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# The Nature of Phototypesetting

The purpose of this unit is to provide the necessary background for the Linotype salesman's discussions of this new aspect of typography. It supplements printed matter issued with the introduction of the Linofilm. It defines technical terms which have recently come into more general use and it discusses some of the features of competitive machines, now in use or being developed

THE PHOTOMECHANICAL processes, with their rapid growth in new methods and new materials, have now affected typesetting practices to such an extent that the Linotype salesman must be prepared to talk the language of the processes, and with understanding of their general principles.

To meet these trends, which the International Typographical Union calls "a real challenge" to its members, ITU has issued a booklet which details the new skills and techniques in the composing room that handles phototypematter. Entitled "Photocomposing Machines and the Brewer Keyboard," this publication describes the Brewer device and its use on Teletypesetter equipment. It also describes various new machines. A copy of this booklet has been procured for each holder of the SALES MANUAL—and it is assumed that the reader of this unit has read and can refer again to the ITU publication in making comparisons of the new competing machines.

This unit also must assume the reader's familiarity with the basic printing processes and their relation to type, as discussed in another unit of this Manual, with which a chart of the processes illustrates their technical differences. With respect to the printing of typematter, we must keep constantly in mind the process requirements:

**For Letterpress (Relief) Printing** all typematter must consist of characters in relief, whether its substance be type metal or any of the metal, plastic, or rubber materials now being used for relief printing plates. For the application of phototypematter to the letterpress process it must be etched on metal, as discussed later.

**For Planographic (Offset) Printing** phototypematter, produced on film or paper with variations discussed later, becomes an integral element in the processes of platemaking. It is this field which has been mainly responsible for the modern developments in phototypography.

**For Gravure—Roto or Sheet-Fed** phototypematter is welcomed by the process workers because it avoids losses in printing quality hitherto caused by the use of reproduction proofs.

## Photographic Principles and Terminology

THERE are no photographic mysteries in phototypesetting for the man who knows the techniques of photography, photoengraving, offset lithography and gravure. But when we consider the requirements of typography, as expressed in photographic images, we appreciate the many complications which have accompanied the various adaptations of machine Typesetting to the photomechanical medium.

To attain typographic quality, competitively comparable to the product of the conventional hot-metal machines, type composition by photographic means must succeed in:

1) the production of clear, true type images which preserve traditional design characteristics of the most-used type families;

2) the provision of microscopically accurate fitting and alignment;

3) spacing and justification of the composed line, with quadding and centering when needed, to meet all the conventions of type arrangement;

4) practicable means for correction and makeup of type-on-film.

Having attained those major essentials, the successful phototypesetting machine must meet other factors: it must be free from undue restrictions of darkroom manipulation of its films or photographic paper; and, above all, it must be economically practical in terms of first cost, operating costs, and depreciation.

Because this field is so new, comparative data on the various competing machines are not complete but are frequently discussed in meetings and publications.

In making comparisons or discussing new developments, we encounter a new series of words and phrases —so new that the trade press has not yet standardized them editorially. The competing companies likewise vary in their advertising and publicity terminology.

For Linotype and Linofilm phraseology, the following have been adopted as spelled and defined here—they should be observed in correspondence, printed matter, and discussion:

**Phototypesetting** has now become the most generally accepted word to define type composition by photographic procedures. It replaces the earlier term "photocomposition" which may mean typesetting to a printer but quite a different operation to lithographers and photoengravers. These technicians have had "photocomposing" machines for years—such machines being often called "step-and-repeat" machines because they do just that. They are built with a camera mechanism and micrometer controls to repeat a given unit image across the surface of a printing plate. Their use is often termed "photocomposing"—hence the need to use the more specific word "phototypesetting" (from which the hyphen has been deleted.) In units of this Manual, produced several years ago, references to "photocomposition" reflect the changing trends in technical terminology.

**Phototypography** or **Phototypematter**—a general term to cover typography for use in the photomechanical processes; composed type on either photographic paper or film. Phototype can be produced either *directly* or *indirectly*.

**Direct Phototypematter** is the product of a camera mechanism, reproducing pattern letters, either by keyboard action or from hand-assembled characters.

**Indirect Phototypematter** has been previously composed in metal types or by one of the typewriter devices, supplied for reproduction in the form of repro proof or on paper.

**Photolettering** is the product of a camera mechanism using hand-assembled patterns, usually to produce display lines or headings on photographic paper or film. The lithographers have had photolettering mechanisms for some years preceding phototypesetting developments.

**Phototypesetting** is currently preferred as the word to designate the use of a keyboard mechanism to control an automatic photographic device, using pattern letters to produce composed typematter on film or paper. Again let us repeat that editors and technical writers still mis-use the word "photocomposing"—a term which should be consistently applied only to the mechanical assembling of designs or type forms on a printing surface.

Process conditions differ in the making of plates or printing cylinders, necessitating several standard variations for the production of phototypematter. All processes require that the emulsion or photographic face of the type film normally remain in contact with the sensitized metal surface of the plate or cylinder during its exposure to light before etching. The type image may be needed as black characters on transparent film, or as transparent characters on a black film. The process may require left-to-right or right reading of the phototypematter, as viewed with its emulsion side toward the reader—or just the opposite. The emulsion side may be detected by its slightly duller surface as compared with the shiny surface of the supporting film or glass. These conditions lead to these further definitions:

**Right Reading** means that the phototypematter, viewed with its emulsion side toward the reader, may be read normally like any printed matter. Equivalent terms are *"left-to-right-reading"* or *"readable"* matter.

**Wrong Reading** involves a condition just opposite to the preceding paragraph. Equivalent terms are *"right-to-left-reading"* or *"unreadable"* type. This applies to conventional metal typematter when read with the top of the page uppermost (but printers read it left-to-right when the bottom of the page is uppermost).

**Positive,** referring to an image on paper or film, means the normal black-on-white relationship of type as printed on paper or of the shadow and light portions of a photograph or drawing.

**Negative,** referring to a photographic image, means the reversal of black-and-white or gray tones by photograpic process, either on paper or film. Thus the conventional photograph, as made on your camera's film, is first a negative from which positive prints are made. And it is a *"wrong reading negative"* if you happen to include any reading matter.

*Reversed* images in any of these processes need further specific definition to meet varied conditions. In the earlier days of photoengraving, the word *reverse* (more specifically *laterally reverse)* called for the turning of the image so that wrong-reading becomes right-reading. This is done by stripping a film from its supporting base and turning it over, or it is accomplished optically by the use of a prism or reversing mirror.

But a *reversed* image is often intended to transpose the blacks and whites of the original, as when white typematter is desired against a dark background.

Thus the *right-reading* or *wrong-reading* factor is always important, plus the indication of *lateral* or *tonal* reversing of the image.

These factors of variation in the nature of the photographic image to be met in the production of phototypematter may be broadly classified as follows:

## Four Basic Kinds of Phototypematter Needed for Various Processes

To PRODUCE normal, black-on-white type images in the printed product, without supplementary photographing, the phototypematter must be prepared for plate or cylinder processing as listed below. Its dimensions (body size, line lengths and overall areas) must be as desired in the printed product.

If furnished in other photographic variations, or on repro proofs, the process workers must make supplementary negatives or positives as indicated.

**For Photoengraving** relief plates, phototypematter is furnished as a *negative, right reading,* on film. The transparent type characters permit light to pass through them onto the sensitized metal. This light action hardens the resist on the metal against the subsequent etching action. The result is a wrong reading relief plate for letterpress printing.


Negative, Right Reading

This is the appearance of the film negative (viewed with its emulsion toward the reader) from which a *photoengraving for letterpress printing* will produce typematter in black type on white paper.

**For Offset Lithography—Albumin** phototypematter is furnished as a *negative, wrong reading,* on film. The albumin process utilizes light action (as in photoengraving) but the background areas on the plate, unaffected by light, remain susceptible to dampening in the printing process. The offset plate prints first on a rubber offset cylinder which, in turn, prints its ink image on the paper. Hence the difference in right-to-left reading.


Negative, Wrong Reading

This is the appearance of the film negative (viewed with the emulsion toward the reader) from which an *albumin offset plate* will produce typematter in black type on white paper.

**For Offset Lithography—Deep Etch** phototypematter is furnished as a *positive, wrong reading,* on film. The deep etch process etches the type characters (and the dots or lines of illustrations) slightly below the surface of the metal plate. The etched images are then filled with ink-receptive chemicals, producing a printed result that is usually superior to albumin-plate reproduction. Deep etch plates are also more durable for long press runs.


Positive, Wrong Reading

This is the appearance of a film positive (viewed with its emulsion toward the reader) from which a *deep etch offset plate* will print typematter in black type on white paper.

**For Gravure, Roto or Sheet-Fed** phototypematter is normally furnished as a *positive, right reading,* on film. Light action through the transparent background hardens the coating on the copper cylinder or plate. The type characters are etched *into* the copper, with a cross-ruled screen dividing their areas into tiny cups which hold the ink of this intaglio process.


Positive, Right Reading

This is the appearance of a film positive (viewed with its emulsion toward the reader) from which a *gravure cylinder or plate* will print typematter in black letters on white paper.

The foregoing basic varieties of type-on-film are used for other typographic needs. The silk-screen process usually requires a positive, right reading on film. Movie titles or TV cards may call for positives or negatives, depending on results desired. Sometimes the phototypematter must be supplied on paper, rather than on film, to be subsequently processed for special purposes. Thus the phototypesetting machine must handle either film or paper, with facilities for right-reading or wrong-reading sequence of characters, and for either positive or negative background treatment.

## The Need for Duplicate Proofs

DAILY routines in advertising, printing, and publishing call for proofs of typematter at various stages of its first composition and subsequent corrections and revisions. These needs may involve the making of only two or three duplicate proofs, or the quantity uses of advertising proofs may call for several hundred duplicates.

When phototypematter is thus to be duplicated for proof functions, several different procedures may be used. The following designations, encountered in the trade, are defined for their relationship to phototypesetting.

Phototypematter *on paper* involves further photography for duplicate proofs, when full detail must be preserved—otherwise it may be duplicated by one of the copying devices listed below.

Phototypematter *on film* may be directly reproduced without further photography. But the nature and number of the desired proofs will determine, for either type-on-paper or type-on-film, what method is to be used:

**Photostat**—a special camera mechanism, with inbuilt facilities for developing and fixing prints without darkroom limitations, which makes copies on photostat paper. It is optically equipped to preserve the lateral relationship of the original subject—i.e., left-to-right reading is held in the copy. But the first photostat print is a negative in photographic values—black type on white or transparent ground becomes white type on a black ground. When the required photostat must be a positive print, a preliminary negative print becomes the original from which positive duplicates may be made in any number. Reductions or enlargements can be made within limits. Photostats (often called "stats" in the trade) are relatively slow in production and are subject to slight distortion in size through use of water.

**Velox Print**—a direct contact print on Velox or similar developing paper. Slow and relatively expensive, but the contact printing and black image retain sharpness of typematter that is sometimes lost in photostats.

**Blue Print**—direct contact print with blue image on white paper, often used by process workers as a proof to the customer to show the complete form to be printed by offset or gravure. Blue prints may be distorted in size by the water used in their processing. This adaptation of the blue-print process should not be confused with draftsmen's blue prints which have a white image on a blue ground.

**Vandyke Print**—direct contact photographic print, with a brown image on white paper. It is used in place of blueprinting in some plants, subject to the same general conditions.

**Ozalid Print**—direct contact print which is made as a positive from a positive original, often preferable to a blue print or Vandyke print. The patented Ozalid process uses light-sensitive dyes that are destroyed by strong light but are made permanent by exposure to ammonia fumes. Development of the image is dry. therefore Ozalid proofs preserve more accurate dimensions—often an important factor in typography. Proofs thus made are sometimes called "ammonia prints" in the trade.

**Bruning Copies** are made by a process somewhat similar to Ozalid, but without ammonia vapors. This is currently the most-used process in plants operating phototypesetting equipment.

**Photomechanical Proofs** are usually supplied when larger quantities are specified. They are printed by offset lithography, using the phototypematter as original copy. The latter may serve for direct contact preparation of the necessary offset plate or further photography may be required, depending on the nature of the job. Such quantity production of proofs of phototypematter is directly comparable with the powerpress proofing procedures with metal type forms.

## The Nature of Photographic Type Images

To Understand how a pattern type character becomes a type image on a light-sensitive surface requires, of course, a fair knowledge of the general principles of photography. That field of applied science has now grown into a tremendous industry, comprising not only all the professional ramifications but also one of the more widespread hobby diversions of our times.

The average American family includes at least one enthusiast in photography. In the beginning he is often just a "button-pusher," relying upon the photo-finishing industry to develop his exposed films and to make prints as desired. From such a simple introduction on into the ownership of elaborate apparatus, home darkroom and studio facilities, and the intricacies of color photography (both for "stills" and movies)—today literally millions of Americans are active photographers.

With a parallel growth in the photomechanical processes for the Graphic Arts, it has often been urged that printers and publishers (notably their sales and technical personnel) should practice photography as a hobby. Such amateur interest brings the familiarity with photographic principles which is essential to the general understanding of process techniques. This is especially true of the approach to phototypesetting.

When the Linotype salesman was earlier concerned only with a type metal product he then encountered questions of reproduction quality in Linotype composition to be used in process work. Today he must also be prepared for discussions of phototypesetting with customers who may be steeped in the modern developments of cameras, lenses, shutters, films, papers, color filters, flash mechanisms, stroboscopic lights and all their applications to the process field.

These conditions are less perplexing to the Linotyper who has practised photography, even on a "drug-store basis." But the Linotype salesman, who now finds himself confronted with Linofilm and its presentation to the trade, must deliberately study photography if he hasn't had at least amateur experience. The study is easily undertaken, with camera shops offering advice and a variety of instruction books, plus the many educational courses and camera clubs.

When the amateur photographer gets acquainted with the photomechanical processes he finds that familiar photographic principles apply, although the apparatus has been highly elaborated.

*Process cameras,* as compared with the amateur's simple box, are big—sometimes built into the darkroom itself, and often equipped with power-driven, micrometer controls for varying size and focus of the image. Their copy-boards are illuminated with high-intensity lamps of various kinds.

*Process lenses* are also larger masses of optical glass, combining scientifically-ground segments of various kinds of glass to achieve the essentials of a true image. It must comprise lines that remain sharp and true; right angles must hold their 90-degree squareness; color must be accurately transmitted. These, and other optical requirements, carry technical terms often encountered in the process field, such as

*"rectilinear"*—squareness of image;

*"anastigmatic"*—preserving uniform sharpness of image especially near its edges;

*"apochromatic"*—maintaining color and spherical correctness in the image.

Process lenses also carry *"stops"*—varying shapes and sizes of internally placed openings which control sharpness of image and the formation of halftone dots as used with varying cross-ruled screens.

*Process films,* while basically similar to the amateur's little rolls, may differ in their sensitivity to light and in other details aside from their range of large sizes. Glass dry-plates and the earlier collodion process have been increasingly supplanted by film in recent years. For the finest detail in line reproduction (as in phototype) film of very fine grain and vigorous contrast is essential. "Strip film" provides for reversing and for combining images.

*Process imposition,* for offset and gravure forms, covers the assembling of negatives for proper arrangement and spacing. This necessarily precedes the platemaking step.

*Process prints* (or platemaking) are made on sensitized metal, as compared with the various photo papers used by the amateur or professional photographer.

*Photoengraving* uses zinc, copper and new developments with magnesium—normally on plates about .064″ thick.

*Offset* uses thinner plates, about .025″, of zinc, aluminum, and (more recently) bimetallic combinations of thinly coated steel, copper, aluminum, chromium, etc.

(For small offset presses, such as Davidson, paper plates have special uses and economical merits.)

*Gravure* uses cylinders or plates of copper.

The various metal surfaces are made light-sensitive by coating them with solutions whose special quality is to become hardened or changed by light action so that they later will resist etching by acid or other chemical process. Sensitized plates are exposed thus in large printing frames, usually equipped with vacuum devices to maintain close contact of the negative with the plate.

*Process developing and etching* go beyond the related techniques of "picture photography." On metal surfaces various chemical actions take place—for letterpress or gravure the etching reaction must eat away several thousandths of the metal plate or cylinder. On offset plates "etching" may be merely a transformation of the surface, while with deep-etch plates the actual actual depth of etching is much less than that of a relief plate.

*Process finishing* is one of the final steps in plate- and cylinder-making. But "photo-finishing" covers the extensive services which handle the developing and printing for amateur photographers.

The finishing steps in photoengraving may involve the hand re-etching of halftones, hand-tooling, and usually type-high blocking.

Offset plates have had most of their "finishing" procedures in the negative stages—the etched plate gets little handwork.

Gravure surfaces are normally re-etched and hand-tooled in some degree.

*Process proofing* requires special presses, each designed within the basic process, which may compare in scope and cost with production presses. Such proofs are primarily to test printing quality.

Whether in relief plates, offset or gravure, a printing surface which has gone through the conventional procedures is far past the point at which typographic corrections can be readily made. Therefore, with phototypematter, preliminary okays are of vital importance, using the various proofing methods discussed on p. 4. Letterpress printers have consistently argued that their process permits flexibility in essential changes up to the moment the presses begin to print—sometimes an important advantage. But phototypematter for letterpress has become an engraving, with equal importance on preliminary planning and working okays.

And how does all this highlighting of process techniques relate to the nature of photographic type images?

The answer is that, in every branch of the Graphic Arts, the executives and technicians who may be interested in phototypesetting are familiar with one or more of the basic processes. They will have been faced with the problems and costs of transplanting typography in metal types to the photomechanical surfaces—and their discussions will involve all of the process details mentioned here, and more. The Linotype salesman *must be prepared* accordingly.

Thus, in comparing "standard" metal typography with phototypematter, let's consider advantages thus far demonstrated for type-on-film. They summarize as:

*a) Sharpness of detail* in the photographic image as against proofs from metal types.

b) *Flexibility in sizes* of enlargement or reduction, inherent with photographic procedures.

c) *Adaptibility of film,* as the original typematter, to the process manipulations.

At conventions of advertising typographers and of the Craftsmen, these technical merits of phototypematter have been warmly endorsed by plant executives who have used the Fotosetter for some time. Other phases of Fotosetter operation (costs of installation and Fotomat equipment, the need for special training of operators, and radical changes in production methods) have been such as to provide sales arguments for Linofilm—to be detailed later. But the innovation of type-on-film has been enthusiastically received by process workers in many plants.

As to *sharpness of detail,* the testimony of all users of phototypematter has been emphatic. It is sharper and cleaner than any repro proofs, even the most careful proofing with Vandercook's specially equipped press. Book pages retain uniformity of "color" or weight, an essential which is easily varied in a series of repro proofs. In making large display lines from film-set negatives, this element of sharpness has permitted ample latitude in size.

On this point we recognize that any impressions printed under pressure from the inked surfaces of metal types are affected in some degree by the actual spreading of the ink itself. That factor has been established as an element that the type designer must consider—how it has influenced newspaper body faces is shown in the Sales Manual unit on that subject. But the photographing of pattern letters completely eliminates this uncertainty of ink-spread and variations due to printing impression on repro proofs. There is no challenge to the claim that phototypematter has superior sharpness of detail (whatever may happen to it in the course of offset or gravure printing), but we shall find debatable elements among the competing machines as to *how* that sharpness can be best achieved and uniformly maintained with differing optical systems.

*Flexibility in enlargement or reduction* (with the constant preservation of sharpness) has modified the need for a whole series of subtle changes in designing

pattern letters for the successive body sizes of a type face. Linotype's experience over many years established a procedure of changes in the weight and serif formation of body types, to meet the conditions of ink-spread under impression. A set of letterdrawings for a 10-point face might be used for 9-point or 11-point, but not for more extreme reduction or enlargement. This limitation is lessened in type designing for phototypesetting, although certain optical factors still vary the conditions between the smaller body sizes and larger faces.

Users of the Fotosetter, Hadego, and the various paper-pattern systems (such as Reditype, Artype, etc.), have featured the many incidental and profitable uses of phototypematter for the preparation of posters, displays and advertising presentations. Enlargements ("blow-ups" they are often termed) up to ten times the size of a photoset negative have been sharp, crisp, and decidedly economical as compared with hand lettering or the purchase of big foundry types in hand composition.

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## "Phototypesetting Requires New Skills and Techniques in Composing Room"

THE ABOVE heading is set with quotes because it heads the chapter in the ITU booklet which illustrates and describes the changes in working details which have come with phototypesetting to operators and floormen in the Niagara Falls plant of Moore Business Forms, Inc. An article in PRINTING MAGAZINE, March, 1954, further describes this special use of photographic methods, stating that it "has eliminated problems peculiar to this field of printing and provided savings as high as 50% in production time on unusual jobs."

While the ITU pictures and descriptions of operations are based on ruled form work, they typify the general handling of type-on-film as compared with metal typography. As against the letterpress procedures of makeup and lockup of type forms, the use of type-on-film (or paper) involves a broad process of "cutting and pasting" which has hitherto been more the function of a commercial artist than of a composing room worker.

Trade discussions have emphasized the requirement for much more precise layouts for phototypesetting than have been normally used in typography. The photo mechanisms provide for line spacing (in one way or another) and the several competing systems make varying provisions for corrections and changes. But all these procedures involve the handling of film or paper against the traditional manipulations of leads, slugs, and spacing material. If printers are to carry on in this new field, as urged by ITU, they must learn new methods of work. Drafting tools and layout tables, shears and trimmers, adhesives and patching devices—all these become a phase of phototypography. Their use is becoming a contest between the printer and the artist.

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## Competing Machines and Accessories

FOR their recognition in trade discussions, we list here the various machines and accessories in this field, leave detailed comparisons and competitive arguments for another Manual unit.

The keyboard photoypesetting machines, now introduced or being actively developed, include:

1)—**Linofilm**—as described in introductory booklet.

2)—**Fotosetter**—as described in Intertype printed matter and the ITU booklet.

3)—**Photon**—as described in ITU booklet

4)—**Monophoto**—as described in ITU booklet

5)—**Phototextype**—described by inventor Huebner as a "phototronic typewriter."

Most elaborate of the non-keyboard machines is the **Desk Model** of the **Fotosetter.** Simpler in mechanism is

6)—**ATF Hadego**—as described in ITU booklet.

A smaller photographic machine, called **Filmotype,** uses pattern alphabets on film rolls, produces display lines on paper for paste-up typography.

The accessories for phototypography include various systems of pattern alphabets, printed on film or paper (some with special adhesive), to be hand-assembled. They supply display lines but are rarely used for body matter—too slow and relatively costly. Among these are **Reditype** (Davidson product), **Artype, Craf-Type, Fototype,** and **Letter-It.**

The Linotyper will find it highly illuminating to visit a plant which prepares phototypematter with any of the listed machines or accessories.

## Recommended Reading

TRADE PAPERS which are familiar reading material for all of us contain increasing editorial matter and advertising devoted to the new photographic techniques. Such matter now becomes pertinent to the general trade information on which we try to maintain current awareness.

For more technical knowledge of the various subjects discussed in this unit, the following books are recommended. They may be found in some Public or Craftsmen's Libraries—all of them might well be added to the salesman's home library for use when convenient.

BEGINNER'S BOOK OF PHOTOGRAPHY. *By Wallace E. Dobbs.* Ziff-Davis Pub. Co., Chicago—New York. One of thirty small manuals of the photographers' LITTLE TECHNICAL LIBRARY, sold by photo supply shops. Good if you're getting into the use of a camera as a hobby.

THIS IS PHOTOGRAPHY. *By Thos. H. Miller and Wyatt Brummitt,* staff members of Eastman Kodak Co. Garden City Pub. Co., Garden City, N. Y. Valuable for its non-technical but comprehensive description of methods, apparatus, and photographic principles. Many illustrations. Highly recommended for the Linotyper's understanding of the photographic procedures involved in phototypesetting.

ATA HAND BOOK. *By Don Herold—2d Edition edited by Harry L. Gage.* Advertising Typographers Association of America, New York. Covers brief descriptions of the basic processes as related to advertising typography, a more detailed chapter on photoengraving, a discussion of printing repro proofs, and a useful glossary of technical terms. Available through ad typographers or from the ATA.

ADVERTISING PRODUCTION. *By Ben Dalgin.* McGraw-Hill, New York. Plain, practical guide which explains in clear detail the mechanics of printing production processes, written by the Director of Art and Production of the *New York Times.* Valuable to the Linotyper for its broad picture of typographic routines, as well as for its process explanations.

HOW TO PREPARE ART AND COPY FOR OFFSET LITHOGRAPHY. *By William J. Stevens and John A. McKinven.* Dorval, Maywood, N. J. Provides detailed explanations of reproduction techniques, well illustrated, for better understanding of phototype handling.

MODERN PHOTOENGRAVING. *By Louis Flader and J. S. Mertle.* Modern Photoengraving Publishers, Chicago. Now out of print, but can be found in photoengraving plants and some technical libraries. The most comprehensive of recent process manuals, excellent for a more technical understanding of process cameras, lens systems, metal printing and etching—all the techniques that are basic in the new application of phototypesetting to the letterpress process.

The foregoing are just a few of the many technical books which may be profitably studied toward an essential knowledge of the nature of phototypesetting.