working Group No. 6
Interpretation of Ice

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PHOTOGRAPHIC Interpretation as a science, was introduced in the International Society of Photogrammetry by the author at the World Congress at The Hague in the fall 1948. It was there adopted as a special commission, called "Commission VII—Photographic Interpretation," and was soon widely supported by scientists in many countries throughout the world. In September 1958 this successful Commission could celebrate its first 10-years jubilee.

Interpretation of Ice

To-day, of the six Working Groups for various subjects, Working Group No. 6 deals with "Interpretation of Ice." This ice is of different types and conditions in as distantly separated areas as the Arctic and the Antarctic. The author, as chairman of this Working Group is cooperating with scientists from many countries, amongst others Canada, England, Japan, Sweden and U.S.A. It is hoped that also there will be opportunity for close cooperation with representatives from other Arctic and Antarctic interested Nations, e.g. Denmark, France, Norway and Soviet Union.

All the fellow-workers are preparing papers for Commission VII on interpretation of ice. Some of these subjects deal with the Arctic, e.g. Ice Islands, ice and shipping conditions in the North West Passage, in waters north of Alaska and along the Northern Sea Route, etc. Further, papers on Antarctic ice and ice conditions in other regions of the world, as well as glaciers, will be presented on the basis of photo interpretation.

International Sea-Ice Conference

Specially good contacts between the scientists were made at an International Conference on Arctic Sea Ice, the first conference of this kind, held at Easton, Maryland, in February 1958. This was the conference sponsored by the National Academy of Sciences-National Research Council, Washington. Recent experiences as regards Distribution and Character of Sea Ice, Ice Observation, Physics and Mechanics of Sea-Ice Formation, Growth, and Disintegration, Drift and Deformation of Sea Ice and Sea-Ice Prediction Techniques were presented in excellent papers and instructive lectures. About 80 scientists attended, representing nine countries—Canada, Denmark, England, Finland, Germany, Japan, Sweden, Soviet Union and United States. At the Conference, were shown very fine sea-ice verticals in color from the Beaufort Sea, North of Alaska, printed with U. S. Navy's new electronic scanning printers. The result was marvelous, with the finest details clearly visible even in the darkest shadows of the negatives.

All the delegates at this Conference expressed the opinion that all countries interested in shipping in Northern waters should intensify their Arctic Research.

A Technique for the Identification of Farm Crops on Aerial Photographs[1]

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ABSTRACT: *This paper includes a description of a technique developed for the purpose of setting down aerial-photo identification criteria for various farm crops at several stages of growth in Northern Illinois. The general aspects of the photo appearance of these crops are also described.*

GEOGRAPHERS have long been interested in the areal distribution and intensities of production of commercial farm crops. The major problem confronted in studies of farm crops has been the development of techniques which provide both speed and accuracy in field mapping. During the 1930's, it was ascertained that certain features, mostly physical, could be mapped with speed and accuracy from aerial photographs. Aerial photographs, however, have had relatively little use in the mapping of farm crops. Before this study was begun in 1950, no definitive method of identifying farm crops on aerial photographs existed.

The technique used in the study described in this paper rests primarily on descriptions of the ground appearance and the corresponding

[1] This paper was excerpted from the author's doctoral dissertation entitled *The Aerial Photographic Identification of Farm Crops in Northern Illinois*. The dissertation, available for interlibrary loan from Northwestern University, is based on research conducted in compliance with a contract between Northwestern University and Geography Branch, Earth Sciences Division, Office of Naval Research.