Some methods
of printing
and reproduction:
an outline guide by H.R. Verry
(also in French and Spanish)

II - *African Languages and English in Education*
(also in French)

III - *How to Print Posters*, by Jerome Oberwager
(also in French)

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Some methods of printing and reproduction:

an outline guide by H.R. Verry
PREFACE

In carrying out programmes of teaching reading and writing, whether to adults or children, educators must make decisions on at least three groups of problems: In which language shall the teaching be carried out? What methods of teaching will be used? How shall the teaching material be produced? The phrase "groups of problems" is used advisedly, for each of these interrogation marks conceals, or may conceal, a host of related ones which may be material, social or psychological. Through study, conferences and publications(1) Unesco has given attention to each of the three groups of problems in turn. The study of each of these will continue. It is planned, for example, to issue a more comprehensive survey of methods of teaching reading and writing in 1955. The present work marks the first stage(2) in a study of the production problems involved in literacy campaigns.

It is realized, of course, that this booklet will interest other than literacy workers. It will be seen, however, that we have given a preponderance of space to processes which would meet the conditions in which many workers in fundamental education find themselves: namely, modest budgets, lack of access to power supplies, need for only small editions of printed matter - to select only three conditioning factors. However, since some may be more fortunately placed or others planning expansion and improvement, we have included in the range of processes described some of the more advanced techniques which are still within reach of those who have not served long apprenticeship in the printing trade.

It must be clearly stated, however, what this booklet is and what it is not. The title and subtitle suggest its purposes: an outline guide to some of the cheaper methods of printing, using the term printing in its widest sense. In other words, the intention is to give some indication of the possibilities which exist. The booklet is not a training manual nor does it pretend to say the last word on the processes or to exhaust the possibilities. Many readers may feel that too much has been left unsaid and other things dealt with too briefly. But, we feel, enough is said on the capacities, limitations and nature of the processes to lead the reader to the method or methods which suit his requirements, staff, budget and material conditions. It is at this point that he must seek fuller and more comprehensive information from the literature describing each process. Some guide to this is given in the bibliography at the end of the booklet.

Fuller descriptions of some of these processes can also be found in the Manual on Document Reproduction and Selection/MANUEL DE REPRODUCTION ET DE SELECTION DE DOCUMENTS recently issued by the Fédération International de Documentation, The Hague, Holland. Most manufacturers issue literature giving full details on their products, and are willing to give advice and help on all aspects of the process or the machine they market.

The Secretariat of Unesco intends to use the present booklet as the starting point for two further enquiries: one, which will be an expansion of the aims of the present booklet - to gather together comprehensive information on apparatus available, including suppliers, prices, equipment necessary, capacities, etc. The second will be aimed at finding out the equipment and staff needed to run an average production unit. The second study would necessarily enter into questions of budget, training of staff, production targets, preparation of texts. If the responses to these enquiries justify it, readers can expect to see one or two supplementary publications to the present work.

The author of this booklet, H. R. Verry, is adviser on photographic and allied processes to H. M. Treasury, London, a Fellow of the Institute of British Photographers and an Associate of the Royal Photographic Society. He has had practical experience of the processes described in this booklet both in industry and in government service since 1919, and before assuming his present position controlled, within a research unit of the British Government, photographic and allied processes. He is the author of various books of instruction and has previously carried out a world survey of microfilm for Unesco.


(2) See also: Jerome Oberwager, How to Print Posters ("Educational Studies and Documents" No. III) Unesco, Paris, 1953. References to this process are found in Chapter II below.
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GLOSSARY OF TERMS

Achromatic lens - A lens corrected for black and white photography.

Airbrush or aerograph - A small gun used by artists for spraying colour or tone on negatives and photographs, drawings, etc.

Albumin - Egg albumin scales mixed with water ammonium hydroxide to make albumin solution used as a sensitizer for offset plates.

Aluminium plate - Highly flexible plate used in the offset process.

Arc lamp or light - A powerful light source, blue light being created from an incandescent arc formed between two electrodes.

Artype - Type faces which are printed on acetate sheets gummed on the back. The required letters are cut out of the sheet and pressed into the required position to create the copy "round copy".

Beattie process camera - A vertical camera with contact screen for process work. It is manufactured by the Beattie Company, United States of America.

Binding - A means of holding a number of pages together such as wire, spiral and stitching.

Blanket - Used in the offset machine. It is a hard rubber blanket onto which the image is "offset" before being transferred to the copy paper.

Blanket powder - An absorbent powder for removing excess tackiness from the surface of the blanket.

Blanket wash - A preparation for washing the image from the rubber blanket.

Colours, primary - The three basic colours from which all others are obtained by mixing.

Colour sensitivity - Defines the response given to various colours by the sensitive emulsions. Process emulsions are sensitive only to blue and ultra violet light. Panchromatic emulsions are sensitive to all the colours of the spectrum.

Colour separation - A term used normally in negative-making when filters are used to separate colours for creating separation negatives for colour printing.

Combination - Refers to copy or plates combining both line and half-tone images.

Contact screen - Screens designed to be used in contact with the emulsion.

Contrast - The range between the extreme tones in a print or a negative.

Copy - Frequently refers to material to be reproduced, but can also be the printed result from an original.

Copy board - A board designed to hold the copy when being photographed.

Copy holder - A device which may be a simple board or an elaborate vacuum frame designed to hold the copy before the camera.

Deep etch - A method of preparing litho plates and which gives better quality and longer runs.

Direct image plate - A plate on which an image can be directly applied.

Duplicator - A machine for duplicating copies, normally of the hectographic stencil or offset process.
**Enlargement** - A photographic print which has been made larger than the negative.

**Eraser** - Made of spun glass, for removing errors on offset plates.

**Etching** - The cleaning of the non-printing portion of the developed plate, to desensitize it to ink.

**Etching, dot** - A method of reducing the size of the dot on half-tone negatives or positives.

**Exposure** - The length of time a plate or film is exposed. This time varies according to the light value, lens stop used, sensitivity of the plates and the type of the original being copied and the relative size of the copy being produced.

**F. number** - Refers to the number used on the lens mount which is controlled by the iris diaphragm. Process cameras are normally fitted with lenses having maximum apertures of F8 or F11. The higher the F. number the smaller the aperture, thus F8 will allow double the amount of light to pass through the lens in a given time as will F11.

**Flat copy** - A copy having no contrast, not normally suitable for process work.

**Focal length** - The distance between the lens and the image when a lens is focused on infinity. The focal length of a lens determines (wide angle excepted) its covering and the size of the picture it will make. The normal lens used generally has a focal length equal to the diagonal of the largest plate to be used in the camera.

**Folding machine** - A machine which folds printed matter.

**Gravure** - A commercial method of printing. The image is etched into a copper plate and therefore printing is from a sunken or intaglio image. In printing the ink is pulled out of the etched part to form a copy on the paper.

**Ground glass** - Special glass used in the back of a camera in the same plane as the sensitizing emulsion, for focusing the image.

**Gum Arabic** - A solution used to preserve offset plates.

**Half-tone** - A method of making a copy of a photograph through a screen which breaks the image into dots. When printed by the ink processes these dots according to their size give the impression of tone variation.

**Indian ink** - A drawing ink having great density and used to create drawings designed for reproduction.

**Intermediate master** - Generally photographic copy of original master from which further copies are reproduced.

**Layout** - Completed design to indicate how the final copy will appear.

**Lens** - Elements of optical glass assembled according to a mathematical formula giving an image of sharp definition. Process lens are designed to give a sharply defined image on a flat plane.

**Lens covering power** - The ability of a lens to cover a given area with good definition even in the corners.

**Lens focal length** - See focal length.

**Lens stops** - See F. numbers.

**Letterpress** - A major commercial method of printing from relief or raised letters and images.

**Line drawing** - A drawing without tone, reproducing in solid black and white.
Litho crayon - A special crayon for drawing on litho plate.

Lithography - A major commercial printing process done from a flat (planographic) surface.

Majenta screen - A special contact screen made for creating half-tones.

Master - Original plate, stencil etc. from which copies are produced.

Middle tones - The tones which lie midway between the highlights and the shadows.

Multilith - A small offset machine made by Addressograph, Multilith Company.

Negative - Photographically the opposite from a positive having the tones reversed, thus the white in the copy becomes black on the negative.

Negative paper - A special paper for negative-making.

Offset - To transfer. Offset lithography differs from direct lithography in that the image is transferred from the plate to a hard rubber blanket and is finally again transferred to the printing paper.

Opaquing - Painting a negative with an opaque liquid to block out thin holes and other defects or render certain parts unprintable.

Orthochromatic - Photographic materials which are sensitive to green and yellow as well as blue light.

Oxidation - An action given when air contacts areas of litho plates not adequately gummed.

Panchromatic - Photographic materials which are sensitive to all visible colours.

Paste-up - Material which has been pasted in position for making a new copy negative.

pH - The measure of acidity or alkalinity of a solution.

Photofloods lights - Incandescent bulbs giving a very brilliant light for a period of a few hours only. They can be fitted into existing lamp-holders.

Photostat - A photocopying process using a lens and a prism thus giving a negative reversed in tone but reading correctly.

Pin holes - Tiny round transparent dots which appear after development. They are normally removed with opaque.

Positive - A photograph in which the tones are similar to those of the original. A negative when printed photographically produces a positive print.

Printing lamp - Lamps used for exposing sensitive material. In pure photography they are normally tungsten type, in photo-mechanical work arc or high-power pressure mercury lamps are often used.

Process camera - A large camera used for making half-tone or line negatives for photo-mechanical work. These cameras frequently have their own rail system either on the floor or suspended from the roof. The camera end holding the plate or film is generally part of the dark room and is controlled within that room.

Proof press - A small press used professionally for making proofs.

Ream - Four hundred and eighty to 520 sheets of paper. There is a tendency to standardize it at 500 sheets.

Reduction - Making to a smaller size.
Register - A position on a plate which prevents a second colour overlapping on a first.

Retouching - The application of pencil, dye or paint to a photographic negative or print to improve its quality for printing.

Ribbon, carbon - A continuous strip of carbon used in all forms of typewriters.

Rubber cement - An adhesive used to make paste-ups etc.

Saddle stitch - Stiching down the centre of a book or magazine.

Screen distance - The distance at which a half-tone screen is placed to bring the dot into proper focus.

Screen, half-tone - Made of glass or film for giving a series of dots on the negative which when printed will resemble tone. Screens of varying types are available some of which must be used at a predetermined distance from the negative, others are designed for use in contact with the film or plate.

Screen ruling - The number of lines per linear inch in a screen gives its ruling. They vary from 55 to 400 lines per inch. For offset from 110 to 133 are normally used.

Scum - A thin coating of ink which appears on litho plates due to a break-down in the desensitizing solution.

Sensitizers - Light sensitive solutions applied to a plate for the purpose of photographic reproduction.

Spotting - Opaquing pin holes and other blemishes on a negative, or white areas on a print.

Tinting - The application of shading or special effects to art work.

Type - A small metal block having its face so shaped as to produce, when inked and pressed on paper, a letter or figure. Type is used in relief (sometimes called letterpress) printing.

Type photography - A method of setting type by photographic means. Expected to be of value in photolithography.

Ultra violet - Light having a shorter wave-length than that of visible light.

Vacuum frame - A printing box designed to bring the negative and the plate in perfect contact by vacuum pressure. The vacuum may be created by hand or electric pumps.

Water house - Found chiefly in old lenses where the iris diaphragm is replaced by a metal strip having the stop or lens aperture cut out of the centre. The strip is inserted in the lens barrel and each stop has a separate strip of metal.

Whirler - A device allowing the rotation of a litho plate to spread evenly the sensitizing solution applied to it.
INTRODUCTION

The purpose of this book is to give some guidance on how to make copies by reproduction methods and the simpler types of printing machines which are not expensive and do not require expert skill to operate them. No endeavour has been made to make the information comprehensive or to provide a manual of instruction on the methods mentioned. Those requiring such information should study the books specially written on each subject. This booklet is intended only to acquaint the reader with the machines and the methods, to outline their usefulness and to indicate the purpose they are intended to serve.

The Appendix contains a number of charts designed to assist in the selection of a suitable process and to indicate the number of copies these methods can produce economically. Where applicable, the theoretical running speeds of the machines have been quoted. These speeds give the maximum number of copies which can be produced by the machines in one hour. In practice such speeds can never be maintained, because of numerous factors which restrict the output. For instance, when the number of copies required is small the master on the machine must be frequently changed. Whilst this change is being made the machine is not producing copies and cannot therefore maintain the number it can give when long runs are required and the master is changed only infrequently. The speeds are given merely as a rough and ready guide. It can be assumed that, under very favourable conditions, the output may be about two-thirds of the figure given. Under average normal working conditions probably only 50% of the maximum output can be expected.

It may be very helpful to consider the charts before making a more detailed study of the processes. They will indicate that each method has particular advantages and disadvantages and that it can be used only for certain classes of work. It is well to remember that no one process can meet all the requirements necessary in the wide field of reproduction, but that some methods are able to be used for a variety of purposes.

Carbon paper

The simplest form of making additional copies is by the use of carbon paper. This paper has been in existence for a very long period and is now widely used with the typewriter and similar machines to create a number of copies simultaneously. Carbon paper can be purchased in various qualities, the better quality being specially prepared to give a greater number of copies than the cheaper type.

The number also varies according to the instrument being used. By the use of a ball point pen or hard pencil a cheap hard black carbon will produce only two additional copies, but a better quality carbon will produce up to six copies. The same carbons when using pens will produce only one additional copy with the cheaper type and three additional copies with the better quality carbon.

Typewriter

Typewriting can be considered as an intermediate step between writing and duplicating. It is able to eliminate the drudgery of handwriting and to prepare copy in a more readable and acceptable form and at a greater speed. By the use of carbon paper a number of additional copies can be created simultaneously. This number will depend on the various factors, including the type of machine, the thickness of the papers, the quality of the carbon and the pressure on the typewriter keys by the operator. The number given by the average typewriter is four to five copies, but with thin paper and a hard platen up to eight copies may be expected. The electrically operated machine may produce up to 20 copies, but the carbon copies are not of very good quality and any errors made in typing will need correcting on each additional carbon copy. Further, the quantity of typing produced by each typist will be considerably reduced since the insertion of each carbon and the necessary paper will considerably restrict the output. When more than a small number of copies are required, the use of one of the duplicating processes is advisable.

Translucent paper

A method which has become popular recently where diazo machines are available is the use of a translucent sheet of paper typed with a heavy carbon ribbon or with a normal ribbon and a sheet of carbon paper, preferably red or yellow, behind the copy but with the carbon facing the back of
the copy. When typed, this translucent paper is heavily coated with carbon and is then fed into
one of the diazo machines. The advantages of this method are that any mistakes require only one
correction and that every copy produced on diazo is of good quality and easily readable, and is
also on good paper. Makers of diazo paper can supply the necessary materials for this method.

Photocopying

In addition to these ways and means of producing copies by manual methods, duplicating or
printing processes, there is a range of photocopying methods which use sensitive paper. These
processes are specially suitable for making copies from originals already in an acceptable form.
Such copies may be articles from periodicals, reports, letters and similar material. The type-
writer is not generally used to create a master from which copies are made, as is necessary in
the duplicating processes. The translucent paper method previously described is an exception to
this rule. The photocopying methods are not included in this book, but it is recommended that
they should be studied since they are frequently used to create intermediate masters which can be
used with other methods of reproduction and are useful for producing a few copies.

Plan copying

There are also a number of processes which were developed to create copies of plans, engineers'
drawings and similar originals. These methods are called plan copying processes. They usually
require an original on a translucent paper or linen and are able to print much larger sizes than the
usual duplicating methods. The Ordoverex process belongs to this group, but has wider applica-
tions since it is able to create copies of extremely high quality. It is discussed later in this book.

The reproduction methods generally called printing processes normally produce with ink from
raised or relief type. This means that the face of the master which is inked is raised well above
the surface of the plate. The illustration of a piece of type (page 22), clearly indicates this point.
There are however a number of printing processes which do not use relief type, such as lithography
and gravure.

This booklet will deal only with duplicating and the printing processes of the simpler kind. Some
reference to other methods of printing will be necessary by way of explanation. These methods
however require considerable skill to operate, which could only be gained by long experience with
the machine and under the guidance of a skilled operator. It would not therefore serve any useful
purpose to deal with them in this book.
Chapter I

OUTLINE OF THE PROCESSES

The following brief outline of a number of processes and methods is given so as to classify them and to indicate the type of work for which they are most suited.

Damp paper processes

This is one of the oldest methods of direct reproduction. The iron copying press used in this method was first patented in 1714 and later was followed by the screw press patented in 1718. The process is still used but generally with improved apparatus. The master is prepared by typing through a copier ribbon or writing by the use of special ink or pencil. Ordinary black ribbons and fountain pen or roll ball pens are not suitable. Copies are produced by using special translucent papers which have been impregnated with water and glycerine (hence the word damp) and this is pressed into contact with the master copy. From the ordinary ribbon supplied about ten copies can be produced, but by using the ribbon as used in hectography up to 30 copies are obtainable.

The copy produced is on a translucent paper and is reversed in reading. This requires that the copy is held to a light so that it can be read through the paper. The image may be reflected in a mirror, which will again reverse the writing correctly. Small viewing apparatus is also available which reflects the image onto a mirror and makes it readable.

Rotary machines are now available, both hand and electrically operated. The process is designed for facsimile reproduction of letters originally prepared in handwriting or typewriting. It has largely been superseded by the hectographic method of reproduction.

Hectography

This is a method of producing copies by first making the master by use of a special carbon or liquid dye. It is a very easy process to operate and is useful for making relatively small numbers with cheap apparatus.

There are two different methods available. The very simple method uses a gelatine substance which may be poured into flat tins and allowed to set. Rotary machines with rolls or sheets are also used. The text is written or typed on paper with a special methyl violet dye, and is then pressed on the gelatine substance which transfers the dye to this material. When a sheet of paper is placed in contact with the dye it is again transferred to the paper. The speed of working this machine is very slow and probably only up to about ten copies per minute may be expected from the trays and not more than 30 to 50 per minute from the rotary apparatus.

As the dye is used the copies become fainter until the dye is exhausted. After use the gelatine is wiped with warm water and allowed to set before another master is transferred to it.

This method has been superseded by other forms of hectography known generally as the spirit process. This method is widely used and is far more suitable for general work. It is very easy to use and produces reasonably good copies cheaply.

In this method the text is typewritten or drawn on a highly glazed paper using the hectographic ribbon, which deposits a thick layer of carbon on to the master. This master is placed on a machine and copy paper, which has been made slightly damp by a special fluid, is brought into contact with it. Each sheet of damp paper softens a fine layer of the carbon deposit on the master and allows it to be transferred to the paper, thus creating a copy.

It will therefore be seen that the thickness of the dye deposit controls the number of copies which can be produced from a master, for when the dye is exhausted no further copies can be obtained.

Normally the process is designed for restricted runs of about 200 copies, but specially coated masters are now available which allow runs up to 500 copies. These masters are much more
expensive and should not be used unless the length of run justifies it. The master can be stored away and re-run later until the dye deposit is exhausted.

There is a wide variety of machines available for this method, including the simple hand-operated type and power-driven machines able to give reasonably high speeds. The latter are normally limited to a maximum size of 13" x 16" but some are able to print up to 20" x 24".

The unique feature of the hectographic process is that it is able to produce simultaneously copies up to seven different colours. This is made possible by using different coloured carbons when preparing the master. For example if one line of a letter is typed using a black carbon and additional lines are typed with red, green and other coloured carbons the various colours of carbon are deposited on the master which when softened by the damp paper will produce the print in these colours. It is the only process able to produce simultaneously prints having a number of colours.

The masters are quickly changed on these machines which makes the process particularly suitable for producing a few copies from many masters.

A disadvantage of the process is that it requires care to avoid carbon stains on both the operator and the copy. Prints also are not permanent and will fade if subject to strong sunlight.

Summary

The process uses a special carbon to produce the master: it is suitable for runs generally up to 300 copies. Apparatus is available, both flatbed and rotary. The rotary has largely superseded the more simple kind. Copies are produced by damping the copy paper which attracts a fine layer of the carbon master when in contact with it.

Up to seven colours can be printed at the same time by the use of different coloured carbons when making the master.

The master can be typed or drawn by hand or prepared by machines, rubber stamps etc. The method is simple and is cheap; the copies are not durable.

PORTABLE SPIRIT DUPLICATOR
STENCIL Duplicators

The stencil method of duplicating uses a machine, either flatbed or rotary, to which is attached a stencil master for the production of copies. The stencil is a fibrous sheet, covered with a material which will not allow ink to pass through it. When this is placed in a typewriter the action of typing cuts the stencil by breaking the material. When the stencil is attached to the machine and pressed into contact with the ink it enables the ink to penetrate where the stencil has been cut. By bringing a sheet of paper into contact with the stencil a copy is therefore produced. The flatbed type of apparatus is very simple and cheap and does not require much skill to operate, but it is slow in operation and is intended to be used for short-run work only. Perhaps its one great advantage is that it enables good registration to be obtained when multicoloured runs are being made. The rotary type of machine is available in a wide variety of models including the hand-operated type as well as those electrically driven and fully automatic.

The skill required to operate them can be readily learned and the results are of good quality. With the power driven machines up to 3,000 prints per hour can be obtained and with careful handling often over 10,000 copies can be made from one stencil.

To obtain this large number of copies it would be necessary to have the best stencils and a good operator and machine. Stencils which contain a lot of lines made by excessive cutting or stylo pens may soon break and become useless for making further copies. The stencil machine is normally used for runs of 2,000-3,000 copies.

It is also possible to print in many colours. For each colour the ink must be changed on the machine and the paper run through the machine to receive that colour of ink. Some machines are fitted with drums which are easily changed; by using one drum for each colour of ink the change from one colour to another is made with the minimum loss of operating time.

Preparation of stencil

A stencil may be prepared by a number of various methods. Usually it is typed. The typewriter should be cleaned frequently to produce work of good quality. If a sheet of thin plastic or acetate is placed in front of the stencil it assists the typewriter to cut it cleanly and give better copies. Many typists use a backing sheet which also assists. Typewriters having very small type are not satisfactory for stencil-cutting as they frequently give very poor reproduction. In all cases the stroke of the machine should always be firm to ensure that the stencil is adequately cut. Capital letters also want more pressure but less pressure should be given to punctuation marks since these are small. The typing of a stencil requires a little more skill than that required for the normal typing of paper copies.

To correct errors made when typing, a special correcting fluid is available. This is thinly painted over the mistake and allowed to dry after which it is retyped. Large corrections can be made by patching in a small piece of a newly cut stencil.

All ruling or underlining is done with a wheel pen or stylo. It is not advisable to use the typewriter for this purpose, as this frequently causes the stencil to break when being used to make the copies. A large variety of these special pens and stylos are available from all the manufacturers.

After use a stencil can be cleaned and stored for re-running later if desired.

Photo stencils

Stencils can also be made by photographic or electronic means. These are particularly useful for creating stencils from materials which cannot be typed, such as drawings and photographs. The photostencil is sensitized; the normal type can be used with normal electric lighting. The original to be copied must be of very good quality and on a translucent material. Where it is not suitable it is necessary to make an intermediate master by one of the photocopying processes or other photographic methods.

This master is exposed with the photostencil to a powerful light. The stencil is then developed, conditioned and dried, after which it is suitable for use on the stencil machine. The makers of
these photostencils also sell small outfits complete with lamp exposing unit and trays for finishing the stencil. The booklet given with the outfit explains in great detail how to do the work necessary to obtain a good quality stencil. The method is not difficult and can soon be learned. For preparing half-tones a screen is necessary to break the image into small dots. The reason for this is described in greater detail later in this book (see page 37 et seq.).

There are two alternative methods available by which stencils can be made. One is a small machine called the Photoscope. This is really an upright camera and the copy is placed in a holder and photographed through the lens on to a special sensitive stencil. This method can copy from opaque or translucent drawings since it is able to photograph all types of copies.

The stencil used is more sensitive to light than the other type and must therefore be developed in a room lit with special safe lights. After exposure the stencil is completed in the same manner as the other type of sensitive stencil.

A special machine employing electronic methods is widely used in some countries to make stencils. The machine consists of two drums. On one is placed the original to be copied and on the other a special stencil. When the drums are rotated the image is scanned by an electronic cutter which burns this carbon stencil and creates a copy of the original. Only same-size copies can be produced but the results are of good quality. It is also suitable for half-tone work and does not require a screen. Unfortunately these machines are not on the market, but a quick and efficient service is given by the Roneo Company who operate them.

The stencil process is widely used in most countries and gives satisfactory results with a minimum amount of operating skill. A minor disadvantage of this process is that it is generally necessary to use a paper which is semi-absorbent. If a hard smooth paper is used the image is offset on to the back of the sheet falling on it after being printed. To avoid this when paper with a writing surface is required, it is necessary to interleave, that is to place a sheet of blotting or similar paper between each printed sheet. This delays printing and is inconvenient since it must be taken out when the print is dry.

Summary

Stencil apparatus is available in cheap flatbed form or hand- and power-driven rotary machines. It prints with ink in any colour and uses a stencil which is prepared by being cut by a typewriter or stylo pen. It is suitable for short or medium long run work producing copies of good quality which are durable. The absorbent type of paper normally necessary is a minor disadvantage.
STYLUS PEN FOR STENCIL CUTTING

STENCIL PRINTING MACHINE
OFFSET LITHOGRAPHY

Lithography is a well established method of producing prints of good quality. It is widely used by professional printers for high class work of large sizes. The machines described in this book are of the simpler types and do not require the skill and training necessary for normal lithography on the larger apparatus. They do however require a little more skill than the processes previously described. These small offset machines are also able to produce excellent work and are suitable for half-tone (see page 38) and colour illustrations.

Lithography is based on the well-known principle that grease and water will not mix. The master used in this process therefore consists of a material able to hold water or other chemicals and an image of a greasy nature which attracts the greasy ink used in the process. Originally the master used was a special stone having porous qualities. This method produced very good results but was very slow.

There are two forms now in general use, one which creates the copy direct from the master and the other which transfers the image from the master to another roller which is made of hard rubber and is known as a blanket. The copies are produced from this blanket and this gives it the name of "Offset" since the image is offset from the plate to the blanket and then again to the copy. (See illustration)

The offset method has many advantages over the direct form of lithography. Its chief value is that it allows typing or drawing to be done directly on to the master. The offset method also allows paper of a much cheaper quality to be used. A serious disadvantage of the ordinary form of lithography, including the stone method, is that the image must be drawn or transferred in reverse so that the prints taken from it read correctly. This is a very serious handicap particularly when using a typewriter.

For many years metal plates, zinc or aluminium, have been in common use. Recently paper or plastic plates have been made available and these are obtainable in different qualities, the cheap one being designed for very short runs. The better quality paper plates are able to produce many thousands of copies. It will therefore be seen that by the use of an appropriate plate, paper or metal, this process is suitable for all type of work. The metal plates can be specially coated to enable them to make extremely long runs of many thousands of copies when these are required.

Both the metal and non-metal plates can be stored for re-use. Some of the cheaper paper plates are not suitable for storage over long periods. The life of these cheap plates depends a good deal on the method of use. Operators using too much moisture can weaken the plate and thus reduce its life considerably.

Operators

The machines used in offset are all of the rotary type and electrically driven. Some are hand fed or have simple friction feeds, but most models have suction feed and work at high speed.

The maximum size they are able to print is generally up to 14" x 20", though in some countries they are available for larger sizes. Offset machines of the traditional type are available in most countries. These are big machines and are able to print from large rolls of paper or cut sheets and frequently in two or more colours. Such machines are in effect a number of machines in one and the printing is done consecutively, the sheet or roll passing from one colour to another, emerging finally as a full colour print. To operate such machines requires professional training and much skill and these are therefore not discussed in this book.

Reproduction of the master

There are numerous methods by which offset masters can be prepared. They can be typed direct, written or drawn with the aid of a greasy pencil, pen or crayon. The image may also be transferred from a stencil or by other intermediary masters. Anything that can be photographed same size or reduced or enlarged can be printed down on to a metal plate. Stencil apparatus of the flatbed type or the Ordoverex process can also be used to transfer the image to a plate.
A metal plate is typed by using special greasy ribbon. This can be corrected by erasing the greasy ink. Paper plates are typed with a carbon paper ribbon and erased with a special fluid which removes the deposited grease. For writing or drawing direct on to the plates special greasy pencils or ball point pens are available. These are erased by the same method.

The plate can also be coated with a sensitive emulsion which when dry allows an image to be printed on to it. The coating is done by pouring this solution on to the plate while it is being revolved in a whirling machine, which causes the emulsion to spread in an even coat. It is dried by the application of hot air as it revolves. These operations are conducted in a normal room lighting since the emulsion is not very sensitive to light. The plate and the master are held in contact in a pressure frame and are exposed to a powerful light, normally arc or mercury. Greasy ink is then rubbed over the plate followed by a gentle wiping under a jet of water.

Where light has passed through the negative, the emulsion has been hardened but where it has not received an exposure it is still soft and is therefore rubbed away, leaving the hardened image with the grease-attracting ink attached to it. This, when attached to the machine, will attract the greasy ink and therefore create the image which is later transferred to the copy.

Paper plates which have been presensitized by the manufacturers are also available. These are useful where photographic plates are only occasionally required.

The photographic method widens the scope of the offset machines and enables intermediate masters, which can be prepared by photography or photocopying or other processes, to be used.

In some countries yellow or green stencils known as diapositive stencils are available. When typed these can be printed on to the sensitized plate, since the yellow stencil acts as a barrier to the blue printing light but allows light to pass through the parts cut by the typewriter or stylo. It is claimed for this method that it gives a better result and that the stencil is more easily corrected. It also can be more conveniently stored since it is dry and is therefore readily withdrawn for any additional runs when required.

The metal plates prepared by photographic means can be immersed in an acid bath to remove the previous image and make them suitable for re-use. This is useful when plates are difficult to obtain, and saves considerable expense.

**Continuous tone**

When photographs are required to be printed on ink printing machines it is necessary to use what is called a half-tone screen. A photograph printed photographically from a negative is called a continuous tone print; a reproduction printed with a screen is termed a half-tone print. The screen breaks the image into small dots of varying sizes according to the density of the black image on the original. Screens known as 120 or 133 are most frequently used in the offset method. The method of producing half-tones is discussed in detail under "How to illustrate the work".

The use of other forms of screens and the copying of line and originals is also described later in the booklet.

**Summary**

The offset process is confined to rotary machines generally giving a high output.

It uses masters made of metal, plastic, or paper. It can be used economically for both short and long runs according to the master used. Special plate coatings enable extremely long runs to be made when these are required.

The prints are of good quality. They are durable and can be printed in many colours.

The process is widely used throughout the world.
LITHOGRAPHIC PRINTING FROM STONE
Machines which use ordinary printers type are known as letterpress, type set or relief printing machines. Type is normally made of metal and is available in a large variety of faces or styles, each being known by a different basic name in order to distinguish it. It is also supplied in various sizes. There is a wide variety of names given to the different type designs, such as Gill, Times, Bodoni, etc. These basic designs are subdivided to styles which have a general resemblance but have their own particular characteristics. Thus the Gill family is divided into Gill Light, Gill Sans, Gill Sans Bold, Gill Sans Italic and many others. Since all these types which originate from the basic type have resemblances in some way or another, they are known as families.

The printer measures his type in terms of "points" - e.g. 10 point times or 8 point Gill sans. But note that the point used by American and British printers is smaller than the point used by printers on the European Continent; so buy type from one or other area, but not from both. A complete alphabet including the additional signs required is generally called a font or font.

The machines which use relief type are often large and costly and specially designed for extremely high speeds. They require skilled staff to operate them and will therefore not be described in this book. There are, however, a number of both very small and medium sized machines which are able to produce prints of a very good quality and which can be operated without special training or skill. This type of apparatus is available in small flatbed or semi-automatic and power rotary machines. Some are available which print from carbon ribbon roll and are used to give the printed matter the appearance of having been produced on a typewriter. This enables circular letters to be printed in large numbers but each having the appearance of an individually typed letter.

There are various methods of setting up the type when using these small printing machines. It is necessary in all cases to prepare it in reverse or backward because the printing is direct and the copy paper being in contact with the type face will therefore reverse the image again to read correctly. Loose type is laid out in special boxes, each letter having its own compartment. This makes the selection easy and reliable.

The rotary type of machine is fitted with grooves or segments which hold the type securely. Special composing sticks or forks are available and the type is first transferred into these holders and when complete is placed line by line into the grooves of the machine.

Both line and half-tone blocks can be made for use in relief apparatus. The preparation of these is generally beyond the scope of the average reproduction unit, but the makers of the machine hold large stocks of designs and will supply special designs on request.

The instruction booklet issued with each machine clearly indicates how the type is set and gives instruction on how to space and justify - i.e. to even the right-hand margin. This type of machine is useful for a wide variety of purposes but particularly for preparing the covers for reports, and booklets where large type is essential.

They are also valuable for over-printing, that is adding additional information to already printed material.

The rotary machine is able to print at normal duplicating speeds and is therefore ideal for the production of forms and such material as cannot be produced by other types of machines. It is able to use various colours of inks and the carbon type can print several colours simultaneously since the use of carbon makes it in effect like an hectographic machine.

The small machines, using relief type which are really miniatures of the big type-set machines, are available in most countries. They are in appearance only toys but are well made and capable of producing work of first-class quality. The cheaper type are slow in operation since each sheet is placed on the machine by hand, but apparatus is available capable of giving up to 1,000 prints per hour.

Numerous small and cheap booklets are available which outline in detail how to set up the type to use in these machines. These are available from the makers of the apparatus and should be
carefully studied by all who require the type-set appearance and cannot afford the large costly machines.

The low price and the simplicity of these small machines should not be taken as an indication that they are not capable of producing good work. They use the same type ink and paper as the very large machines and with care and a little experience will produce comparable results, though not at comparable speeds or of comparable sizes.

Summary

The relief methods of printing are able to produce very good quality results. They use printers type which is set up to provide the master. Type is available in a wide variety of sizes and styles.

The copies are produced by printers ink. Apparatus is available from simple hand to fast automatic rotary machines. They can be used after short instruction.
RELIEF HAND PRINTER

EXAMPLE OF PRINTERS TYPE

THE FREINET PRESS

RELIEF PRINTER,
FLAT BED TYPE.
A small press using printer's type has been made available by C. Freinet of France (see Bibliography: Freinet, C. . . . ) and this is specially designed for use in schools. It is claimed by the author that, while duplicating methods can be used, their educational value is considerably less than that of a small printing press.

The attached illustration indicates that the press is of a very simple nature, but both automatic and semi-automatic types are available able to print up to 21 x 32 cms.

Ordinary printer's type is used normally up to 16 point. It is claimed that the manually operated press can produce about 160 copies per hour.

The type is fed in a compositor's stick, each line being correctly spaced. When completed it is transferred to the galley and corrected. The type is then justified to give the even margin and is finally transferred to the press.

The ink is then evened out on a sheet of glass or special plate and transferred to the roller. Those made from gelatine are especially suitable but are fragile and melt in sunlight. Rubber rollers, whilst reasonably satisfactory, are generally too hard but are made more resilient by covering with a piece of bicycle tyre inner tube.

When correctly charged with ink the roller is run lightly over the type, transferring the ink ready for the impression. A sheet of paper in contact with the ink type face will create an impression when the pressure shutter is brought into contact with it.

The sheets are dried by hanging in a warm room for a few hours or by the use of blotters or large books having absorbent pages.

Illustrations are normally produced by Lino Cuts or similar methods. Colour printing requires, as in all ink processes, a separate master and inking to produce primary colour runs.

Where colours are widely separated they can be individually inked in their correct colour by the hand roller and two or more colours produced simultaneously. Each Lino Cut is traced from the original with carbon paper. Means of registration are essential to avoid overlapping where the various colours are applied.

The recommended methods of producing a five colour Lino Cut are: first print black, second print red and green, third print brown, and fourth blue. It is essential to clean the type between each colour run, and in any case frequently; otherwise the crevices in the smaller letters may block up and, when dry, prove difficult to remove.

The use of an old toothbrush with a little petrol is recommended. The type should finally be wiped before being removed. The ink roller should also be occasionally cleaned.

The Freinet School Press was particularly designed for educational work and to teach children the general principles of printing. The methods of use as described by Mr. Freinet make it suitable for team-work. The use of Lino Blocks is of special value to the children with artistic inclinations and although the illustrations are simple they are designed to develop the art of illustrating and the use of colour.

The small presses of the Adana type previously described could be used equally well. With these machines line and half-tone blocks are also available, which would widen the knowledge and increase the interest of those receiving instruction.

In some countries the spirit duplicator has been extensively used to create school magazines and small booklets. This simple method, which allows reproduction to be easily made in seven different colours, is particularly suitable for this work. Printing can be done by typewriter or by hand. Using the small office machines the single sheet can be designed to take two pages and these can be "saddle stitched" as described later to produce a presentable booklet. Covers carefully designed in three or more colours add considerably to the appearance of the work produced.
When schools prefer the stencil method all drawings must be created on translucent paper using dense black Indian ink and the master created by use of the photo stencil.

THE SILK SCREEN PROCESS

The silk screen method is very similar to the flatbed stencil process. It consists of a frame covered with a piece of silk material which is tightly stretched across the frame. This frame can be lowered to bring it into contact with the copy paper and raised again to remove the finished copy. The illustration will explain this simple operation.

Printing may be done by the use of stencils, handcut or made by photographic means, or the silk screen may be painted with a special medium. The stencil is attached to the underside of the silk, allowing the solid parts to act as a protective layer against the paint used in the process.

To make copies, the frame holding both the stencil and the silk is lowered into contact with the paper, card or other material to be printed and by the use of a rubber squeegee paint is spread over the silk. Where the stencil allows it the ink will pass through the silk to make a copy on the paper beneath it. After the screen has been raised the copy is removed and the operation repeated to make more copies.

The illustration shows a simple silk screen table. The process has become so popular that new types of machines have been developed. These machines enable over 1,000 copies per hour to be made and they are available in quite large sizes for poster and similar work.

The simple type of machine is however quite effective and still widely used. It can be home-made with little difficulty. The base may be an ordinary flat table top. The wooden frame should be hinged and some simple method of automatically raising the frame is desirable. This can be a piece of string running over a pulley with a small weight attached, or springs may be arranged to lift the frame.

The outside frame is made to carry an inner frame to which the bolting silk is tightly stretched. This allows a number of stencils to be prepared and inserted into the frame without loss of time. It is particularly necessary if colour prints are being made.

Stencils of the poster type can be cut by hand. A steel rule and a sharp knife together with a few wooden curves are all that is necessary for this work. Before cutting by hand a drawing is first made on the paper. The outline is cut out with a sharp knife or similar tool. Unlike the ordinary stencil masks used for other purposes, no "tie in" letters are required since the centre parts are held to the screen by first coating them with paint. After cutting, the stencil is laid on the baseboard of the apparatus, and after treatment the screen is lowered into contact with the stencil which will adhere to the screen in its correct position.

A special waterproof protective film can be purchased which can be painted on to the silk. The desired stencil or pattern can be created by this method and after use the protective layer is removed and another one added as required.

The photographic stencils are made from positive masters. The sensitive layer is a special carbon tissue, such as is used in the Gravure process. This is hardened by light and the portions not hardened are easily removed to provide a stencil. Various types are available, some of which require skill to operate, but certain papers are easily manipulated and can be used after a careful study of the instructions supplied. These stencils allow a much finer or greater detail of line to be produced and therefore extend the possibilities of silk screen printing.

Half-tone effects require the use of a half-tone screen, but shading mediums or tints as described elsewhere in this book can be used to give tone effects into the original line drawings. Completed stencils may also be supplied by the makers of the silk screen apparatus and materials.

Printing may also be done on a wide variety of materials including glass, wood and fabric. Various coloured papers and cards can be used to give two-colour effects. Luminous paints are also available which are effective with large posters.
Once the stencil has been produced and the ink made to the right consistency printing is very easy. An almost unlimited range of materials is available for silk screen printing and this makes it a process with unusual opportunities.

It is now used chiefly for posters, advertising and similar work and particularly for creating a pattern or design on material which cannot be accommodated in a printing press.

Summary

The silk screen produces copies by pressing ink through a stencil on to the material to be printed.

It can print on a very wide variety of materials including cloth and plastic.

Copies may be produced in different colours and luminous inks may be used.

The apparatus can be made if desired. It can produce large-size copies and is therefore suitable for poster work, advertising and similar requirements.

HOMEMADE SILK SCREEN PRESS
The Ordoverex method is lithographic in principle and is frequently called True-To-Scale because it is a dry process and is therefore considered able to produce copies which are reasonably accurate in size. From the illustration it will be seen that the apparatus is a wooden stand with three rollers and a band of flexible material, generally linoleum. On this band an emulsion is coated which consists of gelatine, iron salts and water. This is melted to a thick mass to prepare what is known as the jelly.

In its hot liquid state this composition is poured into a trough provided and when the lino band is moved slowly by turning the handle attached to one roller, a thin even coating is laid on the band. This is allowed to set.

The original from which copies are to be made must be on a translucent material. Where opaque materials only are available an intermediate positive master must be prepared by one of the photocopying or camera processes.

The translucent master is then exposed in a photoprinting machine together with a sheet of ferro Prussiate paper which is usually known as Blue Print. The ferro paper is then placed face down and in contact with the composition on the Ordoverex table and after a few seconds is removed. The unexposed parts of the Blue Print, which correspond to the lines on the original, react with the jelly and leave a dry impression which will attract greasy ink when this is applied to it. The damp jelly elsewhere will repel this ink thus creating a suitable surface for making copies.

Hand rollers coated with ink are then run over the jelly and when this is sufficiently inked, paper card or other material is laid in contact and when removed will be found to hold an inked copy of the original. The impression on the jelly can be re-inked and where conditions are satisfactory, up to 100 copies can be produced. After use, the gelatine can be scraped off the lino and melted for re-use.

An advantage of this method is that prints up to 18' in length can be produced on the large sized tables. It is particularly suitable for line drawing and plans and is able to produce prints in a number of colours. The prints are of extremely good quality, and durable.

Some experience is required to operate this method successfully. The jelly must always be of the right consistency and the ideal working conditions are between 60 and 70 degrees Fahrenheit. In hot countries fans must be employed to keep the plate in a cool condition and receptive to the ink.

Summary

The Ordoverex is a lithographic method preparing ink copies on paper or other substances. The apparatus consists of an endless band of linoleum on which is coated a special compound.

An exposed Blue Print is laid on the compound which prepares the jelly to take ink. After removal, the ink is rolled over the surface of the table and is attached to the parts which were dried by the unexposed portions of the Blue Print. Paper is then placed in contact to give a copy.

It is able to give very large prints and also in colour if required. The process must be worked between 60 and 75 degrees to get satisfactory results.
ORDOVEREX TABLE
The Oberwager method of printing posters from a glue plate has been adequately described and illustrated in the Educational Studies and Documents Series (1) published by Unesco.

The method consists of making a wax plate on which the picture to be reproduced is engraved. From this a glue plate is cast which, when it is cool and solidified becomes a printing plate from which copies are reproduced.

To make the wax plate a mixture of paraffin wax and bees wax is poured on to a sheet of glass to form a layer 3 mm. thick. On this plate is drawn the picture or poster to be reproduced and this is cut out or engraved by special tools or gouges. The soft wax is easily removed and forms a recess in the plate.

A mixture of glue and glycerine is then melted and in its liquid state this is poured over the wax cast and allowed to cover it with a layer 2 cm. thick. This liquid is then allowed to cool for approximately 8 hours when it becomes flexible like soft rubber. When removed from the wax plate the raised lines of the glue plate correspond to the engraved recesses and these form the printing surface which when coated with ink, are able to transfer an image to paper and so produce the final copy.

The glue plate is extremely sensitive to ink and requires only a light pressure with an inking roller. Any ink may be used and over 1,000 copies are obtainable from each plate. The printing plate will last in good condition for about three months. The wax plate can be kept indefinitely. When no longer required it is remelted for further use.

The necessary apparatus can be easily made, and this may be either the flatbed type or a simple rotary machine which will allow an increased production speed. Copies may be produced in various colours by the normal methods of using different plates and coloured inks.

The advantages of this process are that it can produce on any type of material, including cloth, wood, leather, glass or metal, cement, plaster as well as all kinds of paper.

The flexibility of the plate allows it to be moulded to all types and shapes of surfaces. It is unlimited in size and is therefore particularly suitable for the production of large copies of the poster type.

The method is also cheap in material costs but the output is restricted, since the plate requires re-inking for each copy.

Summary

The Oberwager press uses the lithographic principle. A wax plate is prepared and "cut" and from this a glue printing plate is prepared. This is inked to provide the copies which may be large in size.

OBERWAGER METHOD

ENGRAVED LINE

GLUE

REMOVING GLUE PLATE

PRINTING SURFACE

GLUE PLATE, FACE UPWARDS
A brief outline of this process is given because it is a short run method capable of giving very satisfactory results. It does require more skill to operate than most of the methods previously described. Where such skill is available the process may be of particular value.

Collotype is a photographic method of producing a printing surface in gelatine from which reproductions in tone may be produced without the aid of a half-tone screen. The plate used is a glass support on which is coated bichromated gelatine. This is heated in an oven during which process the gelatine reticulates and hardens. The reticulative property of the emulsion enables the half-tone printing to be achieved without the aid of a screen.

A reversed negative is printed, by exposure to light, on this film. The light penetrates some parts of the negative and makes the bichromated surface impervious to moisture in direct ratio to the tones of the negative, so that the parts receiving the most exposure will be hardened and therefore moisture resistant. When washed in water the soluble parts absorb the water and swell according to the exposure received.

The printing plate is prepared by a mixture of glycerine, ammonia and water. When ink is applied to the plate it receives it in the soluble parts and repels it in the moistened parts. Printing is then done by a press similar to a lithographic flatbed machine.

Although it cannot be considered generally suitable for long run work it is able to produce prints of exceptionally good quality. It is frequently used for high class reproduction where absolute fidelity is required. In colour work this process excels, particularly reproduction of works of art. It can be used to give up to seven or eight printings and produces a richness and quality of tonal fidelity not possible by any other process.

A weakness of this method is the difficulty of maintaining the uniform moisture conditions which control gradation. Many experiments have been made to overcome this weakness - with some degree of success.

One method has been to use bichromated gelatine on a finely grained zinc plate with a 400 line screen. The gradations here depend on the dot area and are therefore not truly collotype. This method was developed in the United States of America and is known as Aquatone.
Chapter II

FACTORS TO CONSIDER IN SELECTING

The outline of the various processes as given in the previous chapter will have served as a brief introduction to the various methods now used. It was given to show how they worked, what type of apparatus was necessary and the type of copy they produced. The number of processes now being employed makes the selection of a method for a particular need very difficult.

It will have been noticed that many of the methods which have been outlined are able to do similar types of work. Often there is little difference also in the cost of using different processes and experienced operators may prefer one process to another and disagree in making a selection because they have become experienced with the method they have always used and therefore prefer it.

The reader may also have noticed that some of the methods described are able to do work which cannot be done by any other method. One must remember that there may be many reasons why one should or should not employ a particular process in a particular country. Factors which make one process suitable for one country may make it quite unsuitable for another. For instance, the type or quality of the labour available may greatly influence choice of apparatus. The price of materials in one country may be very different from the cost in another country and this will be an important factor.

When you have decided on the process you desire to use but are still uncertain of the make of apparatus to purchase you should make enquiries to find which firms supplying such equipment are able to give a maintenance service to their machines in your area. In the wide experience of the author of this book in supplying apparatus abroad, when other things are equal make of apparatus supplied is decided by whether the firm concerned has agents in the country in question and can repair the machine quickly or supply parts without delay. After long use all machines require attention and occasionally this is more than can be given by the operator. If it is necessary to send the machine back to the makers for repair many weeks of useful service are lost and staff kept idle - which adds considerably to the cost.

When considering the type of process which should be used or the apparatus required the following points may be of assistance:

Number of copies

This is one of the most important considerations apart from cost. One must always remember that processes which produce a few copies cheaply cannot be used to produce large numbers also cheaply. It is never possible to print 10 and 10,000 copies by the same process economically. The chart in the Appendix gives some idea of the number of copies a process is able to give without increasing the cost.

Under no circumstances should one use the photocopying methods to make a large number of prints unless no other apparatus is available.

Quality of the copy

You will have noticed in the outline of the processes that some of them are not able to give durable copies and some do not give copies of a very high quality. If the work you want to do must be kept over long years or if good quality is essential then you should consider only those methods which give copies on good paper and by inks which do not fade in the sunlight or by chemical action.

Size of copy

Many of the machines previously described are able to produce small sized copies only. The largest apparatus in most duplicating processes does not make copies larger than 20 x 14 ins. If you require large sizes you will be compelled to consider such methods as are able to print the size you require or alternatively to paste a number of smaller sheets together. This may be done occasionally but it is difficult, costly and time-consuming.
Type and quality of the original

When you are required to make copies from originals sent by other people it is essential that your apparatus should be able to reproduce them. Frequently requests are received for large or small copies on linen, card or other material. These requests are often for instructional or similar purposes and may be required in a number of colours.

Sometimes archival documents have to be reproduced facsimile. These require careful thought before the apparatus is purchased.

Cost

It is generally necessary to consider how cheaply copies may be produced. The chart given in the Appendix indicates the relative cost of some of the reproduction processes and photocopying methods. It does not unfortunately give any indication of the cost of some of the processes described. You must always bear in mind that costs are only relative and cannot be universally applied. If you want to know what it really costs to reproduce your own copies it is essential that you calculate materials and other factors and then divide these by the number of copies you produce and so estimate what the true cost is.

The figures given by experts in any country other than your own can only be a rough guide. In some countries labour costs are low but material costs high and in other countries labour is much more expensive an item than machines or material.

The type of machine you use will make a big difference to the cost of your copies. A small hand-operated machine will produce only a small number of copies per day and if your labour is expensive this will add considerably to your costs. A fast power-driven machine may produce as many copies as two or three hand machines together, with only the cost of one operator.

When you are purchasing machines it is most necessary to remember that the running speeds given by the maker are the maximum speeds of the machine and that in practice it will be difficult for you to obtain more than half of this number of copies.

If you desire to get an accurate cost of your work it is necessary not only to consider labour, materials but overheads and machine depreciation. In some countries machines depreciate rapidly particularly when there are no servicing facilities available.

A rough and ready guide, however, can be made by costing labour and materials only.
Chapter III

CLASSIFIED SELECTION OF PROCESSES

Circulars, handbills and reports

Circulars and handbills may be printed by most of the available processes. As they are small in size the duplicating and small printing processes are particularly suitable. Where circulars are required to create the personal touch the special relief type machines using carbons, such as the multigraph or roneo type, should be used. These machines, by using the ribbon printing, give a copy which in appearance closely resembles an individually typed letter.

The offset process when used with a varityper is able to produce copies having print quality. When type larger than 14 point is necessary a suitable intermediate master would have to be created from the relief type of machine or by one of the composing machines able to do this class of work. This could then be photographically copied and printed down on to the litho plate.

Where a large number of copies are required, machines of the relief type would be satisfactory. The initial high cost of setting up the type would be offset by the quantity produced.

Reports are normally restricted in area size to not larger than an average book or magazine. Frequently they may contain either charts or diagrams and other illustrations which may be larger in size and therefore require folding into the book. In some countries it is customary to print all illustrative matter on larger paper so that the illustrations are outside the book area and can be studied together with the text. This practice necessitates the use of a machine giving at least twice the area of the report page unless other processes are available which can make these illustrations.

Generally, reports are printed on any available duplicating machine. Where a range of machines is available the process is generally decided by the number of copies required or the other factors as outlined in Chapter II. Where large numbers are required which must be of good quality with a durable image the use of offset is desirable. Letterpress and other high class printing methods are not normally used for reports unless they are to be made available to a wide public and the finest possible quality is required.

Photographs may be included in a report either as continuous or half-toned illustrations. When the number of copies does not exceed 100 or extremely good quality of reproduction is necessary it may be preferable to use ordinary photographs and not to make half-tone copies. The bulk created by photographic paper can be considerably reduced by the use of an airmail type paper which has the advantage of allowing the book to remain flexible and the photograph to be folded when necessary.

When a number of photographs are required on one page together with line illustrations or typed matter, the master can be made same size or preferably larger - but in correct proportion to the finished page. It is advisable to attach the photographs adding any information and printed matter and then rephotograph the whole to the required size. The result can be made quite attractive and of good quality.

Chapter IV outlining the treatment of illustrative matter, deals more fully with the preparation of photographs for half-tone printing and also illustrations in colour.

Booklets

A booklet, being of some importance, normally requires good presentation. These are also required in large numbers and therefore are limited to the processes which are suitable for their preparation. The use of a varityper or an electromatic type of machine is described later. These, together with the offset process, produce a high quality copy which is particularly suitable for this class of work. Illustrations - line, tone or colour - may be included and if printed across the page the copies may be saddle stitched, that is stapled down the centre of the page giving a professional appearance. This is illustrated in the drawing on page 54.
The saddle stitch method will require some care during printing since it may be necessary to print both the first and the last pages on the two halves of the same sheet. A rough mock-up will indicate which pages should be printed together on one sheet; this will of course vary according to the number of pages contained in the booklet. Work of this type is normally done by the large typeset printing machines which are outside the scope of this book. The small typeset machine could be used, but the expense of arranging the type would be reasonably high since the method is slow in comparison with automatic machines designed to set type speedily.

Where booklets have already been printed and are required for republication a useful method is to use a large camera and photograph the individual pages. Negatives are used to print direct on to offset litho plates. This method is not only cheap but is able to give an exact reproduction of the original book. It is a method widely used because it gives very satisfactory copies with a minimum of cost.

Posters

Posters vary considerably in size and can only therefore be printed on the machines able to accommodate them. Small posters may be prepared on any of the duplicating or small printing processes but the choice should be restricted to those able to produce a durable image. Where the work is subjected to climatic conditions durability is of particular importance.

Large posters will require machines able to hold metal type from 48 to 72 point unless they are prepared by other methods.

The silk screen process has been widely used during post-war years for this type of work. It is particularly suitable since it is able to create copies of almost any size with great density of ink and of a permanent quality. The recent widespread use of luminous inks for poster work has increased its use and indicated its wider possibilities in this field.

When making posters of an exceptionally large size it is necessary to use several sheets with slight overlap on each. Poster paper may be obtained in three main sizes 20 x 30 ins. which is known as one sheet, 30 x 40 ins. two sheet and 40 x 60 ins. four sheet. To avoid undue registration problems, it is desirable to use the sheets as large as screening permits. The normal order of laying out a poster sheet is to work from right to left, thus leaving the overlap on the left side of the right-hand sheet in addition to that in the centre.

When creating the layout the use of a projector will assist. If the image is projected on to a wall full size and the outlines are pencilled on the poster sheets it will help when cutting the final stencil.

The large size of copy obtainable by the Ordoverex process has made it a suitable method for poster reproduction where limited numbers are required. The ease with which numerous colours are obtainable makes it exceptionally suitable, particularly for teaching work.

Where work of a more artistic nature is desired the method of drawing direct on to stone or zinc plates known as Autolithography is particularly suitable. By this method many fine series of reproductions have been created and Autolithographers have set a high standard of poster and commercial work.

With the development of a suitable technique, varied and beautiful effects are possible. Such drawings give the artist freedom of expression and are suitable where creative work is required.

The method of making posters by the Oberwager method has been described earlier in this booklet. It is claimed for this process that it is cheap and requires no exceptional skill, and as it is able to print durable copies in both monochrome and colour it would appear to be an ideal medium for poster work.

A method of adding colour very cheaply and easily to posters and similar work is outlined in the chapter on illustrating the work.
Chapter IV

ADDITIONAL CONSIDERATIONS

TYPEWRITER TYPE-FACE MACHINES

To give the professional appearance of printer's type, which is used in all high class printing machines, a number of typewriters have recently been introduced which are able to produce comparable results.

The important features which give typeset its good quality and distinguish it from work produced by normal typewriters are:

(1) differential spacing and
(2) justification of line

The popular form of typewriter gives unit spacing, where each letter occupies one unit of space. Differential spacing means that each character is spaced according to its individual width. Thus narrow letters like I and L are allowed less space than the wider characters such as M or W.

Line justification means that the right-hand edge of each line is so spaced that the last letter of each line is directly beneath the one above. The result obtained is a straight line down the page, on each side of the typed part. All newspapers and books are line justified.

Perhaps the foremost of the typewriters giving type quality is the Varityper Coxhead D.S.J. This is known as an Office Composing machine and as its letters indicate, is able to give both differential spacing and line justification. The machine is electrically operated and therefore gives a uniform impression, which is automatically controlled. This feature, common to all electric typewriters, produces masters of superior quality since it allows a different impression to be made on each letter according to its size, thus creating masters of an extremely high standard. The D.S.J. machine is also able to print from 41/2 to 14 point sizes. A selection of many hundreds of type faces is available. There are types of every kind to meet all requirements including foreign languages, mathematical, chemical and other symbols. The change from one type to another is effected in a few seconds, by simply withdrawing the old type and inserting the new. Two different sets of type are contained in the machine at the same time.

The Varityper A. 20 model is considerably cheaper in price, but gives unit, not differential, spacing - it however gives line justification. It also has a wide variety of type faces and symbols.

The I. B. M. range of electric typewriters includes the well-known "Executive" model which can be equipped with a number of modern types, but having only one type for each machine. These machines produce distinctive results, which are pleasant to read and add much to the quality of the finished product.

A number of similar machines are available in other countries. When typeset quality is required on duplicating machines, their use to create the master is essential.

In recent years there have been introduced a number of photocomposing machines, which indicate that they will be widely used in the future for offset and other processes. They are, however, very large and costly and, together with monotype, linotype and similar machines, are outside the scope of this review.

When a larger sized type is required than can be given by the varityper, a number of machines are available which can produce large letters on paper. These can be added to the sheet and photographed. Another method is to photograph the required type done by varityper or electromatic machines and enlarge this photographically to the size required. These methods will require the use of a large camera, but are valuable for making the covers on reports and similar books. The small typeset machines are also widely used to create the large type required. This can be overprinted on the duplicated sheet, or photographed and added to the stencil or offset master.
THE FLEXIBILITY OF TYPE AND SPACING

This entire page is written with one style of type, the 361-9. The first paragraph is written at 10 spacing horizontally and at 4½ lines vertically. The heading was written at 16 and letter spaced.

The Vari-Typer Composing Machine is undoubtedly one of the most important tools for British Business developed within recent years. It is the wide variety of types and spacings which enables 10 spacing horizontally and 6 lines per inch vertically.

The Vari-Typer Composing Machine is undoubtedly one of the most important tools for British Business developed within recent years. It is the wide variety of types and spacings which enables 10 spacing horizontally and 4½ lines per inch vertically.

The Vari-Typer Composing Machine is undoubtedly one of the most important tools for British Business developed within recent years. It is the wide variety of types and spacings which enables 12 spacing horizontally and 6 lines per inch vertically.

The Vari-Typer Composing Machine is undoubtedly one of the most important tools for British Business developed within recent years. It is the wide variety of types and spacings which enables 14 spacing horizontally and 6 lines per inch vertically.

The Vari-Typer Composing Machine is undoubtedly one of the most important tools for British Business developed within recent years. It is the wide variety of types and spacings which enables 14 spacing horizontally and 6 lines per inch vertically.

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Specimen composed on the Vari-Typer Model A-20, using one style of type but different horizontal and vertical spacings ★★★★★
INTERNATIONAL 'ELECTROMATIC' TYPEWRITER
WITH PROPORTIONAL SPACING

The International Electromatic Proportional Spacing Typewriter gives typed pages the grace, distinction and easy readability of a perfectly printed book. This sheet shows work that has been produced on this machine.

Each character automatically takes the correct amount of space according to its width instead of every character taking up the same space as with the ordinary typewriter, as will be seen from the following examples.

\[
\begin{align*}
\text{i} & \text{i} \text{i} \text{i} \text{i} \text{i} & \text{M} \text{M} \text{M} \text{M} \text{M} \\
\text{o} & \text{o} \text{o} \text{o} \text{o} \text{o} & \text{O} \text{O} \text{O} \text{O} \text{O} \\
\text{m} & \text{m} \text{m} \text{m} \text{m} \text{m} & \text{S} \text{S} \text{S} \text{S} \text{S}
\end{align*}
\]

The different characters are given varying units of space according to their width so that each takes the correct space for the type design as in printing.

There are two space bars on the machine, one of two units and one of three units enabling variable spacing between words as follows:

This is to show spacing between words using two units
This is to show spacing between words using three units
This is to show spacing between words using five units

The operator can also automatically expand the space between characters by simply pulling out a lever. The expander is used for word emphasis display in headings and such other uses as lend character and distinction to a letter or subject matter.

All the usual features of the Standard Electromatic Typewriters are embodied in this model including controlled impression which ensures perfectly produced Multilith plates.

There are three distinctive styles of type available:

\[
\begin{align*}
12 \text{ point} & \quad \text{Fine Line Type (with which this is typed)} \\
12 \text{ point} & \quad \text{Book Face Type} \\
10 \text{ point} & \quad \text{Modern Type}
\end{align*}
\]

As in all Electromatic Writing Machines this model is completely controlled by electricity. The feather light touch (2 oz) operates each key as compared with the much heavier touch required by manual typewriters.

***************

The above work is test specimen of typing direct on to Multilith plate,
HOW TO ILLUSTRATE THE WORK

Printed illustrations are normally classed as line or half-tone. Line work is restricted to
drawings and similar material not containing tone. This is the easiest of all to illustrate, but it
is capable of producing most satisfactory results with modern techniques.

Half-tone reproductions are produced from photographs or other illustrations which contain a
range of tone varying from highlights to shadows. This type of material must be photographed
through a half-tone screen, as described later in the book.

Line drawings

A previous chapter has briefly outlined the various methods of reproduction, and described how
the masters for each process are created. Many of these are suitable for direct drawing either
with stylo, pen, greasy pencil or other means. Illustrations may also be used from existing
books or drawings and then printed by the use of an intermediate master, either photographically
or by electronic means.

The use of photocopying methods such as photostat and reflex processes, or particularly the
direct positive type of paper, are specially suitable for making such masters for most of the re-
production methods other than relief presses. Where typeset machines are used, a block or
stereo is required. The preparation of these requires considerable skill and such work is nor-
mally done by makers of the machine, or a trade printing house.

Half-tone

A photograph normally contains about 30 tones, ranging from highlights through medium tones
to dark shadows. It is therefore called a "continuous or full tone" print. Since it is not possible
to create this range of tones by varying the shades of ink, the illusion of tone is given by dividing
the printer's reproduction into thousands of very small dots. This is done by the use of a half-
tone screen, either in contact with the film or supported a few millimetres away from it.

The normal half-tone screen is housed in a large camera, used for copying photographs. This
is generally called a Process Camera. A wide range of screens is available, varying from a 55
line screen for coarse work to 400 line screens for high class printing. Those normally used for
offset are about 120 or 133 lines per square inch. The dots created on the finished copy vary only
in size and not in number, Where the dots are large they give the impression of a solid black,
where they are small, they resemble a light or grey tone. Therefore, according to their size,
they create the illusion of tone, and such reproductions are called half-tones. One of the latest
methods of making half-tones is by the use of a flexible contact screen. These are available from
Kodak Limited, and are known as Magenta Screens. It is claimed for these that they give im-
proved and sharper results and a more faithful tone reproduction, together with control of tone
contrasts. Booklets describing their use and how to fit them to the existing cameras are available
from the makers.

To avoid the use of a screen, Kodak Ltd. have recently introduced a new film with a screen in-
corporated on its surface. This is known as Kodalith Autoscreen Ortho film. This film is ex-
posed to a continuous tone image, and when developed produces a dot pattern automatically, just
as if a half-tone screen had been used in the camera. Booklets are available from Eastman Kodak
Ltd. which describe this new film and give complete instructions on how to use it, together with
the chemical formulae for processing the film. The use of this material allows an ordinary type
of camera to be used without any special fitments to hold the screen. It also is excellent for copy-
ing both tone and line on the same negative, and can be enlarged to provide a suitable positive for
silk screen work.

For the best quality work and particularly where photographs contain fine detail, the use of
print retouching is desirable. Technically, the purpose of print retouching is to restore tonal
values lost when making the half-tone negative and prints.

Retouching is done by mounting the photograph on card and then separating the delicate tones
by spraying with the use of an Aerograph apparatus. Using process white and process black paints
mixed to give the desired tone, the paint is sprayed on to the photograph. Where such detail is small the surrounding parts may be protected by specially prepared papers. These will adhere to the print by the warmth of the hand, and the parts to be sprayed are cut out with a sharp knife. When completed, the masking paper is peeled off, leaving the photograph undamaged.

Half-tone effects can also be created by the use of tints or shading mediums. They are on transparent material, and consist of dots varying in size and other patterns to represent different tones. These shading tints are "let in" to line drawings and when rephotographed and printed, reproduce the half-tone effect. Many variations are possible by this method and the result is a distinct improvement on the simple line type. These mediums are widely used in fashion advertising, particularly in the daily papers or cheap magazines. They are illustrated at the end of this chapter.

Existing half-tone copies, when required for further reproduction, may be rephotographed without the use of a screen. They should be treated as line subjects but will reproduce half-tones, since the screen has already been applied to them. Another method is to make a photographic enlargement in contact with a screen. This will give the dots required, and when copied as a line subject create a tone effect. A special screen known as an Orange Screen is available from Kodak Ltd., which is designed for use in the enlarger as described. Booklets are obtainable for both the Orange and the Magenta screen previously described. This gives all the necessary instructions for their use.

Where artists are not available to prepare illustrations, both line and tone subjects can be readily created by simple methods, requiring no ability to either sketch or draw. One method frequently used is done by the aid of a photographic print. This print should clearly show what the author wishes to illustrate and it should also be light, or weak, in tone. The photograph is then carefully outlined by Indian ink, using a mapping pen for this purpose. When dry the print is immersed in a bleaching solution which will remove the photographic image, leaving the outline clearly defined on white paper. This is photographed as a line drawing.

A further method which will, with a little skill, create pleasing drawings is done with the aid of a photographic negative and an enlarger, or projector. The negative to be illustrated is projected on white paper to the size required. By the use of both hard and soft pencils, the light parts of the projected image are filled in to create a completely black image, as seen on the paper from the negative projection. When the projector light is switched off and the room light switched on, it will be seen that a positive copy of the original has been created. The principle of this will readily be understood if the reader imagines that a line drawing has been photographed and the negative projected. The black line of the original will be transparent on the negative, and so will project as a white line on the paper. When filled in on the paper with the pencil or ink, it will produce a positive copy of the original line drawing. From these outlines, intermediate masters are prepared by a camera, contact printing or other methods.

In some countries epidiascope projectors are available which project a photograph or drawing on to a translucent screen, allowing a tracing to be created. These tracings may be used to trace the outline direct on to a paper plate, or on to the spirit or stencil masters, using greasy pencils, stylos or other methods as required.

The use of a cheap pantograph is also helpful for creating a drawing from any form of illustration. The advantage of this method is that the drawing can be enlarged or reduced in size. A new photographic method of converting a photograph into a line drawing has been introduced by Kodak Ltd. The result is similar to a pen and ink drawing. The method would appear to require some photographic knowledge, since it combines the use of a negative and positive film, but the results are very satisfactory and, where artists are not available, the trouble involved would be well justified. It is claimed that the making of line drawings by this method is considerably cheaper than by the normal methods. A small booklet called Line Effects from Photographs by the Tone Line Process is available from Kodak Ltd. without charge. This describes the method in full detail, giving complete working instructions.

Where considerable numbers of illustrations are to be reproduced, particularly with offset and similar processes, the use of a large camera is desirable. Process cameras designed for this

(1) See Appendix 1.
work are expensive but the old square bellows type, which is not now used professionally, can be obtained very cheaply and adapted to meet all the requirements. As the use of such a camera can be of great value in all reproduction sections, a later chapter describes how this can be made with little cost. By the use of autoscreen plates it will meet practically all requirements.

When illustrations are required to attract attention or to create effect, a very simple method which can be used with all the ink processes is to dust the printed copy, whilst still wet, with bronze or silver dust. This dust consists of very fine particles of metal and can be purchased cheaply. The dust is spread lightly on to the copies. It will adhere to the printed parts and can be shaken off the rest of the copy.

Where large illustrations are available, both bronze or silver powder may be used to create an unusual but artistic effect. When special effects are required, the copy can be dried and the letters required to be powdered can be painted with spirit or varnish. When applied, the powder will be held by this medium.
THE USE OF COLOUR

The use of colour in printing or duplicating adds to the appeal of the illustrations, but also to the cost of reproduction. If several colours are to be used, only one can be printed on the machine at the same time. A sheet of paper has therefore to be put through the printing machine for each succeeding colour. The hectographic method is the only exception to this rule. In addition to the additional runs necessary, a number of masters for each colour must also be prepared.

Basically colour is made up of the primaries yellow, red and blue. An additional black printer is added to give depth, and sharpen the result. Colour reproductions in tone therefore require at least four masters, four plates and four separate runs through the printing machine. This requirement adds considerably to the cost of the process.

For much work, the addition of one or two colours may be sufficient to indicate what is required. Cost can always be reduced by careful planning and, in all cases, colour should never be used merely for decoration. Its purpose is to clarify or to emphasize the text or the flow travel of material, or to identify parts which are connected with each other.

An example could be found in a car manual, where one colour could be used to indicate the passage of petrol from the tank to the carburettor and cylinders, until finally exhausted through the valves. The same illustration could outline, in a different colour, the electrical current, thus indicating the various functions of the car engine by quickly recognizable means.

Permanent publications of this type would justify the expense of colour more than those dealing with experimental machinery, which may quickly be outdated and therefore require reprinting.

Colours used in posters and similar documents serve an entirely different purpose. They are designed to attract and call attention to the poster, and therefore to its contents. The justification of colour would depend on the importance of the poster, and the message it is designed to convey.

The value of colour - for whatever purpose it is required - cannot be denied, but it must be related to the increased cost of producing it.

The improvement made both in colour photography and colour printing has considerably increased its use in every field of activity, but its cost is a limiting factor in manuals of the educational and instructional type. The use of the Ektalith process, developed by Kodaks in the United States of America, is particularly designed for cheap runs of high class colour, up to 5,000 copies. When this process is more readily available it will meet a long felt requirement in the publications of such booklets as at present do not justify the cost of long run colour printing.

It should, however, be always remembered that colour printing will always cost much more than printing in one colour. It will also always require more skill to produce it.

Where colour is required, a copy roughly coloured by crayons or ink will be sufficient for the artists or the printers to prepare the necessary masters. All instructions should be clearly given to avoid error, and the proof carefully examined before passing to the machines for final printing.

The preparation of masters for simple line subjects is less difficult than for tone. The original may be photographed without the use of colour filters; from the negative, additional negatives or positives may be created. Negatives may be painted out with opaque paints to remove all but the required lines, a separate negative being necessary for each colour. Some form of registration will be necessary, depending on the closeness of the registration required.

This method of master preparation can be simply illustrated by supposing that an original bearing the letters A, B, and C is to be printed in red, green and blue. A negative taken showing the three letters would be used to create two other negatives. These would be painted out to give three negatives having A on the first, B on the second and C on the third. A printing plate of each having been created, they would then be placed on the machine and the copy made, first the A inked in red, then B inked in green, finally C inked in blue. The final prints would therefore be in their full colour. It is, of course, necessary to clean down the machine for each change of colour, unless a number of machines are available already using the coloured inks required.
Drawings may also be prepared in the same manner and these printed down on the plates. Tone reproduction will necessitate the use of a large camera and some degree of skill. Using colour-sensitive material, four negatives will be made, each one photographed with a different colour filter. These filters are blue, green and red, and each absorbs the other two primary colours, allowing only its own or near colours to pass through it. When printing, the yellow filtered negative is used to prepare the blue plate, the green filtered negative the red and the blue filtered negative the yellow printing plate. The effect given by the over-printing of the colours is roughly illustrated by the accompanying drawing.

The above simple description will allow the principle of colour printing to be understood. Perhaps for greater accuracy it should be stated that the primary spectral colours are orange, green and violet. The primary pigmentary ink colours are red, yellow and blue. A printing plate for each primary pigmentary colour is obtained by using the filter of the other two, so that the orange filter, which is a combination of red and yellow, gives the blue printing plate, the green filter, yellow and blue, provides the red printing plate and the violet filter, which is red and blue, gives the yellow printing plate.

The spectrum ranges from red to orange, yellow, green, blue and violet. When the primary colours orange, green and violet combine with the complementary colours, red and yellow and blue, they combine to make all the colours of the spectrum.
Showing how the primary pigmentary colours (red, yellow, blue) combine to produce the secondary colours (orange, violet, green) and black.

The Principle of multi-colour letterpress rotary machines, used for fast printing in several colours. The paper can be fed in sheets or from the reel.
THE USE OF A LARGE COPYING CAMERA

When a wide range of duplicating equipment is used, the use of a large camera is invaluable. This apparatus enables intermediate masters to be created from all types of originals, and is particularly useful when these are required either enlarged or reduced. The type of camera normally used is known as a process camera, and is rather expensive. It includes screen gear for half-tone work, powerful arcs and other lamps, and methods for holding large drawings. The whole apparatus is suspended on springs to eliminate vibration, and fitted on rails which require considerable room space.

The use of this type of camera is not always essential, and many reproduction departments have done excellent work with simpler equipment, costing only the fraction of the cost of a process camera.

Cameras of the old-fashioned, square bellows type, which are now no longer used professionally, are obtainable very cheaply. This type is ideal for the purpose. The old lenses fitted to these cameras may not give the definition obtained by the use of a modern anastigmat lens, but if these are used at a small aperture they will give adequate sharpness over the whole of the film area.

To enable these cameras to be used with films of different sizes, a sticky material or liquid is available from film manufacturers which enables a glass plate, or other support, to be treated. The sticky substance will hold a film of any size quite flat, when this is pressed on to it. The ground glass of the camera should be marked to allow the different film sizes to be focussed within the required area, and the sticky support also marked to enable the films to be positioned correctly.

Special adaptor backs are also available, able to use film or plate holders of different sizes. To enable the camera to be moved at right angles to the copy, two strips of wood can be fixed on to a table to act as rails. These should carry a cradle, or support, on which the camera can be attached and can also be moved along the rails, to and from the object to be copied. Two lights of not less than 150 watts each can be placed near the copy. These can be suspended, or used in ordinary reflectors with stands. The correct position is shown in the accompanying sketch. If a line is drawn at 45 degrees from the centre of the board, the lights are placed just within this line nearest to the copy, giving an angle of between 30 and 40 degrees. This method is working on the well-established law of the "angle of incidence and reflexion". The distance from the copy board will depend on the size of the original being copied but, if the lights are kept in one position, it will help to estimate the correct exposure, as the light will always be a constant factor.

When moving the lights, it should be remembered that they work on the inverse square law method, and that if moved twice the distance, the film will require four times the exposure.

The copy board should be made of soft wood to enable drawing pins to be pushed into it, and so hold the copy. Linoleum or cork mats are also useful for this purpose.

Exposure can be estimated by the aid of a photo exposure meter, or by exposing a film with a series of varying exposures, and, after development, judging the one which is required. Exposure will always differ according to the type of copy, the degree of reduction, and the type of emulsion used. Any variations from the normal should be marked on a card and hung on the camera for easy reference.

The type of emulsion used for photocopying line subjects is known as photomechanical or process. These give extreme contrasts, that is, opaque, black and clear lines. They are used with special developers. All makers of films and plates issue booklets dealing with the materials for process or photomechanical work. These booklets should be obtained and studied to ensure success.

Continuous tone photographs require a fine grain emulsion, capable of producing the tones on the original photograph. When screens are used for copying photographs, then the process type of film is used to prepare the half-tone. A careful study of some elementary books on copying will readily indicate how to produce negatives suitable for either printing on photographic papers or directly on the offset litho plates.
VERTICAL CAMERA

PROCESS CAMERA
ARRANGEMENT FOR MAKING OCCASIONAL COPIES

OLD TYPE CAMERA ON WOODEN RAILS
THE USE OF ARTISTS

Where illustrations of high class quality are required the assistance of a trained artist or illustrator is essential. Artists accustomed to this type of work will produce illustrations of all types, either direct from the original article or from a photograph. The camera angle should show clearly what the text describes, so that the artist may illustrate the points described by the author.

A wide range of illustrating methods is available. Most of these are attractive when adequately reproduced, and enable variety to be added where numerous illustrations are required. The scraper board effect is particularly good and suitable for many types of work. The use of shading mediums and tints has previously been described. All experienced artists will be familiar with these methods.

For good quality half-tone work a photograph should be retouched. This requires some skill and experience. By the use of an aerograph machine, tones are sprayed on to the photograph to lower the tone range and make it more suitable for half-tone reproduction.

Where the amount of illustrative work does not justify the employment of an artist, occasional work may always be undertaken by the makers of machines or firms who specialize in this type of work.

TRAINING OF STAFF

It is desirable to give training instruction to staff, no matter how simple the machine to be used. The makers or representatives of most machines usually provide excellent training and instructional services, with capable and experienced staff. They are always willing to teach operators, and generally no better instruction is available.

Where new works are opened, it is desirable to have at least one person able to handle the machines and teach other staff how to use them. Where no training facilities are available and no instruction can be given, the booklets supplied by the makers of the machines and such other literature as is available should be carefully studied and applied until sufficient experience is gained to operate the apparatus and produce good results.

Many manufacturers give special books of instruction to their staff operators and sales representatives. Where difficulty is found in obtaining instruction, the makers are generally prepared to issue these more informative manuals.

STORAGE OF MATERIALS

Both chemicals and paper should be carefully stored. Paper used in duplicating and printing machines can give much trouble if it is stored in a damp atmosphere, or where frequent changes of temperature occur. When a large store with suitable temperature conditions is not available, it is helpful to have a small store, suitably heat controlled, where sufficient paper for the following day may be stored overnight. It should be remembered that most photographic papers can be fogged if left in a room with gas or other chemical fumes. Chemicals such as hypo and other sodas will cake or liquify if humidity and temperature are excessive.

Papers of the diazo type have short shelf life and will therefore not keep in good condition for more than a few months.

The makers will readily advise and assist in all these problems. All manufacturers of repute are anxious that their machines should give a satisfactory service, and that the materials they supply should produce the best quality results.

It is better to call upon their wide experience rather than to produce poor quality work, or to struggle by blind experimentation to find an answer to a problem they could so easily solve for you.
Collating

Collating may be described as the gathering of papers and placing them in their correct order or sequence. The requirement for this type of work and the methods used vary considerably, according to the amount of work it is necessary to collate.

The use of small duplicating machines always creates a major sorting problem, since the sheets are small in size and normally printed singly. When large machines are used, it is common practice to print many pages on one sheet and then fold by high speed automatic folding machines, bind and trim, thus reducing considerably the collating problem.

In its simplest form, collating consists of placing the copies in separate files on a table and collecting the top copy from each in correct sequence. Racks are in common use, some of which are portable and can be folded away when not required. The type having a number of separate divisions or "pigeon holes" enables the operator to be seated during the operation, and to collate at her own speed. The revolving table method is also in common use. This consists of a round table driven slowly by power, but is fitted with a device which enables the table to be stopped when required. The stacks of printed material are placed in sequence on the table and, as it slowly revolves, each person removes the top sheet from each pile. This method enables the operators to be seated, but may also slow down the collating speed to that of the slowest operator.

A number of smaller machines have been devised for use where the load is not great. These machines may be operated by hand, treadle or electrically. They vary in size, and in the capacity and number of feed trays they contain. The machines consist of vertical stacks of trays, each containing a rubber tipped arm which rests on a pile of papers in each tray and brings forward one sheet when the treadle, or other mechanism, is depressed. This enables a number of copies to be gathered simultaneously, since by pressing the foot 10 copies may be brought forward to the hand in correct sequence. The increase in speed given by these simple machines is considerable.

A machine of revolutionary design is available in the United States of America. It consists of a large wheel containing 50 pockets around its circumference. A stack of paper is housed on a platform, and as the wheel revolves one sheet is automatically fed into each pocket. This is repeated for each page. Sets of over 50 sheets will require additional runs, and the two piles must be brought together before stitching.

Binding machines designed for normal printing methods are generally too large for use with small, cheap, duplicating and printing machines; but some of the smaller binding machines can be used when the load is reasonably high. Conveyor systems are particularly suitable, and tests made with one machine have indicated that considerable time and money was saved by its use.

Manual methods are always slow and absorb considerable time. The work is monotonous, and mistakes are always costly and cause inconvenience.

Any method which reduces the human element and makes the task more reliable is worth consideration, particularly when such methods save time and reduce the cost.

Binding

The usual method in binding small books, leaflets and reports is by a stapler or wire stitcher. A wide range of these machines is available, from the simple, hand-operated type to very elaborate automatic machines which work at high speed and are able both to collate and wire-stitch.

The simple hand type of stapler does not stand up to the continuous wear usually necessary in a reproduction unit. Hand- or treadle-operated stitching machines working from a reel or wire are robust in build, and therefore are better suited for general work. Some hand machines are fitted with strong springs which drive the staple into the paper. These are reasonably satisfactory.
A few sheets may be stapled in the extreme left-hand corner, the purpose of the staple being merely to hold them in correct sequence. Booklets are frequently stapled on the left-hand edge, and where the number of sheets is limited this method is satisfactory. The general objection to this form of fastening is that it does not allow the book to lie flat when open. Spiral bindings, both wire and plastic, are more satisfactory for this purpose. Saddle stitching is a method of stapling, or stitching, down the centre of the book. This requires that the booklet is printed with four pages on a sheet, that is, two pages on both the back and the front of the sheet. These sheets are collated in their correct order, and are stitched by laying over an iron support like an inverted B. The staple, or stitch, is passed from the back and through the pages, and is secured in the centre of the book. The number of stitches would be in relation to the size of the book, the average being one near each end and an additional one in the centre for larger books.

The use of saddle stitching calls for a little consideration before printing. If a single sheet of paper is folded, it will provide four pages of printed matter. The inside of the sheet will contain pages 2 and 3, and the reverse side 1 and 4. If the sheet is again folded, the arrangement is more complicated, and a further fold also increases the difficulty. The second fold turns the sheet into an 8-page section, and the third results in a 16-page section. The sequence will of course vary, depending on how you make your folds and on whether you bend them to or away from you.

The illustrations indicate how this is done and, if you are in doubt, fold a piece of paper and mark it. You will also note that some pages are printed the reverse way to enable them to be correctly placed after folding and trimming.

Special machines are available for folding. Some of these are small and cheap, giving two or three folds. Those designed for big sheets are power-driven, and are much more expensive.

The use of folded sheets also necessitates a guillotine. These are also available to meet all requirements.

Hand stitching

The more elaborate and high class method of book-binding is done by hand stitching. For simple two-section books this is not difficult, and is quite effective. A single section should consist of not more than 20 pages, or five sheets folded to give four pages, including front and back. Each page is fitted into the other sheet to make a section, as indicated by the illustrations.

The leaves are held together by being stitched with thread in the centre of the pages. The booklet is open at the middle and a hole is then made with a needle, in the centre of the book. The centre of the space on either side of this mark is again holed, to create three holes dividing the book into four equal parts. A darning needle, fitted with strong thread, is passed from the inside through hole No. 1 leaving about three inches of thread. The needle is then returned to the inside via 2, and out again at 3, finally returned to the inside through hole No.1. Pull the thread tightly, and tie a double knot by holding "A" taut and passing the thread round and up, repeating by holding "B" taut. The booklet can be improved, and the stitches protected, by pasting a piece of strong paper on the outside to act as a cover and then trimming to size.

The method of sewing a two-section book is illustrated. It differs a little from the previous method, since there are now 16 holes. Each section is again marked as previously, but additional holes are made one-eighth of an inch on one side of each mark. One additional hole \( \frac{1}{2} '' \) from each end is also made. This then gives eight holes in each section, giving 16 in all.

Insert the threaded needle in at 1 and out at 2, in at 3 and so on, until it is finally brought out at 8. Pull the thread tightly, leaving three inches hanging loose at hole 1. The second section is then placed on top of the first, and is sewn together by passing the needle through 9 and out at 10. Now pass the needle beneath stitch 6 and 7 and then return at hole 11. This method creates a catch stitch which links the sections together. Repeat the catch stitch at 4 and 5, 3 and 2 and finally emerge at hole 16, pull the thread tightly together, and tie.
The multisection book may be sewn in a similar way to that previously described, but it is preferable to sew them with independent tapes or cords. The use of a sewing machine will enable tapes to be dispensed with, but for cloth-cased books it is better to use them.

To bind, assemble the sections in their correct order, position and mark on the back with a pencil, as previously explained. This allows three tapes which are sufficient for a book up to 10 inches in length. The tape used should be about 5/8ths of an inch wide, the length being the thickness of the book, plus two additional inches. The thread is passed through at No. 1, beginning from the outside, and is then brought back at No. 2 over the tape, placed in position and in at 3, repeating until it emerges at 8. Pull the thread tight, and continue with the second section, starting at the same end until the thread is passed through No. 1, pull the thread tight and tie to the part left on the first section. When taping section 3, a link stitch is made on to section 1 and 2, thus bringing them together. Both 3 and 4 are then treated as previously, and other sections in a similar manner. The edge of the book should be pasted and gummed, and the whole covered with a suitable material, using the loose ends of the tape to be attached to the cover board for security.
FOLDING PRINTED SHEETS TO FORM A BOOK.

FIRST FOLD

SECOND FOLD

THIRD FOLD
BOOK STITCHING
CONCLUSIONS

The purpose of this book has been to indicate the possibilities of some of the cheaper printing methods. It is somewhat difficult to explain in a simple manner subjects which are complicated in their nature. This could only be done if a whole book were devoted entirely to one subject and every part of the process fully illustrated and described in full detail.

As previously stated, this book is not intended as a manual, rather is it designed to lead the reader to such methods as may meet his special requirements, and thus enable him to make a fuller and more comprehensive study of these particular processes.

For those who desire to have a fuller description of the processes reviewed, together with the names of manufacturers of equipment in various countries, the recent publication "Manual on Document Reproduction and Selection", issued by F.I.D. The Hague, Holland, is recommended. This book contains such information and indicates where apparatus and materials may be obtained. These particulars can also be obtained from public libraries or photographic schools, particularly those of the Graphic Arts type. Information regarding machines known to be manufactured in a particular country can always be obtained from the Embassy or the Consul representing that country.

As mentioned in the Preface, the manufacturers issue literature giving the most suitable formulas for their products, and are willing to give advice and help on all aspects of the process or the machines they produce.

It is hoped that all who are anxious to use printing methods or to improve or extend their own equipment will find this brief outline of some value, and that it will serve a useful purpose in introducing such methods as may be most profitably applied.
Appendix 1

MISCELLANEOUS FORMULAS

Bleaching solution

(For removing the photographic image from a print after outlining the photograph with waterproof ink.)

Copper sulphate (cryst) 100 gms.
Common salt 100 gms.
Sulphuric or hydrochloric acid 25 cc.
Water 1,000 cc.

Bleach until only a faint image remains which will take 6 or 7 minutes. Remove the silver chloride residue in a 25% solution of plain hypo, after which there should be no trace of the original image.

Another useful method is to coat a good quality paper with a ferro-prussiate sensitizer such as:

(a) Ferric ammonium citric (green) 250 gms.
    Water to make 1,000 cc.
(b) Potassium ferricyanide 92 gms.
    Water to 1,000 cc.

Mix in equal parts - keep in the dark, filter before use - apply with a sponge or brush. Develop by soaking in water.

When the blue print is made by exposure to sunlight or arc lamp in contact with the negative the image should be outlined and then bleached in a 5% solution of sodium carbonate.

Other photographic reducers such as iodine cyanide or bleaching solutions can also be used. Some of these however may not entirely remove all appearances of the image.

Stay flat solution

For holding film flat in the camera

Gelatine 2 ozs.
Golden syrup 2 ozs.
Glycerol 2 ozs.
Chrome alum 15 grs.
Water to 32 ozs.

Retouching medium

(For applying to negatives to make them receptive to pencil work)

Dammar 1/2 oz.
Turpentine 2 ozs.
Xylol or Benzol 8 ozs.

To dissolve the dammar shake the container at intervals and filter.

Another formula is:

Pale gum resin 200 grs.
Gum dammar 90 "
Gum mastic 20 "
Oil of juniper 1 dram
Turpentine 3 ozs.

Add the powdered gum to the oil and apply with a clean cloth.
Opaque

(For spotting negatives)

Ferric oxide 60' parts
Calcium sulphate 14 "
Dextrin 5 "
Formalin 2 "
Wetting agent 2 "
Water 17 "

Ordoverex jelly

(For use on the Ordoverex Table)

Gelatine - No. 2 grade hard 1 lb. 2 ozs.
Ferrous sulphate (commercial) 4 ozs.
Ammonium oxalate 1 oz.
Oxgall powdered 2 ozs.

The gelatine should be soaked in water and allowed to absorb the maximum amount which it will take.

Time 2 to 3 days.

Special heating urns are required to dissolve the chemicals and gelatine.

Proprietary jelly is also available and this contains full instructions for its preparation.
## Appendix 2

### Reproduction Chart

For making one to 10,000 copies (excluding the typewriter)

#### Basic Reproduction Problems

<table>
<thead>
<tr>
<th>Reproduction Problem</th>
<th>Legend</th>
<th>Number of Copies</th>
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</thead>
<tbody>
<tr>
<td>A Reproduction of an opaque original document without half-tones (Facsimile)</td>
<td>P</td>
<td>5-10</td>
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<tr>
<td>B Reproduction of text without half-tones (Non-facsimile)</td>
<td>P</td>
<td>5-10</td>
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<tr>
<td>C Reproduction of an original containing text and half-tones</td>
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<td>5-10</td>
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<tr>
<td>D Reproduction of an original photograph (Continuous tone)</td>
<td>P</td>
<td>5-10</td>
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<tr>
<td>E Reproduction of line drawings</td>
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<td>5-10</td>
</tr>
<tr>
<td>F Enlarged or reduced reproduction of an original document</td>
<td>P</td>
<td>5-10</td>
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<tr>
<td>G Reproduction in two or more colours</td>
<td>P</td>
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<tr>
<td>H Durable image</td>
<td>P</td>
<td>5-10</td>
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<tr>
<td>I Reproduction of documents on translucent material</td>
<td>P</td>
<td>5-10</td>
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<tr>
<td>J Reproduction on paper with a writing surface</td>
<td>P</td>
<td>5-10</td>
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#### Reproduction Processes

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<td>P</td>
<td>IM</td>
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<tr>
<td>Silk Screen</td>
<td>P</td>
<td>P</td>
<td>P</td>
<td>P</td>
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<td>P</td>
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<tr>
<td>Oberwager</td>
<td>P</td>
<td>P</td>
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<td>P</td>
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<td>P</td>
<td>P</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
### Appendix 3

**A SUMMARY OF SOME COPYING PROCESSES SHOWING COST PER COPY 1-100 FROM ONE ORIGINAL**

<table>
<thead>
<tr>
<th>No. of copies from one original</th>
<th>Autopos and Diaz</th>
<th>Photostat</th>
<th>Reflex</th>
<th>Typed master</th>
<th>Duplicating stencil</th>
<th>Spirit process</th>
<th>Typing with carbon 1+0 to 1+5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>pence per copy</td>
<td>pence per copy</td>
<td>pence per copy</td>
<td>pence per copy</td>
<td>pence per copy</td>
<td>pence per copy</td>
<td>pence per copy</td>
</tr>
<tr>
<td>1</td>
<td>5.84</td>
<td>7.86</td>
<td>8.22</td>
<td>48.86</td>
<td>53.63</td>
<td>47.32</td>
<td>42.4</td>
</tr>
<tr>
<td>2</td>
<td>4.21</td>
<td>6.16</td>
<td>6.59</td>
<td>25.49</td>
<td>27.13</td>
<td>23.92</td>
<td>22.0</td>
</tr>
<tr>
<td>3</td>
<td>3.66</td>
<td>5.59</td>
<td>6.05</td>
<td>17.69</td>
<td>18.29</td>
<td>16.12</td>
<td>15.3</td>
</tr>
<tr>
<td>4</td>
<td>3.39</td>
<td>5.31</td>
<td>5.77</td>
<td>13.80</td>
<td>13.9</td>
<td>12.22</td>
<td>11.9</td>
</tr>
<tr>
<td>5</td>
<td>3.23</td>
<td>5.14</td>
<td>5.61</td>
<td>11.46</td>
<td>11.23</td>
<td>9.88</td>
<td>9.8</td>
</tr>
<tr>
<td>6</td>
<td>3.12</td>
<td>5.02</td>
<td>5.50</td>
<td>9.90</td>
<td>9.46</td>
<td>8.32</td>
<td>8.5</td>
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<tr>
<td>7</td>
<td>3.04</td>
<td>4.94</td>
<td>5.42</td>
<td>8.80</td>
<td>8.20</td>
<td>7.20</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>2.98</td>
<td>4.87</td>
<td>5.36</td>
<td>7.95</td>
<td>7.25</td>
<td>6.37</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>2.94</td>
<td>4.83</td>
<td>5.32</td>
<td>7.30</td>
<td>6.5</td>
<td>5.61</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>2.91</td>
<td>4.80</td>
<td>5.29</td>
<td>6.8</td>
<td>5.93</td>
<td>5.20</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>2.79</td>
<td>4.68</td>
<td>5.18</td>
<td>5.2</td>
<td>4.16</td>
<td>3.77</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>2.74</td>
<td>4.63</td>
<td>5.12</td>
<td>4.5</td>
<td>3.28</td>
<td>2.86</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>2.69</td>
<td>4.57</td>
<td>5.06</td>
<td>3.6</td>
<td>2.40</td>
<td>2.07</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>2.66</td>
<td>4.54</td>
<td>5.04</td>
<td>3.2</td>
<td>1.96</td>
<td>1.71</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>2.64</td>
<td>4.53</td>
<td>5.02</td>
<td>3.0</td>
<td>1.71</td>
<td>1.49</td>
<td></td>
</tr>
<tr>
<td>75</td>
<td>2.61</td>
<td>4.50</td>
<td>5.00</td>
<td>2.7</td>
<td>1.36</td>
<td>1.20</td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>2.60</td>
<td>4.49</td>
<td>4.99</td>
<td>2.6</td>
<td>1.19</td>
<td>1.05</td>
<td></td>
</tr>
</tbody>
</table>
# Appendix 4
## REPRODUCTION PROCESSES
### MAKING AND AMENDING THE MASTER

<table>
<thead>
<tr>
<th>PROCESS</th>
<th>TYPE OF MASTER</th>
<th>METHOD OF MAKING THE MASTER</th>
<th>AMENDING THE MASTER</th>
<th>CONSUMABLES</th>
<th>MACHINES AND EQUIPMENT REQUIRED</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. HECTOGRAPH</td>
<td>Hectograph carbon deposit on art paper.</td>
<td>Write, draw, type on art paper in contact with hectograph carbon or ribbon.</td>
<td>Use rubber or plastic eraser and rewrite or retypew Corrections can be pasted on to master.</td>
<td>Art paper, hectograph carbon (sheet, ribbon or prepared roll) proof paper, carbon or fabric ribbon.</td>
<td>Typewriter, writing and drawing accessories.</td>
</tr>
<tr>
<td>2. STENCIL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(A) Written or typed</td>
<td>Cellulose stencil.</td>
<td>Write, draw, type or use printers type face to cut stencil.</td>
<td>Apply correcting fluid and rewrite or retype.</td>
<td>Cellulose stencils, carbon for proof.</td>
<td>Typewriter, wheel pen, stylo and drawing accessories.</td>
</tr>
<tr>
<td>(B) Photographic</td>
<td>Sensitized stencil.</td>
<td>Expose sensitized stencil in contact with translucent original, develop and dry the exposed stencil, cut by electronic machine.</td>
<td>The original must be correct.</td>
<td>Sensitized stencils, chemicals for developing.</td>
<td>Exposing and developing unit.</td>
</tr>
<tr>
<td>3. OFFSET LITHO</td>
<td>Plastic plate.</td>
<td>Write, draw, type, use printers type face.</td>
<td>Use rubber eraser or special fluid and rewrite or retypew The original must be correct.</td>
<td>Plastic plates, litho ink, litho fluid.</td>
<td>Typewriter, writing and drawing accessories.</td>
</tr>
<tr>
<td>(A) Typed or written</td>
<td>Plastic plate.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(ii) Photographic</td>
<td>Sensitized plastic plate.</td>
<td>Prepare a negative (film or paper), expose negative in contact with plastic plate to tungsten light, develop, fix, harden, wash and dry plate.</td>
<td></td>
<td>Sensitized plastic plates, negative film or paper, chemicals for developing, fixing and hardening, litho fluid.</td>
<td>Reflex copier, developing, fixing and washing apparatus.</td>
</tr>
<tr>
<td>PROCESS</td>
<td>TYPE OF MASTER</td>
<td>METHOD OF MAKING THE MASTER</td>
<td>AMENDING THE MASTER</td>
<td>CONSUMABLES</td>
<td>MACHINES AND EQUIPMENT REQUIRED</td>
</tr>
<tr>
<td>---------</td>
<td>---------------</td>
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<td>---------------------</td>
<td>-------------</td>
<td>--------------------------------</td>
</tr>
<tr>
<td>3. OFFSET LITHOGRAPHY (cont'd) (B) Metal plates (i) Direct</td>
<td>Metal plate.</td>
<td>Write, draw, type, use printers type face.</td>
<td>Use rubber or glass eraser or spirit and rewrite or retype.</td>
<td>Metal plates, litho ink or ribbons, litho fluid.</td>
<td>Typewriter, writing and drawing accessories.</td>
</tr>
<tr>
<td>(ii) Stencil transfer</td>
<td>Metal plate.</td>
<td>Write, type, draw or use printers type face to cut stencil. Use flatbed duplicator to ink through the stencil to the plate.</td>
<td>Amend the stencil by using correcting fluid or amend the plate by using rubber or glass eraser or spirit, rewrite or retype.</td>
<td>Cellulose stencils, litho ink, proof paper, metal plates.</td>
<td>Typewriter, wheel pen, stylo and drawing accessories, flatbed duplicator.</td>
</tr>
<tr>
<td>(iii) Diapositive stencil</td>
<td>Metal plate.</td>
<td>Write, draw, type or use printers type face to cut diapositive stencil. Expose diapositive stencil in contact with sensitized metal plate to arc light.</td>
<td>Use correcting fluid to amend stencil, rewrite or retype.</td>
<td>Diapositive stencils, metal plates, sensitizing solution, developing ink, litho fluid.</td>
<td>Typewriter, wheel pen, stylo, reading box, whirler, air dryer, exposing unit, facilities for washing and drying the plates.</td>
</tr>
<tr>
<td>(iv) Film</td>
<td>Metal plate.</td>
<td>Photograph the original to produce a negative (film or paper). Retouch the negative, expose negative in contact with sensitized plate to arc light. Use developing ink, wash off unwanted emulsion, dry plate. <strong>NOTE:</strong> When deep etched plates are needed a film positive must be produced from the negative. The positive is exposed in contact.</td>
<td>The original must be correct.</td>
<td>Sensitized film or paper, developing chemicals, metal plates, sensitizing solution, developing ink, litho fluid.</td>
<td>Process camera (Half-tone screen), developing, fixing, washing and drying apparatus, proof-reading box for retouching, whirler, exposing unit, facilities for washing and drying the plates. Also acid.</td>
</tr>
<tr>
<td>4. RELIEF TYPE INCLUDING FREINET</td>
<td>Type face, half-tone or line blocks set up on a blanket segment or bed.</td>
<td>Compose type face, prepare half-tone or line blocks and assemble on blanket segment or bed.</td>
<td>Rearrange type face.</td>
<td>Half-tone or line blocks and wear on type face.</td>
<td>Type founts, composing forks, type-setter, blanket segments or type beds.</td>
</tr>
<tr>
<td>----------------------------------</td>
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<td>------------------------------------------------------------------</td>
</tr>
<tr>
<td>5. TRUE-TO-SCALE</td>
<td>Undeveloped blue (ferro prussian) print.</td>
<td>Expose original document in contact with ferro prussian paper in photoprinting machine.</td>
<td>The original must be correct.</td>
<td>Ferro prussian paper, carbons for photoprinting machine.</td>
<td>Photoprinting machine.</td>
</tr>
</tbody>
</table>
## Appendix 5
### CREATING THE COPIES

<table>
<thead>
<tr>
<th>PROCESS</th>
<th>MACHINES AVAILABLE</th>
<th>CONSUMABLES</th>
<th>TYPE OF SKILL REQUIRED</th>
<th>SPECIAL ANCILLARY EQUIPMENT</th>
<th>OTHER ANCILLARY EQUIPMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hectograph</td>
<td>Flatbed or rotary</td>
<td>Spirit, Hecto masters, Non-absorbent papers</td>
<td>Instructional</td>
<td>Unit for creating photographic stencils from existing masters</td>
<td>Stapling machine, Stitching machine, Punching machine, Drilling machine, Trimmers, Guillotine, Folding and binding machines, Collating machine or tables, These are necessary according to the type of work required.</td>
</tr>
<tr>
<td>Stencil</td>
<td>Flatbed or rotary</td>
<td>Stencils (typewritten or photographic), Ink, Semi-absorbent paper</td>
<td>Instructional</td>
<td>Plate-making unit</td>
<td></td>
</tr>
<tr>
<td>Offset</td>
<td>Rotary power driven hand, friction or suction feeds</td>
<td>Plates - metal or non-metal, Litho ink, Proprietary fluids, Sensitizing solution</td>
<td>Short training for normal work. More skill is required for half-tone and colour</td>
<td>Drying rack</td>
<td></td>
</tr>
<tr>
<td>Relief type</td>
<td>Hand or rotary</td>
<td>Founts of type, Ink, Paper</td>
<td>Instructional to short training according to the machine used</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ordoverex</td>
<td>Hand-operated various sizes</td>
<td>Gelatine composition, Litho ink, Ferro-prussiate paper</td>
<td>Training</td>
<td>Urns for heating and mixing the composition, Photocopier for exposing the ferro-prussiate paper</td>
<td></td>
</tr>
<tr>
<td>(T. T. S.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Silk screen</td>
<td>Hand or automatic</td>
<td>Ink, Stencils, Paper or other materials</td>
<td>Instructional for simple work, Short training for other classes of work</td>
<td>Silk screen</td>
<td>Drying racks</td>
</tr>
<tr>
<td>Oberwager</td>
<td>Hand-operated</td>
<td>Wax, Glue, Ink, Paper</td>
<td>Instructional</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
SOME INDICATION OF MACHINES AVAILABLE AND APPROXIMATE COSTS (1)

(a) A SPIRIT DUPLICATOR (capable of colour printing in 7 colours) hand-operated with maximum printing area of 9 x 13 inches using maximum paper size of 9 x 14 inches and having maximum output speed of 30 copies per minute is available to purchasers in the United Kingdom of Great Britain and Ireland for £39.

(b) A DUPLICATOR hand-operated with maximum printing area of 17 x 13 inches using maximum paper size of 17 x 14 inches and having a maximum output speed of 30 copies per minute, is available to purchasers in the United Kingdom of Great Britain and Ireland for £58.

(c) A DUPLICATOR hand-operated with maximum printing area of 17 x 29 inches using maximum paper size of 17 x 30 inches and having a maximum output speed of 30 copies per minute, is available to purchasers in the United Kingdom of Great Britain and Ireland for £62.

(d) A DUPLICATOR hand-operated and automatic feed, with maximum printing area of 17 x 29\(\frac{1}{2}\) inches using maximum paper size of 17 x 30 inches and having a maximum output speed of 45 copies per minute, is available to purchasers in the United Kingdom of Great Britain and Ireland for £134.

(e) A DUPLICATOR hand-operated with maximum printing area of 17 x 29\(\frac{1}{2}\) inches using maximum paper size of 17 x 30 inches and having a maximum output speed of 30 copies per minute, is available to purchasers in the United Kingdom of Great Britain and Ireland for £115.

(f) A DUPLICATOR electrically operated and automatic feed, with maximum printing area of 9 x 13\(\frac{1}{2}\) inches using maximum paper size of 9 x 14 inches and having a maximum output speed of 70 copies per minute, is available to purchasers in the United Kingdom of Great Britain and Ireland for £154.

(g) A DUPLICATOR, electrically operated with optional autofeed, with maximum printing area of 9 x 13\(\frac{1}{2}\) inches using maximum paper size of 9 x 14 inches and having a maximum output speed of 45 copies per minute, 70 copies per minute with autofeed, is available to purchasers in the United Kingdom of Great Britain and Ireland for £158, with autofeed £172.

(h) A DUPLICATOR, electrically operated with optional autofeed, with maximum printing area of 17 x 13\(\frac{1}{2}\) inches using maximum paper size of 17 x 14 inches and having a maximum output speed of 45 copies per minute, 70 copies per minute with autofeed, is available to purchasers in the United Kingdom of Great Britain and Ireland for £195, with autofeed £215.

(i) A DUPLICATOR, electrically operated and autofeed, with maximum printing area of 17 x 13\(\frac{1}{2}\) inches and having a maximum paper size of 17 x 14 inches and having a maximum output speed of 70 copies per minute, is available to purchasers in the United Kingdom of Great Britain and Ireland for £178.

(j) A DUPLICATOR stand machine, hand-operated with maximum printing area of 13 x 8 inches using maximum paper size of 14 x 9 inches to single post-card and having a maximum output speed of 85/90 copies per minute and is available to purchasers in the United Kingdom of Great Britain and Ireland for £90.

(1) As will be seen these examples are taken from one country only, the United Kingdom, merely as indications. Prices vary throughout the world and should be checked with reputable dealers or with consular offices.
(k) A DUPLICATOR stand machine with electric drive with maximum printing area of 13 x 8 inches using maximum paper size of 14 x 9 inches to single post-card and having a maximum output speed of 85/90 copies per minute. This machine is completely automatic and correct. Ink distribution without any pre-setting or adjustment. Usable first copy colour change in 25 seconds. Double-sided work without interleaving with blotters on normal duplicating paper. It is available to purchasers in the United Kingdom of Great Britain and Ireland for £135.

(l) A DUPLICATOR stand machine with automatic feed and electric drive with maximum printing area of 163/4 x 13 inches using maximum paper size of 18 x 14 inches and having a maximum output speed of 65 copies per minute. This machine is completely automatic and correct. Ink distribution without any pre-setting or adjustment. Usable first copy colour change in 25 seconds. Double-sided work without interleaving with blotters on normal duplicating paper. It is available to purchasers in the United Kingdom of Great Britain and Ireland for £185.

(m) A DUPLICATOR, portable (weighs 28lbs,) and hand-operated with maximum printing area of 13 x 8 inches using maximum paper size of 13 x 8 inches and having a maximum output speed of 85 copies per minute. Has automatic feed and inking. Available to purchasers in the United Kingdom of Great Britain and Ireland for £35.

(n) A ROTARY machine with maximum printing area of 8 x 121/2 inches using maximum paper size of 83/4 x 13 inches and having a maximum output speed of 5,000 copies per hour and is available to purchasers in the United Kingdom of Great Britain and Ireland for £395.

(o) A LETTERPRESS power-operated (treadle) machine with maximum printing area of 91/2 x 7 inches using maximum paper size of 101/2 x 15 inches and having a maximum output speed of 2,000 copies per hour, and a size of 30 x 30 x 30 inches when packed, is available to purchasers in the United Kingdom of Great Britain and Ireland for £92-10-0 (treadle) and £142-10-0 (power).

(p) A LETTERPRESS hand-operated machine with maximum printing area of 35/16 x 113/16 inches and no restriction on paper size and using a maximum output speed of 1,000 copies per hour, is available to purchasers in the United Kingdom of Great Britain and Ireland for £4-17-6.

(q) A LETTERPRESS hand-operated machine with maximum printing area of 53/4 x 31/8 inches and no restriction on paper size and using a maximum output speed of 1,000 copies per hour, and a size of 15 x 15 x 25 inches when packed, is available to purchasers in the United Kingdom of Great Britain and Ireland for £9-10-0.

(r) A LETTERPRESS hand-operated machine with maximum printing area of 81/2 x 51/2 inches and no restriction on paper size and having a maximum output speed of 1,000 copies per hour and a size of 30 x 24 x 22 inches when packed, is available to purchasers in the United Kingdom of Great Britain and Ireland for £24.

(s) A LETTERPRESS hand-operated machine with maximum printing area of 93/4 x 71/4 inches and using an absolute minimum paper size of 10 x 8 inches and a maximum output speed of 750 copies per hour, is available to purchasers in the United Kingdom of Great Britain and Ireland for £16-5-0.

(t) A LETTERPRESS hand platen machine with maximum printing area of 8 x 5 inches and no restriction on paper size and having a maximum output speed of 1,000 copies per hour and a size of 23 x 12 x 17 inches when packed, is available to purchasers in the United Kingdom of Great Britain and Ireland for £16-16-0.
(u) AN OFFSET LITHOGRAPHY machine with automatic friction feed, with maximum printing area of 13 x 8\(\frac{1}{4}\) inches and a maximum paper size of 13\(\frac{1}{2}\) x 9 inches and having a maximum output speed of 4,000 copies per hour. Has "Rotafount" automatic damping without damping rollers. Available to purchasers in the United Kingdom of Great Britain and Ireland for £445. (1)

(v) AN OFFSET LITHOGRAPHY machine with automatic suction feed, with maximum printing area of 9\(\frac{1}{2}\) x 13 inches and using a maximum paper size of 12\(\frac{1}{4}\) x 13\(\frac{1}{2}\) inches and having a maximum output speed of 5,200 copies per hour. Has "Rotafount" automatic damping without damping rollers. (Micro cylinder pressure adjusters £10, extra if required for card work.) Available to purchasers in the United Kingdom and Ireland for £985. (1)

(w) AN OFFSET LITHOGRAPHY machine with double-width printing and automatic suction feed, with maximum printing area of 17\(\frac{1}{4}\) x 13 inches and using a maximum paper size of 20 x 13\(\frac{1}{2}\) inches and having a maximum output speed of 5,200 copies per hour. Has "Rotafount" automatic damping without damping rollers. Micro cylinder pressure adjusters included within general structure of machine. Available to purchasers in the United Kingdom and Ireland for £1,595. (1)

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(1) Prices quoted include installation to suitable point and free training of operator.
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