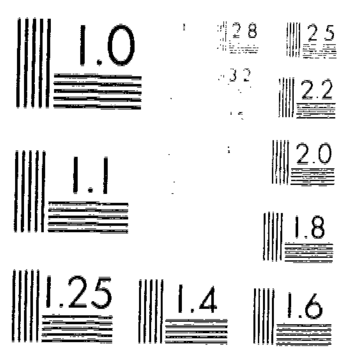
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ABSTRACT

This booklet is designed to assist teachers in their use of overhead projectors when teaching geography. With the overhead technique, relationships among patterns can be suggested bit by bit on inexpensive, easily prepared overlays that are projected to sizes appropriate for a particular instructional situation. A general discussion of the features of overhead methodology includes the anatomy of the overhead projector, overhead transparencies, and techniques of overhead presentation. The preparation of overhead transparencies is described, using original drawings, one-to-one copies, and photographs. The use of slides is also described. An overhead projector has many roles, such as replacement for other types of projectors, chalkboard substitute, substitute for wall maps and charts, superimposition, and dual screen. Teachers can experiment or use the 17 transparency masters that conclude the booklet. Guidelines are included for using the masters, which represent simple and complex progressive disclosure, simple additive-subtractive cells, production techniques, and reproduction techniques. (ND)

DO IT • This Way

7

GEOGRAPHY VIA THE OVERHEAD PROJECTOR

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NATIONAL COUNCIL FOR GEOGRAPHIC EDUCATION

GEOGRAPHY
VIA THE
OVERHEAD PROJECTOR

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PREFACE

Geography Via The Overhead Projector was planned and written by Dr. Thomas D. Best to assist teachers in their use of this medium in their teaching of geography. A unique feature of the publication is the inclusion of 17 masters with which teachers can experiment on their own.

Appreciation is expressed to Dr. Best by the Publications Committee of the National Council for Geographic Education for writing *Geography Via The Overhead Projector* and preparing the master cells to illustrate the opportunities available to teachers of geography.

KERMIT M. LAIDIG
Director of Publications

NATIONAL COUNCIL FOR GEOGRAPHIC EDUCATION

Founded in 1915, "to promote geographic education and research and to secure cooperation between the various fields of geography in the public schools and colleges," the National Council for Geographic Education has grown into an organization of teachers of geography with members in every state in the United States and in many foreign countries. The distinguished editors of the National Council for Geographic Education have developed *The Journal of Geography* into the leading publication in the nation for geography teachers. The annual meetings, usually held in the autumn, bring together teachers of geography in the elementary, junior high, and high schools and in the colleges and universities from all regions of the continent in a stimulating and pleasant fellowship. The programs provided at these meetings, together with the articles published in *The Journal of Geography*, furnish an excellent cross-section of scholarship in geography. Membership in the National Council for Geographic Education is available to all whose field of interest is geography.

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INTRODUCTION

One of the most promising equipment items to enter the geography classroom in recent years is the overhead projector. This device is capable of creating a large screen image from a transparency that remains accessible during projection from a normal teaching position in the classroom. These characteristics not only allow direction of attention with an ease atypical of traditional projection devices, but more importantly permit on-the-spot addition or subtraction of image elements. From the geographer's viewpoint, this latter feature is the real clue to the overhead's usefulness. Heretofore, distributional information has been crammed onto comprehensive polysymbolic maps or fragmented into several discrete sheets. With the overhead technique, relationships among patterns can be suggested bit by bit on inexpensive, easily-prepared overlays that can be projected to sizes appropriate for a particular instructional situation. Moreover, any type of transparent image (short, of course, of motion picture film on the move) can be accommodated by the machine. The overhead projector may not relegate conventional equipment or techniques to immediate obsolescence, but it could well become the key visual integrating element in feasible multimedia instruction.

At this point in time, overhead technology is neither brand new nor fully integrated into instructional media practice in geography. This booklet is designed, therefore, to provide a brief introduction to the family of overhead projectors, to outline their uses, and to identify applications in which they may be most-useful instructional devices for communicating geographic facts, principles, and concepts.

Emphasis will be placed primarily on the medium and secondarily on the discipline. This orientation has been fostered by the wealth of groundwork in geographic visual interpretation already provided by Phelps, Halverson, and Rich and Young in booklets in this series. Old standards by Anderzohn, Lobeck, Raisz, Robinson, and Thralls also contain much information in the same field. Their works have provided valuable insight into the fundamental characteristics of visual materials in geographic use; the overhead projector merely provides a new and highly efficient means for effecting their suggestions.

In order to facilitate appreciation of the overhead's versatility, one distinctive feature has been incorporated into this booklet. Master drawings suitable for preparing at least five overhead slides have been reproduced in lieu of graphic material that otherwise might merely have illustrated the text. For those unversed in the ways of the overhead, the techniques needed to execute the materials will prove indicative of the medium in general: for those familiar with the techniques, the topical aspects of the slides may be of interest. This endeavor stems in large part from the often-expressed desire of in-service teachers for "something they can use." Although the net contribution to that cause may not be overly great, it may repay in part the author's debt to those who have provided much-needed encouragement when his own presentations drifted from pure content toward methodologic matters in moments of abject frustration with the "system" of traditional instruction.

Although all blame for inferior outcomes of the project must rest on my shoulders, substantial support has been provided by associates at California State College at Los Angeles. Dr. Adam Diehl and members of his Audio-Visual Services crews have helped up-date our instructional performances in both philosophic and technological matters. Their equipment was always available until the Department of Geography became essentially self-sustaining in media matters. Our hope is that some of the many students in teacher-preparation courses may become intrigued with the "hardware" as well as the content and, perhaps, emerge as hybrids who are as much at ease with instructional technology as they are with subject concepts. Mrs. Sonia Seeman, former graduate student in geography at CSCLA, seems to be in this category; the original maps that appear in this booklet were prepared by her, and, although some of my less obvious oversights may have slipped by her, she has shortstopped several potentially substantial blunders during the preparation of these materials.

GENERAL FEATURES OF OVERHEAD METHODOLOGY

In most devices designed to project an enlarged image onto a viewing screen, transparent slides or similar image-carrying films are placed between a light source and a lens; despite its distinctiveness, the overhead projector uses this old principle. The *opaque* projector, which an overhead machine resembles superficially, differs markedly in that light is reflected through its lens from the surface of an opaque image. Because of the significant design variations among overhead projectors, prospective purchasers may need to evaluate equipment in terms of their own requirements. A brief description of equipment, with attention to some specific design details of concern to the classroom teacher, seems in order before instructional possibilities are investigated.

THE ANATOMY OF THE OVERHEAD PROJECTOR

The contemporary overhead projector is not an attractive machine. Its projection lens is cantilevered above an illuminated stage. The stage, generally ten inches square, lies horizontally, as does the axis of the lens. A precision mirror near the lens accomplishes the dual task of bending the light toward a vertically- or obliquely-arranged screen and reversing the image so that it appears correctly oriented to both the viewers of the screen and the user of the projector. The user can therefore face his audience while projecting and working on the slide in place on the stage (Figure 1). Aside from the post supporting the lens-mirror assembly, the operator finds nothing between him and the image of his slide material. The greatest operational freedom is provided by machines on which the support post is positioned beyond one corner of the stage rather than in the center of the rear section of the stage. Although slides must be changed manually at this state of the art, they are large enough to be handled easily by the lecturer himself with the projector at or near the customary lectern position. A typical machine will produce an image about six feet square with a projection throw of about ten feet.

High-intensity illumination is delivered to the stage by one of three basic optical systems. Larger, more expensive, and generally more effective machines use a precision mirror to direct light from a high-wattage conventional lamp. Less expensive, more-portable, and sometimes less-effective machines depend on a lighthouse-like, concentric-ringed Fresnel lens below the stage to distribute and aim light from a conventional lamp or from a modern quartz-iodide tube. The glare of this surface-illuminated system may obscure the operator's view of his

transparency on the stage, and Fresnel lines ma}
screen. A recent clean-cut entry into the field fe
opaque-projector-like illuminating system; a bri
overhead lens housing is focussed on a precisi
tance stage on which the slides are placed. Alth

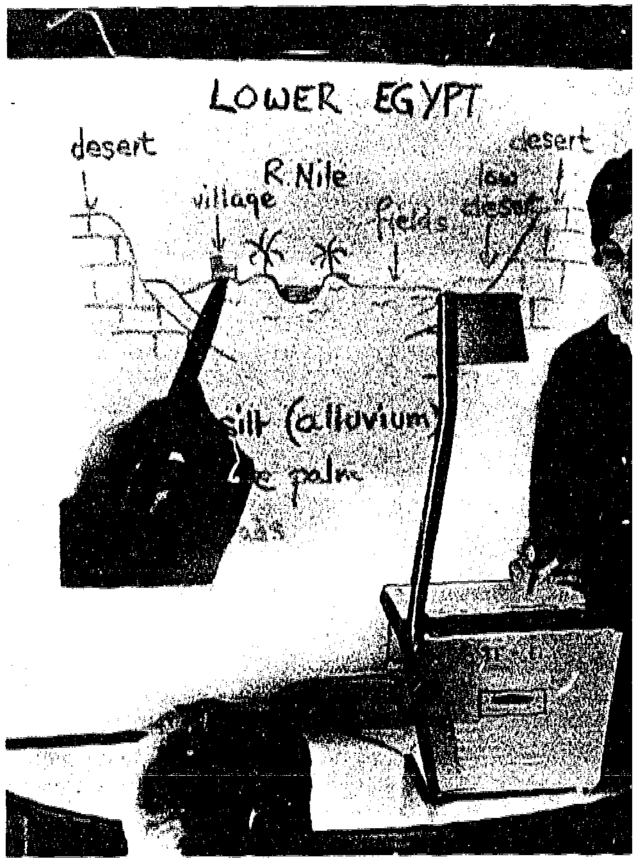

Figure 1. The Overhead Projector in Use in a Fourth (I.S.U. Photo Service).

system is entirely adequate for simple transparen
prime attributes of overhead methodology is los
tiple overlays and full-color slides will not proje

Operating controls of the machines are simp
heat is high, a dual lamp-blower switch replaces
control. On higher-quality machines, microswitc
porated to handle light-switching automaticall}
inserted or removed. Considerable improvement

cumstances results from darkening the screen between slides, but awkwardly-placed manual switches tend to discourage the procedure. Focussing is accomplished by moving the projection lens via systems ranging from crude friction to precise rack-and-gear devices. Although resharpening the screen image is no more necessary with the overhead than with conventional projectors, fuzzy images moving in and out of focus are extremely distracting and some overhead projectors provide unduly unsmooth adjustments. Aiming of the image is undertaken by tilting the entire projection head, the mirror portion of it, or in rare instances by repositioning legs on the base of the machine. The latter method is, as might be expected, optically more perfect but operationally more awkward.

Contemporary machines range in size from hat-box-sized, folding, portable models to squarish devices larger than several breadboxes. Even the larger projectors, however, are light enough to be within the lifting range of frail elementary teachers. Although they usually appear as separate items on the inventory, overhead projectors are available as integral portions of lecture desks. In this latter case, some image quality and operational ease may be exchanged for assured availability and reduced set-up time. Conventional machines range in price from about $150 to almost quadruple that amount. They are not discount-house items, although occasionally camera stores in larger metropolitan areas offer used machines.

OVERHEAD TRANSPARENCIES

Slides for the overhead projector resemble king-size editions of the conventional cardboard-mounted 35-mm. color transparencies. The current standard overhead transparency is based on a 7½-by-9½-inch horizontal format; a few current machines will not accept this frame size in a vertical orientation. Although rigid or flat-lying materials may not require mounting, cardboard frames are usually used to provide added rigidity and ease of storage, as well as to offer the necessary space for hinging overlays. In general, these mounts fit standard letter-size filing cabinet drawers, but a few brands are too high for these logical storage spaces. Home-made mounts can be designed to appropriate outside and inside frame dimensions. A few types of plastic frames have appeared on the market, but storage problems may be compounded with some of the more massive of these items. Some commercial transparencies are fashioned of laminated plastic, but glass or similar abrasion-resistant forms are not yet common. Although they are no more fragile than conventional slides, overhead transparencies may deteriorate rapidly because of their exposed position in use and the minimal protection offered by the mounts. Sheathing of new transparencies in renewable clear plastic sheeting should be well worth the time and expense inasmuch as the inexpensive material will bear the brunt of use on *both* sides of the slide.

Without the large stage size, the unusual configuration of the overhead projector would be of little avail. Although a lecturer may point directly at key features of a 35-mm. slide on a miniaturized overhead machine, preparation of dynamic overlays for that scale may be difficult and even simple static transparencies probably will require a photographic step not imperative with the page-sized overhead format. Drawing and reproduction at 1:1 allows reasonable registration of image elements without elaborate equipment. Moreover, the limited enlargement that occurs during projection (roughly one-sixth that needed for a 35-mm. frame) definitely favors the overhead machine in terms of quality of the resulting screen image.

References to "dynamic transparencies" for use in "brightly-lighted rooms" may have created some misconceptions about overhead slides. Overhead transparencies of line drawings look very much like slides of similar subjects in other sizes; the parallel persists throughout the range of content types. In many instances the effective level of screen illumination produced by an overhead projector is not markedly higher than that produced by other still transparency projectors working to the same screen-image size, so room-illumination circumstances must be similar if screen images from the machines are to appear similarly bright.

Although the individual "cells" used for progressive image development on the overhead machine resemble those used by cinema animators, no comparable illusion of motion is associated with the overhead slides. Some simulated action is possible with polarization techniques, but the general dynamism of the overhead slide occurs as elements of the image are manipulated on a base frame without the need for cycling to another individual slide. Obviously, the motion-picture film can portray the same general level of dynamism as can the overhead slide, but its progressive change is difficult to still for explanation of a process. Moreover, even rather simple pointing or flow-tracing motions must be planned and executed as the film is made or otherwise be carried out in the beam of the projector in competition with the moving images.

TECHNIQUES OF OVERHEAD PRESENTATION

Regardless of the role of the overhead as a visual adjunct to presentation of geographic information, several distinctive techniques are particularly appropriate with the machine. Although every overhead presentation permits direction of attention to portions of the screen image by direct indication by the lecturer on the slide in place on the machine, slides tend to be classifiable into three types. Some are fundamentally static in nature throughout their use. Dynamic types are capable of providing a changing image either by addition or subtraction of image elements.

Static Transparencies: Fact or Fancy?

Even though the slide itself changes no more than the resurgent "lantern slide" or the 35-mm. transparency, the accessibility of the overhead slide tends to foster changed screen images. The minor gymnastics often required merely to point out details on a conventional image (illuminated pointers notwithstanding) are completely unnecessary with overhead slides. In contrast to the inconvenience of built-in pointers on opaque projectors, with which the operator's only indication of success or failure is the screen image itself, convenient pointing at appropriate portions of the overhead slide is routine procedure. The former is groping and covert; the latter is deliberate and overt. A well-sharpened, flat-sided pencil can be positioned rapidly and precisely on the overhead slide as either a pointer or an underlining device. A colored transparent instrument will do the same duty, of course, without completely obscuring other portions of the image. If appropriate, several color-coded pointers can be left in place during projection.

Symbols and strips of place names, dates, and other features are addable items of immediately apparent use to geography instructors. A single base map can be used to reinforce association of information with place as represented on that base. Conversely, add-ons whose symbols and nomenclature become familiar in one configuration can be used with unfamiliar projections to suggest differing visual arrays without complete loss of identification with earlier work. One quite obvious application of this use of "static" transparencies might be to show the apparent changes in relative position of major cities when plotted on cylindrical and azimuthal grids. Commercially-prepared sheets of key geographical nomenclature could be of considerable aid in this approach.

Purists or skeptics may wish to suggest that the use of add-on external gadgetry or writing emphasis material on clear film at the time of presentation really represents the use of a dynamic transparency. Actually, however, these are merely fundamental techniques usable with the overhead alone among the projection devices. Certainly, semantics should not be allowed to detract from the process principles. Simple, readily-executed devices can in fact be used with a static base slide on demand, in contrast to the more formally-organized multiple-cell parcels of types to be suggested in following sections. Work can be done with an unchanging basic screen image. Emphasis can be accomplished at the presentation position as well as at the screen position. The mark of the overhead "convert" is eye-contact alternation between audience and transparency with only minimal time lost to checking the screen image.

Dynamic Transparencies: The Overhead's Optima?

Nomenclatural difficulties can arise rapidly when the concept of "dynamic" transparencies is offered as counterpoint to the notion of "static" slides. Presentation techniques are similar, to say the least. Generally, however, dynamic slides are designed to be seen in their entirety at the climax of a presentation if at all, whereas static slides may be shown in full throughout their use without more than incidental modification or emphasis.

For example, one fundamental dynamic technique is formally identified as progressive disclosure. It consists of little more than deliberate timing of the display of portions of a complete static slide. In its simplest form, progressive disclosure of a complex table can be effected by moving a sheet of densely-translucent material, such as bond paper, downward line-by-line at an appropriate rate. The instructor always can see the remaining data through the sheet, incidentally, even though no image reaches the screen. (Master I provides such a table laden with more data than should be revealed *en masse*.) A far more sophisticated form of progressive disclosure can expose bits and pieces of a basic image by sequential removal of properly-shaped opaque masks. (Aspects of the expansion of the known world are presented through this technique with Master II.)

The contrast between progressive disclosure and additive buildup, a second basic dynamic overhead technique, is best illustrated with a case analysis. Given the problem of presenting information about a series of explorations, what are the possible visual techniques? Each route might be plotted on a separate map, but the traditional cartographic approach has been to present the entire series on one base map and to rely on symbol differentiation to clarify the components of the resulting pattern. Opaque cartography seems to offer no other option, but overhead cartography provides two variants. In their American history series of overhead slides, Keuffel and Esser elected progressive disclosure for the *Exploration of a Continent* illustration. In its original form, six cells are used. Three — land, water, and routes of twelve explorers — are mounted permanently on the slide frame. Three masking cells, executed in black, are hinged to one side of the frame so that removal of each uppermost cell opens up more recent areas of penetration.

For demonstration purposes, these cells have been reworked into two different additive forms. In one, each of the three route groups disclosed by the original masks was made into a cell to be added in turn to the combined land and water base. Although the same historic distributions appear as on the original, they are seen against the setting of the entire continent. The brightness of the slide decreases somewhat with each added cell. With the masks as originally designed by K&E, attention is directed toward brightening action areas, and visual wandering toward the northwestern *terra incognita* is discouraged. For the second modification, each of the twelve routes was prepared as a separate overlay. With these, the attention-guiding function of the masks is also lacking, and in addition the screen image becomes markedly dimmer as explorers proliferate on North America. This ultimate additive slide does encourage consideration of one route of exploration at a time, and comparisons of relationships among voyages are facilitated. Although preferences may be largely matters of individual impressions and specific use requirements, conceptually intriguing differences between the basic techniques exist, and detailed analysis of the contrasting approaches should prove rewarding.

Often additive approaches involve more than filling in of details, and frequently subtraction of cells may be integrated into a slide. Both procedures suggest relationships between elements rather emphatically, and permit directing attention to facets that might be visually lost in a conventional static form. The five cells produced from Master III will positively indicate topographic map color symbolism even when used as a static multicolor slide. However, an additive procedure should facilitate learning the idea of multicolor printing as well as multicolor symbolism. Additive and subtractive manipulations should enhance speculation as to cause-and-effect relationships among physical and cultural elements. Master IV forms the skeletal basis for a slide of the distribution of the major climate regimes. Again, execution as a static item is possible, but the enhanced feel for the fit of the regimes that comes with additive and subtractive manipulation must be experienced to be appreciated.

Removal and replacement of image elements may be necessary to portray changes other than simple additions that can be indicated additively. Removal of something is usually related to introduction of something else. Canals or railways have been built (additive cells) and later abandoned (subtractive cells). Although at first glance one set of cells should serve, two different slides may be necessary unless the routes were abandoned in the same configuration as they were built. Colonial empires have receded as new independent nations have emerged; certainly former colonial areas could be removed chronologically cell-by-cell. At some point along this continuum of thought, however, the fundamental nature of overhead cells may become a handicap. With transparent cells, for example, portrayal of the transition of an area from one of in-town buildings to one of parking lots would require a pair of cells — one of "old" use and one of "new" use — for each change mapped. If the total area ever to be shown as parking lots were produced as one cell, removal of a "former buildings" cell would in fact reveal the new use color, but a confusing welter of color variants would remain until the last structure was razed. In fact, an initial distribution of parking lots and a combination of buildings-plus-eventual-parking-lots would be evident at most stages. "Thinking transparent" is a basic design requisite in overhead work. Some additional aspects of design will be suggested elsewhere in this booklet.

PREPARATION OF OVERHEAD TRANSPARENCIES

Often the availability of overhead materials is directly related to the needs and abilities of the prospective user; relatively simple personal preparation of overhead transparencies adds to the appeal of the medium. Because of the scale of this booklet, the diversity of talents and interests of classroom teachers, and the ever-changing array of suitable materials, this section can do little more than suggest possibilities. In general, three methods of production are possible: direct working on transparent material, machine reproduction at a 1:1 scale, and copying with camera equipment allowing "automatic" enlargement or reduction to appropriate size.

HAND-MADE TRANSPARENCIES

Single copies of transparencies can be made directly by hand by several methods. Some techniques can be thought of as comparable to the on-the-spot use of the chalkboard, whereas others are more akin to the prior preparation of conventional slides or handout materials.

In its simplest form, the overhead transparency need be nothing more than a sheet of clear plastic on which drawing is done at the time of delivery. For the ultimate in economy, cleared X-ray film may be available from local technicians for far less than fresh plastic stock. Crayons, or "china-marking" pencils, are similarly minimal-cost writing instruments. Any opaque writing will project as black, however, regardless of its actual color. Even fingerprints and abrasions may appear as black as intentional lines on a drawing, incidentally. Some plastic-surface pencils, such as *Stabilo* and Projection Optics' *Fine Line*, have been specially designed to produce thinner lines than ordinary markers. Several pencils, including gaf-*Drafton* and K&E's *Audio-Visual Translucent* lines, will produce projectable colored lines on finely-grained plastic sheets. Mars *Lumocolor*, Koh-I-Noor *Projecto-Color*, and some Tecnifax pencils will write on untreated clear plastic with fairly brilliant colors. Rapid-drying felt- and nylon-tipped markers use truly transparent colors, and those that adhere to plastic (Eberhard Faber *Projectachrome*, 3M *Fine Line Coloring Pens*, for example) will project suitably. Evenness of color cannot be counted on, even with the better of these items, but they do allow rapid, inexpensive creation of an image. For variety and emphasis, colored cell backgrounds can be used. Many proponents of X-ray film as standard base material claim that its neutral-density tone minimizes screen glare likely to be common with simple single-cell transparencies.

As a rather gimmicky variant to the conventional positive approach, a one-time-use carbon film allows the projection of a clear image against a dark ground. *Trans-Film* and K&E *Projection Carbon Film* are representative brands of material. Most effective when the carbon coating is removed at the time of presentation, the material can provide a remarkable illusion of artistic or cartographic proficiency. If a perforated stencil of key features is made and chalk dust is pounced on the carbon film through the stencil prior to use, at the time of presentation the user need only "connect the dots" (which are visible only to him) and a "freehand" sketch appears relatively effortlessly on the screen.

Excessive casualness and weak coloration related to the aforementioned point-of-presentation media can be avoided by preparation of the slide in total or in part before its use with a group. The impact of rather static diagrams and long tabular items may be increased by this method. Although the materials noted as useful for delivery-time production can be used for prior production, alternate materials are likely to provide better results. Colored acetate drawing inks and transparent printers' inks offer bright clarity in return for leisurely drying, but even with these materials uniform coloration of broad areas is difficult and precision of line work and lettering is governed by the abilities of the user.

Even basically unskilled individuals can produce crisp, professional-looking work with commercial aids, however. A visit to an artists' supply store is well worth a classroom teacher's time, even if the latter is personal time during a rare trip to a major city. For example, self-adhesive color sheets (*Transhesive* and Bourges *Cutocolor*, for example) are available in a broad range of tones. For general use, these sheets are merely peeled from their backing, cut to shape, and pressed in place. Sometimes careful cutting after the film is positioned is preferable. For graphs and diagrams, virtually the entire spectrum is available in tapes of diverse widths; ACS, a representative line, offers twenty colors. In the realm of lettering, projectible images can be typed on clear plastic with reasonable care and Ozalid opaque carbon, *Projection Carbon Film*, or *Trans-Typing* ribbon in place in an ordinary machine. For more impressive and more legible work, an extremely broad range of sizes and type faces is available in black dry-transfer lettering under such brand names as *Instant Lettering*, *Letter-Press*, and *T-Sheet*. Transparent red, blue, green, and yellow dry-transfer lettering in a more limited variety is marketed as *Color-Stik*, *Project-a-Color*, and several other brands. Dry-transfer lettering is simply positioned on the transparency film and rubbed until it transfers from a backing sheet. Novices should be aware that cut-out lettering such as *Para-Tipe* and *Formatt* are better suited for materials to be reproduced as slides; their backing sheets may show if they are projected directly from clear film. Moreover, new purchasers should be sure that sales personnel realize that color sheets and tapes are to be used for projection inasmuch as some materials are intended for viewing by reflected light rather than transmitted light despite their disarming clarity on direct examination.

Despite any multicolored treatment, however, a single-celled item, be it commercial or home-made, lacks the dynamism inherent in the overhead technique. Preparation of dynamic slides requires no more talent and little more time than does preparation of single-celled items. Essentially, several layers of plastic are stacked and marked so that they can be reassembled in register. Components of the slide are then drawn on individual films so that the image elements can be handled independently if desired. If a single original drawing with properly-matched register marks is properly traced onto individual cells, no problems should be encountered.

In practice, some limit to the number of cells soon becomes apparent. Each layer of "transparent" film so reduces light transmission that although eighteen or so cells can be projected in a darkened room, four or five in depth may cause illumination problems in brighter circumstances. This limit is not unique to hand-made transparencies, however. Cells can be hinged with durable Mylar *Techinges* or other tapes so that registration will be preserved while manipulation is relatively unhindered. If a constant sequence of display of cells is desired, all may be hinged to whichever side of the mount best suits the working habits of the instructor. Flexibility of sequencing calls for deliberate planning, too. Four cells can be displayed in any sequence if each is hinged to one side of the mount. Additional cells can be hinged atop the first four, but upper cells obviously cannot be shown without the lower ones on the same side. Random access to more than four cells can be attained by grommetting the registered cells to one corner of the mount so that any or all can be rotated into position over the aperture. Experience with but one apparently logical but complex multicelled slide will convince the novice that several well-arranged slides are to be preferred to a massive multipurpose item.

TRANSPARENCIES FROM 1:1 COPIES

Although many effective overhead presentations can be made with single-copy originals of the types just described, some common reproduction processes can broaden the scope and improve the quality of a slide collection. Currently, extant materials of appropriate size can be copied for classroom transparencies, but this convenient mode of visual enrichment may be inhibited by copyright revisions. Frequently, personally-produced items will be reproduced from their original form to gain better color or more uniform appearance, or to provide duplicates of a slide series. Definite advantages can be cited for routinely copying an original and projecting the copy. Reprints can be made when copies become worn, and the effort thus required is far less than that needed for repreparing a handmade cell. Actually, preparation of an original for reproduction may be considerably simpler than preparation of a projectible cell itself because many minor flaws can be lost in the reproduction procedure.

One-to-one copies can be made by several increasingly common processes of "wet" or "dry" copying or duplicating. In several methods, printing is transferred bodily from a page to a sheet of clear film. Because the nature of the processes conditions the type of work that can be done, familiarity with the techniques of reproduction is desirable. In many instances classroom teachers may be disinclined to enter into graphics production and may depend on curriculum materials centers to prepare items for them. Under these circumstances, the teacher should realize the technical limitations on production. When such production centers are not available, teachers may become reproduction specialists with moderate effort when the capabilities of commonly-available equipment and materials are recognized.

"Wet" Process Copies

The characteristic contemporary "wet" copying process is the no-darkroom "Polaroid"-like system found in many offices. A sheet of light-sensitive negative stock is placed in face-to-face contact with the material to be copied. If the original is on translucent stock with no material on the reverse side, the exposure can be made by light transmitted through the original. In the reflex approach, light is passed through the negative paper; in this case, the original can be on any base. With either variant of the basic process, the exposed negative is placed face-to-face against a sheet of positive stock and fed into a machine that passes the sheets through a "transfer" solution, forces the sheets together, and squeezes out excess liquid. After a brief time for the chemicals to work, the sheets are peeled apart to provide a damp useless reverse-reading negative and a damp direct-reading positive. Equipment and supplies in the A. B. Dick, Gevaert, *Verifax*, and many other lines are in this category.

Crisp positive copies can be produced on three types of material. Those made on film can be projected "as is." A less expensive translucent stock is intended for use as an intermediate stage in transparency production, and paper copies are, of course, the least expensive form. Because the photocopies can be reproduced by virtually any process that will yield a projection transparency in color, the clear film photocopy may not be the ideal answer. Current wet-process images are black regardless of the colors of the material copied. The quality of the images is comparable to that produced by either the familiar photostat process or conventional lens-type photography.

"Instant" "Dry" Processes

Three very different types of "dry" copying produce ready-to-use transparencies without the traditional fluid-using development step. Activators ranging from heat to electrostatic action are available in a fast-changing welter of machines and manufacturers.

Thermal copying machines have long been familiar office aids, and most common machines can produce overhead transparencies rapidly and economically. Contact exposure of a heat-sensitive film to a metallic- or carbon-inked original produces either a negative or positive image according to the material used. The negative variety, produced with 3M *Type 128* film, results in bright colored images on a black background. This form provides variety in presentation but offers limited on-the-spot modification opportunity. Positive images differ greatly in crispness, but the unusual white lines of 3M's *Type 125* film are in general sharp enough for all but the most demanding work. This, and all other current single-step thermal positives, produces a black screen image. Some semblance of color can be acquired by hand-coloring the lines on *Type 125* film, but results tend to appear crude and other color techniques seem preferable.

In contrast to the single-step processes, several recently-introduced thermal materials produce dry copies rapidly using a two-sheet technique. One sheet is exposed with the original to be copied, then a second treated sheet is placed in contact with the exposed material while a heat treatment "develops" a dark brown or near-black image. Although these processes, typified by 3M *Type 628*, produce images that are sharper than most of the one-step thermal materials, rendering of fine details tends to be inferior to that of the wet-process lines. Thermal copies cannot be reproduced by most useful color-producing processes, regardless of the apparent density of their image.

Electrostatic copying machines are widely advertised for routine copy work. Some can produce their copies on any material, including clear film, but most of the common machines require treated paper stock and are of no direct use for transparency production. Electrostatic copies are reproducible on thermal films and other transparency materials, however, so they are potential transparency sources.

The Diazo Process

The traditional key to impressive overhead slides lies in another direct-copying process. Long familiar as a replacement for the old blueprint, the diazo process produces transparent film copies as well as paper prints, and the colors possible on films are unmatched for clarity and brilliance. Two forms of diazo materials are currently available in transparency film.

Considering its effectiveness and despite its chemical complexity, the normal diazo process is remarkably simple in execution. The diazo salts coated on a clear film are sensitive to ultraviolet rays. During a contact-printing exposure to a rich ultraviolet source, areas protected by opaque detailing are unaffected while unprotected areas are "burned off." When the exposed film is placed in a container of ammonia fumes, the residual coated areas develop into the color determined by the specific coating of the film. A transparent positive image in one of a score of hues is the result. The material can be exposed by sunlight or photofloods and developed in a plastic bag of ammonia fumes, or it can be processed through one of many commercial devices ranging from the older Tecnifax *Proto-Printer* and *Pickle Jar* to continuous-feed *Ozalid* whiteprinters.

With conventional diazo film, only one color can be produced on each sheet, but with a related process, several colors can be developed on a single film. Varityper *Multicolor* materials are exposed under the same conditions as are conventional fume-developed diazo sheets, but the color dye couplers are incorporated in developing solutions rather than in the film. No processing equipment is necessary inasmuch as the desired color couplers are swabbed onto the film. Because the undeveloped image is faint, the film often is placed atop the original so that the developer can be directed to the image components. Film coated on both sides facilitates this process, provides somewhat stronger colors, and, by permitting development of both sides of the same image in different colors, produces a broader range of colors. Although a fair degree of control is possible during application of the developers, image elements to be done in different colors should be separated a bit on the original. *Multicolor* films can be developed into single-color individual cells and only one package of film is necessary for the full color range. This economy factor, which contrasts with the need for stocking a package of film of each possible color in standard diazo technology, should prove of considerable value to the low-budget, low-volume producer.

Because many materials block ultraviolet rays, originals for the diazo process can be made in many ways. Original art work in pencil, India ink, commercial lettering (either dry transfer or cut-out), and shading films reproduce well. Actinically-opaque but visually-transparent red, red-orange, or brown materials (such as *Parapaque*) reproduce clearly on diazo films even though their visual clarity allows easy registration work as they are prepared into originals. Photographic negatives or positives work equally well, so black-and-white copies can be transformed into colored cells easily with the diazo process. Working from a photocopy instead of the original preserves the original and permits fairly simple modification of the photocopy if necessary.

Multicell work is facilitated by the differentiating color sensitivity of diazo foils. Although transparent reds will block ultraviolet, even rather distinct-looking blue images will not. Several copies of basic outlines can be made on non-reproducing blue *Texray* diazo tracing paper, or a blue spirit master may be run onto several acetate sheets. If appropriate areas are opaqued on each of the blue-line copies, resultant diazo prints should register well and extraneous line work should disappear. Master IV will offer practice in this work.

Generally preparation of a color cell by diazo is far simpler than hand application of transparent colors, tapes, or sheets, but some minor problems exist. Occasionally a visually-uniform inking will not be actinically uniform, and a blotchy foil may result. Sometimes foils exposed in hot-running machines may lose precise registration. Extremely finely-detailed maps and diagrams might lie at the margin of registrational surety of contemporary diazo materials, but most geographic graphics seem thoroughly safe in this respect.

Because of the near-ideal attributes of diazo materials, prospective intensive users of overhead equipment might well acquire diazo machines at the same time. Few existing devices are inexpensive, however. Slide-size printers range from about $100 upward, and efficient combination exposing-developing devices for large sheets as well as page-sized materials may run five times that amount. Because larger machines, such as *Diazit*, can be used for reproducing larger project maps and drawings, they might be readily justified at a district level. Most makes of copying machines, even those with visually bright illumination, do not issue sufficient ultraviolet to properly expose diazo foils. The unit cost of transparency films is high enough to require rather demanding standardization of exposure conditions, so controlled sources seem preferable to dependence on sunlight in most areas.

Miscellaneous Techniques

Although most non-commercial overhead transparencies have been made by one of the foregoing processes, a few other office-machine techniques for producing 1:1 slides seem noteworthy.

Matched sets of slides and handouts can be prepared from the same masters by several processes, but two require no additional work to speak of. Gestetner materials for the relatively rare electronic mimeograph stencil cutting machines can produce an overhead transparency of the stencilled item as it makes the mimeo stencil. Transparencies in as many as five colors can be produced remarkably simply on more common machines. If frosted acetate is loaded into the paper feed of the ubiquitous spirit duplicator, a prepared spirit master can be printed as a slide before the distribution copies are run on ordinary paper. The colors will project adequately if not vividly and are as stable as the copies on paper. Transparent sprays will clear the slide a bit, and spirit transparencies can be written on and erased without loss of the spirit image.

A very promising recent introduction in the materials field requires the use of thermal machines and hand treatment with specialized fluids. *Parlab* films produce a broad range of crisp positive images of both line and continuous-tone originals in a spectral selection of colors. Multiple colors can be added to single cells if their image elements are sufficiently discrete. Another product in the same brand line produces sharp reversal images with little effort. With all Parlab processes, originals are "charged" with a special compound in one pass through a thermal machine. In another pass, the charged original and a sheet of film react to the heat treatment. Weak images on the film are dyed (in the positive lines) or cleared (in the reversal forms). Excess dyes and clearing solution are removed, and a sealant is added for permanance. Transparencies comparable to diazos are possible with these materials. The widespread availability of thermal machines suggests that this process may well become a standard transparency-production method in the schools.

Because of the persistence with which they are mentioned, "lift" processes must be noted here. Prints on clay-coated paper can be sealed by heat or pressure to clear plastics, and, with luck, separated from the paper stock by soaking. Although the procedure does work, it is erratic at best under ordinary circumstances; certainly attempts to "lift" really good originals should be undertaken with full awareness of a high loss-rate potential. High-quality laminating machines do produce surprisingly good transparencies, however, and improvements in the process may be forthcoming.

TRANSPARENCIES BY PHOTOGRAPHY

If materials suitable for use at a 1:1 scale are not on hand, conventional photographic processes can be used to make overhead transparencies from off-size originals. Both black-and-white and color films project as well on overhead machines as in conventional projectors. Continuous-tone and line images are equally satisfactory. In addition to directly-made photographic overhead slides, photographic and photostat processes can be used to produce masters for diazo and other transparency processes.

Cameras accommodating 8 x 10-inch film can be used to make slides directly. Color transparencies on reversal films such as *Ektachrome* or *Anscochrome* can be treated as large-scale versions of the common 35-mm. slide. Black-and-white film can be contact-printed on film-base stock to provide a positive transparency. Many graphic items may be more effective in the reversed tones of an 8 x 10 negative.

Admittedly, 8 x 10 cameras are not common school or personal equipment items; fortunately, comparable results can be achieved by competent darkroom workers using smaller photographic originals. Small black-and-white negatives can be enlarged onto fine-grain positive film stock. *Kodacolor* or other color negatives can be enlarged onto *Ektacolor Print Film* with relative ease. Even conventional positive color slides can be enlarged onto Ansco *Type 5470* duplicating film stock for large-format, full-color images. Some custom color-finishers offer this process, so a casual photographer can adapt to overhead-size colorslides effortlessly, albeit at some cost. In the mid-sixties, quoted prices for the service range from five to ten dollars for the first print from a slide.

Photographic intermediates can be used with other graphics films to provide more traditional transparencies. Masters can be photographically adjusted in size from any original and reproduced on diazo or Parlab film to gain inexpensive color. Both standard photography and photostat work will serve. The distinct advantage of oversize original working can be achieved in this manner; multi-color overlay drafting at 1:1 scale is somewhat less than ideal when originals are but 8 x 10 size! Continuous-tone photos on black-and-white positive film stock can be converted to high-quality transparent images, and occasionally a semblance of natural color can be simulated in the process. Keuffel and Esser *Helios-UHS* diazo films seem particularly competent to deal with a moderate tonal range. Full-color photos, drawings, or maps can be color-separated by conventional selective-filtration procedures to provide film masters balanced to cyan, magenta, and yellow diazo films that can be recombined into a static full-color slide. Commercial services are offered in this realm also. Tecnifax, for example, will convert a 35-mm. color slide to overhead size via separation, diazoprinting, and assembly of the cells for about $30 for the first copy; reprints are available at about one-tenth of that cost. These diazoprints are bright, and the plastic film curls far less in use than do either black-and-white or color photographic films. Cost factors suggest that this process might be of greatest interest to districts planning curricular supplements.

SLIDES FROM COMMERCIAL SOURCES

Although one of the principal attributes of the overhead slide is its propensity to reflect the personality of a creative user, an increasing stock of commercially-produced slides is being marketed to service those who prefer the traditional "approved" and readily-available materials. Because of the rapid changes in this realm, detailed statements about commercial items become obsolete rapidly, but some indication of the types of materials thus available seems warranted. Some commercial slides are completely excuted and ready for use. Some are fundamentally bases to be modified to individual needs. Others provide masters from which the user makes his own projection transparencies. As might be anticipated, the unit costs of commercial products decrease from $5.00 or more for the completely-executed items to as little as about $0.05 for each do-it-yourself master. Materials for the latter may raise the actual transparency cost to the ready-made order of magnitude, especially if unskilled personnel are involved in the reproduction procedures!

READY-TO-SHOW COMMERCIAL SLIDES

Not surprisingly, many of the ready-to-show commercial slides are the products of familiar names in the field of educational media. Established manufacturers of wall and desk maps, scientific suppliers, and textbook publishers have entered the field most intensively. The overhead items round out their lines in a new direction, but frequently the traditional suppliers have offered little more than their extant items printed in overhead slide form. Nystrom, for example, offers beautifully-executed direct copies of its Richard Edes Harrison's sculptural-relief continental maps and history maps from several series; none are any more dynamic in character than the Harrison set, and in that line the sole movable overlay is of miniscule place names and political boundaries. The former Aero Service Corporation's series of *Aero-Vue* slides are limited regionally to the United States and make minimal use of the overlay potential; although each map is comprised of several individual cells, few are really useful as separates. Some Denoyer-Geppert world maps have been moderately redesigned for overhead use, but lettering legibility rather than dynamism has been the prime design modification. The Denoyer-Geppert slides, as well as a series from Rand McNally, are designed to be used with a special projection stage that permits notation during presentation on a substantial protective overlay. Hammond's map line, entirely redesigned for overhead slides, offers many technical advantages in method as well as materials. Nystrom also offers appropriately-colored landform and hydrographic cells of its desk outline map series on which any normally-competent instructor can build his own set of meaningful overlays without having to create his own bases.

Similar observations can be made about supplies of more diagrammatic subjects. Hubbard markets an earth science collection in which overlays are in fact designed to indicate changes or relationships. Unfortunately, many of the processes illustrated are far more effectively dealt with in traditional motion picture films. Overhead materials really present stage or status concepts rather than notions of continuous flows. Overhead cells can show an alluvial fan at several stages of development, for example, but they cannot show the actual development of a small fan as it is produced in the laboratory. The excellent Strahler illustrations are marketed in a static overhead form; their use is open to the imagination of the user and many may be enhanced by judicious addition of color work and overlays.

Many other manufacturers have produced similar types of items. This commentary should not be construed as discriminatory against those firms not mentioned or as singularly derogatory toward those noted. Prospective users of ready-to-show commercial items should be cautioned, however, that blind acquisition of these newer media materials is every bit as hazardous as acquisition of a film series without preview or adoption of a text without thorough critical reading and re-reading. Few overhead items will become self-teaching devices under present circumstances, and prospective users should demand trials to confirm that the materials really *can* be used if an instructor should happen to try to use them.

COMMERCIAL MASTERS

As is to be expected, many of the do-it-yourself masters commercially available are the products of firms known in the field of copying materials and machines rather than in the traditional schoolroom trade. Some of these masters are rather straightforward timesavers; 3M offers a series of state outline maps, for example, that reproduce on its thermal and dry-copying machines and substantially reduce preparation time in the process. One of the more intriguing products in the field to date is the Keuffel and Esser series of diazo masters previously mentioned. Although at the time of writing pure geography materials are regarded by K&E as an enterprise for the future, their American history master set is a revelation in the field of overhead-projection materials. Some 300 individual cell masters are provided; 88 thoroughly legible and generally effective slides are the result. Some slides are static, but many utilize progressive disclosure or additive techniques especially adaptable to the overhead.

A very practical rationale stands behind the notion of production and sale of masters rather than the finished items. Aside from the obvious fact that the manufacturers are in the business of selling reproduction materials on which, hopefully, their masters will be run, the system does provide noteworthy protection to transparency users. Most overhead slides will deteriorate or become abraded in several seasons of use, and some may disappear through various channels. With masters on hand, replacement is always possible. If visibility is not as great as anticipated, cells may be re-run in stronger colors. Also, additions, corrections, and similar modifications can be accomplished by the user if he has access to masters. Hopefully, too, manufacturers might be more inclined to correct their own errors by issuing replacement masters for faulty cells. Admittedly, shop time is necessary for production from the masters, but this is a minor disadvantage.

As with fully-prepared slides, prospective purchasers should appraise the quality of master sets carefully before acquisition. Content errors of various magnitudes have been discovered even in the midst of the Keuffel and Esser sets. Rapid proliferation induces errors in all media.

THE ROLE OF THE OVERHEAD IN PRESENTATIONS

Following an appraisal of the characteristics of the overhead projector and its slides, a brief systematic review of the fit of the overhead into the media field seems appropriate. Although the overhead machine often is the only piece of visual equipment used in presentations, it may be just one element in a multimedia approach. Beginning users of overhead projectors may soon find a strong tendency toward coordinated equipment use emerging as they gain proficiency with the overhead as a tool in its own right.

THE OVERHEAD AS A SOLO INSTRUMENT

In general, the solitary use of the overhead falls into one of three categories. It may be a replacement for another form of projector, a substitute for chalkboard, or a substitute for a wall-hung map or chart.

The Overhead as a Replacement for Other Projectors

Briefly, about the only still-projection chore that cannot be done by the overhead machine as well as or better than by conventional equipment is projection of an opaque original. The practical limitations of the overhead are more matters of cost than of optical competence. Any transparent image of appropriate size can be handled by an overhead under room illumination conditions comparable to those suitable for projection of smaller slides. As suggested earlier, one of the competence-enhancing factors of the overhead family is the large transparency used on them. To produce a six-foot-wide image on a screen, overhead transparencies are enlarged only eight diameters, whereas a forty-eight-diameter linear magnification is necessary for a double-frame 35-mm. transparency. Far less is demanded of the overhead's projection optics. This case is, perhaps, the epitome of the fact that large slides routinely deliver better screen images than do small slides of comparable quality. Projectors tend to be the weak links in the visual chain.

Aside from its superior image quality in many cases, the utter simplicity of pinpointing details and otherwise manipulating the image during projection cannot be found on conventional slide projectors. When detailed analysis of a projected image is necessary, the overhead cannot be excelled. When progressive changes are necessary on the screen image, the overhead can do with a single overlay-equipped slide what might require a series of separate slides on other devices. The only still-picture competition for the overhead's facile comparison of one cell with another comes at present from 35-mm. projectors featuring lap-dissolve control. With this procedure, two complete optical systems are arranged to blend a new brightening image onto the prior image as its brilliance is diminished. Although the procedure is effective, especially when sequential slide images have been made in perfect register, the equipment is expensive and no access to the images is convenient.

Realistically, however, cost factors rather severely limit the use of the conventional overhead projector as the sole still-projection device. Aside from one drawn completely by hand, even the simplest single-color cell for the overhead projector will cost about as much as a mounted full-color 35-mm. slide. A full-color transparency for a single overhead slide will cost roughly as much as three processed rolls of 6x6-cm. color film. Although the picture: word value ratio has been publicized for centuries, no contemporary sage has estimated the relative worth of a static overhead illustration compared to the same portrayal in less expensive formats!

Some inroads on the cost problems have been made by designers of hybrid projection devices. One, the CIP-*Overslide* projector, even at its present stage of development warrants attention from instructors committed to small-group presentations. True to its initials, the CIP unit projects a composite image. The upper portion of the machine resembles many conventional overheads when it is opened into operating position, and it accepts conventional overhead slides. Its light source, and the source of another image, is a Kodak *Carousel* 35-mm. projector within its base. The Carousel produces a 6x9-inch image of a 35-mm. slide at the stage of the Overslide unit, at which point the operator can point at or write on it just as if it were an enlarged transparency on a conventional machine. The price for the use of low-cost slides for analytical purposes is at present a screen image of only moderate brilliance. More such devices can be expected as classroom teachers recognize the opportunities sophisticated hardware can offer and begin to generate a demand.

The Overhead as a Chalkboard Substitute

Aside from those presentations requiring progressive and complete use of dozens of running feet of space, few chalkboard uses cannot be accomplished on the overhead stage. Often legibility may be enhanced because the mere act of hand lettering a page-sized cell may force an instructor to write in larger effective sizes than might otherwise be his habit. In fact, if accepted ratios of viewing distance to image width are observed, it is virtually impossible for the overhead user to form a letter so small as to be illegible to rear-row viewers. When used as a source of 1:1 copy, for example, pica typewriter face becomes a bit less than an inch high on a six-foot-wide screen image; lettering of that size is at about the limit of legibility from a viewing distance of 30 feet. Additional observations related to slide legibility are presented in conjunction with Master V.

Integration of student work at the desks and the teacher's work before the group is far more difficult with traditional chalkboard approaches than with overhead methodology. When work with manual materials, style sheets, or similar items is called for, the use of the chalkboard technique to simulate the material is certainly more arduous than projection of a copy of it. As noted before, simple thermal transparencies and those made from spirit masters seem particularly useful in this function.

Often a substantial savings in time may be a great asset of overhead use in this context. Considerable class contact time is lost by traditional chalkboard' presentation of tabular or elaborate diagrammatic material that might be prepared as a transparency, used, filed, and reused whenever needed. Progressive disclosure of a long table should be far more effective than either a blow-by-blow addition to a chalkboard table, or complete revelation of a prepared table covered by a tear-off sheet or a potentially-disconcerting roll map until the time of its use.

In general, the clarity of chalkboard-equivalent uses in a normally-lighted room is satisfactory if no exceptionally strong light falls directly on the screen. Older classrooms may not have adequate control over front' room lights to permit maximum screen images without some dim-out of the room. When ambient light poses no problems, color differentiation is facilitated on the overhead far beyond that possible with the less messy of the colored chalks. Clear film, especially recovered X-ray sheets, is virtually expendible without concern for cost; chalkboards or slated maps that will not clean up properly are not. Introduction of new white writing surfaces may lessen the advantage of the overhead in this respect, however.

The Overhead as a Substitute for Wall Maps and Charts

Because wall maps and charts often serve dual purposes, overhead slides may be ideal or impossible substitutes for them. Although an overhead slide may be displayed with rear illumination for post-lecture student viewing, it is likely to be less effective in this use than a wall map because of its small size. Moreover transparencies may fade with prolonged exposure to strong light of display conditions. For use during a lecture illustrated with slides or motion pictures, the projected image of a map slide should match the viewing conditions more readily than a wall-hung opaque map might. Unless deliberate identifications or changes are to be made on a map during a presentation delivered without other projected visuals, a wall map may prove more rational than an overhead slide; when a dynamic approach is used, however, the overhead projector is at its peak of usefulness in this application.

One outstanding advantage of an overhead slide of a map, regardless of whether it is static or dynamic, is its propensity to be enlarged to fit the classroom circumstances. Most wall maps are too small for effective unaided use in large rooms. If a large screen or an unbroken expanse of light-toned wall is available, the viewability of an oversized image may well warrant a rather dim auditorium. The general rules of screen selection apply to overhead use as well. Matte or lenticular screens permit viewing over a far broader side-to-side range than do beaded ones, but matte surfaces may not produce the brightest images possible. The newer lenticular surfaces look gridded on close examination but provide the most brilliant images under high ambient light conditions; they are expensive, however, and must be taut to be evenly effective. In actual practice, planning for a large expanse of wall surface may be the best general-purpose solution for lecture-hall uses. Certainly a light beige wall works adequately for most projection systems, and it is highly satisfactory for overhead work. Moreover, multiple projection is facilitated. If, of course, an overhead map cannot be projected to a size larger than a conventional wall map, it has no intrinsic advantage for this use other than its portability and lower cost. A portable, fileable overhead slide should cost about one-eighth as much as a cumbersome, large, rod-mounted wall map.

Design aspects are important variables in this application, too. Maps designed for projection tend to be simple in style, lettered for the audience rather than for the lecturer, and, in the case of prime overhead items, dynamic in nature. They are more likely to be introduced for their contributions to the presentation than to serve as backdrops for the lecturer's actions, as so often seems the case with conventional wall maps. These generalizations cannot apply strictly, however, when map transparencies are simply photographically reproduced from extant traditionally-executed wall maps or charts.

The static overhead slide may not always be a justifiable substitute for a static wall map, but no ordinary wall map can approach the usefulness of a well-organized dynamic overhead map. Distributions, both chronological and point-in-time, can be compared via overhead overlays with an ease utterly unknown to users of series of traditional wall maps. Because of this facile feature, however, overhead users and viewers may need specific cautions about apparent correlations versus correspondences, scale problems related to cartographic registration, and related interpretational hazards. If in fact overhead use does cause an awareness of these problems, its contribution to the cause of geographic communication will have been great!

Perhaps analysis of a specific instructional problem might confirm the usefulness of the overhead as a substitute for a wall map and suggest the previously-noted ease for incorporating supporting materials into a presentation. The problem—a common one—is that of dealing with world population patterns and trends. A traditional approach might involve little more than delivery of a lecture, albeit perhaps a well-organized one, in the presence of a wall map of world population distribution. References might be made to the map, but positive identification of areas and symbol meanings, would not be simple for the students. A more enlightened traditional presentation might include simultaneous use of a pair of maps: one of population distribution and one of population density. Both might be analyzed and their relationships clarified. Graphs might be sketched on the chalkboard in either presentation. For contrast, consider the ease and effectiveness of this hypothetical overhead approach to the same presentation:

I Project OH slide of handout of lecture outline; progressive disclosure
- Change to OH slide of base map handout; clarify purpose
- Change to OH slide of base graph handout; clarify purpose
- Return to OH slide of base map
  - Add cell of population distribution (current)
  - Add cell of continental population shares; bar graph
  - Replace with cell of early population distribution
  - Add cell of early continental population shares; bars
  - Add cell of current population shares
  - Add cell of population trends; semilogarithmic
  - Replace with cell of current population distribution
  - Add cell of areas with minimum population density
  - Replace with cell of areas with maximum population density
- Change to OH slide of key facts and conclusions; progressive disclosure or on-the-spot production

II Project OH slide of handout of lecture outline; progressive disclosure
- Change to OH slide of base map handout; clarify purpose
  - Add cell of population distribution

Replace with all cells of population density
Replace with cell of population distribution
Add cell of water bodies
Add cell of high-latitude lands (E regimes)
Add cell of dry lands (B regimes)
Add cell of highlands (H regime)
Add cell of minimum population density
Return to base map plus cell of population distribution
Add cell of winterless areas (A regimes)
Add cell of mild-winter areas (C regimes)
Add cell of four-season areas (D regimes)
Add cell of land less than 500′ in elevation
Add cell of maximum population density

Change to OH slide of key facts and conclusions; additive or on-the-spot production

Unfamiliar as the foregoing context may seem, no really unusual content material has been injected into this program. Although in the overhead configuration many cells have been suggested, these can be easily identified as repackaged components of two traditional population maps, a climate map, and one showing hypsometry. Only the graph materials, distributed in proper parts of the world base, are not included in standard items. With overhead methodology, students are not asked to extract specific distributions from the welters on each of four standard maps and then to try to discern distributional relationships. Quite the contrary occurs as they are led to relate each additional distribution to those previously dealt with.

THE OVERHEAD IN MULTIMEDIA APPROACHES

Although effective instruction can be accomplished with the overhead projector as the solitary visual support, the machine is particularly effective as a supplement to the use of other media. Orientation and interpretation of both traditional printed or opaque items and other projected materials can be facilitated, and a useful variant of conventional chalkboard technique is simply effected.

Superimposition Methods

Several different approaches to orientation or keying-in of slides and films are possible with the overhead. The simplest of these depends on the overall brilliance of the overhead's image to white out another projected image. Labels, lines, or other materials on a positive overhead transparency will replace most of the image produced by another projector, although occasionally a ghost of the other materials will remain. This technique permits the injection of an orientation item into a film or slide series as often as necessary from the instructor's position and without manipulation of the basic projector. A similar effect can be achieved with prepared slides in a second projector, but the point-of-presentation possibilities of the overhead are, of course, lacking in this case. A considerably more effective variant is equally simple, but it reduces the spontaneous possibilities. Graphic materials or captions are prepared in advance as negative cells. When these items are superimposed on the previous screen image, the explanatory material appears as a familiar subtitle without destroying the rest of the scene. This technique is enhanced by the use of a slotted mask over the aperture of the overhead stage. Well-spaced negative captions can be positioned over the slot after it is aimed correctly at the screen. Negative subtitling can be undertaken with a second conventional projector, also.

A similar technique can be used with ordinary wall maps or chalkboard drawings. Projectible overlays can be made to fit an extant wall map (one commercial firm is experimenting with an overhead-to-globe system), but an uncommon freedom from disturbance is required for this method to be repeated regularly with assured success. Very slight positional changes of either wall map, projector, or slide become distressingly obvious. If extreme precision is not expected, however, transparencies can be designed to the proportions of existing maps and provided with aiming and scale-matching registration marks. At the very least, prepared or on-the-spot cells of place names or similar identifications can be displayed intermittently *on* appropriate parts of wall maps to replace the usual written work generally positioned only loosely *near* the items in question. Projection directly onto the chalkboard can simulate familiar board diagrams, and the image can be traced quickly with appropriate chalks to facilitate lagging freehand artistic abilities. When this can be done, operating time of the overhead can be reduced. These methods can serve as useful variants to either traditional methods or completely-converted overhead sequences, especially during the period of development of a course package of media materials.

Dual-Screen Techniques

Paired-projection techniques have offered challenges to creative instructors ever since the advent of classroom projectors; the overhead opens the field even wider. Projection of a large-symbol overhead adaptation of a familiar extant wall map can aid recognition of the characteristics of the stock map during other presentations. Handouts of the abstracted map slide should prove especially useful for note-taking and reference after the projected image is removed and the class is left with the opaque wall map for the rest of the presentation. In another direction entirely, significant detail areas of the general wall map could be prepared as overhead slides so that the standard map itself would become a basis for position referencing while work progressed on an area that otherwise would be visually miniscule to the class. For example, a good but small-scale wall map of North America could become a reference item for a projected overhead transparency featuring a traverse across Appalachia.

A more intensive example of this technique may prove worthwhile as an idea generator. Consider the following proposal for a multimedia presentation of a lesson about a representative climate type area:

Project OH slide of handout of lecture outline; add emphasis
Display wall map of world climates alongside screen
Change to OH slide of base graph
- Add precipitation and temperature values; complete on-the-spot

Change to OH slide of complete climate map in multicell form
- Remove non-pertinent cells
- Analyze residual pattern of climate under study
- Add climate controls cells, with time-of-presentation hand work

Change to conventional slides or film of type area
Change to OH slide of key facts, concepts, places; progressive disclosure or on-the-spot preparation

In the previously-described cases, the bright screen image formed by the overhead in normal circumstances was featured in counterpoint to opaque visuals; another paired-presentation technique incorporates dual screens and dual projection. Often notes and position references provided during slide or film presentations are ineffectual unless controlled spotlights can be directed on a chalkboard area or map display zone without hampering the projection screen. The ubiquitous fit of the overhead image into many illumination levels allows comfortable viewing of two projected images. Although two overheads might be necessary to allow the maximum image manipulation, the more common approach pairs an overhead with a conventional slide or motion-picture projector (Figure 2). At first look, the need for two machines might not be apparent. A substantial amount of comparison of parts of images can be accomplished by designing overlay cells for use on one machine, but if the comparison must be made between two complete images instead of image elements, the problem of image size arises. Overly small images resulting from splitting the slide frame vertically or horizontally can be avoided by dual screening. Opportunities for this technique are numerous. For example, the details of a scene, aerial photograph, or topographic map segment can be traced onto an overlay cell as the class watches. The instructor using only the overhead now has three image choices. He can show either the original or his sketch separately, or he can show both in superimposed form. With a duplicate original in a second projector, the sketch can be shown on one screen while the original is projected alongside it. This side-by-side comparison may aid sketching by students who must create their versions of a scene from life or from an image that they cannot trace.

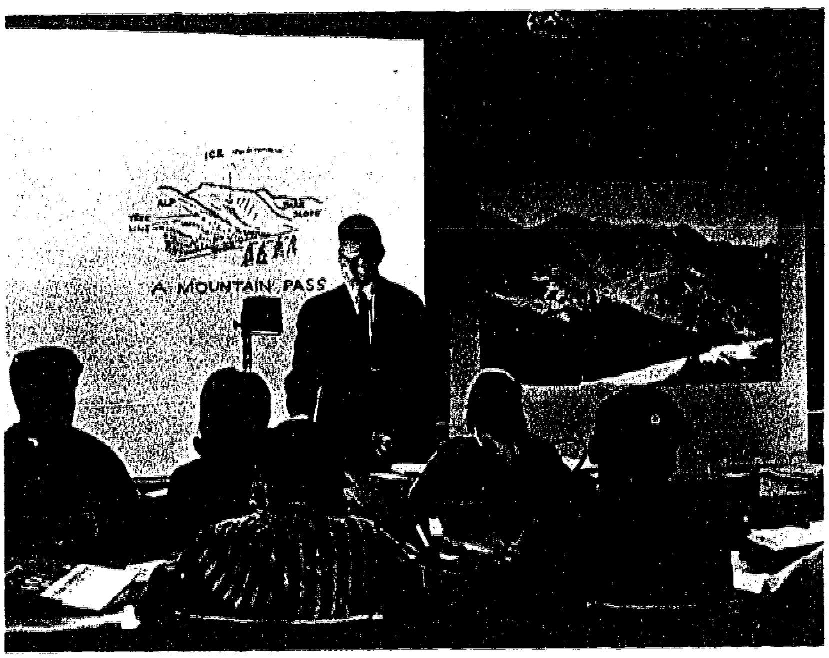

Figure 2. The Overhead Projector with the Slide Projector in a Physical Geography Class in High School (I.S.U. Photo Service).

Far more sophisticated presentations are possible with the overhead as one of two projectors working together. As an example, the possibilities for dual-screen work in topographic map analysis are quite evident:

Screen 1	Screen 2
Project OH slide of handout of lecture outline	
Issue desk copies of map; display instructor's copy on tackboard	
Project OH slide of entire map	Project series of 35-mm. slides; key elements of map
Change to 35-mm. slides of scenes shown by map segments	Change to series of 35-mm. slides; map segments of scene areas
Add subtitles, etc., as needed using OH slides	
Change to OH slide of key facts and concepts; progressive disclosure	

GENERAL CURRICULAR OBSERVATIONS

The content of this booklet has been slanted away from specific guidelines for overhead slides for grade-level or topical applications for several reasons. On the purely practical side, space and funds do not permit such an elaboration at this juncture. Of equal real import, however, is the author's conviction that the maximum effectiveness of any medium, the overhead not excepted, comes with the use of materials prepared for individual instructional needs and not drawn from a well of visual clichés. Hopefully, suggestive examples have been included ranging from items suited to hand-made preparation by individual teachers to multicell slides or full-color photographs that might more rationally stem from district action to support a course of study. Possibly the surest way to retrogress overhead technology (and, in all probability instructional efficiency as well) is to succumb again to the easy urge of uncritical acquisition of existing trade items.

From the geography teacher's viewpoint, the overhead facilitates effective portrayal of relationships and legible presentation of nomenclature to a greater extent than do most other media. Materials are not difficult to prepare, and the machine is unobtrusive and easy to live with. Substantial savings of time and increased effectiveness of presentation may stem from the disciplining involved in thinking out and preparing sets of overhead slides. Although the conceptual dike between "organizing" and "canning" is notoriously low, charges of courses becoming stereotyped slaves to instructional media seem absurd considering the rigidity inherent in many conventional teachers' notes and lesson plans.

Perhaps the timesaving and organizational aspects of preparing a brace of overhead materials may be their most important contribution to the primary-grade teacher. The opportunity to prepare something beforehand, "at leisure" and in comfortable circumstances, should not be minimized. Most chalkboard "rituals" could be equally well or more effectively handled with fileable, reusable overhead slides. In some respects, though, this quality of overhead methodology may prove even more appealing to elementary or upper-grade teachers (or even to college professors) involved with multisection and multiroom presentations. Changeover time can be reduced markedly with overhead slides substituted for roll maps and chalkboard emphasis, and the teacher can be ready to start with a new group without significant prior access to a particular classroom.

This emphasis on advance preparation of materials should not be construed as favoring complete prior execution of all detail work. Certainly items requiring excessive time should be done in advance, as should outlines, flow diagrams, and the like. Progressive disclosure could become monotonous, however, so prepared overlays or on-the-spot additions should be considered as well. The goal is to reduce the time-of-presentation work to that really necessary to make a point, but that point must be made well to justify the media involvement. For another case in point, evaluate the three approaches to identifying the continents for a presentation to a young group. Names could be written by hand at the time of the lesson; problems: misshaping or even misspelling under classroom duress. A label overlay could be prepared in advance, and the fully-named continental array could be placed on the projector and left there; problem: saturation of name-place associations. Names could be prepared on individual cells or on drop-on pieces, and added to the base as appropriate; problem:? Even with the latter approach, and certainly with the second, the teacher might well outline the continents one-by-one as their names are used. No excuse for incorrect spelling or language usage exists if items are prepared in advance, however, and any answers or totals included on slides really ought to be correct unless the slide is designed to be a test of observation!

In the elementary and upper levels, a prime attribute of the overhead is its capability to produce a legible image, in contrast to many front-of-the-room visuals. Consider briefly the quandary of the child who, with no desk guide, hears the sound "yourasia" associated loosely with an indeterminate position of an invisible name on a map or globe some thirty feet away. Acutely apparent personal experiences with elementary-level attachment of the prefixes "my" and "your" to the root "ami", according to the normal rule of possessives, has confirmed the possibilities of such events. If legible nomenclature is available as an overlay or drop-on, showing the terms might occur more readily than if the teacher is forced to construct the needed names on the board when they should be used. The prospective size of overhead image elements should favor interpretation of symbols and general pictorial detail, too.

One fundamental geographic realm in which overhead use should prove especially rewarding is that of orientation study. Directional analysis requires reorientation of the map details; with conventional materials, nomenclature will also be reoriented as the drawing is turned. As a starter, the basic triad of (a) classroom map, (b) school grounds, and (c) setting in the community can be prepared as overhead cells. Labels for each can be made, either as loose drop-ons, or as series of registered cells. If the latter choice is made, a cell should be prepared with correct-reading characteristics for every orientation of the base cell. The utter flexibility of this approach may aid in "doing in" the North-at-the-top myth more rapidly than traditional efforts. A demonstration slide illustrating the difference between a reoriented map with "upside-down" lettering and the same map with "correct" lettering might even prove useful at higher levels. One might even be developed from the masters provided with this booklet and a sheet of preprinted first-order geographic nomenclature. Its content could be a base map transparency of continents and unnumbered grid and two separately made and separately hinged name cells. In use, the slide would be shown first in the traditional orientation, then it should be turned on the stage to invert the screen image names and all. Finally, the first name cell would be removed and replaced with the second on which the names and grid numbers are normally positioned.

Scale is another general geographic issue that lends itself readily to overhead presentation. Given a map slide showing the three scale notations: verbal, representative fraction, and graphic. A rather slight movement of the overhead away from or toward the screen will induce a noteworthy change in the size of the screen image. As the overall image size changes, the graphic scale changes in unison with it. This process contrasts markedly with the verbal and RF statements, which increase or decrease in visual size but not in value. No opaque material offers such an easy demonstration of scale, and no other projector makes it as simple as does the overhead. Illustration of distance calculations is made easier on the overhead, too, inasmuch as gravity is on the teacher's side in holding the measuring materials to the map. Construction of transparent graphic scales for each scale to be used should be no major project; photo copies of originals should work if renumbered for greater legibility.

The usefulness of the overhead in dealing with non-cartographic geographic graphics should be apparent. Bar, line, and area graphs are common illustrations in geography texts, but are less familiar adjuncts to classroom presentations. In part, at least, this omission must be related to the awkward possibilities offered by opaque graphics. A graph easy to work on will be too small to be seen, whereas one large enough to be readily legible seems bound to be crude in freehand work. Because the overhead enlarges all image elements in their proportions as originally drawn, trend lines, bars, and the like come through well onto the screen, even when they are done at the time of presentation.

GUIDELINES FOR THE MASTERS

At this juncture, attention to the appended overhead-cell masters may prove a logical conclusion for this incursion into graphics technology and machine techniques. Although each has been mentioned briefly in the text, additional consideration of the content rationale as well as detailed production suggestions seem warranted. Readers should remember that the masters have been designed primarily to clarify overhead techniques and secondarily to provide fresh content material. If the slides are useful after they are made, fine. If not, the experiences of preparation will have justified their inclusion. Certainly not all readers will agree with all subjective aspects of these choices; comments and suggestions will be welcome.

Master 1. Process: Simple Progressive Disclosure
Topic: Estimated Population of Planet Earth, circa 1952

This particular example has been included because of the generally high level of response generated from most groups with which its prototype has been used. In its original form, this cumbersome table was typed with an audiovisual captioning typewriter and reproduced directly on 3M *Type 125* film. In use, a translucent white plastic mask is moved downward at a rate appropriate for group reaction. Obviously, if this were to be written on the chalkboard in the presence of a group, the instructor might not make it past the "worms and termites" entry. As an example of our homocentric approach to things, it seems useful contentwise. Although viewers often initially regard it as a hoax, it can be shown to be an example of authentic documentation of unlikely data, and of the extreme use of statistical sampling and projection of results.

This master can be reproduced by any of several means for comparative purposes. The translucent sheet is designed to accommodate diazo reproduction, as are all the masters in this series, but it can be copied thermally. Suggestion: prepare at least one copy as a positive and one as a negative. In the latter mode, the mask alignment will be less critical in use. Parlab reversal film (in black) should provide the easiest and clearest copy. Because of the separation of the title and credit lines from the body of the table, this is a good item to try on *Multicolor* diazo film or on Parlab line film with several dye applications. For serious classroom use, a rainbow effect should be avoided, but for purely experimental transparency production, each line could be colored differently from its neighbors.

Although counting the places from a distance may be awkward, this type should be legible for viewers seated to about fifteen times the width of the projected image. Conservative legibility standards have been used for these masters, but in this case the task of fitting the data into the space dictated the type size.

Master 11. Process: Complex Progressive Disclosure
Topic: Discovery and Exploration from 1400 to 1800

The prime purpose of this slide is to create awareness of the problems and prospects for sequential disclosure of erratically-distributed phenomena, in this case routes of exploration set into a century-by-century context. The slide is a direct outgrowth of the Keuffel and Esser history masters noted earlier in the text. This topic would be ideally suited to motion picture animation, timed to space the events appropriately. Progressive disclosure of overhead cells designed to focus attention to areas of new penetration is a secondary presentation mode, therefore. As suggested in the text, each route might be shown additively, but the problem of visual wandering into irrelevant areas would be present. The present technique is not without its own problems, however, as inspection of areas revealed through the masks will show bits and pieces of routes not established at the periods shown.

Several general design aspects might be noted at this time. The cylindrical equal-area projection has been used for two reasons. Philosophically it perpetuates the visual link between common quantitative graphs and the specialized place-graphs that are called maps. On the purely practical side, no redrawing is necessary if different arrangements of the land and water masses are desired; with a rectanguar grid, plotted distributions can be photocopied, cut apart, and repositioned as needed. Those used to finely-detailed opaque maps may find the style of this item coarse. Actually, design of projected visuals should tend toward a poster style. Considering the effective scale of the image and the nature of the medium, this level of generalization seems appropriate. Although generalizing a fjorded coastline into the straightness of an emerging shore ought not to happen inadvertantly in any case, traditional cartographers' styles may be too "fussy" for contemporary visuals.

Although users may wish to modify the cells provided or to add their own, the basic package is designed to be printed on diazo films and assembled in a specific array. Cells should be printed in the colors noted in the master margins and stacked in alphabetical order from bottom to top. Incidentally, cells *b* and *c* are negative and positive of the same drawing, insofar as the diagram itself is concerned. If the intent had not been to provide a self-sufficient set of masters for this slide, users could have produced the same results with either original and reversing film. Cell *d* probably will be reproduced in monochrome, although some curious users may try to color individual explorers' routes in separate hues. The effort would be recommended, in fact, if this drawing were of larger scale. The remaining cells should be prepared as blackly as possible, stacked to register, and hinged wherever the "handedness" of the instructor is best served. Maximum masking values may be obtained with wet photocopy film or double-coated black diazo film (Tecnifax *KBKD* or *Multicolor* black.)

Two alternate activities are suggested by these masters. A few specific routes might be traced from the route cell and printed as separates. Voyages of Da Gama, Magellan, and Drake would lend themselves to this treatment. These three cells could be used with cells *a*, *b*, and *c* to contrast the additive approach with progressive disclosure. If the space below the diagram is not to be used for written comments about the image, it can be removed effectively by taping opaque material across the lower portion of cell *e* prior to printing. Note that, in the design of masks for progressive disclosure, patterns that are to persist need to be on the last mask together with the final areas to be revealed. Masks for earlier periods need not be all-encompassing, then, as long as they block areas to be revealed later.

Master III. Process: Simple Additive—Subtractive Cells
Topic: USGS Color Symbolism

The rationale for this master set should be self-evident. Visualized as one slide in a series dealing with topographic maps, it lends itself naturally to color-by-color reproduction of a segment of a traditional sheet. Because a 1:1 copy of a 7½ by 9-inch map area may not project well enough for rear-row viewing, this segment has been enlarged from its original 1:62,500 scale. Scale references have been omitted deliberately to avoid any pitfall of scale statements relative to the projected image (on which the scale can be determined from section lines), and to concentrate attention on the topic of color symbolism. Other slides that would be appropriate in the series might deal with scale, symbolism other than the basic colors, and similar general topics.

Execution of the slide as designed needs little clarification. Except for cell *e*, all masters are simply printed as provided. On the master for cell *e*, the word "special" should be cut out carefully, moved ¾-inch directly to the right, and taped into position with 3M *810 Magic Mending Tape*. This procedure, actually compensating for an in-plant error not caught until the masters were printed, suggests the ease with which corrections and changes can be made on originals. Past use has suggested that building up the full-color map from the contour cell or stripping the completed map down to the ground are equally feasible approaches. Mounting of the cells by corner grommetting would permit unhampered display of any component or combinations thereof, but if the red cultural cell is placed atop the black one, as the cell letters suggest, four-sided hinging is fully adequate. Because of the need for rather precise registration of this map segment, the latter procedure is suggested.

The slide has another possible function, however. The particular portion of Oregon shown on the map segment portrays a cultural array well integrated into the physical landscape. If relationships between man and land are to be suggested by manipulation of the cells, the stock captions would be distracting. They can, of course, be trimmed from the masters and replaced with careful tape work after printing. Users electing this specific approach should know that this slide is a portion of the Marcola quadrangle, edition of 1950.

One general-purpose printing manipulation might be appropriate with this slide. If the print from the vegetation master seems too dark, it may be lightened fairly easily in another print. Tape a bit of opaque material over the caption area of the *film* temporarily, then expose the rest of the film for about one-third of a standard exposure. Do this without the master in place. Then, without developing the film, remove the protective tape from the caption, position the film and the master, and expose the combination for the normal time. This procedure will weaken the color somewhat; if more modification is desired, pre-exposure should be increased.

Master IV. Process: Sample Production Techniques
Topic: Principal Climate Regions

Until now the production demands made on the user of these masters have been minimal; this slide has been included to offer opportunities for technique experience in several transparency materials. Only one master, including the outlines of the five "capital-letter" climate regimes and major highlands, together with captioning material, is provided. The climate distributions will register with the grid and oceans cells of Master II. When the latter cell is reprinted for this slide, the pre-exposure technique suggested for the green cell of Master III should be used to lighten the blue cell and the master should be modified slightly.

A number of different procedures can be used with this master. One copy of the cell should be run in black and be transformed into a static slide by coloring the various areas with Lumocolor or similar products. Another could be done entirely by hand using adhesive color films; if this approach is selected, the films should be applied to the back of the outline print so that the line work is not damaged when the color sheets are cut. With either of these approaches, a touch of appropriate color should be placed near the code letters. For true presentations of colors, small openings should be cut into the blue oceanic master near each letter position, because the climate-area color will appear over both blue water and clear land areas on the final slide. If an undisturbed original master is desired, this would be an ideal time for a photocopy of the master to be modified to meet these specific needs.

Multicelled transparencies should be attempted with the master, too. They could be made by either of the processes suggested for the single cell by using either a separate print of the master for each color base, or more logically, by preparing one copy of the master and using it as a base from which appropriate cells are traced onto clear acetate sheets.

For more advanced impressions of master development, the transparencies should not only be multicell projects, but they should be diazo prints as well. Given only this single master, how can six-color diazo transparencies be prepared? Three methods might be used. The master can be used as a tracing base and appropriate areas can be outlined on tracing stock, filled in, and printed. This approach can be used, incidentally, with any conveniently-sized existing drawing. For the purposes of technique instruction both alternate methods are advisable. Both depend on the selective sensitivity of diazo film; both require individual blocking-in of all areas to appear on each cell. One set of six copies of the master should be run on non-reproducing blue diazo tracing stock. The proper portions of each should next be inked or otherwise opaqued to the contact of adjacent color areas. The resulting intermediate masters should then be printed on diazo films. Because the bases were in non-reproducing blue, none of the outlines or lettering of the master will print, and critical contacts between colors may be uneven if opaquing was not done well. For the third solution, another set of six copies of the master should be run on reproducible sepia-line tracing stock. Because the outlines themselves will print automatically in this case, adjacent colors will overlap slightly on the final printed cells. Moreover, all the outlines and all the lettering will appear on all the cells. With the sepia approach, opaquing is somewhat less critical and the slight color overlap often looks better on the screen than a beginner's job on blue-line work; the latter may feature both color overlaps and white gaps along misfitted edges. If the total outline pattern is not desired, the unwanted portions of the sepia copies can be cut off before printing. Captioning is a challenge in both methods. A static title and label cell can be made for both slides by cutting the distribution outlines from a print on sepia paper, then printing the cut-out sheet to provide both the caption and all code letters. With this approach, a patch of opaquing can be placed on each cell to key the climate being presented to its code letter. If letters in the colors themselves are desired, blue-line users can cautiously tape each of the sepia code letters into a cut out on the appropriate cell master. Sepia masters, on the other hand, can be modified by cutting out all inappropriate letters from the individual cells.

For complete freedom in use, these cells must be corner-grommetted. Practice with the prototype slide has confirmed that this operation is desirable unless duplicate slides are made to incorporate specific relationship contingencies. For example, if one does not wish to show drylands only with the high-latitude realms also visible, one must plan accordingly with corner hinging or several slides.

Completion of these slides by the methods suggested should convince a novice that he can tackle just about any overhead graphics task. Few will be as miniscule and convoluted as the cells for this one, and few will require as many separate sheets to be dealt with.

Master V. Process: Various Reproduction Procedures
Topic: Lettering, Line, and Symbol Legibility

This master is included for purely internal utility. Because so much depends on the clarity of an overhead image and so many variables are present in the production of transparencies, this master has been prepared as a test item to pinpoint a few design standards. It should be run on each type of film in the user's inventory, projected, analyzed, and recorded for reference in future design and production efforts.

Before analyzing the content of the master, a brief look at the minimal ground rules of projection legibility is warranted. Generally, legibility is a function of visual contrast and apparent size. Given proper contrast, a person with normal vision should be able to read 1½-inch letters readily from a distance of thirty feet. To facilitate planning of slides, Eastman Kodak authorities have long set viewing-distance standards in terms of a ratio to screen image width rather than in terms of raw distance alone. Optimum viewing lies between two and six times the width of the screen image, or in the 2W-6W range by Kodak notation. With the emergence of television and rear-projection devices to be used in normally-illuminated rooms, viewing ranges based on one foot of distance for each inch of diagonal image measurement have been proposed. This development calls for planning for viewers up to 15W. The standards suggested in this booklet are based on both purely empirical study of legibility at 15W and on works, such as those by Robinson, in which theoretical limits of vision have been used. Because conditions frequently seem to be less favorable than "normal," these suggested standards are toward the conservative side, yet their use results in reasonably pleasing work that does not appear overlettered or heavyhanded.

The master provides a representative sampling of type sizes and faces, symbols, and lines in both positive and negative form. When evaluating the slide, users should cover the contrasting half to secure conditions approximating those of full images in either configuration. When it is desired to compare positive items against backgrounds in various colors, the cells should match adequately. For this purpose, though, a cardboard mask for the projecture aperture is suggested to limit viewing to a confined portion of the slide and to minimize stray light. The negative, or reverse, form is often recommended for slide or film work because it carries well with significant amounts of stray light in the room, results in a less glary image, and minimizes spillover onto adjoining screens during multiple projection.

Even though users should form their own opinions about the effectiveness of the several samples, some preconditioning with general observations may not be out of place. Lettering less than one-twentieth of the height of the slide becomes difficult to read in many cases, and that more than about one-sixth of the height becomes limiting in terms of long words. On 1:1 originals, then, lettering should be between 3/8 and 1 inch in height for complete and easy legibility from 15W; actual height choices within the range will depend on the layout demands of the original. Lettering as small as 1/4 inch can be useful for incidental notations for use at 15W, and 1/8 inch lettering will serve the same purpose up to 6W. Lines less than 1/16 inch thick on a 1:1 original will be clearly visible, but color differentiation may require heavier line work according to the colors involved. Point symbols should be at least 1/10 inch in diameter for adequate resolution at 15W, and if colors are to be readily apparent, larger sizes seem appropriate.

These observations on size should not detract from considerations of form of letters and symbols. Although simple work is less likely to suffer in reproduction than more complex designs, the stereotyped look of mechanical drawings need not be forced onto overhead cells in the guise of clarity or efficiency in preparation. The broad range of type styles available in dry transfer and cut-out materials provides for personalization of designs. Because ornate lettering is less legible than clear-cut faces, it need not be discarded; larger sizes can be substituted to compensate. In general, lower-case letters are considered easier to read than upper-case letters of the same overall size, so normal capitalization practice should be followed in most work. If size of lettering is to be a clue to differentiation among details, height differences of about 25 per cent may be required to provide clear-cut distinctions between separated words. Marked width differences may prove useful in some applications, as the master suggests. From the purely expedient standpoint, casual lettering styles are much easier to work with when preparing originals and they may be more compatible with on-the-spot freehand work than would highly regular and formal faces.

Lettering used for these masters would not be employed for 1:1 cell production because the originals for the masters were enlarged or reduced to their present size. Otherwise unidentified lettering (original, and, when possible, equivalents to the master items) is tabulated below.

Master I.
Varityper Headliner V 36-119 (36 point); reduced. No exact match, although V 30-119 is approximate.

Master II.
Main and supplementary titles: *Formatt* 5150 (Libra; 36 point). Enlarged 2x and 1.5x from stock type, then reduced with entire original. No exact match, but *Headliner* Style 30 in smaller sizes might serve if needed. Grid numbers: *Letter-Press* THK-2-3-24 (24 point). No match.

Master III.
Main title: *Instant Lettering* 591 (Soho; 36 point). Additional titles: *Letter-Press* THK-2-3-24 (24 point). Both enlarged to master size; 590 and THK-2-3-35 should substitute, but lower-case "g" on additional titles is a reworked letter on these masters.

Master IV.
Instant Lettering 588 (Soho; 72 point). Reduced; 591 is a near match.

Master V.
This master was reproduced 1:1 from the original, so all materials should match as identified.

1 and 4 *Instantype* L-1545 (Action Script; 36 point).
2 *Instant Lettering* 145 (Playbill; 72 point).
3 *Mico/Type* T-642 (Craw Modern; 24 point).
5 *Instant Lettering* 578 (Hand-drawn No. 2; 36 point).
6 *Instantype* L-1320 (Univers #49; 60 point).
7 *Instant Lettering* 591 (Soho; 36 point).
8 *Deca-dry* 5248 (Helvetica; 48 point).
9 *Deca-dry* 1748 (Narcisso; 48 point).
10 *Instant Lettering* 586 (Hand-drawn No. 5; 36 point).
11 *Formatt* 5417 (Optima; 36 point).

Note particularly that point size in itself indicates neither actual height of letters nor their legibility. Reading ease may be hampered considerably by overly-compressed type styles, and probably messages that need such compression to fit on a slide are too long to be used. Also, finer lines (as in the body of 11 and the serifs of 3) may be lost somewhere in the reproduction processes or during projection. Very bold faces (3 and 10) may prove useful to help lettering in light colors carry adequately, but reproduction by thermal processes may be uneven. Although in general less complex lettering designs are more legible, "hook-topped" a's (as in most examples and *Instant Lettering's* 232, a 48-point Albertus) are more recognizable than those of the "o"-like faces. Because of their similarity to manuscript characters, the latter style (Futura, here in *Para-Tipe* 1305; 48 point) may be of use to primary-grade teachers. Some reading authorities advise against the use of either manuscript printing or cursive writing on prepared visual items, however, and recommend treating a slide as a printed page.

The point symbols and lines are more easily compared to available detailing items. The dots and asterisks are from *Artist-Aid* sheets 630, 631, and 633. Lines are, from the top, *Chartape* 564, 532, 516, 508, and 504.

* * * * *

Although geography via any medium retains its essence, geography via the overhead projector may be more bloom than thorn!

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Wrathal, J. E.; "The Overhead Projector — A New Aid for the Geographer"; *Geography*, Vol. 51, January 1966, pp. 38-41.

SOURCES OF OVERHEAD MATERIALS

Although investigation of material and equipment sources may be undertaken through district and similar instructional media centers, some potential overhead users may choose to contact manufacturers directly. Many of the foremost producers of overhead supplies are identified in the following list; a complete directory of all possible sources would require a volume in itself. Specific exclusions are entirely accidental, and no evaluative indications have been provided. Aid in evaluation of materials for production of slides should be forthcoming from art suppliers, who stock most of the do-it-yourself materials. Prefabricated geographic-term lettering sheets are currently available from the author.

ACS Tapes, Inc., 217 California St., Newton, Mass. 02158

American Optical Co., Instrument Division, Eggert and Sugar Roads, Buffalo, N. Y. 14215

Artype, Inc., Crystal Lake, Ill. 60014

Charles Beseler Company, 219 S. 18th St., East Orange, N.J. 07018

Bourges Color Corporation, 80 Fifth Ave., New York, N.Y. 10011

Buhl Optical Co., 1009 Beech Ave., Pittsburgh, Pa. 15233

Chart-Pak, Inc., Leeds, Mass. 01053

The Craftint Manufacturing Company, Cleveland, Ohio 44112

Denoyer-Geppert Co., 5235 Ravenswood Ave., Chicago, Ill. 60640

Diazit Co., Monmouth Junction, N.J. 08852

A. B. Dick Company, 5700 Touhy Ave., Chicago, Ill. 60648

Eastman Kodak Co., 343 State Street, Rochester, N.Y. 14650

General Aniline and Film Co., 140 W. 51st St., New York, N.Y. 10020

Graphic Products Corp., Rolling Meadows, Ill. 60008

Hammond, Inc., 515 Valley St., Maplewood, N.J. 07040

Hubbard Scientific Company, 2855 Shermer Road, Northbrook, Ill. 60062

Instantype, Inc., 7005 Tujunga Ave., North Hollywood, Calif. 91605

Keuffel and Esser Co., 300 Adams St., Hoboken, N.J. 07030

Jay G. Lissner & Sons, 3417 W. 1st Street, Los Angeles, Calif. 90004

3M Company, Visual Products Dept., 2501 Hudson Road, St. Paul, Minn. 55119

A. J. Nystrom and Co., 3333 Elston Ave., Chicago, Ill. 60618

Para-Tone, Inc., La Grange, Ill. 60525

Printing Arts Research Laboratories, Inc., 273 La Arcata Bldg., Santa Barbara, Calif. 93104

Projection Optics Co., Inc., East Orange, N. J. 07017

Seal, Inc., Brooks Street, Shelton, Conn. 96485

J. S. Staedtler, Inc., P.O. Box 68, Montville, N.J. 07045

Tecnifax Corporation, 195 Appleton St., Holyoke, Mass. 01042

Varityper Corporation Division of Addressograph-Multigraph Corporation, Newark, N.Y. 14513

Visual Impact Materials, Inc., 812 E. Apache Blvd., Tempe, Ariz. 85281

DO IT THIS WAY SERIES #7

The correct stacking sequence for the cells of Master II is

top	cell e	The "known world" c. 1400 mask
	cell f	1400-mask
	cell g	1500-mask
	cell h	1600-mask
	cell i	1700-1800 mask
	cell d	routes
	cell c	land
	cell b	oceans and background
bottom	cell a	grid

NCGE Master I see brochure

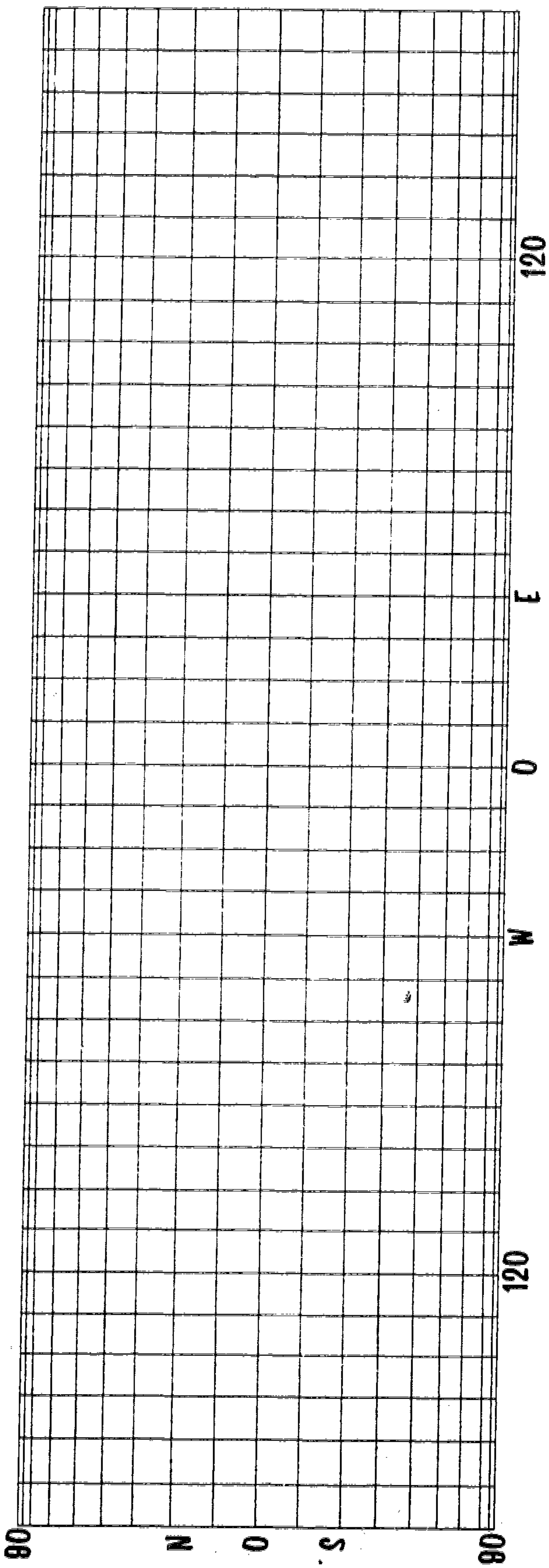
ESTIMATED POPULATION of PLANET EARTH, circa 1952

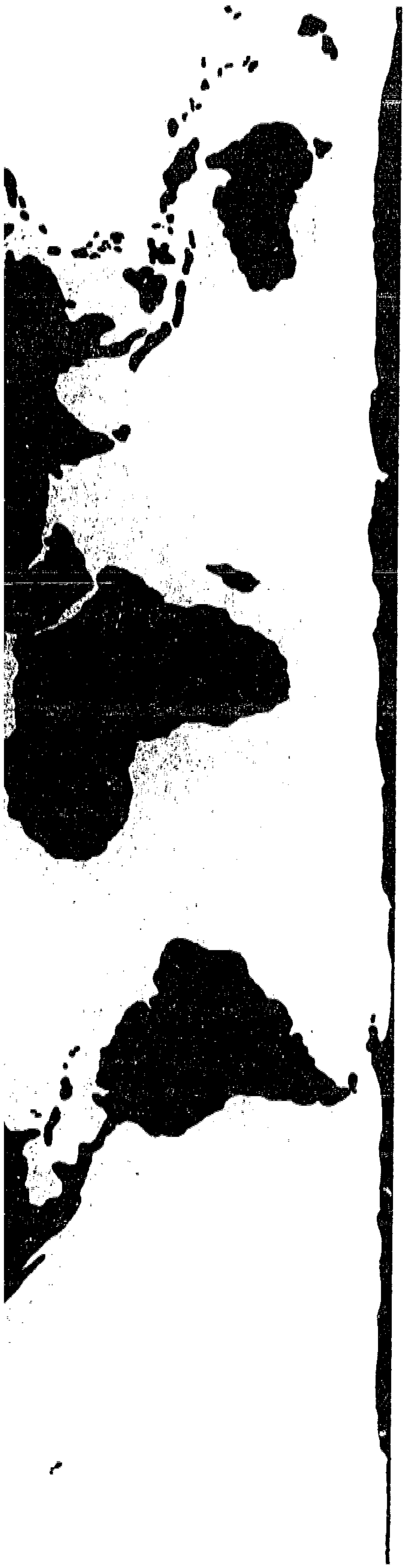
Human Beings	2,500,000,000
Domestic Pets	2,600,000,000
Food and Work Animals	4,400,000,000
Water Animal Life	580,000,000,000,000
Wild Animal Life	1,667,000,000,000,000
Worms and Termites	92,428,683,600,000,000,000,000,000,000
Insects	3,416,341,600,000,000,000,000,000,000,000
Protozoa and Algae	70,781,761,494,767,278,000,000,000,000,000
Land Plants	721,386,396,106,333,000,000,000,000,000,000
Bacteria	2,165,105,198,325,000,000,000,000,000,000,000
Total	2,960,764,126,209,700,280,247,009,500,000,000

from DOANE, WORLD BALANCE SHEET, p. 103.

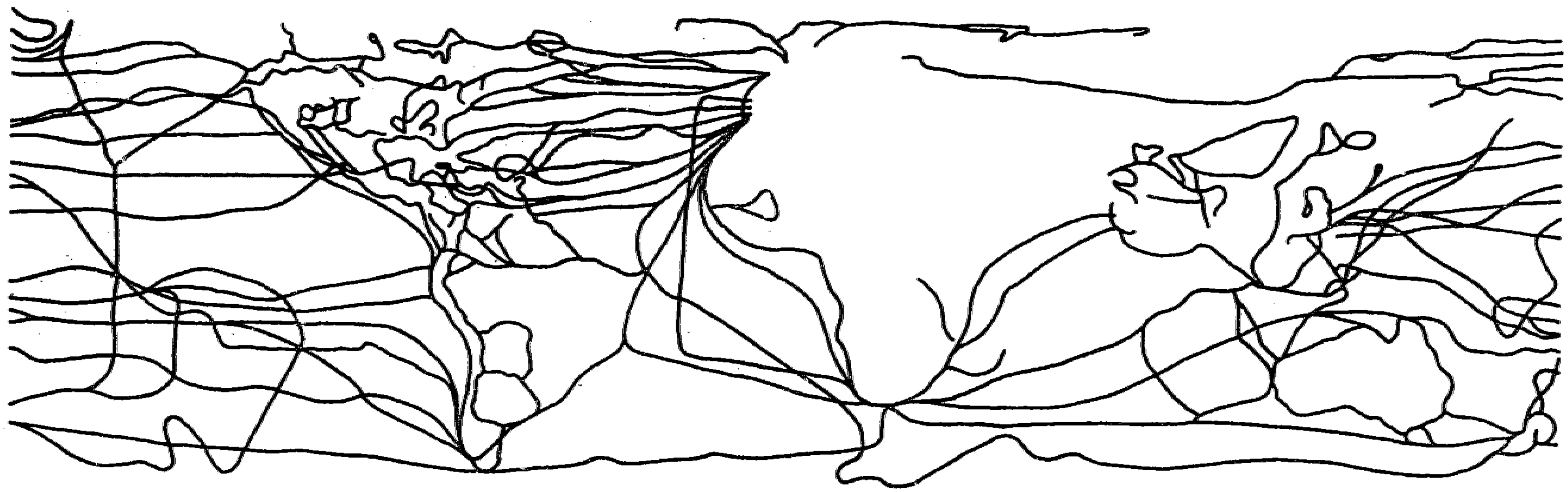
Source: Doane, Robert R., World Balance Sheet. New York: Harper and Brothers, 1957. Table VI-1, p. 103.

NCGE Master II Cell a VIOLET or BLACK





Discovery and Exploration from 1400 to 1800



Routes highly generalized after Debenham, Discovery and Exploration, and others.

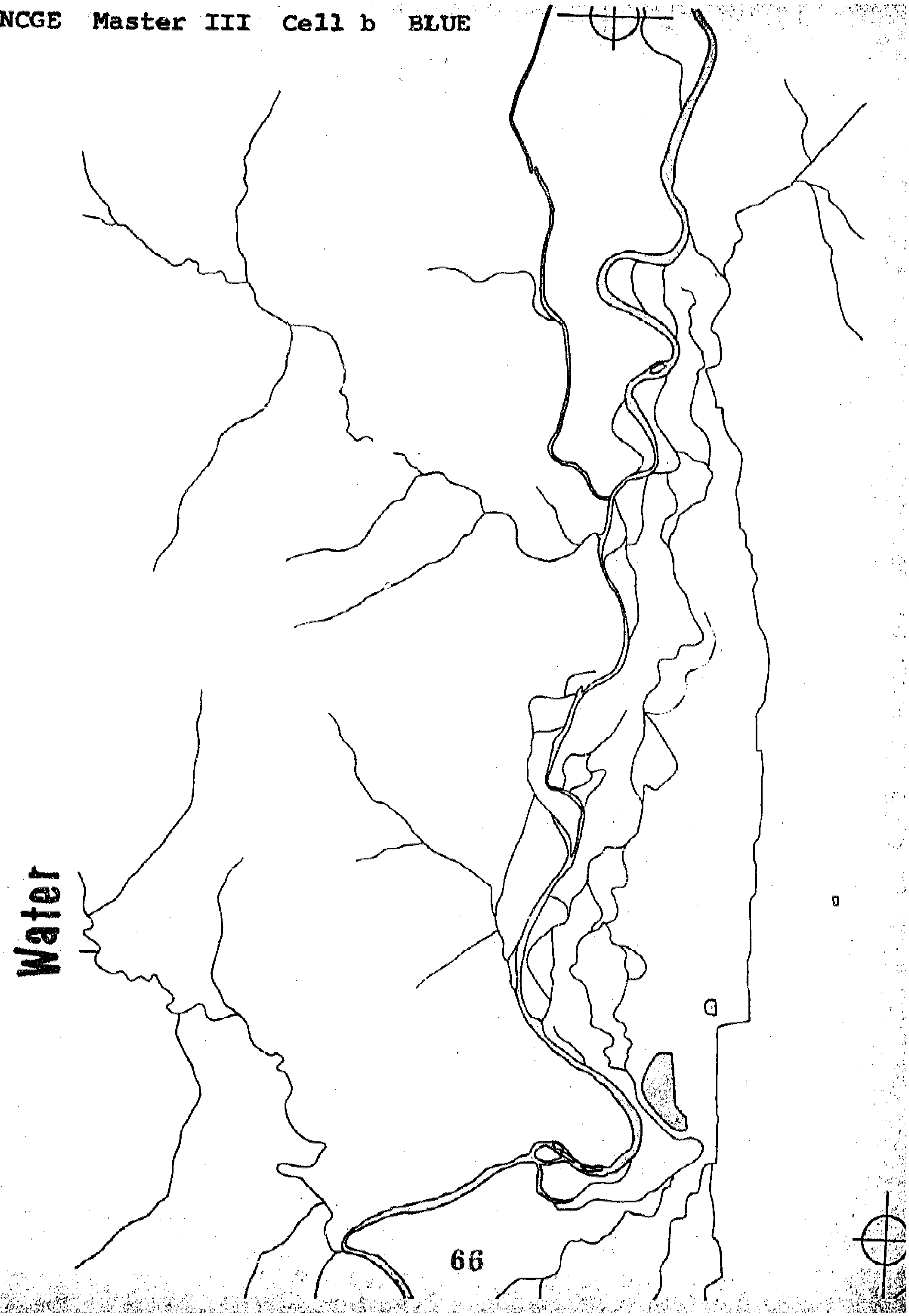
the "known world" CIRCA 1400

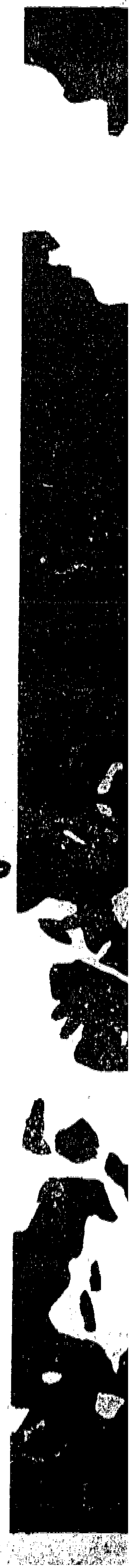
CK

1600

1700 - 1800

USGS Color Symbolism
Landforms

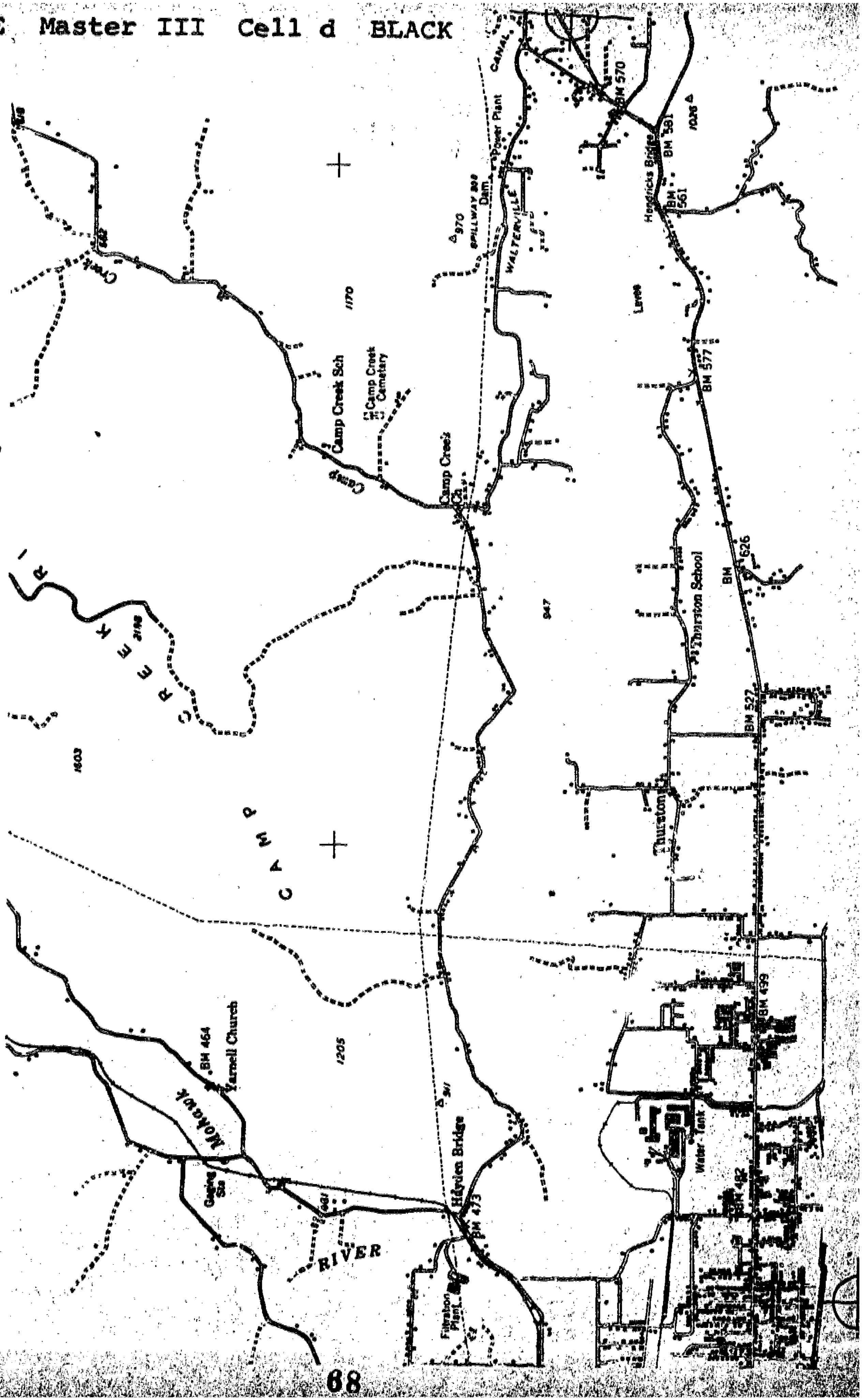

Water



Vegetation

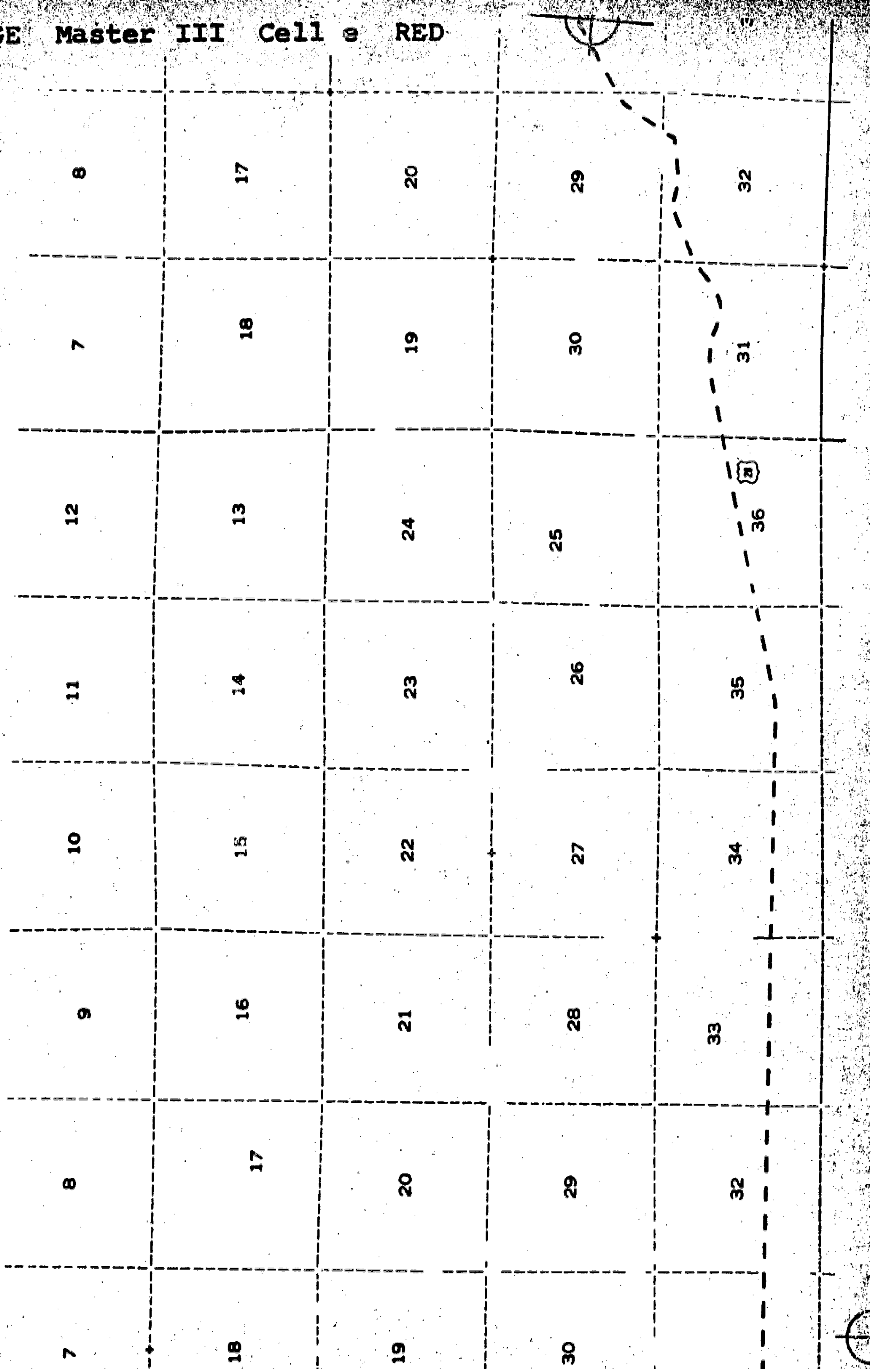
GREEN

Culture general

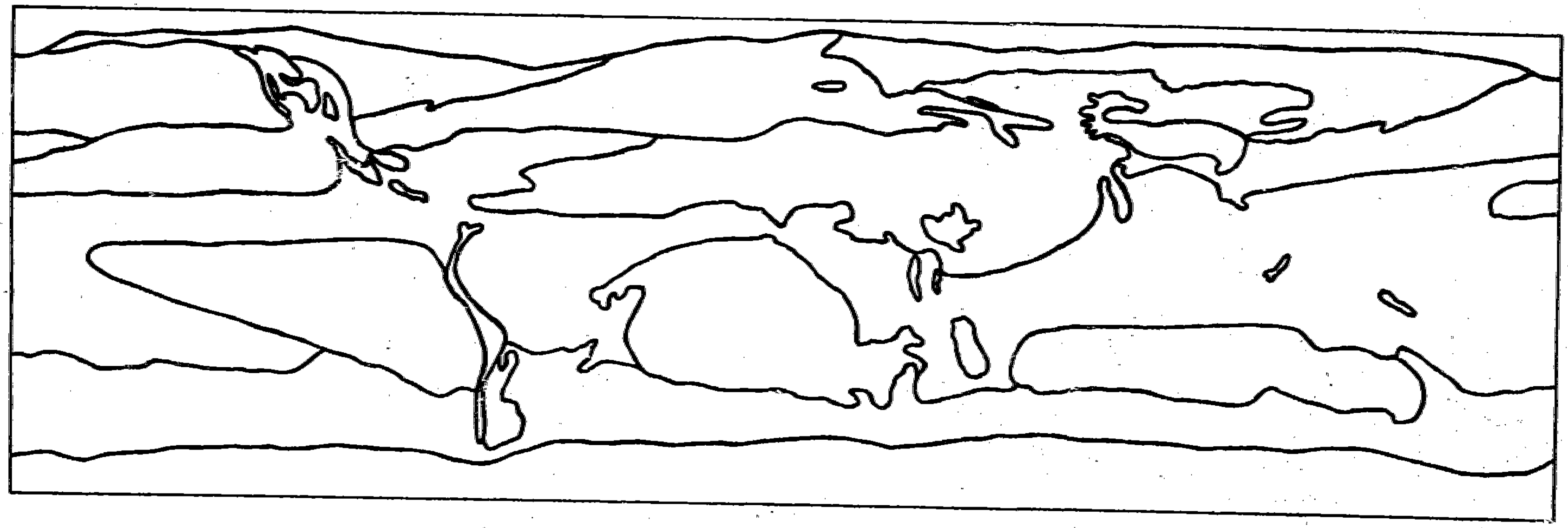


NCGE Master III Cell 8 RED

Special



Primary Climate Regions



A B C D E H

Patterns highly generalized after Koppen, Trewartha, and other sources.