

THE NEON LIGHT DRAWER

- 1 Neon grill to fit the bottom of the drawer
- 1 Acme Cold Cathode Fluorescent Lighting Transformer. Pri. Volts 115; Sec. Volts 7,500. Secondary Midpoint grounded to case. Volt. Amp. Capacity 450
- 1 Piece Plexiglass $\frac{1}{4}'' \times 13\frac{7}{8}'' \times 20 \times \frac{3}{8}''$
- 8 Glass receptacles for neon grill
- 1 Plexiglass safety rod $20\frac{1}{2}'' \times \frac{3}{4}''$ diameter
- 2 Plexiglass safety guards for receptacles under floor of this drawer to prevent static discharge to operator.
- 2 Cable connectors
High voltage wire for hook-up and from transformer to receptacles
- 2 male Amphenol plugs 61 M
- 4 Ventilation guards

THE FLUORESCENT DRAWER

- 38 General Electric 95×432 Lampholders
- 19 General Electric 95×299 Starter sockets
- 19 General Electric 89G435 Ballasts
- 19 General Electric F8 T5/cw Lamps
- 19 General Electric FS-5 Starters
- 19 S.P. S.T. Switches (Heavy duty)
- 9 Ventilator guards
- 1 male Amphenol plug 61-M
- 1 piece of Plexiglass $\frac{1}{4}'' \times 13\frac{7}{8}'' \times 20\frac{3}{8}''$

THE TUNGSTEN LAMP DRAWER

- 24 General Electric 49×698 Lumiline receptacles

- 24 General Electric 49×805 Lumiline sockets
- 12 General Electric L 40/1 F Lumiline lamps
- 12 IRC 500 ohm 50 watt rheostats
- 12 S.P.S.T. switches
- 4 Ventilator guards
- 1 male Amphenol plug 61 M
- 1 piece of Plexiglass $\frac{1}{4}'' \times 12\frac{3}{8}'' \times 20\frac{3}{8}''$

ELECTRIC EQUIPMENT FOR THE TABLE PROPER

- 1 TN 5321 Herbach and Rademan Blower
- 5 Amphenol receptacles 61 F
- 2 Pilot lights, one-inch, one red, the other green
- 2 S.P.S.T. switches
- 16 feet of 18 gage rubber cord with 2, 20-amprec fuses

HARDWARE

- 3 pair Grant Drawer-slides No. 306
- 3 pair $1\frac{1}{2}''$ chrome drawer knobs
- 1-piece of chromium-plated pipe $56'' \times 1''$ outer diameter (to serve as base bar)
- 2 pieces of chromium-plated pipe $29'' \times \frac{3}{4}''$ outer diameter (the standards or up-rights)
- 1 piece of Flash opal glass $10'' \times 19''$

WOOD FOR THE TABLE PROPER

- 1 piece of oak plywood $\frac{7}{8}'' \times 4$ feet $\times 8$ feet
- 3 pieces solid oak $2'' \times 4'' \times 28''$
- 8 sq. ft. $\frac{3}{4}''$ and $\frac{1}{2}''$ gum plywood.

*A Study of the Private Photogrammetric Mapping Activity in the United States**

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INTRODUCTION

PHOTOGRAMMETRIC mapping is an important technical and professional activity in the United States. Although many engineers are aware of the large federal mapping agencies and their extensive use of photogrammetry, very little information has been available on the extent of the private practice in this field. This report presents the results of a survey of the private firms engaged in aerial photography and stereophotogram-

metric mapping. It is hoped that the results of this study will increase respect for photogrammetry and encourage even greater use of its professional and technical services.

THE SURVEY

During the early part of 1956, questionnaires were sent to approximately one hundred firms throughout the United States. Approximately one half of these firms were excluded from the final study because, although they were engaged in

* The material reported in this publication is from an unsponsored study conducted as a professional service, Publication 102, August 1956.—THE AUTHOR.

some form of aerial photographic activity, they could not be considered engaged in professional photogrammetric mapping.

Of the questionnaires returned, the data on 50 firms was used in the final study. These firms represent an estimated 98% of the total private activity. Several small firms did not participate in the study. It is felt that the composite results on the 50 participating firms are quite significant and establish an order of magnitude which the industry has previously lacked.

CLASSIFICATION AND NUMBER OF FIRMS

The firms were classified as aerial photographic or photogrammetric. Aerial photographic firms were defined as those firms engaged in taking aerial photographs for mapping purposes but not equipped for or engaged in stereophotogrammetric mapping. Photogrammetric firms were defined as those firms engaged in stereophotogrammetric mapping. Of the fifty firms participating in the study, eighteen were classified as aerial photographic and thirty-two as photogrammetric firms. Thirteen of the photogrammetric firms subcontract the aerial photographic phase of their projects to other firms and ten subcontract all or a major portion of their ground control to others.

Fifteen of the firms classified as photogrammetric are actually consulting and civil engineering firms with a photogrammetric division. Five were forestry engineering firms with a photogrammetric division. Many of these twenty firms were engaged in photogrammetry primarily as a mapping method for their own engineering projects and not involved in offering large scale services to others.

The growth of the number of firms engaged in aerial photography and photogrammetry is shown in Figures 1 and 2. Eight of the firms first engaged in aerial photography before 1930. The major expansion in the number of firms occurred during the decade following the war. The growth of the number of firms engaged in photogrammetry is even more dramatic. Only four firms were equipped with stereoplotters prior to 1946, increasing to twelve before 1950. The number of firms nearly tripled in the five year period from 1950 to 1954 or an average of four new firms per year. A major expansion of the entire industry occurred during this period as a result in part of the contract mapping

program of the Army Map Service.

The classification of the firms according to range of activity is as follows:

| Range of Activity | Number of Firms |
|-------------------|-----------------|
| Local | 5 |
| Regional | 26 |
| National | 9 |
| International | 10 |

The geographic location of the base of operations of the firms is as follows:

| Geographic Location | All Firms | Local and Regional Firms |
|---------------------|-----------|--------------------------|
| North | 14 | 7 |
| South | 5 | 1 |
| Midwest | 3 | 1 |
| Southwest | 4 | 1 |
| West | 24 | 21 |

The number of firms in an area is not necessarily an index of the amount of photogrammetric work in that area. For example, national firms located in California and Texas are active in the Eastern area and Eastern firms are active on Western projects.

EQUIPMENT

The firms included in the study own and operate 158 airplanes, 261 aerial cameras, and 277 stereoplotters. The total investment in aerial photographic and photogrammetric plant and equipment held by the firms is approximately \$9,000,000. Although the average investment per firm was \$180,000, the extreme varied from a high or well over \$1,000,000 to a low of less than \$5,000. Five firms account for approximately 64% of the total and ten firms account for 81% making the average investment of the forty smaller firms approximately \$43,000 each.

A wide variety of airplanes is used by the firms for photographic purposes. Five of the firms operate 87 of the total of 158 airplanes. The types and number of planes in use are listed below:

| | | | |
|------------------|----|-----------------------|----|
| Cessna 165 | 10 | Lockheed Lode-star | 2 |
| Cessna 170 | 8 | Lockheed P38 | 20 |
| Cessna 180 | 15 | Dehavilland Mosquitos | 7 |
| Cessna 195 | 22 | Dehavilland Dove | 3 |
| Beechcraft D17S | 14 | Northrup P61D | 1 |
| Beechcraft AT11 | 14 | PBY | 2 |
| Beech Bonanza | 3 | B17 | 4 |
| Pipers | 12 | DC3 | 3 |
| Consolidated L13 | 6 | Miscellaneous Light | 11 |

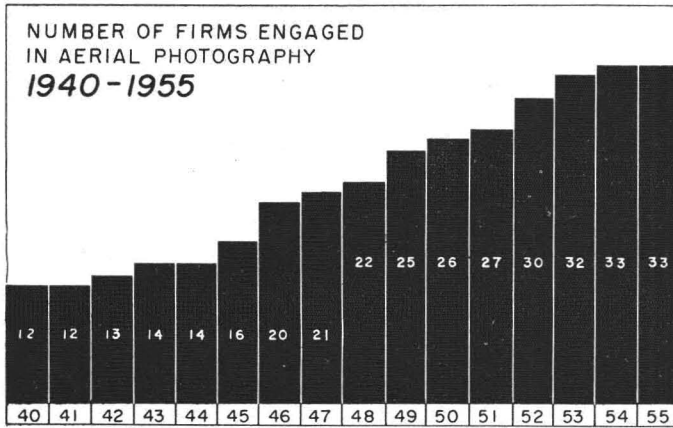


FIG. 1

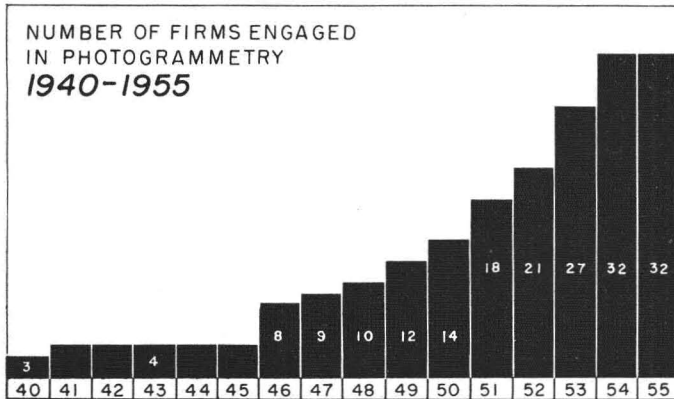


FIG. 2

Of the 261 aerial photographic cameras reported, 140 were listed as calibrated precision cameras. A very large variety of cameras was reported including Fairchild, Park Hurd, Hycon, Aero, Wild and Zeiss. With regard to focal length, 99 were 6", 62 were 8 1/4", 34 were 12", the remaining 58 being of miscellaneous focal lengths.

The breakdown of the 277 stereoplotters in use by the 32 photogrammetric firms is as follows:

| Plotter | Number |
|----------------------------------|--------|
| Kelsh Plotter | 139 |
| Bausch & Lomb Multiplex—3' unit | 70 |
| Bausch & Lomb Multiplex—7' unit | 40 |
| Bausch & Lomb Multiplex—14' unit | 5 |
| Bausch & Lomb Balplex | 5 |
| Wild Autograph | 12 |
| Zeiss Stereoplanigraph | 3 |
| Santoni Plotter | 3 |

A total of 346 projectors were being used on the 115 Bausch and Lomb Multiplex units. Four Balplex projectors being used on a 14' Multiplex bar by one of the firms were counted as two Balplex units. The Balplex had only been on the market for a few months when this survey was made. It is understood that a much larger number are now in use.

The 30 firms engaged in ground control surveys reported they were prepared to equip and mobilize 181 control survey parties. With regard to survey instruments being used, the following is of interest:

- (1) 19 firms were using optical theodolites only.
- (2) 2 firms were using transits only.
- (3) 9 firms were using both optical theodolites and transits.
- (4) 14 firms were using the subtense bar on

- part of their work.
 (5) 16 firms have their ground control parties radio equipped.

PERSONNEL

The average number of employees employed by the firms during the previous years totaled 2,784. The total for some of the principal classifications of interest is as follows:

| | |
|--------------------------|-----|
| Pilots | 120 |
| Photographic Technicians | 314 |
| Engineers | 264 |
| Stereoplotter Operators | 325 |
| Draftsmen | 742 |

The firms have a total of 80 registered engineers and 74 registered surveyors on their staffs. Seven of the photogrammetric firms do not have a registered engineer or surveyor. Only one of the firms engaged solely in aerial photography reported a registered engineer on the staff.

The firms reported they would classify 186 of their men as Photogrammetric Engineers. Of these, 120 were college graduates but only 40 had received any college education in photogrammetry. In practically every case, it was reported that the Photogrammetric Engineers had learned their profession through professional experience, in large part through previous employment with a federal mapping agency or military experience. The failure of the colleges to provide education facilities in this important field is quite evident from these figures.

ANNUAL BUSINESS VOLUME

Each firm was requested to report its average annual business volume. The resulting totals must be considered as establishing an order of magnitude and not precise industry-wide totals due to the wide variation in methods of accounting, fluctuations in individual firm volume, and the general inaccuracy in attempting to use average figures of any form. However, as an order of magnitude, it is felt that the figures are of value and interest.

The total average annual volume for the fifty firms was approximately \$23,000,000 consisting of approximately \$8,300,000 for aerial photographic services and \$14,700,000 for photogrammetric services. The five largest firms did 65% and the ten largest did 81% of the total business volume. Five firms did 72% and ten firms did 83% of the total aerial photographic

business. Five firms did 70% and ten firms did 85% of the total photogrammetric business. The classification of the firms according to annual business volume result in the following:

| Annual Business Volume | Number of Firms |
|------------------------|-----------------|
| Below \$50,000 | 16 |
| \$50,000 to 100,000 | 5 |
| \$100,000 to 200,000 | 10 |
| \$200,000 to 300,000 | 4 |
| \$300,000 to 500,000 | 5 |
| \$500,000 to 1,000,000 | 4 |
| Over \$1,000,000 | 5 |

The percentage of the total business volume represented by the three principal client classifications is as follows:

| | |
|----------------------------|-----|
| Federal Government | 33% |
| State and Local Government | 27% |
| Private Industry | 40% |

The fact that private industry is using aerial photographic and photogrammetric services to the extent of \$9,200,000 per year is quite significant. However, it is expected that some firms included contracts received from consulting engineering firms on projects such as turnpikes, airports, and dams in their private industry percentage whereas many of these could be considered as state and local government projects.

The percentage of total business volume received through competitive bidding varied widely with individual firms. Some of the larger firms reported as much as 90% of their work came from competitive bidding whereas other large firms reported as low as 1%. For the total of all firms, competitive bid work accounted for 46% of the total business volume.

The number of firms which have performed services for the principal federal government agencies is as follows:

| | |
|------------------------------------|----|
| Commodity Stabilization Service | 20 |
| Corp of Engineer Districts | 32 |
| Army Map Service | 24 |
| Aeronautical Chart and Inf. Center | 14 |
| U. S. Geological Survey | 24 |
| Bureau of Reclamation | 18 |

The firms completed approximately 3,200 aerial photographic and 1,200 photogrammetric projects during 1955.

COMMENTS

Due to the wide variation in the individual firms, an accurate and detailed analysis of the industry is not practical.

However, it was felt that a report of this type would be of interest and value to the photogrammetric profession and the users of its services.

The report reveals that *private photogrammetric mapping is a well established and quite extensive professional and technical activity* in the United States and should serve to offset the mistaken conception held by many that this is a rather limited field. *The extent to which government and industry are using the services of the private firms should encourage use of*

photogrammetry by those who have not yet taken advantage of these services. The study should also justify more attention to photogrammetry in our engineering schools.

The statistics given in this report may be considered "as of" the end of 1955. There is wide evidence that the industry has been undergoing another major expansion during the year 1956 which will probably continue for the next several years in response to the expanded highway program. It is therefore planned to conduct a similar study in approximately two years.

A "Ready-to-View" Holder for Stereoscopic Pairs of Vertical Aerial Photographs*

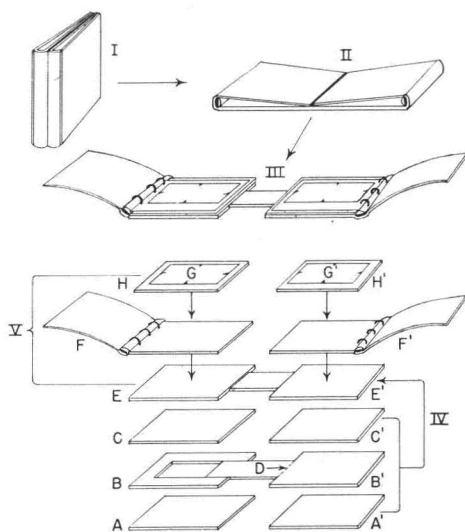
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Two three-ring notebooks joined by a sliding arm provide an excellent holder for selected stereoscopic pairs of vertical aerial photographs. See the illustration. The mounted photographs can be viewed stereoscopically using a mirror or prism-type stereoscope that accommodates an image separation of $6\frac{1}{2}$ to 15 inches. The separation of the photographs can be adjusted by means of the sliding arm for comfortable stereoscopic viewing.

When not in use, the two notebooks can be folded together in book form and filed in a bookcase. Different holders containing selected photographs of different subject material are an excellent training aid.

- I. Holder not in use, folded in book form.
- II. Holder unfolded, not in use.
- III. Holder open, adjusted to suitable separation and ready for stereoscopic viewing.
- IV. Sliding arm assemblage: *A, B, C, A', B'* and *C'* are cut from light weight cardboard and glued together to form *E* and *E'*. The arm of *B'* is cut at *D* and rejoined to *B'* with bookbinding tape. This is to provide a hinge for folding the two units together.
- V. Two three-ring notebooks, *F* and *F'*, are attached to the sliding arm units, *E* and *E'*, using bookbinding tape. The right and left member of a stereoscopic pair of aerial photographs, *G* and *G'*, are dry mounted on light weight cardboard, *H* and *H'*, and inserted in the notebooks.



* Publication authorized by the Director, U. S. Geological Survey.