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# *Plotting, Theory and Instruments*

# *The General Report of Commission II*

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## Introduction

THE General Report of Commission II, International Society for Photogrammetry, for the period 1960 to 1964 is based on information gathered in a questionnaire sent to all National Societies. The questionnaire concerned itself with data defining the type of organization reporting; activities carried out, when established and number of personnel involved; types of equipment utilized for compilation and aerial triangulation; scales of map products; other uses of equipment than mapping; use of automatic plotting and orthophotoscope type of equipment; use of comparators, coordinate readers and/or auxiliary equipment; types of cameras; possible use of infrared, radar and color photography; use of Airborne Profile Recorder (APR) data, Shoran-type photography, Shoran-type trilateration, Statoscope equipment; reseau grids; use of film or glass plate photography; and data on new instruments and techniques perfected or used since 1960.

Questionnaires were sent to each National Reporter (or National Society Office) of 42 member countries of ISP. Each reporter, in turn, was asked to send copies to those organizations within his respective country concerned with photogrammetric effort. Of 42 countries represented, 17 turned in replies. For example, in the United States, of 277 questionnaires distributed, a total of 78 were returned with data; in Australia 22 replies were received, in Japan 19 replies were received; and in West Germany 21 replies were received. Besides the 78 replies received from the United States an additional 109 were received from 16 other countries. These latter included Australia, Austria, Belgium, Brazil, Finland, France, Germany (Democratic Republic), Germany (West), Holland, India, Japan, Malaya, Morocco, Norway, South Africa and Switzerland.

## Photogrammetry and Aerial Photography Products and Uses

The questionnaires have revealed that photogrammetry and aerial photography have been used in connection with the following:

1. Planimetric, mosaic, topographic, geologic, forestry, cadastral, soils, terrestrial, reconnaissance, aeronautical, aeromagnetic, military and hydrographic map and chart compilation and revision work.
2. Instruction and training of Civil Engineering, Surveying, Geology, Geography, Mining, Forestry and Photogeology students.
3. Development and manufacture of equipment and cameras.
4. Photointerpretation, aerial triangulation, analytical bridging, radial template bridging, and numerical triangulation.
5. Plans and studies concerning agriculture, water supply, hydroelectric power, soil classification, vegetation, flood control, mosquito breeding ground, rural improvement, high tension lines, navigable waterways, route surveys, monument and battlefield sites, historical temples, hydraulic models, wave movement, animal body configuration, city planning, highway and railroad locations, profiles and cross-sections, perspective picture compilations, cloud positions released by rockets, comparison of reduced and actual models, architecture, research and experiments, coordinate cadastral measurements, resources, terrain profiles, stereo vision tests, land consolidation, glaciology, tropical rain forests, placer and coal mining, area compilation,

consulting, geophysical scintillation surveys, magnetometer surveys, crop estimation, forest stock surveys, off shore pollution, road alignment, railroad car clearance surveys, ocean currents, satellite geodesy, crustal movements, terrain models, watershed surveys, earth volume, tidal currents, stellar triangulation, medical and dental, ice flows, drain tile location, landslide and soft foundation surveys, water depths, construction material surveys, missile positioning and altitude, weather predictions, and ocean bottom surveys.

## AUSTRALIA

### Organizations

GOVERNMENTAL

*Civil*—The Snowy Mountains Hydro-Electric Authority (SMHEA); Dept. of Lands South Australia (DSLA); Lands Survey Branch—Northern Territory Administration (LSB); Dept. of Lands and Survey (Hobart, Tasmania) (DSL-H, T); Division of National Mapping (DNM); Dept. of Public Lands (Brisbane) (DPL); Dept. of Land and Survey (Western Australia) (DLS-WA); Dept. of Lands (Sydney) (DL-S); Dept. of Crown Land and Survey (Melbourne) (DCLS).

*Military*—The Royal Australian Survey Corps, Dept. of the Army.

INDUSTRY—Adastra Airways Pty., Ltd. (Sydney) (AAP); Australian Aerial Mapping Pty., Ltd. (Sydney) (AAMP); Queensland Aerial Survey Co. Pty. Ltd. (Brisbane) (QAS).

UNIVERSITY OR INSTITUTE—Univ. of Sydney (US); Univ. of Melbourne (UM); Univ. of New South Wales (Sydney) (UNSW); Univ. of Adelaide (UA); Royal Melbourne Institute of Technology (RMIT); Univ. of Queensland (UQ); Univ. of New England (Armidale) (UNE); Univ. of Western Australia (UWA); South Australian Institute of Technology (SAIT).

### Activities

SMHEA—Mapping and surveying from aerial and terrestrial photographs for the investigation, design and construction of hydro-electric projects for the Snowy Mountain Hydro-Electric Authority; 10 years; scales 1:600 to 1:16,000.

DLSA—Topographic and large scale mapping; 15 years; scales 1:480 to 1:31,680.

LSB—Providing engineering plans for development schemes in agriculture, beef roads, water supply, etc.; just started; scales 1:31,680 to 1:63,360.

DLS H,T—Analytical bridging by stereocomparator, stereo-plotting, at scales from 1:480 to 1:25,000; 18 years.

DNM—The Photogrammetric Section of the Topographic Branch, Division of National Mapping prepares planimetric and topographic map compilation sheets usually at small or medium scales from vertical aerial photography; 15 years; scales 1:2,400 to 1:100,000.

DPL—Aerotriangulation and plotting for standard mapping at 1:31,680 with 25 ft. contours and project mapping at various scales and contour intervals for engineering purposes; 12 years; scales 1:7,920 to 1:31,680.

DLS-WA—Basic topographic mapping for standard 1:25,000 to 1:250,000 series in Western Australia plus engineering and project mapping for government sources; 10 years; scales 1:480 to 1:16,000.

DL-S—Production of topographic maps; 11 years; scales 1:600 to 1:25,000.

DCLS—Topographic mapping and determination of quantities; 18 years; scales 1:480 to 1:23,760.

RASC—Production of Australian military maps; also reproduction of air force and naval charts; 36 years; scales 1:20,000 to 1:50,000.

AAP—Aerial photography, photogrammetry, ground survey, aeromagnetics; 33 years.

AAMP—Large scale engineering surveys to medium scale reconnaissance and topographical plans; 4 years; scales 1:480 to 1:15,840.

QAS—Engaged principally in large scale plotting work, mosaicking, etc.; 2 years, scales 1:480 to 1:4,800.

US—Teaching of elementary photogrammetry and photo-interpretation to Civil Engineering students; 30 years.

UM—Course in photogrammetry; 75 hours of lectures, 150 hours practical work for Bachelor of Surveying; 14 years.

UNSW—Instruction in photogrammetry in surveying and engineering degree courses; 13 years.

UA—Brief reference to theory in final year lectures for civil engineering students (2 hours); 10 years.

RMIT—Education; 8 years

UQ—The teaching of elementary photogrammetry to surveying students; 8 years.
UNE—Elementary photogrammetry and photo-interpretation for geology and geography students; 3 years.
UWA—Activity confined to 8 lectures and three 3-hour practical periods for fourth-year civil engineering degree students; 3 years.
SAID—Engaged in lecturing and instructing undergraduates in surveying; 4 years.

### Personnel

SMHEA—7; DLSA—11; LSB—10; DLS—H,T—11; DNM—42; DPL—15; DLS-WA—24; DL-S—45; DCLS—31; RASC—70; AAP—10; AAMP—5; QAS—14; US—2; UM—1; UNSW—9; UA—1; RMIT—4; UQ—1; UNE—3; UWA—1; SAIT—not known.

### Plotting and Aerial Triangulation Equipment

SMHEA: 1 Wild A7; 1 Zeiss Stereotope.
DLSA: 3 Wild A5; 4 Wild A6.
LSB: 1 Wild A8; 1 Zeiss Stereopret; etc.
DLS-H,T: 1 Wild A7; 3 Wild A8; Hilger—Watts Stereocomparator.
DNM: Wild B8; 1 Wild A6; 9 Zeiss Stereotope.
DPL: 1 Wild A5; 1 Wild A8; 1 Wild A6; 2 Wild B8; 5 Williamson Multiplex SP3.
DLS-WA: 1 Wild A7; 2 Wild A8; 1 Thompson-Watts Plotter; 2 Kelsh plotters; 3 Multiplex (7 projectors) 2 Stereotope.
DL-S: 2 Wild A5; 2 Wild A8; 7 Wild A6; 3 Wild B8; 1 Kelsh; 1 Multiplex.
DCLS: 2 Wild A5; 6 Wild A6; 2 Wild A7; 1 Wild A8; 5 Williamson Multiplex (1–7 Projectors; 4–3 Projectors); 1 Kern PG2; 1 Zeiss Stereotope.
RASC: 32 Williamson-Ross Multiplex (22—3 Projectors; 10—7 Projectors); 1 Zeiss Multiplex; 1 Wild A9; 2 Wild B9; 3 Wild B8; 11 Zeiss Stereotope.
AAP: 1 Wild A7; 1 Wild A8; 1 Nistri Photomapper; 4 Williamson Multiplex.
AAMP: 2 Wild A8.
QAS: 1 Wild A8.
SAIT: 1 Wild B9; 2 Stereoscopes (1 Zeiss; 1 Tokyo); 1 Zeiss R.S. II Templet Outfit.

### Aerial Data Recording

#### CAMERAS

SMHEA: Wild RC8—115 mm. and 210 mm.; 18×18 cm.
DLSA: Wild RC5—115 mm. and 210 mm.; 18×18 cm. Wild RC7a—100 mm. and 170 mm.; 14×14 cm.; Wild RC9—88 mm.; 23×23 cm.
LSB: F-24—5 in.; 5×5 in. format.
DLS-H,T: Wild RC8—$4\frac{1}{2}$ in. and $8\frac{1}{4}$ in.; 7×7 in.
DNM: Wild RC9—88.5 mm.; 23×23 cm.
DPL: Eagle IX—152 mm.; 9×9 in.; Wild RC5a—152 mm.; 9×9 in.; Wild RC8—152 mm.; 9×9 in.; Wild RC9—88.5 mm.; 9×9 in.
DLS-WA: Zeiss RMKA—6 in., 9×9 in.; Eagle IX—6 in. (no longer in use), 9×9 in.; Eagle IX—12 in., 9×9 in.
DL-S: Wild RC5a—114 mm. and 210 mm.; 18×18 cm.
DCLS—Wild RC7, 100 mm. and 170 mm.; 14×14 cm. glass.
AAP: Wild RC8—6 in., 9×9 in. Wild RC5—$4\frac{1}{4}$ in., 7×7 in.; OSC—6 in., 9×9 in.; Wild RC9—$3\frac{1}{2}$ in., 9×9 in.; Eagle IX—6 in., $8\frac{1}{4}$ in., 10 in., 12 in., 14 in.; 9×9 in.
AAMP: OSC—6 in., 9×9 in.; Wild RC8—6 in., 9×9 in.
QAS: Wild RC8—115 mm. and 153 mm., 7×7 in.; Wild RC9—88.5 mm., 9×9 in.; T-11, 153 mm., 9×9 in.; Eagle IX—153 mm., 9×9 in.

#### INFRARED AND COLOR

LSB: *Color*—Future use in soil classification and vegetation surveys.
DLS-WA: *Infrared*—First work carried out in June 1963 in a project to determine the area of high and low tides within a special area. Results were excellent. Planned at present—flood photography; city and suburban areas will be flown to locate probable mosquito breeding grounds. *Color*—Ektachrome tested in location of iron ore and further photography is planned for forestry and agriculture purposes. Camouflage detection film tested in forestry to locate "Die-Back" in hardwoods; results fair only. Future photography is planned in this and soil surveys.
RASC: *Infrared and radar*—Under current consideration for the future.
AAP: *Infrared and Color*—Limited use at present.
RMIT: *Infrared*—Appears to be useful for terrestrial.

### New Instruments and Techniques

DPL: *Instruments*—1 Multiplex APN for plotting; 2 Wild B8 for plotting; 1 Wild EK5a for digitizing for bridging of terrain models. *Techniques:* GE225 Electronics Computer programs strip adjustments of

aerial triangulation; plane traversing for extension of control; block adjustment of horizontal control.

DL-S: *Techniques*—Block adjustments for standard mapping by graticules.

RASC: *Instrument*—Wild A9, B9, B8, Zeiss SWA 3-projector multiplex for spatial triangulation, 1st to 4th order.

AAMP: *Instrument*—Wild PUG-2 for point transfer.

## AUSTRIA

### Organization

GOVERNMENTAL—Bundesamt fur Eichound-Vermessungswesen

### Activities

Production of the topographic map 1:50,000; Cadastral photogrammetry (1:1,000).

### Personnel

Management, 3; Supervision, 6; Professional, none; Technicians, 50; Servicing, 1.

### Aerial Triangulation and Plotting Instruments

Wild A7+EK3 (3); Wild A8-EK5 (6); Wild B8 (1); Wild A6 (1); Zeiss C5 (2); Automatic Readout and Recording Systems (4)

### Aerial Data Recording—cameras

| *Type* | *Length* | *Lens* | *Format* | *Range, m.* |
|---|---|---|---|---|
| RC5 | 210 mm. | Aviotar | 18×18 | 1,000–6,000 |
| RC5 | 115 mm. | Aviogon | 18×18 | 1,000–5,000 |
| RC7 | 100 mm. | Aviogon | 14×14 | 1,000–1,500 |
| RC7 | 170 mm. | Aviotar | 14×14 | 1,000–2,000 |
| RC8 | 150 mm. | Aviogon | 23×23 | 1,000–5,000 |

## BELGIUM

### Organizations

STATE ORGANIZATIONS: Military agencies (e.g. the Military Geographic Institute); Public Services (e.g. Ministry of Public Works); Semi-government services (small land holdings under the jurisdiction of the Department of Agriculture).

UNIVERSITIES AND OTHER EDUCATIONAL INSTITUTIONS: It is impossible to give a complete summary of the activities and means used in the photogrammetric field, considering that some organizations have not supplied the necessary information. This is also true of universities and other educational institutions which are primarily considered with scientific research.

### Activities

PHOTOGRAMMETRIC ELABORATION OF TOPOGRAPHIC AND CARTOGRAPHIC PLANS

(1) Topographic plans at 1:5,000, 1:1,000 and 1:2,000 for the study and laying out of automobile roads, routes, navigable waterways, high-tension lines, etc.
(2) Plans for rural improvement projects, usually at 1:1,000.
(3) Plans for urban projects at 1:5,000.
(4) Belgium's base map at 1:25,000.
(5) Small-scale maps at 1:50,000–1:100,000.

The assignment of these tasks among the different organizations is done as follows: Activities (1) and (2) are divided among Government agencies and private companies, but most of them go to the former due to the fact that at present these agencies have at their disposal superior equipment and trained personnel. Activity (3) is performed exclusively by Government agencies, and, more particularly, by the Ministry of Public Works. Activities (4) and (5) come exclusively under the jurisdiction of the Military Geographic Institute, which is a Government agency.

NON-TOPOGRAPHIC USES OF PHOTOGRAMMETRY. The use of photogrammetry is spreading to more and more fields, but at the present time it is only Government agencies which are making use of it. The following examples may be cited as some of the uses of photogrammetry: (1) Terrestrial photogrammetry—making plans of already existing monumental structures and sites in Belgium, as well as in foreign countries, as for instance, for the temples of Buhen and the two Semnas which are menaced by the waters of the great Aswan dam in Upper Egypt; (2) Controlling the stability of engineering works, such as bridges; (3) Studying water streams and the swell of the waves; (4) Making hydraulic models; (5) Measuring true-to-scale the physical forms of animals (at the University of Liege), etc.

### Photogrammetric Equipment

In regard to the use of surveying cameras, there is almost a unanimous preference for the "wide-angle" camera type with a focal distance of 11 cm. and 15 cm. and a film or glass-plate negative of 18×18 and 23×23 cm. The 21 cm. focal distance lenses seem to have completely failed in present-day projects. As for plotting apparatus, this consists for the most part of instruments of the so-called First-Order, due to the fact that the most urgent need is for large-scale plans which are expected to be used for projects requiring high precision and as working plans. Although surveying cameras, film and glass-plate surfaces, and plotting instruments have undergone only minor improvements, these have made it possible to increase gradually the ratio between plotting scales and photograph; whereas in those instances in which the methods have not been greatly developed from the theoretical point of view, we find that an especially great progress has been made in the use of these methods by means of auxiliary instruments, such as electronic coordinatographs, profiloscopes, etc., and the utilization of results by means of electronic computers. Here again efficiency and lower cost are the principal considerations attributed more and more to these powerful auxiliary instruments.

### Résumé

Until 1962, all photogrammetric activities in Belgium were divided between State organizations (public or military agencies) on one hand, and universities and other educational institutions, on the other. Recently, private companies, and, more specifically, their research departments, have begun making use of photogrammetry and acquiring the necessary equipment for this kind of work. This spreading of photogrammetric activities among private companies is explained by the fact that after 1962 public agencies have been assigning regularly the study of the lay-out of automobile roads and the engineering projects associated with them to the research departments of private concerns, whereas in the past these activities came under the jurisdiction of state agencies. The result of this is that the continuous research aimed at greater efficiency and lower costs prompts private companies to use rational methods for the preparation of basic topographic plans. Inasmuch as we are at the beginning of a new development, we are not able to give, at this stage, exact information in regard to the photogrammetric equipment and the organizational system of these research bureaus; consequently, we must confine ourselves to stating that their immediate objective is to prepare large-scale topographic plans (as a rule 1:1,000) which are expected to serve as ground work of projects. In view of what has been said above, all photogrammetric activities in Belgium at the present time may be divided in three categories from the standpoint of the users of photogrammetry.

## BRAZIL

### Organization

INDUSTRIAL—Servicos Aerofotogrametricos Cruzeiro de Sul S.A.

### Activities

Aerial photography, photo-mosaics (uncontrolled and controlled), photogrammetric surveys at scales from 1:100,000 up to 1:500. Printing Department—correlated activities; inventories of raw materials.

### Personnel

Management, 15; Supervision, 10; Professional, 100; Technicians, 35; Servicing, 40.

### Aerial Triangulation and Plotting Instruments

Zeiss Stereoplanigraph (4); Santoni Stereocartograph (1); Kelsh Plotter (2); Wild A9 (2); Wild Aviograph B9 (2); Coordinate Recorders (1). (In addition to normal plotting and aerial triangulation instruments.)

### Aerial Data Recording

Zeiss, RMK 51/23, 153 mm., Pleogon, 23×23, 750–6,000; Wild RC5, 115/210, Aviogon, 18×18, 1,050–1,575; Wild RC9, 88 mm., S. Aviogon, 23×23, 3,600–6,200; Fairchild, 153 mm., Metrogon, 23×23, 1,530–6,000.

## FINLAND

### Organization

GOVERNMENTAL: General Survey Office of Finland; Topographic Survey of the Defense Forces; National Board of Public Roads and Waterways in Finland.

INDUSTRY (CIVIL): Imatran Voima Osakeyhtio; Finnmap (Engineering).

UNIVERSITY OR INSTITUTE: Institute of Technology.

### Activities

Compiling of maps for various purposes in scales 1:2,000, 1:4,000, 1:10,000, 1:20,000, 1:100,000, and 1:4,000,000.

Compiling maps for military and civil purposes.

Using of photogrammetry in highway planning.

Photogrammetric mapping for hydroelectric power planning purposes.

Surveying and photogrammetric mapping, road planning, rural and city planning

### Personnel

Management—range, 1 to 3; average, 1.3.

Supervision—1 to 10; 4. Professional—2 to 15; 6.

Technicians—4 to 60; 18. Servicing—0 to 5; 2.

### Aerial Triangulation and Plotting Instruments

Zeiss C8 (2); Zeiss C5 (4); Wild A8 (12); Zeiss Stereotope (1); Kern PG1 (1); B&L Balplex Plotter (9); Wild A7 (1); Coordinate Recorders added to normal plotting and aerial triangulation instruments.

OTHER USES made of equipment besides map compilation and aerial triangulation: Instruction and Research; Preliminary highway planning; Photogrammetric profile and cross section recording; Photogrammetric cross sectioning; Compilation of perspective pictures.

### Aerial Data Recording

| CAMERA TYPE | *Length* | *Lens* | *Format* | *Range, m.* |
|---|---|---|---|---|
| RMK 15/23 | 150 mm. | Pleogon | 23×23 | 500–9,000 |
| RMK 21/18 | 210 mm. | Topar | 18×18 | 3,000–4,500 |
| RMK 21/18 | 210 mm. | Orthometar | 18×18 | 3,000–4,000 |
| RC8 | 15 cm. | Aviogon | 18×18 | 4,500 |
| Wild RC8 | 15 cm. | Aviogon | 23×23 | 150–6,500 |

RECORDING MEDIUM—Present and future use: Some infrared experiments have been carried out; horizon pictures are being used to get rectification data (RMKH 21/18).

AUXILIARY DATA UTILIZED Statoscope: Readings are recorded at flying altitude of 4,500 m.; horizon camera RMKH 21/18 is being used.

### New Instruments

INSTRUMENTS: Photocartograph Model VI; Balplex plotter; RMK with automatic control; Wild B8 and A8.

PURPOSE: Compiling of topographic maps; to be used with aerial photography of altitudes 500–9,000 m.; making of contact prints on paper or glass; plotting of maps 1:500–1:5,000 and cross sectioning.

## FRANCE

### Organization

GOVERNMENTAL: Institute Geographic National (IGN)

INDUSTRY: General Society of Photo-Topography (GSPT); French Society for Topographic and Photogrammetric Works (FSTPW); Aero Photogrammetry Association (APA)

### Activities

IGN, a public organization attached to the Ministry of Public Works and Transportation, succeeded to the Geographical Department of the Army 1940. Its task among others to chart the French Territories (Metropolitan France and overseas departments and territories). Within the framework of cooperation, it also makes base charts of the independent states of Dark Africa that once belonged to the French Community. All base charts are now made by aerial photogrammetry.

GSPT was organized in 1933 to carry out aerial stereophotogrammetric and terrestrial mapping at scales of 1:500 to 1:10,000 with approximately 80 personnel. Equipment includes the Wild A7 (with EK 5), Wild A8, Poivilliers "BP" and Wild A2 (for terrestrial use). Products include profiles, geologic silt measurements and numerical photogrammetry studies.

FSTPW was organized in 1960 with about 45 personnel to carry out photogrammetric mapping at 1:1,000 to 1:50,000 scales and aerial photography activities. Equipment con-

sists of the Wild A8, Poivilliers D4, Morin instruments, the Wild RC8 (115, 152, and 210 mm. focal lengths) and the Zeiss 30×30, (750 mm. focal length) cameras; as well as auxiliary equipment for numerical photogrammetry operations and coordinate recorders. Both black and white and color photography are used.

APA was organized in 1957 with eight personnel to carry out cadastral and topographic mapping at scales of 1:500 to 1:20,000. Equipment consists of three Photo-Cartograph SFOM-Nistri, Type 6.

### Personnel

Photogrammetric Department of IGN:

10 geographical engineers (chief geographers)
35 engineers of geographical works of the state
65 technical assistants
300 workers (compilers, photographers, illustrators)

A group of photographic aircraft is attached to the Photogrammetric Department which has important resources in personnel and material (10 teams and maintenance personnel, 12 four-engine planes, 8 twin-engine planes (Type H.D. 34)).

### Aerial Triangulation and Plotting Instruments Employed

The Photogrammetric Department (IGN) has the following equipment available which is assigned to large and medium scale work; the scale of the negatives on plates varies from 1:3,000 to 1:30,000.

#### AEROTRIANGULATION

1 Nistri T.A. 3
3 SOM Stereocomparators
3 Type B Poivilliers equipped with coordinate recorders
51 Type B Poivilliers—1st class equipment with coordinatographs
2 Operators (1 compiler and 1 draftsman)
11 Poivilliers Type C (Requirements no longer needed).

#### COMPILATION

The scale of the image is intermediate between the viewing scale and the "restoration" scale. For example:

| | | | | |
|---|---|---|---|---|
| Scale | negative | 1:3,000 | 1:13,000 | 1:30,000 |
| | image | 1:2,000 | 1:10,000 | 1:20,000 |
| | drawing | 1:1,000 | 1:5,000 | 1:20,000 or 1:10,000 |

#### EQUIPMENT ASSIGNED to medium scale and small scale work (1:50,000 to 1:200,000):

57 Poivilliers D (2nd order instruments). (This type of equipment makes it possible to make an anamorphic restitution and permits the use of film made with the Wild RC 9 camera.)

5 Stereoflex; simplified equipment assigned to small scale work in regions with very few hills (low relief).

A few units of Poivilliers Type B instruments are used for work on terrestrial photogrammetry (architecture, comparison of reduced and actual models, determination of position of clouds released by rockets, etc.).

Note also the Poivilliers Type B are outfitted with recorders of coordinates for the determination of points, recorded on tapes and punch cards with a view toward the selections of the best highways (programming toward computation on electronic computer under study at the Highway Department).

### Aerial Data Recording

#### CAMERAS

At IGN all the photographic coverage that will be made use of by aerotriangulation or by restitution are made on glass plates with automatic Poivilliers SOM plate cameras. The format of the plate is 19×19 cm. The focal lengths are: 125 mm. Aquilor lens; 210 mm. Orthor lens and 300 mm. The IGN also has cameras for SOM film (Aquilor lens, 125 mm., 19×22 cm.) used for infrared coverage; the Wild cameras, etc.

The scale of original negatives varies from 1:3,000 to 1:65,000 for coverage made with automatic Poivilliers SOM plate cameras. For 1:65,000 cover (focal length 125 mm.) the photographic height is 9,000 to 10,000 meters. Finally, the RC 9 camera enables IGN to get cover at a scale of about 1:100,000.

#### RECORDING MEDIA

The infrared and color films at IGN are not used for cartographic purposes but solely for interpretation. It is easy and cheap to obtain simultaneous panchromatic and infrared coverage. The simultaneous study of the two coverages is priceless for interpreting.

The infrared and color films are requested by Water and Forestry Department and other Departments.

APR profiles made in the recovery zones of photographic strips give, after internal and external adjustment, the required reading for small scale restitution. In open and low

terrain relief the average precision of the reading is 3 meters.

Statoscope auxiliary data is used for aerial triangulation.

For the restitution, the original negatives are used. Control points and enlargements are made from the negatives.

Contact prints are generally used for infrared coverage.

Starting with the original negatives, positives at the same scale or enlargements are made of the color photographs.

## GERMAN DEMOCRATIC REPUBLIC

### Organizations

GOVERNMENT. National Main Administration for Surveying and Cartography; 10 years.

INDUSTRY

Centers for terrestrial photogrammetry at the regional mining enterprises; for routine information on placer mining output in soft coal placer mines; 5 years.

National Research Institute; "Geodetic Service" for the entire field of Cartography and Surveying; 10 years.

VEB Carl Zeiss JENA, manufacturer of optical-precise mechanical and electronic equipment; 62 years.

UNIVERSITIES

Dresden Technical University; 30 years.

Freiberg Mining Academy, Freiberg in Saxony; 10 years.

Engineering School for Geodesy and Cartography in Dresden; 10 years.

### Activities

In the GDR, the following types of instruments are used for compilation: Multiplex Stereomapping Instrument; Stereoplanigraph; Stereometrograph; Stereoautograph. Nearly without exception, diapositives are used in all compilations; in the production centers, the compilation instruments are used in two shifts as a rule. Fairly important is the computation of volume in engineering surveys. This is done directly in many cases by using the read or automatically recorded machine coordinates.

### Special Use of Equipment

The only instrument, belonging in this category and used in the GDR, is the Coordimeter automatic computing and recording equipment. By using it, it is not only possible to record the pure machine coordinates but also to transform simultaneously the $x$, $y$ and $z$ coordinates into the national coordinate system. The Coordimeter is also used for automatic area computation and carrying out a semi-automatic numerical method for the relative and absolute orientations of stereo models.

Analytical photogrammetry essentially is still in the experimental stage. For this work, the GDR uses the stereocomparator and the Komess 3030 monocomparator (measurement accuracy .001 mm.) of the VEB Carl Zeiss JENA. The VEB Carl Zeiss JENA is starting now on the production of a special aerial photographic stereocomparator "Stecometer" with attached electronic recorder.

From time to time, a special variant of the Multiplex stereocompilation instrument, with an angular field of 122°, is used for the compilation of ultra wide angle photography.

### Aerial Data Recording

CAMERAS

In the GDR, photogrammetric cameras of the type AFA from the Soviet Union are used and the instruments of the VEB Carl Zeiss JENA. MRB 210 mm., f.l., Pinator (1:4), 18×18 cm., 1,000–5,000 m. MRB 115 mm., Lomegon (1:4), 18×18 cm, 1,000–5,000 m.

RECORDING MEDIUM

Infrared photographs are used exclusively for interpretation. Color photographs have been made only for experimental purposes.

In the photographs, taken with the VEB Carl Zeiss JENA Photogrammetric Cameras, accurately calibrated glass scales are shown along the sides of the picture. This makes possible taking into consideration changes in the dimensions of the base of the emulsion in a similar manner as this is done with the "reseau grid."

In general, contact diapositives are used. The exception is the use of reduced diapositives in the Multiplex stereomapping instrument.

### New Instruments and Techniques

Since 1960, the following new instruments have been built in the GDR: Wide angle photogrammetric camera MRB 11.5/1818; Aerial photo exposure meter "Aerolux"; Aerial photo stereocomparator "Stecometer." In

map production, the following new instruments were presented for the first time in London, 1960: Stereometrograph and Coordimeter. With the introduction of the coordimeter, the technological process changed especially because of the possibilities mentioned in the first sentence.

For the production of pictures, adjusted for contrast, a photo-chemical method was developed which, for a small instrumental effort, furnished equal results as the known electronic equipment. A publication on this will appear in the volume containing the lectures at the International Colloquium on Photogrammetry, 1963, in Dresden.

## WEST GERMANY

### Organization

#### GOVERNMENT AGENCIES

Institut fur Angewandte Geodasie, Abteilung "Angewandte Geodasie" des Deutschen Geodatischen Forschungsinstituts, Frankfurt/Main, Forsthausstr. (IAG).

Militargeographisches Amt, Luftbildwesen, Bad Godesberg, Friesdorfer Str. 194 (MA).

Niedersachsiches Landesverwaltungsamt, Landesvermessung, Hannover, Warmbuchenkamp 2 (NL, Hannover).

Hessisches Landesvermessungsamt, Wiesbaden, Riederbergstr. 39 (HL, Wiesbaden).

Landesvermessungsamt des Saarlandes, Saarbrucken, Scheidter Str. 114 (LS, Saarbrucken).

Landesvermessungsamt Nordrhein-Westfalen, Bad Godesberg, Waasemstr. 19–21 (LNW, Bad Godesberg).

Freie und Hansestadt Hamburg, Vermessungsamt, Hamburg 36, Wexstr. 7 (FH Hamburg).

Landesvermessungsamt Rheinland-Pfalz, Koblenz, Hochhaus, IV. Stock (LRP, Koblenz).

#### INDUSTRIAL FIRMS

Carl Zeiss, Oberkochen/Wurtt. und Zeiss-Aerotopograph GmbH., Munchen 27, Ismaninger Str. 57 (Carl Zeiss, Oberkochen).

K. E. Schmidt, Elektrobau und Optotechnik, Wiesbaden, Dotzheimer Str. 109 (K. H. Schmidt).

#### COMMERCIAL FIRMS

Aero Exploration, Frankfurt/Main, Flughafen (AE, Frankfurt); Deutsche Luftbild Kg, W. Seelmann & Co., Hamburg 13, Frauenthal 10 (DL, Hamburg).

Hansa Luftbild GmbH, Munster/Westf., Elbestr. 5 (HL, Munster); Photogrammetric GmbH., Munchen (P GMBH, Munchen).

#### UNIVERSITIES

Geodatisches Institut der Rheinisch-Westfalischen Technischen Hochschule Aachen, Aachen, Templergraben 55 (GIRWTH, Aachen).

Technische Universitat Berlin, Lehrstuhl fur Photogrammetrie und Kartenkunde, Institut fur Photogrammetrie, Berlin 12, Hardenbergstr. 34 (TU Berlin).

Institut fur Photogrammetrie der Universitat Bonn, Bonn, Nussallee 15 (IPU Bonn).

Institut fur Photogrammetrie und Ingenieurvermessungen der Technischen Hochschule Hannover, Hannover, Nienburger Str. 1 (IPITH Hannover).

Institut fur Photogrammetrie und Topographie der Technischen Hochschule Karlsruhe, Englestr. 7 (IPITH Karlsruhe).

Institut fur Photogrammetrie, Topographie und allgemeine Kartographie der Technischen Hochschule Munchen, Munchen, Arcisstr. 21 (IPTKTH Munchen).

Technische Hochschule Stuttgart, Lehrstuhl fur Vermessungswesen und Photogrammetrie, Stuttgart, Keplerstr. 11 (TH Stuttgart).

### Activities

IAG: Research and experimental work in all branches of photogrammetry and its application; 10 years; scales 1:1,000 to 1:50,000.

MA: Aerial photography; triangulation, revision and construction of planimetric and topographic maps; 5 years; scales at 1:1,000 to 1:25,000.

NL, Hannover: Cadastral and topographic mapping and aerial triangulation; 10 years; scales 1:500 to 1:5,000.

HL, Wiesbaden: Compilation of planimetric and topographic maps and coordinate measurements for cadastral work; 10 years; scales 1:2,000 to 1:5,000.

LS, Saarbrucken: Compilation and revision of topographic maps; 13 years; scales 1:5,000, 1:25,000 and smaller.

LNW, Bad Godesberg: Photogrammetric cadastral work; compilation of 1:5,000 basic maps; revision of 1:25,000 topographic maps; 10 years; scales 1:1,000 to 1:25,000.

FH, Hamburg: Rectification and photo-interpretation; compilation and revision of 1:5,000 topographic maps; 38 years.

LRP, Koblenz: Compilation and revision of 1:1,000 to 1:5,000 topographic and 1:25,000 planimetric maps; 3 years.

CARL ZEISS, Oberkochen: Development and manufacture of photogrammetric, surveying and plotting instruments; 62 years.

K. H. Schmidt: Manufacturing for optical and electrical instruments.

AE, Frankfurt: Aerial surveys, ground surveys, resources; 10 years; variable scales; profile measurements.

DL, Hamburg: Aerial camera manufacturer; optical works; 9 years.

HL, Munster: Aerial photography, stereomapping, mosaic work; 40 years; scales 1:500 to 1:20,000; cadastral and profile work.

P GmbH, Munchen: Aerial photography, compiling and rectification; 45 years; scales 1:500 to 1:5,000; controlled mosaics; terrestrial photogrammetry.

GIRWTH, Aachen: Teaching and scientific works in photogrammetry; 10 years; variable scales.

TU Berlin: Special photogrammetric application work and research; 27 years; variable scales; no aerial triangulation is done.

IPU Bonn: Research, tests and studies in photogrammetry; training of students; 38 years; stereo eye acuity tests; vision tests; theoretical studies of orientation and parallax.

IPITH Hannover: Training of students; photogrammetric research and compilation of maps; 14 years; scales 1:1,000 to 1:5,000.

IPTTH Karlsruhe: Teaching, practical investigations, research work; 4 years; variable scales; coordinate measurements for cadastral operations and land consolidation; engineering and architectural applications.

IPTKTH Munchen: Research of photogrammetric methods, topography, cartography, glaciology, terrestrial photogrammetry; 77 years, variable scales.

TH Stuttgart: Testing work; 10 years.

### Personnel

IAG, 17; MA 18; NL, Hannover, 13; HL, Wiesbaden, 11; LS, Saarbrucken, 7; LNW, Bad Godesberg, 17; FH, Hamburg, 4; LRP, Koblenz, 5; Carl Zeiss, Oberkochen, 30,000 total employees; K. H. Schmidt, not known; AE, Frankfurt, 50; DL, Hamburg, 10; HL, Munster, 132; P GmbH, Munchen, 34; GIRWTH, 4; TU, Berlin, 5; IPU, Bonn, 7; IPTH, Hannover, 8; IPTH, Karlsruhe, 7; TH, Stuttgart, 2.

### Plotting and Triangulation Equipment Utilized

IAG: 3 Zeiss Stereoplanigraph C8, 1 Wild A8, 1 Gigas-zeiss Orthoprojector (Orthophotoscope), 1 Wild Aviograph B8, 1 Zeiss Stereotope.

MA: 1 Zeiss C8, 1 Stereotope, 1 LUZ, 1 Radial Secator RSL, 2 Zeiss SEG V.

NL, Hannover: 1 Zeiss C5, 1 Zeiss C8, 1 SEG V.

HL, Wiesbaden: 1 Wild A8, 1 Zeiss C8, 1 Zeiss Stereotope, 1 Ecomat, 1 Scanning Stereoscope, 1 Zeiss SEG V.

LS, Saarbrucken: no data was furnished.

LNW, Bad Godesberg: 1 Zeiss C8, 1 Wild A7, 2 Wild A8, 1 Zeiss Stereotope, 1 EK 5a for the A7, Coordinate Printer for the C8.

FH, Hamburg: 1 SEG V, 1 Sketchmaster (LUZ), 1 enlarger, 1 parallax bar.

LRP, Koblenz: 1 Zeiss C8, 1 Wild A8, 1 Zeiss Stereotope, 1 Zeiss SEG V.

AE, Frankfurt: 1 Wild A7, 1 Wild A8, 1 Zeiss Stereotope, Coordinate Recorder for A7, 1 LogEtronic Printer.

HL, Munster: 1 Wild A7, 3 Wild A8, 3 Zeiss C8, 3 Coordinate Printers for C8, 5 SEG V, 1 EK3 for A7.

P GmbH, Munchen: 2 Zeiss C8, 1 Stereotope, Coordinate Printer.

GIRWTH, Aachen: 1 Zeiss C8, 1 Wild A8, 1 Jena Stereoautograph 1218, 1 Jena Stereocomparator 1818, 1 Ecomat for C8.

TU, Berlin: Zeiss C8, SEG V, Multiplex, Stereotope, Stereo Pantometer, Radial Secator, Elimgraph, Elimtop, C8 Coordinate Printer.

IPU, Bonn: 2 Zeiss-Pulfrich Stereocomparator, Stereo Pantometer (Jena), Zeiss Stereotope, 4 normal angle Multiplex, 3 wide angle Multiplex, 1 Zeiss C8.

IPITH, Hannover: 1 Zeiss Stereocomparator (PSK), 1 Zeiss C8, 1 Wild A8, 1 Wild B8, 1 Galileo Santoni SMG 4, 1 Stereotope, Orion II/S, 1 Stereo Pantometer, 1 SEG V, 1 Stereoautograph, 2 Pulfrich Stereocomparators, 1 Multiplex, 1 Zeiss small Autograph, 1 Coordinate printer for C8, 1 Automatic Readout IBM 024, 1 Electronic Data Reduction LPG-30.

IPTTH, Karlsruhe: 1 Zeiss C8, 1 Wild A8, 1 Nistri Photomapper, 1 Stereotope, 1 SEG V, Ecomat, Multiplex, Zeiss Klein-Autograph, H-W Radialline Plotter, IBM 024, Zeiss PSK Stereocomparator, Zeiss 18×18 Comparator.

IPTKTH, Munchen: 1 Zeiss Orel Stereoautograph, 1 Zeiss C8, 1 Stereotope, 3 Wild B8, Coordinate Recorder.

TH, Stuttgart: 1 Zeiss C8, 1 Stereotope, 1 18×18 Stereocomparator, SEG V.

### Aerial Recording Data

CAMERAS

IAG: Zeiss Convergent Camera 2×RMK 21/18; Zeiss RMK 21/18, Topar; Zeiss RMK 15/23, Pleogon; Wild Normal, Wide, and Superwide Angle.

MA: Zeiss RMK, 15/23, Pleogon; Zeiss RMK 30/23, Topar; LogEtronic Printer; Pakorol Automatic Developing Machine (film and paper).

NL, Hannover: Zeiss RMK 21/18, Topar; Zeiss RMK 15/32, Pleogon; Wild RC5a, 21 cm, 18×18; Wild RC8, 15 cm., 23×23.

HL, Wiesbaden: Wild RC5, 21 cm., 18×18; Wild RC5, 15.3 cm., 23×23; Zeiss RMK 15.3 cm., 23×23.

LS, Saarbrucken: Wild Aviogon, 15/23 photography done by commercial firms.

LNW, Bad Godesberg: Photography done by commercial firms with Zeiss RMK 21/18², Zeiss Convergent 21/18 and RMK 15/23, Wild RC5a 21/18, Wild RC5a 15/23, Wild RC8 15/23.

FH, Hamburg: 18×18 and 23×23.

LRP, Koblenz: Wild 15/23 Aviogon, Zeiss 21/18 Topar, Zeiss 15/23 Pleogon, Wild 21/18 Avioton.

CARL ZEISS, Oberkochen: RMKA, 15/23, 21/23, 30/23, 60/23; KMKAR, 15/23 Reseau Camera; Photographic Stereo Camera SMK; Photo Theodolite, TMK.

AE, Frankfurt: Wild 153/23 Aviogon, Wild 210/18 Aviotar, Wild 88/23 Superwide Aviogon.

DL, Hamburg: Linhof Aerotecknica Cameras; 13.5 cm., 4×5 Planar; 18 cm. Symmar; 25 cm. Sonnar.

HL, Munster: Wild RC8 21/18 Aviotar, Wild RC8 15/23 Aviogon, Zeiss RMK 21/18 Topar, Zeiss RMK 15/23 Pleogon.

P GmbH, Munchen: Zeiss RMK, 15/23 Pleogon; Zeiss Rb, 20/30 Topogon; Zeiss RMK, 21/18 Topar; Eagle IX, 30/23 Ross; Zeiss Rb, 75/30; F52, 50 cm., 18×21.

IPITH, Hannover: cameras furnished by private contractors—Wild RC5a 21/18, Wild RC5a 15/23, Zeiss RMK 21/18, Zeiss RMK 15/23.

IPTTH, Karlsruhe: TAF, 16 cm., 13/18 cm. (glass plate for terrestrial uses); miscellaneous cameras.

RECORDING MEDIA

IAG: Some color photography is used in tests. The Zeiss Statoscope S2 is used.

MA: Infrared is used for interpretation.

AE, Frankfurt: Possible infrared use in tropics since advent of Zeiss RMKA camera. Color photography scarcely used—mostly for cities.

DL, Hamburg: Black and white and color photography capability.

HL, Munster: Infrared used in tropical rain forest. Color photography for tests and demonstrations.

P GmbH, Munchen: Infrared is used for forestry work. Color is used for photointerpretation.

### New Instruments and Techniques

CARL ZEISS, Oberkochen: Remote control for aerial cameras. Navigation telescope for precise navigation of photo flights. Aerostereo-microscope for interpretation purposes. Rectifier SEG Vb, transportable instrument for use in vars. Profile measuring device for engineering projects. Printing head for Coordimat, and Stereoplanigraph C8 (symbols and figures). Precision Stereocomparator PSK. Precision Monocomparator PEK. Orthophotoscope Gigas-Zeiss. Supragraph, high-precision stereo plotter. Coordimat, for fully automatic plotting of points. Diapositive device for Stereotope. Spotting projector for drawing tables. Marking device, snap marker for identification of natural points and marking of artificial points. Photographic stereo camera SMK. Photo Theodolite TMK. Terragraph, plotter for photographs taken with SMK and TMK.

K. H. Schmidt: Rectifier Type Orion II/S (partially automatic).

GIRWTH, Aachen: Block triangulation—see "Numerical Method" (Bulletin 1962/Nr. 4).

IPTTH, Karlsruhe: Affine restitution application of superwide angle photography.

## HOLLAND

### Organization

GOVERNMENTAL: Topografische Dienst, Delft; Fotogrammetrische Dienst van het Kadaster; Meetkundige Dienst van de Rijkswaterstaat.

INDUSTRY—Aerial photography: KLM Aerocarto, Amsterdam Airport.

INSTITUTES: I.T.C. Delft.

### Activities

All phases of aerial photography, land sur-

veying, aerial triangulation, and plotting mosaics. Making Topographical maps at scales ranging from 1:10,000 to 1:50,000 by means of aerial photography. Training, research and consulting.

### Personnel

Range of numbers employed and the average numbers: Management—3 to 6; 3. Supervision—2 to 15; 4. Professional—0 to 160; 41. Technicians—0 to 70; 14. Servicing—0 to 40; 8.

### Aerial Data Recording—Cameras

| *Type* | *Length* | *Lens* | *Format* | *Range, m.* |
|---|---|---|---|---|
| RC5 | 11.5 cm. | Aviogon | 18×18 | 350–1,200 |
| RC5 | 21 | Aviofan | 18×18 | 630–2,100 |
| RC7 | 17 | Aviofan | 14×14 | 500–1,700 |
| RMK | 21 | Topar | 18×18 | 630–2,100 |
| RC5 | 21 | Aviotar | 18×18 | 4,200 |
| RC5 | 11½–21 | Aviogon | 18×18 | 300–6,000 |
| RC7 | 17 | Aviotar | 15×15 | 500–1,500 |
| RC8 | 11½–21 | Aviogon | 9×9 | 300–6,000 |
| RC9 | 8.8 | Super Aviogon | 9×9 | 2,000–6,000 |
| Zeiss Konvergent | | | 18×18 | 1,000–3,000 |

### Aerial Triangulation and Plotting Instruments

1 Wild A5, 2 Wild A6, 2 Wild A7, 3 Wild A8, 1 Wild RT001, 1 Zeiss C8, 1 Stereocomparator, 1 Stereosimplex.

### Recording medium—present and future use

*Infrared:* Several projects have been flown; possibility this will be continued in the future.

*Color:* A few projects have been flown with Aviogon and Aviotar objectives. At present, production of diapositives and prints, only, is carried out.

### New Instruments

Wild Rectifier; Santoni III for plotting; Wild A8 and EK5 for plotting and aerotriangulation; Analytical Computations for Block Adjustments.

## INDIA

### Organization

GOVERNMENTAL: Civil Survey of India (SOI)
INDUSTRY: Civil Engineering—Air Survey Co. of India (ASI)
UNIVERSITY of Roorkee (U of R)

### Activities

SOI—Surveying from aerial photographs and training in photogrammetric methods; since 1918; plotting at scales of 1:1,000 to 1:50,000.

ASI—Aerial photography, surveying, mosaicking, mapping, litho printing, aviation route maps and geophysical scintillation surveys; since 1927.

U of R—The University conducts a post graduate course in advanced surveying and photogrammetry. It is a one-year course open to holders of a University degree in civil or mining engineering; since 1958. Plotting of scales of 1:10,000 to 1:25,000.

### Personnel

SOI, total of 143; ASI, total of 115; U of R, total of 6.

### Plotting and Aerial Triangulation Equipment

SOI—8 Wild A7, 16 Wild A8, 28 Zeiss Stereotopes, 3 Multiplex.

ASI—2 Multiplex tables, 11 Stereoplotting Williamson-Ross Sp. 3 projectors.

U of R—1 Multiplex, 1 Wild A8, 1 Zeiss Stereotope, 20 stereoscopes and stereometers, 3 Zeiss sketchmasters, 1 Radial Secator, 1 rectifier, 1 phototheodolite.

### Aerial Data Recording

#### Cameras

SOI—Williamson Eagle IX, 6 in. (15 cm.); 12 in. (30 cm.); 9 in.×9 in. format Wild RC 5a, 11.5 cm.; 21 cm.; 18×18 cm. format.

ASI—RC 8, 4.5 in. (11.5 cm.); 7×7 in. film; Eagle IX, 6 in., 9×9in. film; F. 52, 12 in.; 20 in., 36 in., 8½×7 in. film; K20, 163, mm. 4×5 in.; Varitron Camera, 28 mm, 70 mm.

#### Infrared and color

SOI—Infrared expected to be utilized for forestry purposes.

ASI—Infrared used for forest stock survey. Color—oblique views and vertical photography used for forestry, crop estimation, etc.

### New Instruments and Techniques

SOI—Instrument: ITC—Jerie Analogue Computer for block adjustment of aerial triangulation. Techniques: Block adjustment for economic provision of control from minimum field control.

# JAPAN

## Organizations

GOVERNMENT AGENCIES

1. Geographical Survey Institute—National geographical survey
2. Hydrographical Survey, Maritime Safety Agency—National hydrographical survey
3. Geological Survey—National geological survey
4. Forestry Service of Japan—National forestry survey

COMMERCIAL AGENCIES—Photogrammetric and ground surveying companies:

1. Kokusai Aerial Surveys Co.
2. Asia Aerial Surveys Co.
3. Pacific Aerial Surveys Co.
4. Toyo Aerial Surveys Co.
5. Nippon Sogo Consultant Co.
6. Taiyo Koku Co.
7. Higashi Nippon Koku Co.
8. Nito Koku Co.
9. Koku Shashin Sokuryojo
10. Nippon Kogyo Co.
11. Kyodo Sokuryo Co.
12. Oba Sokuryo Co.

MANUFACTURERS

1. Sokkisha Co.—Stereopricking Device KRF, Photocomparator ARC.
2. Nippon Kogaku Co.—Multiplex.

UNIVERSITIES

Institute of Industrial Science, Tokyo University—Application of aerial and terrestrial photogrammetry

## Analog (Classical) Instruments Employed

1st Order Plotter: Total 21—11 Wild A7, 1 Nistri Beta 2, 1 Zeiss C5, 8 Zeiss C8.

2nd A-Order Plotter: Total 32—30 Wild A8 1 Gallileo Simplex, 1 Zeiss Stereometrograph.

2nd B-Order Plotter: Total 88—60 Kelsh Plotter, 7 Belfort Plotter, 6 Nistri Plotter, 15 Kokusai Plotter, Many Multiplexes.

3rd Order Plotter: Total 49—44 Zeiss Stereotop, 2 Gallileo Stereomicrometer, 3 Kuramochigraph.

## Automatic Photogrammetric Instruments Employed

ORTHOPHOTOSCOPE TYPE SYSTEM: The system is an anaglyphical stereoscopic type orthophotoscope developed by Geographical Survey Institute.

AUTOMATIC AERIAL TRIANGULATION EQUIPMENT: This is an electrical device, newly developed by Geographical Survey Institute for aerial block adjustment.

AUTOMATIC READOUT SYSTEM: This is a system developed by Kokusai Aerial Surveys Co. for highway engineering.

## Analytical Photogrammetric Instruments Employed

LINEAR COMPARATORS—Mann Comparator: Kokusai Aerial Surveys Co.

COORDINATE RECORDERS added to normal instruments—Wild EK3: Institute of Industrial Science Wild A7.
Photocomparator ARC: Asia Aerial Surveys Co.

## Aerial Photography and Auxiliary Equipment Employed

PHOTOGRAPHY: Base used, Film; Altitude 500–4,500 m. RMK 15/23 Pleogon. RMK 15/23 Pleogon A; RMK 21/18 Topar; RC 5, 15 cm. Aviogon 23×23 cm. and Infragon (Asia Aerial Surveys Co.); RC8, 21 cm. Aviotar 18×18 cm.

COMMENTS ON PRESENT AND FUTURE USE: *Infrared:* present use (some companies); *Radar:* future use; *Color:* present use (some companies)

AUXILIARY DATA UTILIZED: Statoscope—Zeiss Statoscope S2 (Kokusai Aerial Surveys Co.)

## List of New Instruments Utilized Since 1960

ANALOG COMPUTER for block adjustment—Geographical Survey Institute.

ORTHOPHOTOSCOPE for photomap—Geographical Survey Institute.

PHOTOCOMPARATOR ARC for analytical triangulation—Asia Aerial Surveys Co.

STEREOPRICKING DEVICE KRP for analytical triangulation—Asia Aerial Surveys Co.

PROFILE READOUT attached to Kokusai Plotter for Highway design Kokusai Aerial Surveys Co.

## List of New Techniques Incorporated Since 1960

ANALYTICAL Aerial Triangulation (some companies).

PHOTOMAP Making (some companies).

## MALAYA

### Organization

Government; Surveyor General Federal of Malaya.

### Activity

Topographical mapping small scale and large scale; training new operators.

### Personnel

Management 0; Supervision 0; Professional 2; Technicians 45; Servicing 1.

### Aerial Triangulation and Plotting Instruments

1 Wild A7; 2 Wild A8; 5 Multiplex; 1 Radial Line Plotter; 1 Zeiss Stereotope; 1 Automatic Readout and Recording System.

### Aerial Data Recording

CAMERAS: RC8, 6 in. Aviogon, 9″×9″, 3,000–15,000 ft.

RECORDING MEDIUM

*Infrared*—Experimenting with sample film under tropical conditions with Aviogon lens and yellow filter. *Color*—No demand at present, but forestry and other allied agency may in near future demand color film for interpretation purposes.

AUXILIARY DATA UTILIZED: Recording Barometer for rough scale and height flow, only.

## MOROCCO

### Organization

Governmental—Ministere De L'Agriculture

### Activity

Production of topographic maps and large scale maps.

### Personnel

Management, 1; Supervision, 1; Professional, 2; Technicians, 5; Servicing, 0.

### Aerial Triangulation and Plotting Instruments

1 Wild A7; 1 Wild B9.

Aerial Data Recording—Aerial Cameras Wild RC7a, 10 cm. Aviogon, 14×14 cm.; Wild RC8, 15 cm. Aviogon, 23×23; Wild RC9, 88 mm. Super Aviogon, 23×23.

## NORWAY

### Organization

Industrial (Civil and Aerial)—Wideroe's Flyveselskap.

### Activity

Aerial photography—surveying and aerial mapping for Government and private customers.

### Personnel

Approximately 100 employees.

### Aerial Triangulation and Plotting Instruments

1 Wild A5; 2 Wild A6; 2 Wild A7; 2 Wild A8; 2 Wild B8; 1 Coordinate Recorder (1)

### Aerial Data Recording

Cameras: RC5, 101 mm., Aviotar, 18×18; RC8, 150 mm., Aviogon, 23×23.

## SOUTH AFRICA

### Organizations

INDUSTRY

Dept. of Transport (National Roads); E.I.R.A. Pty. Ltd.; Aircraft Operating Coy.; Air Survey Coy. of Africa (Pty.) Ltd.

UNIVERSITIES: University of Cape Town; University of Natal; University of Witwatersrand.

### Activities

Surveying and compilation of maps from aerial photographs for engineering projects and general mapping.

Dept. of Land Surveying giving formal training in photography for Land Surveying, Geography and Geology students at graduate and post graduate level.

Teaching photogrammetry as part of under-

graduate studies for surveyors and civil engineers—Research.

Mapping 1:250–1:1,000,000 aerial photography, normal, wide and superwide angle.

Photography and large scale mapping for road planning and construction.

Definition of soil types; research purposes; study of off shore water pollution; teaching; experimental work in computing earthwork and road alignment data directly from photos by means of electronic computer.

PERSONNEL

Management, ranges from 1 to 5, average of 2; Supervision, 0 to 6, 1; Professional, 1 to 5, 3; Technicians, 1 to 30, 12; Servicing 0 to 2, 1.

AERIAL TRIANGULATION AND PLOTTING INSTRUMENTS

5 Wild A8; 3 Wild A7; 6 Wild B8; 2 Wild A6; 2 Wild A5; 1 Stereosimplex-Santoni; 1 Nistri Photomapper; 2 Stereo Comparator; 1 Zeiss C8; 1 Multiplex SPC; 1 Coordinate Recorder.

AERIAL DATA RECORDING

CAMERAS: RMK 15/23, 6″, Pleogon, 9×9; RC5, 114 mm., Aviogon, 18×18 cm.; RC5A, 152 mm., Aviogon, 9×9; RC8, 152 mm., Aviogon, 9×9; RC9, 88 mm., Super Aviogon, 9×9; RMKA 15/23, 152 mm., Pleogon, 9×9; RC5, 210 mm., Aviotar, 18×18 cm.; RC8; $4\frac{1}{2}$ in., Aviogon, 7×7; RC8, 6 in., W/A, 9×9.

RECORDING MEDIUM

*Infrared*—identification of soil types and survey in densely wooded areas.

NEW INSTRUMENTS

*Instrument*—Wild PUG 2; Wild B8 Aviograph.

*Purpose*—For aerial triangulation plotting, education and research.

## SWITZERLAND

PHOTOGRAMMETRIC INSTRUMENTS MANUFACTURED IN SWITZERLAND AND CHANGES MADE SINCE 1961

WILD HEERBRUGG, INC., HEERBRUGG

CAMERAS. RC8 Aerial Camera—automatic film camera with interchangeable lens cones: 21 cm. Aviotar, 18×18 cm.; 11.5 cm. Aviogon, 18×18 cm.; 6 in. Aviogon, 9×9 in.

Objectives for infrared photography: same characteristics as above.

Changes: Universal suspension device (camera mount to kill vibrations, etc.); Statoscope and horizon camera. Navigation telescope with detachable head; Kodak projection apparatus for using horizon photography.

APPARATUS FOR TRANSFORMATION OF IMAGES. (Reducing-Enlarging) *Image Transformers U3 and U4.* U3, no change. U4, with automatic adjustment of contrast by electronic method, the "Cintel System."

*E4 Rectification Camera* (New). Equation of conjugate points and Scheimflug condition are introduced electronically, which permits simplified construction.

*Enlarger VGI.* Change: Projection table is provided with a depression device making the sensitized paper strictly flat.

STEREOPLOTTING MACHINES—(Camera) (Plotter)

*Aviograph B8*—for plotting wide-angle photography and super-wide angular photography without reducing size of photos. Changes: addition of large linear pantograph; movement of tracing pencil along the bearing arm is controlled by a wire of invariable length, which makes the construction very light. The ratio of enlargement can go to 1:5.

*Stereomat* (In Research)

*Transfer Apparatus PUG 3.* For transferring passpoints from one photo to the other in aerial triangulation.

KERN & CIE S.A., AARAU

*Stereorestituteur RGI*—First-order plotting equipment. No change.

*Stereorestituteur PG2*—Second-order plotting equipment. No change.

G. GORADI AG., ZURICH

*Coradomat* (New)—Coordinatograph for transferring points by orthogonal coordinates. Finger control of transfer and drawing straight lines. Conversion of scales. Measurement of coordinates of points shown on a plan.

*Digimeter* (New)—Apparatus to measure coordinates of points shown on a plan for computing area of lots.

CONTRAVES AG., ZURICH, HAAG-STREIT AG., BERNE

*Numerical input coordinatograph* (New)—Apparatus for automatic transfer of points

by coordinates. Conversion of scales. Automatic drafting and interpolation up to 3rd degree.

*Numerical output coordinatograph* (New)—Apparatus for measurement of coordinates of points shown on a plan for computation of area of lots.

SWISS FEDERAL RAILWAYS

Equipment for Measurement of Tunnel Profiles. Two phototheodolites are permanently mounted on the front end of a railroad car. They take normal photographs of the tunnel. Their plotting in an autograph plotter thus furnishes the profile. For details see "The New Clearance Recording Car of the Swiss Federal Railways" below.

## New Methods

FEDERAL POLYTECHNIC SCHOOL, ZURICH. Professor Dr. H. Kasper. Constant base aerial triangulation in the Wild A8 stereoplotter and spatial transformation of the coordinates. (Publication to appear.)

POLYTECHNIC SCHOOL OF THE UNIVERSITY OF LAUSANNE. Prof. Dr. W. K. Bachmann. Research on the precision of the numerical orientation of any aerial photography in a universal stereoplotter. See list of publications.

FEDERAL TOPOGRAPHIC SERVICE, BERN. Revision of existing maps is done primarily by aerial photography. Photos are taken according to a flight plan which takes account of the configuration of the ground. Longitudinal overlap of 60 to 80 per cent and side overlap from 20 to 30 per cent. There is no preliminary marking and the stereoscopic model is adjusted by means of existing maps at 1:10,000 or 1:5,000. For the map at 1:25,000, plotting is done directly at the scale of the map by engraving or pencil drafting (scribing). Revision of maps at 1:50,000 and 1:100,000 is done by a new drafting of the 1:25,000 map treated as mentioned above. For several years, plotting of contours at scales of 1:4,000 to 1:10,000 have been done directly by engraving on the base document (original draft). Publication of Mr. Lips, Engineer of the Federal Topographic Service, "Attempt to Convert Photogrammetrically-Obtained Contour Lines in Wooded Areas as Base for Small Scale Mapping." (To appear in the near future.)

### The New Clearance Recording Car of the Swiss Federal Railways (SBB)

"In ever increasing numbers the Swiss railways have to transport goods of dimensions exceeding the standard loading gauge. To a great extent, such transport assignment can be handled by utilizing the margin between the standard loading gauge and standard clearance gauge. In many cases, however, it is necessary to make use also of the gap that exists between the standard clearance gauge and the actual clearance available at given points.

"Numerous cross sections must be checked to judge the feasibility of each excess-dimension shipment, but the structure gauge files are quite dated and largely of insufficient reliability, necessitating the measuring of many new clearances.

"At present, each of the SBB Regions has a clearance recording car of simple design. These cars have proven too inefficient, especially if used on the busy trunk lines with their high traffic density and the resulting short intervals between trains.

"Looking for new equipment, preferably of a kind not requiring physical contact with structures, photogrammetry appeared as a likely solution. It should be explained that to this day the European railway authorities measure their clearances with big pantographs, polar and orthogonal coordinate equipment, feeler devices mounted on railway cars, and by the so-called photographic section method.

"The principle of the photogrammetric method is based on the stereoscopic effect, achieved by photographing the same object from two different exposure stations. For the subsequent restitution process in the office both pictures are viewed in the so-called Autograph, where the operator sees a three-dimensional image. This spatial viewing permits scanning of the 'model' with a mobile measuring mark. The movements of this measuring mark are transmitted directly to a tracing stylus. In this way, total moving dimensions are obtained, in contrast to 'mechanical' cross sectioning methods which supply only a number of individual points of each section. Required accuracy and the mechanical limits of the Autograph determine the limits of the restitution range (maximum camera-object distance); within this range any number of cross sections can be plotted.

"The photographic equipment consists of two terrestrial photogrammetric cameras by Wild-Heerbrugg. They are mounted on a girder of sheet steel which can be levelled; the distance between the cameras is 2.4 meters. Scale of the photographs is checked by means of a 'distance target' located about 23 meters (75 ft.) from the car and photographed with every picture. For this purpose two small four wheel trucks are provided, connected to the survey car by two tubular light metal tow bars. On sidings and during transit runs they are stowed underneath the car. For the photographs, number plates are used as distance targets, simultaneously serving to identify the pictures numerically (the truck nearer the car merely serves as an intermediate tow bar support). Illumination at night and in tunnels is provided by a 3,000 watt floodlight mounted on the girder between the two cameras.

"The clearance recording car, built in the Yverdon shops, consists of a rebuilt three-axle coach chassis and a new body, lined with specially treated hardboard panels of the kind now used in the construction of covered freight cars. Either end of the car has a roofed platform from which the photographs are taken. For immediate checks on the quality of the pictures and for re-

loading of the plateholders the car also contains a well equipped photographic darkroom. Next to this there is another compartment serving for various purposes, such as storage of the camera carrier, photographic and other equipment. The car's suspension can be locked out directly from the platforms to provide stable support for the cameras during the usually quite long exposures.

"Some of the more interesting technical data are:

Accuracy at camera-subject distances—20 m. (65 ft.), approx. 1 cm.; 40 m. (130 ft.) approx. 2 cm.; 100 m. (330 ft.) approx. 5 cm.
En-route speed during transit of survey car: 90 km./h. (60 mph).
Operational speed: 30 km./h. (20 mph)
Approximate time per take (survey car in desired location): 2 minutes.

"Traction is provided by an electric 'Te' yard tractor equipped with welding gear outlet 220 v, $16\frac{2}{3}$ c.p.s. supplying energy for floodlight, car lighting and heating. Voltage fluctuations are eliminated by a voltage stabilizer to ensure even object illumination when the floodlight is used. Storage batteries, recharged through rectifiers, provide current for the car lights.

"The new procedures can be applied in tunnels as well as on the open line. Its advantages are for one that it is no longer necessary to block the parallel tracks nor to switch off the current in the overhead wires, resulting in considerable operational advantages; also the increased efficiency deserves mention—compared to conventional methods a much greater number of cross sections can be measured in a given period of time. Finally there is the further advantage of greater coverage.

"It may be mentioned that a photo-electronic scanning device is under study as a complement to existing equipment, to facilitate locating of critical cross sections."

### Publications

Phil. Zings—Die Anwendung det Photogrammetric bei der Aufnahme des alten Bestandes fur Guterzusammenlegungen.

J. Ikle—Die Luftphotogrammetrie in der Grundbuchvermessung—praktische Erfahrungen in einer Voralpengemeinde.

R. Conzett—Ueberblick uber ein elektronisches Datenverarbeitungssystem fur photogrammetrische Grundbuchvermessung.

A. Pastorelli—Photogrammetrische Aufnahme des alten Besitzstandes.

H. Kasper—Zur Entwicklung eines einfachen photogrammetrischen Auswertegerates.

W. K. Bachmann—Methode numerique d'orientation de vues aeriennes quelconques dans un stereorestituteur.

W. K. Bachmann—Developments mathematiques pour l'orientation numerique de vues aeriennes quelconques dans un stereorestituteur.

W. K. Bachmann—Utilisation de la photogrammetrie et du calcul electronique pour la construction des autoroutes.

W. K. Bachmann—Utilisation des calculatrices electroniques pour la mensuration cadastrale suisse.

W. K. Bachmann—Utilisation de la photogrammetries et du calcul electronique pour la construction de routes.

H. Harry—La mensuration cadastrale par photogrammetrie; possibilities et realisations.

H. Harry—Fehlerhaftes in det photogrammetrischen Praxis. Moglichkeiten einer Anpassung der Organization der Vermessungsarbeiten and der funktionellen Folgearbeiten an die neuzeitliche Entwicklung der Vermessungs und Rechentechnik.

H. Harry—Die Entwicklung der Vermessungsinstrumente, dargestellt an kulturellen Entfaltungen.

Gegenwartiger Stand der Automation in europaischen Vermessungs wesen.

R. Conzett—Ueberblick uber den Einsatz eines elektr. Datenverarbeitungssystems bei der Projektierung des schweiz. Nationalstrassennetzes.

P. Gfeller—Methodische und organisatorische Fragen der Planbeschaffung.

R. Conzett—Normen uber Berechnungen fur die Strassenprojektierung.

R. Conzett—Elektronisches Rechnen im schweizerischen Strassenbau. "Elektronisches Rechnen im Strassenbau und Bruckenbau"

W. Altherr—Crossmasstabliche Gravur auf Folienmaterial.

P. Goldschan—Luftphotogrammetrische Hohenaufnahme 1:1,000 und Herstellung eines Photoatlasses 1:2,000 im Kanton Basel-Landschaft.

B. Hallert—Bestimmung der Prazision und Genauigkeit eines Stereokomparators.

## UNITED STATES

### Organizations

GOVERNMENTAL (Federal) *Questionnaires Mailed*—18, *Responded*—9

U. S. Air Force—Aeronautical Chart & Information Center; U. S. Department of Commerce—Coast and Geodetic Survey—Weather Bureau—Bureau of Public Roads; U. S. Department of Agriculture—Forest Service—Soil Conservation Service; U. S. Department of Interior—U. S. Geological

Survey; U. S. Navy—Naval Oceanographic Office; U. S. Army—Corps of Engineers—Army Map Service.

GOVERNMENTAL (State) *Questionnaires Mailed*—52, *Responded*—23

Arizona, Connecticut, Illinois, Iowa, Kansas, Louisiana, Massachusetts, Michigan, Missouri, New Jersey, Minnesota, New Mexico, New York, North Carolina, Ohio, Oklahoma, Oregon, Texas, Utah, Washington, Wyoming, District of Columbia, Puerto Rico.

INDUSTRY (Practicing Firms—Research and Development—Manufacturing) *Questionnaires Mailed*—108, *Responded*—23

Clyde E. Williams & Associates; Walter and Whiteford, Inc.; Stereofoto, Inc.; The National Survey; K. B. MacKichan and Associates; Lockwood, Kessler & Bartlett, Inc.; International Aerial Mapping Company; Mark Hurd Aerial Surveys, Inc.; Hunting Survey Corporation; Clair A. Hill and Associates; Chicago Aerial Survey; Alster & Associates, Inc.; Fairchild Aerial Surveys; Air Photographics, Inc.; H. G. Chickering, Jr.; National Geographic Society; R.C.A. Service Company-Missile Test Project; Paul Rosenberg Associates; Perkin-Elmer; Keuffel & Esser Company—Photogrammetric Systems Division; Telecomputing Corporation—Data Instrument Division; Eastman Kodak Company; David W. Mann Company; Galileo Corporation of America.

UNIVERSITIES *Questionnaires Mailed*—99, *Responded*—23

Stanford Univ.; Southern Tech; South Dakota School of Mines and Technology; Pennsylvania State Univ.; Ohio State Univ.—Department of Civil Engineering—Department of Geodetic Science; Univ. of North Dakota; Univ. of Minnesota; Louisiana Polytechnic Institute; Univ. of Kentucky; Univ. of Illinois; Univ. of Georgia; Georgia Institute of Technology; Colorado School of Mines; Brigham Young Univ.; Auburn Univ.; Univ. of Alaska; Oregon State Univ.; Univ. of Washington; U. S. Air Force Academy; Univ. of New Brunswick, Canada; Univ. of Sasketchewan, Canada; One Unidentified.

## ACTIVITIES

GOVERNMENTAL (Federal)

Process television and infrared radiation return data from meteorological satellites.

Aerial and stellar photography for hydrographic and topographic data using stereo triangulation and compilation. Conducts research, development and evaluation in photographic, photogrammetry and cartographic procedures.

Provide photogrammetric techniques and production of nautical and aeronautical charting and hydrographic surveys. Studies and application in ocean currents, satellite geodesy, crustal movements. Support of development and applications of numerical photogrammetry.

Preparation and maintenance of National Topographic Map Series; Research and Development of instruments and techniques for mapping activity.

Produce and supply maps, geodetic and allied data for the U. S. Department of Defense.

Provide U. S. Air Force with aeronautical charts, graphical air target materials, flight information, terrain models, maps and related cartographic services.

Surveying and mapping activities for forestry resources including engineering surveys for road construction by photogrammetric procedures.

Large scale maps by photogrammetry for small watershed studies.

Develop procedures and specifications for governmental sponsored highway engineering projects. Produce topographic maps for special purpose design. Training in photogrammetry for highway engineering.

GOVERNMENTAL (State)

By photogrammetric techniques and procedures provide large-scale topographic and planimetric maps and mosaics for design and construction of highways. Aerial photography for public relations and presentation of detail for plan section of plan and profile sheets. Digital read-out and automatic plotting of cross section data. Payment of contractors for earth movement from volumes determined from photogrammetric measurements.

INDUSTRY

Aerial photography, precise ground and airborn systems for geodetic and supplementary control data, compilation of large and small scale planimetric, topographic and resources maps by conventional and advanced photogrammetric and photo interpretation equipment and procedures for all encompassed map users. Consultation, research, development and production of conventional and advanced data recording and data reductions equipment and systems. Application of photogrammetry and photo in-

strumentation to Missile and Space industry and operations.

UNIVERSITIES

Degrees in Civil Engineering and Forestry predominate in having courses in photogrammetry, photo interpretation and photogeology. Through University funds, outside grants and military contracts Research and Development is performed on sensors, equipment, techniques and personal performance. Some engage in actual mapping projects. The Universities offer the following surveying and mapping Graduate Degree Program (Photogrammetry, Geodesy, Geometronics).

| *University* | *M.S.* | *Ph.D.* |
|---|---|---|
| Univ. of Wisconsin | ★ | |
| Univ. of California | ★ | ★ |
| Cornell Univ. | ★ | ★ |
| Georgia Tech | ★ | |
| Kansas State Univ. | ★ | |
| Ohio State | ★ | ★ |
| Princeton | ★ | ★ |
| Purdue Univ. | ★ | ★ |
| Syracuse Univ. | ★ | |
| Univ. of Illinois | ★ | ★ |
| Univ. of Michigan | ★ | |
| Univ. of Texas | ★ | ★ |
| Univ. of Washington | ★ | |
| Univ. of New Brunswick | ★ | ★ |
| Univ. of Toronto | ★ | |
| Laval Univ. | ★ | |

Technical schools offer courses in photogrammetry for techniques.

### Personnel

GOVERNMENTAL (Fed.). Management: range of number of employees, 2 to 26; average number, 11. Supervision, 4 to 73; 28. Professional, 10 to 125; 60. Technicians, 2 to 488; 134. Servicing, 0 to 25; 8.

GOVERNMENTAL (State). Management, 1 to 3; —. Supervision, 1 to 12; 2. Professional, 10 to 125; 60. Technicians, 1 to 52; 16. Servicing, none.

INDUSTRY. Management, 1 to 14; 5. Supervision, 1 to 15; 7. Professional, 0 to 125; 20. Technicians, 1 to 160; 70. Servicing, 0 to 18; 4.

UNIVERSITIES. (No reply).

### Aerial Triangulation and Plotting Instruments

Equipment employed in aerial triangulation and plotting covers the spectrum from conventional to exotic instrumentation. Aerial triangulation is accomplished by optical train instruments, mono- and stereo-comparators, and some use is made of projection type plotters which have digital recordings. Projection type plotters are predominately used in the plotting operations. Computer controlled semi-automatic and automatic instruments have passed the research and development stage, now being used on operational projects for triangulation and plotting.

Other use made of equipment besides map compilation and aerial triangulation are:

Photo interpretation
Terrain profiling for transmission systems
Cross-sections for volume computations of terrain and objects
Automatic digital recording of terrain and objects for digital computer computations and automatic plotting.
Satellite Geodesy
Tidal Current Surveys
Earth Crustal Movement
Stellar triangulation
Medical, dental and architectural three-positional recordings
Research and development
Education
Analog to digital-digital to analog conversation

Of the seventy-eight (78) organizations reporting the following categories of photogrammetric equipment are being used:

AUTOMATIC PHOTOGRAMMETRIC INSTRUMENTS

| | *Number of Organizations* |
|---|---|
| Integrated Mapping System | 1* |
| Orthophotoscope type systems | 2 |
| Automatic Plotting Equipment | 2* |
| Automatic Aerial Triangulation Equipment | 2 |
| Automatic Photo Mosaicking Systems | 1* |
| Automatic Rectification Systems | 3 |
| Automatic Readout and Recording Systems (Pertaining to Photogrammetric Equipment) | 16 |
| Automatic Viewing Equipment | 2 |

ANALYTICAL PHOTOGRAMMETRIC INSTRUMENTS

| | |
|---|---|
| Linear (Monoscopic) comparators | 5 |
| Stereo comparators | 9 |
| Numerical Photogrammetric auxiliary equipment | 4 |
| Coordinate recorders added to normal plotting and aerial triangulations instruments | 3 |

ANALOG (CLASSICAL) PHOTOGRAMMETRIC INSTRUMENTS

| | |
|---|---|
| Projector type instruments | 447 |
| Super-wide angle instruments | 15 |
| Universal (first-order) photogrammetric instruments | 21 |
| Miscellaneous plotting photogrammetric instruments | 51 |

* Experimental Basis.

State governmental agencies reported increased use of automatic plotters (digital to analog) in presenting photogrammetric derived measurements of cross section to plotted sections.

## Aerial Data Recording

### CAMERAS

All four categories of organizations reporting stated that cartographic aerial cameras were used to secure black and white negatives for photogrammetric compilation. Governmental (Federal) own and use practically every type manufactured. The 6-inch focal length, 9×9 in. format, is the most predominately used, with increased use being made of the "super-wide" angle. Photographic altitudes range from 1,000 feet to 38,000 feet above datum with the majority of photography being secured at the higher altitudes for small scale compilation. Governmental (State) only report use of 6 in. focal length, 9×9 in. format, cartographic cameras used at photographic altitudes ranging from 600 to 18,000 feet above datum for compilation; predominately lower altitudes are used to produce large scale surveys for engineering purposes. Industry consistently reported use of 6-, $8\frac{1}{2}$- and 12-in. focal length, 9×9 in. format, cartographic cameras for a wide range of compilation scales, flying at altitudes from 300 to 38,000 feet above datum. Universities reported limited operational use of aerial cameras.

### RECORDING MEDIUM

*Infra-red.* Ice studies; High and low water line surveys; Aerial haze penetration in bad photographic weather areas; Currently used to a limited degree, but increasing gradually, to delineate water features for map compilation; Forestry studies including special and age classification; Photographic interpretation and mapping of soils and ground conditions; Future production use intended, when, and if, state-of-art advances to point of meeting requirements; Research for compilation use; Study for drain tile location in highway planning; Agriculture mapping; Film-filter-scale studies for soft foundation and landslide studies;

*Color.* Determination of water depth and ice characteristics; Aerial time lapse to determine height and location of clouds; Shoreline surveys in charting aids to navigation, rocks, channels, depths and depth curves; Precise positioning and height measurements of obstructions to air navigation; Tidal current surveys; Research project planning for application to topographic mapping; Resource studies; Photographic interpretation and mapping; Future production use intended, when, and if, state-of-art advances to point of meeting requirements; Illustration and display; Construction materials surveys; Forestry surveys for fire damage and insect infestation; Geology; Missile positioning and altitude.

*Radar.* Small scale compilation when state-of-art is improved; Future production use intended, when, and if, state-of-art advances to point of meeting requirements; Experiments conducted for mapping purposes

*Other.* TIROS Satellite TV photography for ice surveillance; Underwater photography for ocean bottom characteristics; Stellar photography for geodesy; TIROS satellite TV photography for weather studies and predictions; Infrared imagery for photographic interpretation; Future production use intended, when, and if, state-of-art advances to point of meeting requirements; Electromagnetic sensors for geophysical surveys.

## New Instruments Perfected and in Use Since 1960

A *deep-sea stereo camera system* was perfected for oceanographic research studies.

*Electronic timing and shutter drive* mechanism modification for adapting Ballistic cameras for satellite geodesy.

*TIROS electronic photo recording system* for many operations required in weather predictions.

*AP/2*, an *universal analytical stereo plotter* instrument for military mapping operations. It consists of a stereo comparator viewing unit, a digital computer and a coordinating unit which make up into a closed loop system. The system utilizes the principle of digital-analytical photogrammetry. In this way all known sources of systematic errors can be corrected.

*AP/C*, an *analytical stereoplotter* instrument designed as a commercial version of the the AP/2. Design simplicity has reduced the production cost. In most respects the AP/C and AP/2 are similar. Both systems afford the use of a general purpose computer when not being used for compilation.

*Universal Table Frame* to accommodate the various projection-type instruments.

*Ferranti Grid Bar System* for measuring $X$ and $Y$ coordinates of stereoscopic models under projection type plotters to record profile, cross sectioning and plane coordinates.

*ECARS* (Electronic Coordinatograph and Recording System). Analog to digital record-

ing of $X$, $Y$ and $Z$ coordinates by use of analog positioning in closed-loop circuitry. Recordings are made from any graphic or stereo presented material in true coordinate values with a continuous scale ability. Supplementary data is coded to present it and the positions in digital form to a computer.

*Kelsh-D1.* Analog to digital recording of $X$, $Y$ and $Z$ coordinates by use of shaft encoders for positioning. Recordings made from graphic or stereo presented material in machine coordinates at discreet scale factors. Supplementary data is coded to present it and the positions in digital form to a computer.

*Kelsh K-5 Plotter.* Anaglyph projection of from one to four models of "distortion" free photography. Universal fame.

*AMS M-2 Stereoplotter.* High precision, first-order, vertical, and accurate anaglyph-projection plotter, presenting one to three modes of "distortion" free photography.

*K&E Terrain Digitizer.* Electromechanical measuring device for use with projection type stereoplotters, or existing topographic maps, in the automatic recording of cross section data and other volume computation applications.

*Wild B8 Aviograph.* Optical viewing stereoscopic plotter for use with either black and white, or color photography, exposed from wide-angle or super-wide-angle camera lenses.

*Terrain Data Translater.* An all-digital, solid-state circuit, $X$ or $Y$ and $Z$ measuring and digitizing unit for recording cross sectional data and other measuring requirements.

*EAI Photographic Rectification System.* Analog to analog general purpose device used in rectifying oblique and panoramic photographs recording from an input coordinatograph for permanent restituted display on an $X$-$Y$ plotter.

*Exaggerated Profile Plotter.* Draws continuous terrain profile from a projected stereoscopic model at $2\frac{1}{2}$ and 5 times vertical scale exaggeration.

*Ballistic* Camera Plate *Previewer Comparator.* Measures coordinates.

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