TOPOGRAPHIC MAP DRAWING

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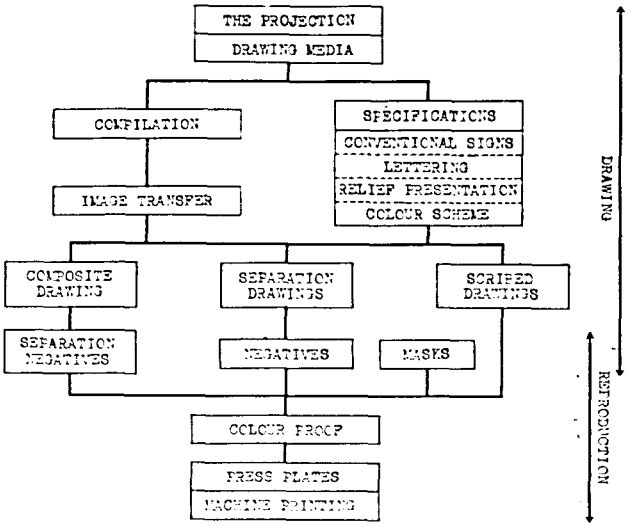
PREAMBLE:

The substance of this talk is confined to just a few of the links in the chain of activity that occurs in the revelation of a previously unknown terrain to mankind in the form of a published map. My brief suggests that it is to be "generally informative rather than technically detailed," and that it be confined to those map production processes that occur between presentation of the field sheets and the commencement of map reproduction. I have endeavoured to keep it so, but some encroachment both fore and aft has been inevitable. For the purpose of the lecture the term "topographic" is being interpreted in its broadest sense to include all maps essentially topographic in character irrespective of map scale or of the completeness or accuracy of the delineation, and inclusive of those often designated as general maps and wall maps. After all we are primarily concerned with map construction techniques and procedures, and these may be discussed more completely when untrammelled by the limitations imposed by technical definition. The general scheme of the discussion is as shown in diagram:—



THE PROJECTION:

A position, or a line, or a topographic pattern is determined on the ground, or with the aid of a photographic image of the ground. Survey is complete when the field measurements have been reduced to the surface of the accepted spheroid of reference. They are terrestrial and not map values. It is only when the terrestrial determination is to be delineated on to a mapping plane that a projection is born.

To map any field survey whatsoever presupposes the existence of a projection, a fact that may not be evident when the area to be mapped is of small extent and when geographical position is unimportant. In such cases the spheroidal surface involved is practically plane. However, with the extension of the mapped area, the disparity between nature and map becomes more and more pronounced, and the greater is the distortion that may be expected in converting the domed surface of the spheroid to the plane of the map, and hence the greater the need for deliberate projection to bring that distortion under control. For example, terrain of 100 miles radius only rises about one mile above the plane of its circumference. Terrain of 200 miles radius rises about five miles.

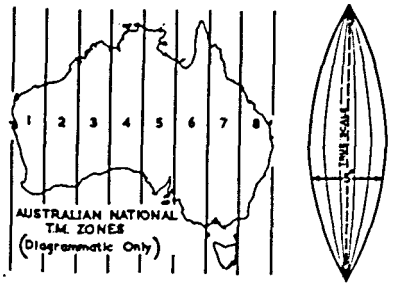


Fig. 2.

However, it must be remembered that this projection system, and its close relative the Universal Transverse Mercator Projection, have been prescribed for the mapping of terrain of rather limited extent. Let us keep it that way and not expect them to provide a cure for all our projection ills. Certain map series of smaller scale, such as the International Map of the World, are being constructed to prescribed and precomputed projection and sheet lines. However, in general, the small scale map is unique and demands a solution of the problem of projection peculiar to itself.

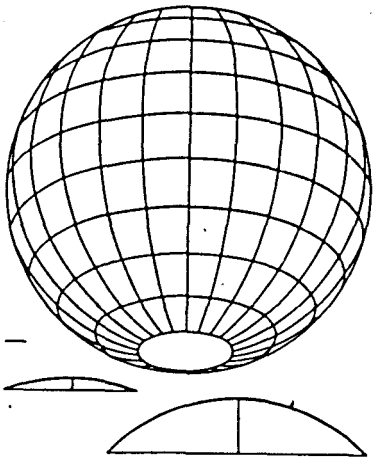


Fig. 1.

The mapping of Australia is developed from a spheroidal segment 180 miles high. When a hemisphere and beyond becomes the subject of the mapping, distortion becomes magnified even unto infinity.

When mapping at standard topographic scales on standard sheet lines, projection difficulties rarely arise. A satisfactory solution exists in the Australian National Transverse Mercator Projection. Grid coordinates for plotting the graticule, and other useful projection data are readily available to meet the most exacting requirements.

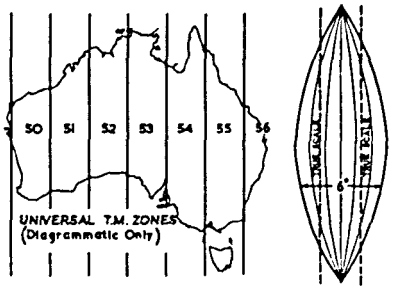


Fig. 3.

The geographic extent of the proposed mapping and the purpose for which it is to be drawn are considerations that are of prime significance in the choice of a projection, which is usually resolved in the sequence of general class, particular case and desirable modifications.

. Projections used in small scale maps produced by the Commonwealth in recent years include:

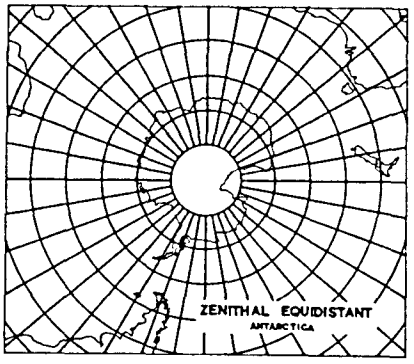


Fig. 4.

1. Northern Territory 1:2,000,000—Transverse Mercator with general scale factor.
2. Antarctica 1:10,000,000—Zenithal (Azimuthal) Equidistant.
3. Australia 1:6,000,000 — Zenithal Equidistant Minimum Error Projection.
4. Papua and New Guinea 1:2,534,400 — Simple Conic with restricted scale factor.
5. Australian Aeronautical Map—Mercator, Equatorial Scale 1:1,000.000.
6. World Aeronautical Chart 1:1,000,000—Lambert Conformal Conic, in zones.
7. International Map of the World, 1:1,000,000 — Lallemand, a Polyconic Projection with two standard meridians.
8. Western Pacific Regions 1:22,500,000²—an outline map on Sinusoidal (Equal Area) Projection.
9. The World (short wave wireless map)—Zenithal equidistant.

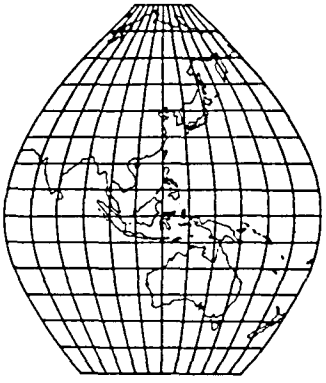


Fig. 5.

Western Pacific Regions Sinusoidal.

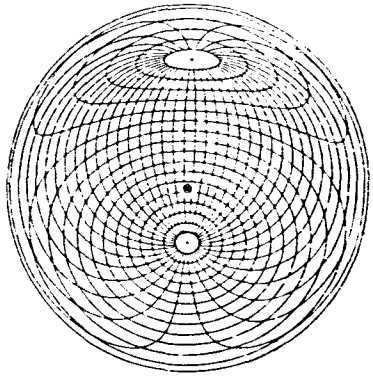


Fig. 6

The World: Zenithal and Equidistant.

The introduction of a scale factor into the computations having either general or limited application has the effect of minimising the magnitude of scale departure from true by reducing the greater at the expense of the less. Although it does not reduce the total range of scale change, it creates a better balance and generally strengthens the map structure.

The computation of rectangular plotting coordinates at the nominal scale of the mapping, and the drawing of the projection graticule are more or less routine operations. When the coordinates have been reduced to a common origin, the provision of a complete grid may facilitate their plotting. The coordinatograph is an instrument designed especially for the construction of a grid or of any other system of parallel and perpendicular straight lines, and for spotting single co-ordinate positions. It is accurate in construction and relatively speedy in operation and any mapping establishment that persists in the use of manual methods to the exclusion of such equipment is indeed prodigal of its manpower. In small scale mapping a grid rarely has any significance other than as an aid to facilitate graticule construction, and it is not usual to include it on the published map. At

such scales the graticule is the real framework to which the topography is tied, and a small scale map without a network of meridians and parallels is practically unknown. In large scale topographic mapping, on the other hand, there is an intimate and sustained association between the topography and the National Grid and it is usual for the grid to appear on the face of the map, or by marginal notation, in addition to the graticule.

The projection name should appear on any published map together with such other details peculiar to its construction as would enable the informed map user to better appreciate its inherent properties within the scope of the map and to evaluate and make allowance for its obvious distortions.

DRAWING MEDIA

The properties most sought after in a drafting medium are dimensional stability and affinity for ink. For compilation purposes transparency is equally desirable. Most drawing papers and cards will not retain size. They absorb moisture from the air and expand or contract with changes in the humidity content of the atmosphere. Again, change of size may not be uniform throughout the sheet, which further aggravates the disability. Hence this type of material is generally not favoured for mapping to current national standards, especially when colour registration problems are involved. This lack of stability may only be controlled and confined within tolerable limits with great difficulty. Sheets of the International Map of the World were drawn on bristol board in four sections. The 40 mile map of Australia was drawn in about 30 sections and stapled throughout at close intervals to defined graticule positions on a specially constructed copyboard for photography and subsequent publication in four sheets. Such a method may seem crude in the light of present day materials and facilities. It certainly demonstrates the difficulties that had to be surmounted by the cartographer of the not so distanct past.

The instability of the drawing papers has been practically eliminated in pagra boards and similar materials consisting of metal foil of various thicknesses sandwiched between and firmly adhering to two paper surfaces. Enamel coated metal sheets and foils are also used with considerable success. Papers have been surface sprayed before use with the same object in view. Tracing linen and tracing papers are sensitive in varying degrees to atmospheric changes. Linen is generally improved by waterproofing during manufacture, transparency being slightly reduced in the process.

A virtual revolution has taken place in drawing techniques during the past twenty-years with the introduction and development of drawing plastics. Those most useful to the map constructor should have a very low coefficient of heat expansion within the range of temperatures usually experienced in the drawing office, and be practically free from moisture absorption. The plastics are marketed under various trade names, astralon, astrafoil and vinylite being those most commonly used in Australia.

Transparent, translucent, and opaque materials are available with either polished or matte surfaces in various thicknesses and sizes. Probably the plastics are the most versatile of all drawing media. They have proved very successful as a compilation base, as a vehicle for masking for land and water tints and for the reception of photographic and lithographic emulsions, for fairdrawing manuscripts and overlays, for contact printing and colour proving, and as a base for scribing. Unfortunately, special inks are necessary and results are not always satisfactory or consistent and never as convenient to apply as is the old fashioned waterproof or mixed up ink to conventional drawing media. A pronounced weakness of certain plastics is a proneness to shatter upon impact, which in the opinion of the author, renders them unsuitable for permanent records. A polystyrene base drafting foil has recently been marketed which takes ordinary drawing inks, is pliable and transparent, and is claimed to be dimensionally stable. All the plastics distort with heat and contact printing may only be undertaken with equipment that does not transmit much heat during exposure.

COMPILATION:

The intricacy of map compilation is to a large extent proportional to the size of the area included in th mapping and to the intensity and nature of the "survey" by which it is known. In the construction of a map made from a single topographic ground survey executed especially for the purpose, or from a number of inter-related ground surveys, it is generally presumed that no compilation is involved

otherwise than in its adjustment into a projection. But nearly always secondary source material exists which must be investigated by the cartographer and which may leave its mark on the publication.

A map of considerable extent incorporates a wide variety of data derived from numerous unconnected individual surveys and sources widely separated in point of time, which must be related one to the others before fairdrawing can be attempted. Herein lies the essential distinction between a "surveyed" and a "compiled" map, the former usually being that of a small area at a large scale, and the latter of a large area at a small scale.

Considerable anomalies may be disclosed during the compilation process which must be resolved on the available evidence. "A map is only as good as its source material will permit" is a truism that applies to all mapping, but is of particular significance to the compiled map. Irrespective of the magnitude of the project, it is sound practice to maintain a job history wherein is recorded the source material investigated, anomalies encountered and their solution, and such other matters relevant to the compilation as may provide the answer to the future enquiry and information basic to any further mapping action.

The physical action of map compilation consists in fitting the source material into the graticule and to plotted control points. When the material is composed of larger scale topographic maps, little difficulty should be experienced in the process, though where conflicting data exists, its utilisation presents a problem for solution. When internal distortion is found to exist in the basic material, as for instance, when the geographic position of a feature is determined subsequent to its publication on the source material in which it is wrongly positioned, it is not possible to obtain an adequate fit by direct reduction, and it then becomes necessary to establish minor control within the mapping. One method is to cut in detail along lines joining control points and continuing the process until the base detail has been broken up into controllable sections. When direct reductions are possible they may be made by the camera, or by projection equipment varying in construction from the simplicity of the tracing table model to the massiveness of the Saltzman. The weakness of the projectors is that the reduction record disappears immediately the light is switched off. The veteran pantograph, which bore the brunt of this work in the early decades of the century, is fast losing favour, though it is still worthy of a place in the drawing office.

A degree of rectification is possible with the aid of suitable projection equipment. A major instance of this nature occurred in the early post war years in the conversion of the existing Mercator mapping of the Australian Aeronautical Map, with its parallel meridians, to Lambert Conformal mapping of a new World Aeronautical Chart, with its converging meridians. The drawings of the former series were photographed in sections on half plate glass to fit the Wild E.2. negative holder. The image of each negative was rectified in sections to fit prepared templates, then printed down on sensitized foil for reassembly onto completed graticules of the World Series to constitute its compilation. The enormous saving in time can be appreciated when it is realised that the projected mapping included the whole of Australia and Territories to the north at a scale of 1:1,000,000. Film positives of source material may also be assembled to a graticule base to serve as the compilation, which may be on glass for direct printing down of the image to the fairdrawing medium.

Major horizontal control points such as astronomical and trig. stations are usually shown on the basic mapping material, or can be positioned thereon in relation to the charted topographic detail from the control data, diagrams and photo identification. When they occur on a graticuled map, the graticule should be accepted as control until their plotted positions have been checked against current values and adjustments made accordingly. Similar action should be taken when an external origin of charted positions is quoted on the face of the map or chart. A graticule or grid presents scale control superior to that achieved by the scale in words or graphic scale.

The utilisation of source material calls for its prior evaluation as an authority for topographic definition, resulting in its complete or partial acceptance or rejection when authorities are in conflict. The age of the source mapping, its purpose, and the intimacy of its ground contact are factors of significance to the compiler. After the selection of material has been made, it is necessary to generalise the delineation. In substance, generalisation is the selection of important features, the preservation of their main characteristics, the simplification of their minute

irregularities, and the subordination or omission of features of lesser importance whose portrayal would otherwise tend to fog the predominant topographic picture. It is a deliberate process based upon the logical appreciation of the terrain and of the limitations of map scale.

The larger scale topographic map is an important aid to small scale mapping. The cadastral map also contains certain topographic features which constitute surveyed boundaries or lines and thus may be accepted as locally correct. Again the cadastral map is constructed by combining all the contained surveys on a systematic basis and hence the entire delineation should be substantially correct. Features removed from surveyed lines are assessed in the light of their remoteness. At the present time a considerable part of the country is covered by aerial photography. In closely settled areas the cadastal system is clearly visible on the photograph and hence it may provide ample intermediate control to the mapping. In remote areas the position is different. Fully controlled photogrammetric line compilations obviously present first class material for the small scale map. However, the stage is far distant when all available photography will be reduced to this form. Even as photo assemblies, the photography constitutes a good source of topographic detail though their value is reduced by any weakness in cohesion or control in the assembly, their use tempered by their inherent scale deficiencies, and their interpretation rarely achieved without close inspection of numerous stereoscopic pairs. The nautical chart holds pride of place for foreshore and ocean bed features. Its inland topography has usually been derived from secondary sources and, with the possible exception of navigational landmarks, is of little value to the compiler. Supplementary topographic detail and altitude data is frequently obtained from land research, geophysical, and geological surveys, from road, railway and boundary surveys, and from reconnaissance and trial surveys. In all cases the datum for altitudes should be determined and values adjusted accordingly, otherwise errors can be considerable. Settlements are usually graded on a population basis, the most recent censure figures being used for the purpose. The Post Office Guide is the authority for spelling in current use. Road Classifications are gleaned from official sources, motorists' associations and commercial organisations, hydrography from official authorities and textual data, and so on. A miscellaneous assortment of odds and ends completes the compiler's data pool.

The States and the Commowealth are the supreme authorities for the approval of names of features occurring within their respective areas and any nomenclature anomalies discovered during course of compilation are referred to the administering authority for solution. When mapping remote areas recently covered by aerial photography, considerable difficulty may arise in the identification of previously named features. The original positions were determined many years ago under extremely difficult conditions and it is small wonder that inaccuracies in positioning occur. Again strong suspicion exists that certain features have been duplicated under different names in slightly different positions as the result of being innocently rediscovered during subsequent exploration. Hence it is frequently necessary to refer back to the published diaries and reports of early explorers of the vast centre, to re-establish their route in the photographic landscape, and so identify the feature originally seen and named during such exploration.

A systematically executed base compilation covering the sphere of responsibility of a mapping authority provides an ever ready aid to speedy and economical map production. The subject area is divided into abutting sheets of convenient size such as those of the National Map Index of Australia. Compilation is affected at a scale sufficiently large to cater for anticipated future mapping requirements. Normally it is designed for drawing office use only and is produced on a routine basis. In course of time complete coverage will be achieved. Sheets of the series are maintained current by periodic charting to date or are held in readiness for immediate revision as required. Adequate records must be maintained on a continuing and systematic basis, new source material being listed as received. The advantages of such a system are obvious in the retention of past endeavour and hence in the prevention of duplication of compilation effort when time separated projects include overlapping areas, and in the minimising of the risk of omission of relevent mapping data from revised editions.

COMPILATION IMAGE:

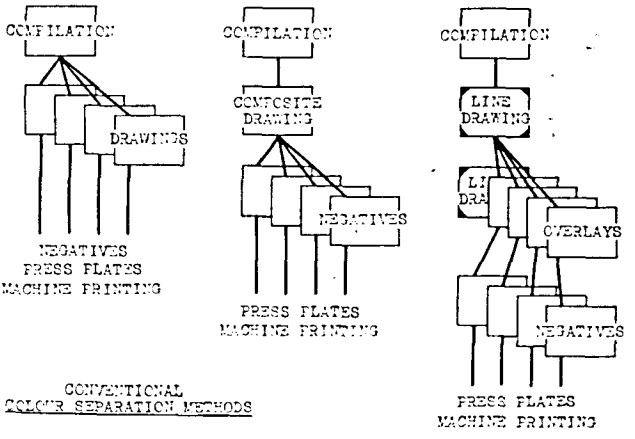
Fairdrawing commences with the plotting of the projection graticule on to the drawing medium, or its transference thereto. The one construction usually

serves for both compilation and drawing. In simple cases a direct manual trace may be justified but generally the need for the preservation of accuracy and for the conservation of effort calls for photomechanical means of achieving the desired result. When the master graticule is drawn on a dimensionally stable transparency, the facsimile copy may be obtained by direct printing down. When it is drawn on an opaque medium, the aid of the camera must be enlisted. The construction of the World Aeronautical Chart 1:1,000,000 illustrates the economy of the method. This mapping is divided into eleven latitude zones, each of four degrees, the sheets of each separate zone being identical in graticule, and each sheet having about 3,500 accurately spaced and measured graticule ticks. One master graticule sheet for each projection zone was drawn on enamelled metal, reduced photographically to drawing scale, and the desired number of facsimile copies (to a maximum requirement of 9 per zone) obtained by exposure through the negative to a light sensitive emulsion on the fairdrawing medium, the latent image being dyed black. Certain other common detail was included on the master prior to photography.

The method followed for the initial compilation of this series has been explained above. The transference of its image to the fair drawing medium was achieved in similar fashion to that of the graticule, the latent image being dyed non-photographic blue. There are other methods of obtaining the image but the basic principles in the printing down processes are essentially similar. Exposure through a negative provides an image composed of a dyed coating adhering to the surface of the fairdrawing medium, whilst exposure through a positive results in the dying of the material itself. The actual coating selected will depend upon the nature of the material about to receive the image. There are "negative to positive" and "positive to positive" plastic processes, as well as albumin, deep etch, ferroprussiate and lithographic printing. The image may be transferred to either side of transparent drawing media.

A stable transparency is usually favoured for compilation purposes because of the facility with which source material may be incorporated. It has the added advantage that when compilation is at same scale as fairdrawing, the image may be transferred by direct exposure. The inks used in the compilation in such cases should be opaque to prevent the transmission of light to the sensitive coating. Further, as exposure is through the transparency, the material should not be too thick otherwise undercutting of the work will occur with possible weakening of the image. It is more economical on occasions to manually transfer a compilation image in lieu of printing down. In such cases a thin material is necessary, otherwise the tracing point cannot describe an image of fine definition. Plastics are generally unsuitable for this purpose. Tracing paper may be used but special care must be taken to provide adequate local control to minimise distortion. When fairdrawing over a manually transferred compilation image, it is essential that the original compilation or its source material be under continuous inspection to ensure that inaccuracies in transferring the image be not perpetuated.

FAIRDRAWING:



CONVENTIONAL COLOUR SEPARATION METHODS

The fundamental fact underlying all map construction, whether it be by fairdrawing or by scribing, is that there must be a separate printing machine plate for each colour desired in the printing of the map, and provision must be made for this colour separation at some stage along the production line. The "line" colours are usually provided for, though not necessarily effected, at drawing stage, and the area tints in association with the reproduction processes.

A fairdrawing may be prepared as a composite manuscript wherein all line-work, including lettering, is delineated on the one sheet irrespective of the colour in which it will appear in the publication; or work which will be published in different colours may be drawn on separate sheets; or a combination of the two methods may be used. The selection of fairdrawing method is largely a matter of personal preference. Each has its relative advantages and disadvantages. Generally speaking, a composite drawing lends itself to a better presentation and is in a more suitable form for revision or for copying in one colour for any special purpose. On the other hand, considerable interference between colours is inevitable in the drawing necessitating corrective measures at subsequent stages. When the drawing can be made at reproduction scale, colour separation drawings on transparent media could speed up the reproduction by eliminating the camera. However, this solution is not as simple as it may sound for in exposing the respective drawings through the material to the machine plates, back to face, a degree of undercutting could occur to the detriment of the image. The correct procedure would be for the drawings to be prepared in reverse thus ensuring perfect contact during face to face printing.

A compilation image is necessary in all cases in order that the work of the respective colours may appear in correct relative positions on the drawings for reassembly in register in the printing machine. When colour separation at the drawing stage is proposed, one compilation key must be provided for each colour of line work proposed for the publication. The compilation master may be used as the common key when fairdrawing are on transparencies, provided adequate precautions are taken against displacement of the drawing medium and parallax of the image during the tracing operation.

Sometimes the "black" and "blue" work may be drawn on the one original, other colours being catered for on overlays. A partial breakdown of colours has been effected in the drawings of certain densely written wall maps by fairdrawing a composite linework base. Partial colour separation is then achieved by preparing separate name overlays on highly transparent material, one for each colour, for subsequent photography consecutively in register with the base. With name slips on paper to obscure the opposing line detail, very little colour separation remains for execution at the negative stage. Inks used on all drawings should be dense and preferably black. However, in the case of the composite drawing, distinctive coloured inks may be used to facilitate, by inspection, colour separation at the negative stage, but each ink must provide a good photographic image. Again, the mapping on a composite drawing may be colour separated in distinctive though not necessarily publication colours for filtering out during photography. However, this process is usually far from perfect, residual images remain which must be eliminated, and generally it is considered uneconomic.

SPECIFICATIONS:

Fairdrawing is always executed to conform to pre-determined specifications. Series of international coverage, such as the International Map of the World and the World Aeronautical Chart (I.C.A.O.), are initiated at especially convened conventions, and map standards and recommended practices promulgated for the guidance of all subscribing States and producing agencies. When domestic mapping is envisaged, it is necessary to prescribe line weights, lettering sizes and styles, conventional signs and publication colours. Such items are sometimes referred to as the map alphabet for they provide the key to the map reading.

The States and the Commonwealth have co-operated through the National Mapping Council in the design and dissemination of standard map symbols for use in topographic maps produced by their respective mapping authorities. When mapping at standard topographic scales in full colour, the prescribed symbols should be rigidly adhered to. For monochrome publication it may be necessary to depart from them in design in some instances in order to create a distinction that is otherwise conveyed by a colour difference. However, as a general rule it is desirable that the monochrome symbol conform in appearance as closely as is practicable to the national standard. In small scale mapping, the limitations of map

scale become prominent. The necessity for exaggeration in size, and for displacement in position of adjacent features, creates problems in presentation that may justify departure from standards designed for larger map scales. Again it may be desirable to depart from conventional colour schemes to create the emphasis desired by a client, but this would apply more to the special purpose map than to one produced for its topographic significance only. But whether a map be individual in character, or be one of a series, it is necessary to predesign specifications in detail so that the map treatment may be consistent throughout.

Lettering is graded in size to bestow relative prominence to the mapped features, and in style to facilitate the map reading. Hand lettering was the common vehicle of map notation of former days, and although high class penmen are still to be found, their numbers are rapidly dwindling, and the skills are being gradually lost through disuse. Hand lettering is more flexible in writing up the map than is its mechanical cousin. Its chief disadvantage lies in the difficulty of maintaining uniformity throughout a map series when a number of draftsmen are engaged upon the work. Recent innovations have undoubtedly improved output and existing trends may be expected to continue but never to the complete elimination of the skilled letterer.

Name pulls may be obtained from raised metal characters assembled in some form of letterpress printing or proving machine, or by photo composition. The latter is developed on sensitized paper or film. Letterpress type pulls may be made on any material that will hold the printing ink. When the names are to appear on a transparent drawing from which direct printing down is to be effected, it is obvious that the pulls must also be on a transparency such as stripping film, thin plastic, permofilm, simplex transfer paper, or the like. If the drawing is to be photographed, then white art pulls are favoured. Various adhesives are used to attach the name slips to the drawing medium and special precautions should be taken to ensure that any dislodgement will not pass undetected. Again, the stick-ons are vulnerable to damage by abrasion and should be protected in use and in storage. The stick-on operation is not as simple as it may seem. Considerable experience and skill is necessary in the arrangement, particularly in congested portions of the mapping. Akin to the type pulls is the area symbol (swamp, ruling, stipple, etc.) which may be provided by pre-printed pattern screens such as Tip-a-tone.

Whilst a compilation image takes care of the registration of the linework on the colour separated drawings, it does not assist to any marked extent in positioning the lettering. When the drawing medium is opaque, it is desirable to maintain a transparent key to the positioning of names to avoid the overprint. When the drawing medium is transparent, the drawings may be superimposed one upon the others when attaching the names. An excellent check to the delineation of the features on the respective fairdrawings is provided by the same method, which may render subsequent colour proving unnecessary.

When writing up a map that is drawn in sections for reproduction in one sheet, it is desirable that the joins be scolloped around names, otherwise in closely written areas a sleared straight track will be in evidence on the published map.

SCRIBING:

Negative Scribing is rapidly overtaking conventional drafting as a means of preparing colour separations. The process is not new. It was the method commonly used in pre-war years for incorporating line and lettering amendments to the reproduction negatives. However, the recent development of the technique which eliminates both conventional drafting and its photography is indeed revolutionary.

Scribing is the clearing of the map image from an actinically opaque background by means of special tools called gravers. In effect it creates an impression similar in appearance and purpose to a photographic negative. A stable plastic or glass is used as the base for the scribe coating. Sheets are usually purchased pre-coated.

As the photolithographic process requires one machine plate for each colour desired in the published map, there must be one scribed negative for each of the line colours. Area tints are provided for by masking. It is desirable to preprint the guide image of the compilation to each sheet of scribing medium in the set. Scribing is performed at reproduction scale so that the map image may be transferred direct to the machine plates, or to other sensitized medium, by the transmission of light through the transparent scribed lines by normal photomechanical process. Unless the base material is very thin, it will be necessary for the scribed image to be in reverse, as it is on a photographic negative, so that

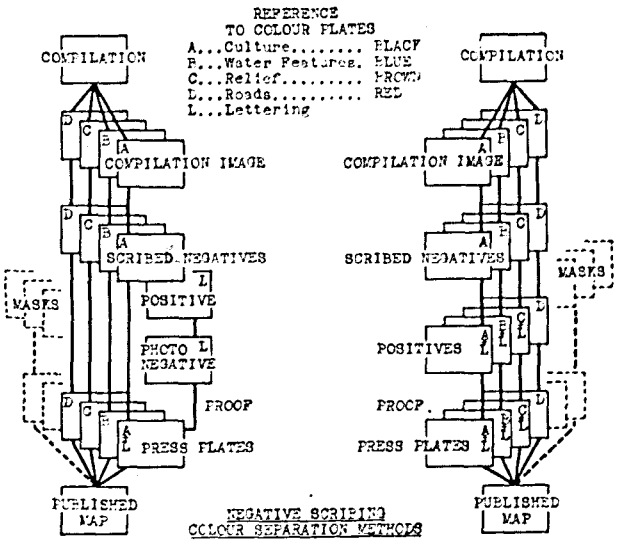


Fig. 6.

the subsequent printing down may be effected face to face to preserve perfect contact and to provide the correct reading image on the offset press plate. When exposure is made with the thickness of the material separating the scribed image from the sensitized surface of the plate, the light is diffused and the plate impression becomes thickened and blurred. The thicker the material, the greater the defect.

A variety of gravers and templates have been designed and a number of different coatings provided to facilitate the scribing process. The inclusion of names presents some difficulty. They may be applied in negative patches directly to the scribed sheet. Alternatively, name slips may be assembled on a separate transparent overlay to the respective feature sheet and printed down to the press plate in combination with it. Again the scribed negatives may be converted to positives by dyeing the image and removing the background, and may then be written up manually, or by transparent stick-ons, and finally printed down to the machine plates by positive processes. With a view to minimising the disabilities associated with writing up the scribed map, the practice of publishing all names in black is steadily growing, to the displacement of the more conventional method of showing feature and its name in the same colour.

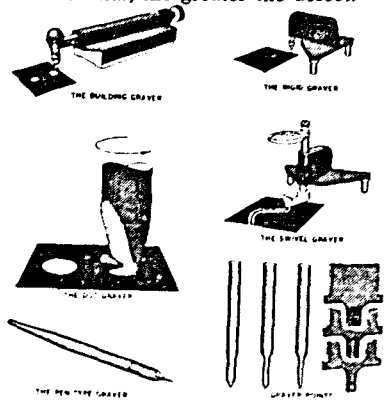


Fig. 7.

Advantages claimed for the scribing process over ink drafting include the elimination of the camera, greater speed in production, improved quality of line, shorter training period, and a greater adaptability to the exploitation of production techniques.

RELIEF:

Wherever possible, relief is shown by contours. When contours are not available but sufficient ruling heights exist and there is an adequate knowledge of the terrain, approximate contours may be designed. Layer tints may be used to emphasise the changes in elevation conveyed by the contour lines, the tones becoming darker with increase in altitude. For aeronautical mapping, critical intermediate prominences are shown by spot heights as a guide to safe flying height. The layer colour is the product of the printing press, but the means for its delineation within the mapping originates with the cartographer.

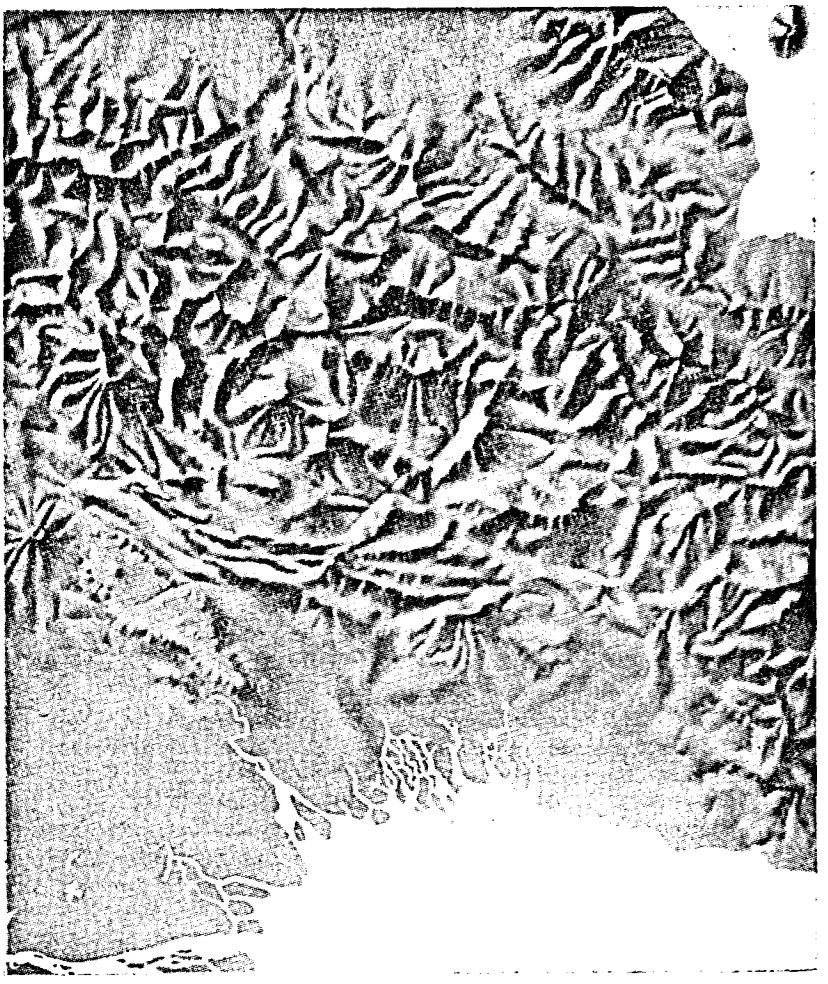
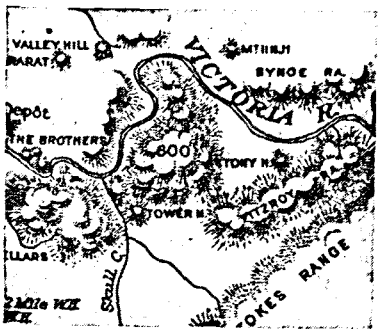


Fig. 8.—*Relief Shading.*

In small scale mapping considerable simplification occurs in the definition of the contour line which renders it less valuable to the used in the interpretation of relief. The land form of the small scale map may be better depicted by relief shading as executed by the air brush. The generalised relief model, as distinct from absolute elevation, is depicted by highlight and shadow effects. Hill shading and contours convey complementary information to the map user and they may be combined with advantage in the one map. On the other hand, gradient tints detract from the shading effects and may totally obscure them in the higher altitudes. The use of shading on large scale closely contoured mapping seems to be an unnecessary refinement. However when there is a wider contour interval. it could be of value in depicting the otherwise unapparent auxiliary feature. The Division of National Mapping is including both half tone relief shading and contours in new four mile monochrome mapping of the Northern Territory. On medium and large scale mapping, the shading is designed after inspection of photomaps of stereoscopic pairs in critical areas. In cases where photos do not exist, and in small scale mapping, the operator relies for his interpretation upon the drainage pattern and indications of relief evident in the source material, upon the reports of field offices, and so on. Unfortunately the tonal range of the airbrush picture

is reduced in its half tone reproduction, and extra colour plates are sometimes used to re-establish contrast.



Hachuring is still used, though with less frequency than formerly. Generally it does little more than define the watershed or the hill feature without any deliberate pretence at quantitative assessment of local prominence or of uniformity of treatment with other similar mapped features.

Fig. 9.

COLOUR:

The colour scheme for topographic mapping has been largely standardised by common usage, and recommended by the National Mapping Council for adoption by associated authorities as follows:

BLACK	Culture	RED	Road infills
BLUE	Water features	LIGHT BLUE	Water surfaces
BROWN	Contours, relief	BUFFS	Land tints
GREEN	Vegetation		

In special purpose mapping, the colour scheme is especially devised to give emphasis and distinction to the aspects illustrated. In certain cases the topography may have location colour. However, every sheet of a map series should be identical in colour schemes and in general map treatment. A major instance of colour selection to meet particular user needs occurred during the war years, when the conventional scheme hitherto used on aeronautical charts was radically altered to provide improved legibility under changed conditions of cockpit lighting.

SEPARATION NEGATIVES:

It has been mentioned that colour separation may be effected at fairdrawing or scribing stages. When the manuscripts are wholly or partly drawn in composite, the work is finally broken up into the separate publication colours on the negatives. The completed drawing is photographed to the desired scale and one negative obtained for each of the "line" colours (as distinct from area tints) required. At this stage, all the negatives will be identical. One negative will be reserved for the black work, one for the blue work, and so on. On the former, all work for publication in colours other than black will be obscured by painting it over with opaque—and so on for each of the other colours. The work remaining on the respective negatives is reunited in publication colours in the printing press. New work may be added to the negatives by scribing or stripping in. No doubt these aspects will be dealt with in detail during the forthcoming lecture on Map Reproduction, but are mentioned here merely to complete the draftsman participation story.

Area tints, such as water surfaces and altitude layers are obtained during machine printing by the use of stipples, rulings and solids printed singly or in combination in self or overlaying colours. Each area is defined on the printing plate by means of a mask which is usually prepared by the draftsman. It consists of a transparent area or areas within a hand painted opaque surround, one mask being required for each pattern desired. It may be prepared on dimensionally stable clear plastic, which is held in close contact with the appropriate negative (or positive) image during the opaquing process, or upon which the key image has been pre-printed in non-photographic blue. Sometimes an extra negative is used for the purpose (one for each mask required), the "window" being obtained by cleaning off the emulsion after opaquing the surrounding area. Recently developed strip mask emulsions facilitate the process. The printing image is obtained by placing a film negative of the desired pattern between mask and press plate during the printing down process. Solids are obtained by exposure direct

through mask to plate. A similar result may be obtained by creating the "window" on the sensitized press plate by gumming over the unwanted portion, after which the desired pattern is transferred from a master plate or is printed down by photo-mechanical means. Solids are hand lithographed. This lithographic drafting method was more common in former years than it is now. A coloured key to the areas for masking is usually prepared for the guidance of the draftsman. A print from the drawings (or negatives) is obtained and the areas affected tinted in strongly contrasting colours. This greatly facilitates the mask preparation and considerably reduces the danger of following incorrect outlines and of missing small isolations.

A colour proof is usually desirable, and sometimes necessary for final examination and subsequent amendment of reproduction material, and with this is completed the story of the drawing of the topographic map.
