

## V. Figures – SEE ADDENDUM –

Figures play a significant role in the expression of scientific ideas. A single well-prepared figure can contribute immeasurably to the clarity of the text, and high standards of presentation are therefore particularly important. Authors themselves must assume full responsibility for the preparation of acceptable figures, because illustrators are not available for this purpose in the editorial offices. Follow closely the detailed instructions given below for the preparation of line drawings and the presentation of photographs. Remember that unacceptable figures are a common cause for delay in the publication of a paper.

### A. GENERAL INSTRUCTIONS

(1) Design figures for reduction to the journal column width (consult a recent issue of the journal for the dimensions). One and a half or two columns may be used when required.

(2) Group the figures in order at the end of the manuscript, after the collected captions.

(3) Identify each figure with the figure number and authors' names. Write the identification where it will not be reproduced, preferably at the bottom of the figure—never within the figure itself, and if possible not on the back of the figure. To accommodate the information that may be added later in the editorial office, leave a space at least 50 mm (2 in.) deep across the bottom of the figure. Be sure the identification appears on all copies as well as on the originals. If the identification must be written on the back of a photograph, write lightly with a soft pencil so as not to make a visible depression that will show through to the face of the photograph. Indicate the correct orientation if there is a possibility of error (write "Top" in the top margin).

(4) Prepare related figures as a group, so that two or three may be printed either down one column or across two. Such an alignment is greatly facilitated if the figures are all the same size, or of common width for a vertical arrangement, or common depth for a horizontal arrangement. Assign the group of figures a common caption. If these figures are referred to separately, refer to them by lower-case letters in parentheses [(a), (b), (c), etc.] and draw the letters inside the figures at analogous locations.

(5) Protect figures against damage in transit. Usually the best way is to mail them flat, protected by heavy cardboard. If a drawing is folded, lines or symbols may be broken or spoiled by the crease. Never roll or fold photographs. Keep them free of clips, staples, or any pressure that might cause damage. Rolling oversize drawings and mailing them in a tube is not recommended; a better plan is to submit photographic reductions of large illustrations of a size that can be conveniently mailed flat.

### B. LINE DRAWINGS

Line drawings use only lines and black areas on the white background. Variations in tone between the black and white extremes cannot be reproduced. Study recent issues of the journal to which the manuscript will be submitted for

examples of acceptable drawings, and see Fig. 2, an example of a poorly prepared line drawing, and Fig. 3, a well-prepared drawing, for some common errors and ways to correct them.

(1) Line drawings should be made with black India ink on Bristol board, heavy smooth paper, or high-quality tracing cloth. For maximum black-and-white contrast use white material only. Do not use Mylar, tracing paper, or ruled coordinate paper. Drawings on board or heavy paper can be protected with an overlay of tissue paper fixed to the back of the drawing and folded over to the front. Glossy photographic prints of line drawings are very satisfactory provided they are sharply focused uniformly across the print.

(2) Draw lines, symbols, and letters that will withstand reduction to the journal column width. To this end:

(a) All lines must be black and have a solid, even, line weight. Gray or thin lines will break up or disappear in reduction. The material on which the figure is drawn is relevant: the less opaque the material, the longer must be the exposure time and therefore the darker must be the artwork.

(b) Draw symbols and letters so that the smallest ones will not be less than 1.5 mm (1/16 in.) tall after reduction; symbols smaller than that may be illegible. For example, a figure 150 mm (6 in.) wide will be reduced to half its original height and width to fit a single journal column. Therefore the smallest symbols and letters should be drawn 3 mm (1/8 in.) high. If the detail to be shown does not permit symbols of this size, only a part of the figure should be included.

(c) Avoid gross disparities in the thicknesses of lines and in the sizes of symbols and letters. Open or half-closed symbols ( $\circ$ ,  $\Delta$ ,  $\square$ ) tend to close up or become indistinct when reduced; draw them slightly larger than closed symbols ( $\bullet$ ,  $\blacktriangle$ ,  $\blacksquare$ ). (Open symbols with dots inside them fill in so easily upon reduction that they should not be used at all.)

To distinguish the principal lettering from the lettering in subscripts and superscripts, draw the principal lettering about one-third larger (approximately 2 mm after reduction) than the smaller lettering. More than two sizes of lettering are unnecessary. Give decimal points a diameter about 1.5 times the thickness of the lines in the lettering.

(d) Letters should not be so closely spaced that they run together in reduction. They should be simple in style, without serifs. Open parts of letters and numbers such as "e" and "6" should be large enough not to fill in on reduction. Handlettering is never acceptable. Most typefaces available on typewriters are also unsuitable. Mechanical lettering sets and stencils are strongly recommended.

(3) Graphs should be self-explanatory, their purpose evident without reference to the text. Indicate clearly what is being plotted, in both the horizontal and the vertical directions. Include appropriate units. Orient letters and numbers so that they may be easily read from the bottom or the right-hand side of the graph. Relevant nongraphic material, such

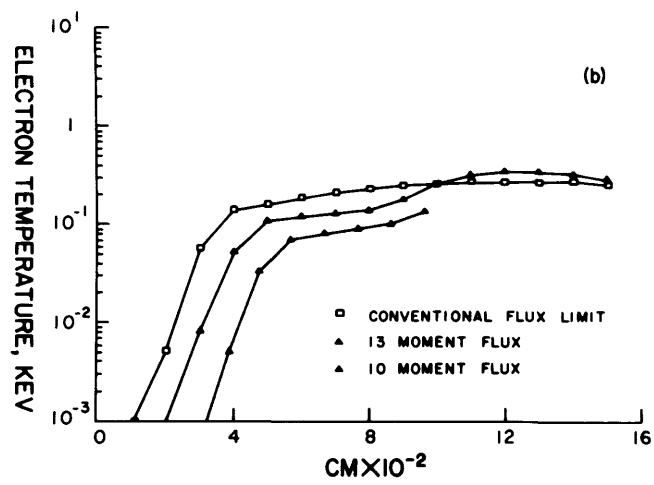
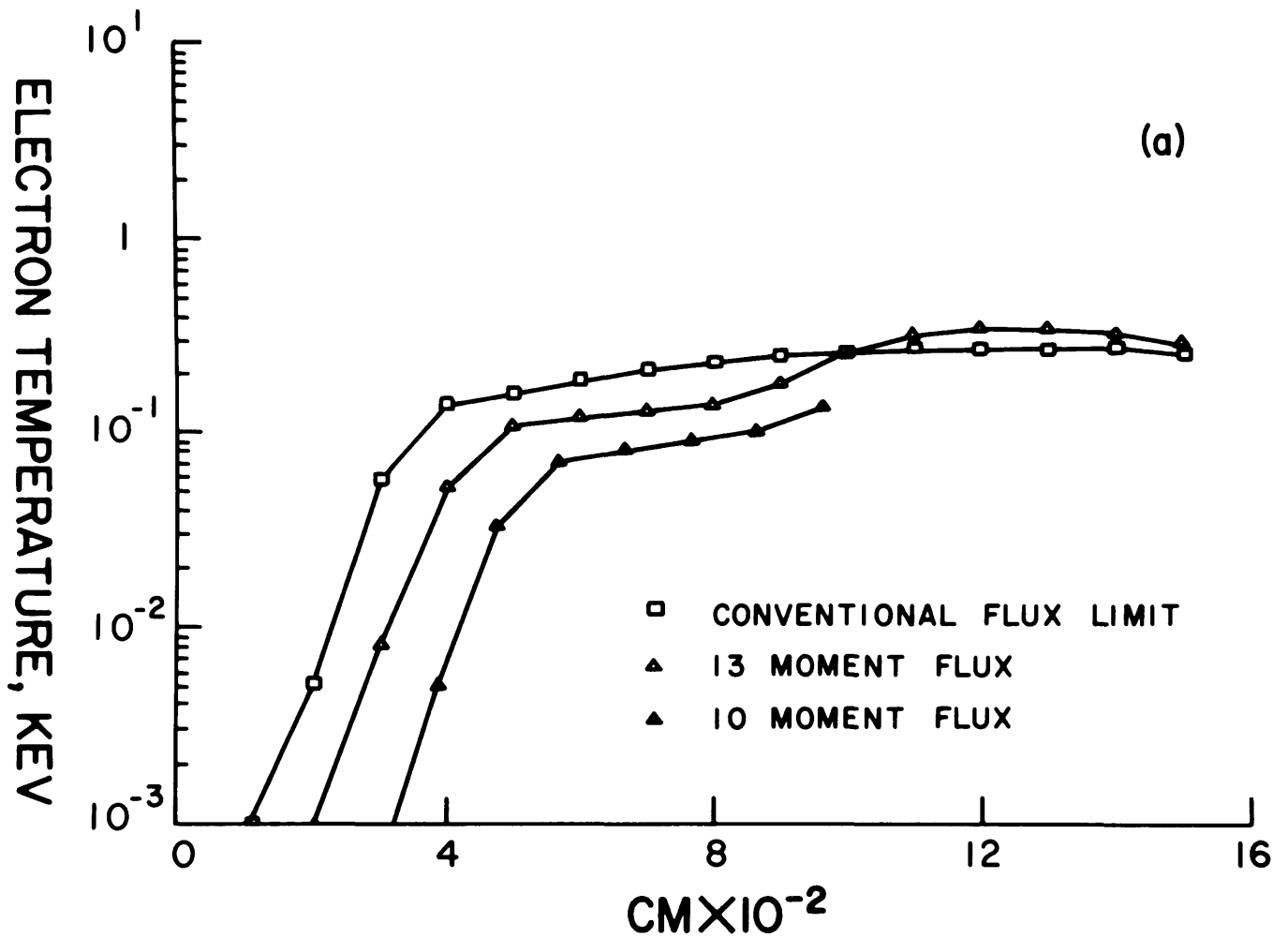


FIG. 2. A poorly prepared line drawing (a) actual size and (b) reduced to the journal column width. For uniform lettering, the axis labels should be diminished, and the lettering within the graph enlarged, to match the size of the axis numbers. The ordinate label is best written "electron temperature (keV)"; it should face the graph. The abscissa should be fully identified; the power of 10 should precede the unit ( $10^{-2}$  cm) or, better, be attached to the largest number on the axis ( $16 \times 10^{-2}$ ). The data symbols in this figure should be at least as large as the superscripts. As drawn, the open triangles tend to close on reduction, and ambiguity results. The ordinate extends unnecessarily and wastes space. The graph should be enclosed by four lines, each with ticks.

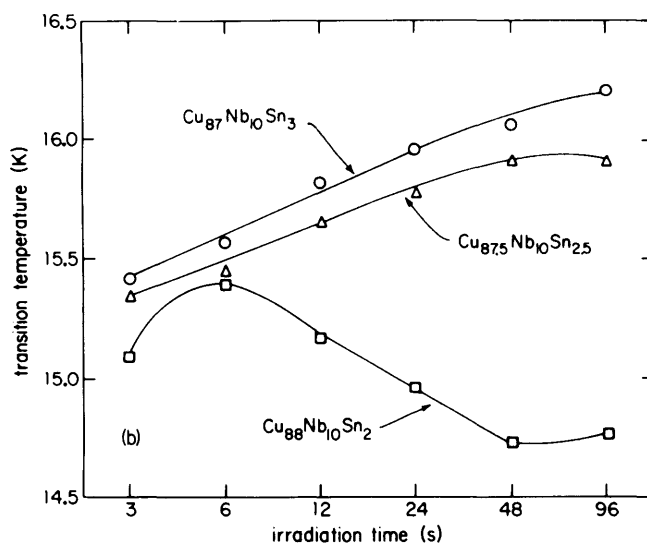
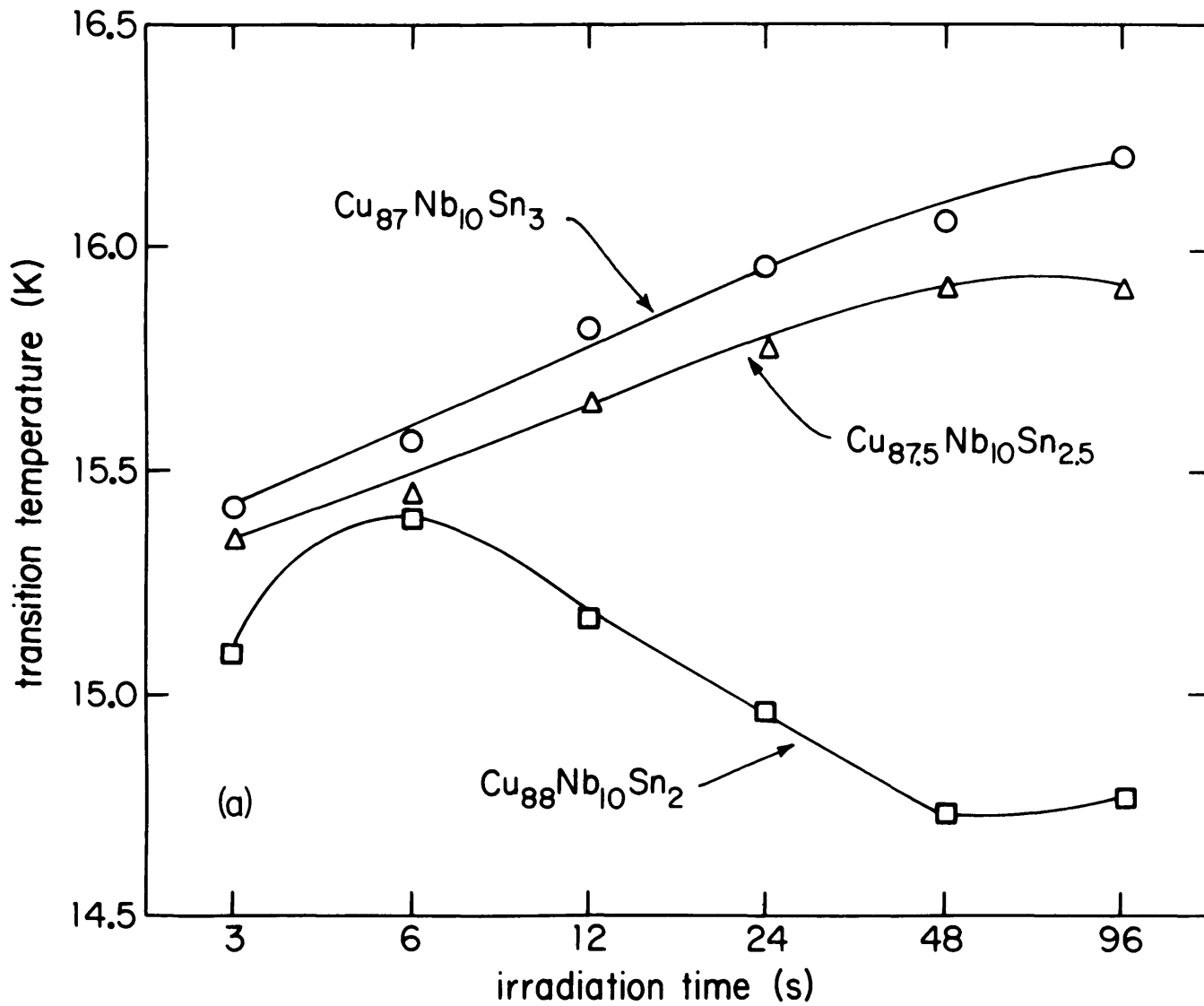


FIG. 3. A well-prepared line drawing (a) actual size and (b) reduced to the journal column width.

as the key to the symbolism in the graph, may be included within the confines of the graph frame if it will fit without crowding; otherwise put the explanatory material in the caption.

In captions, use available symbols (see Appendix F) to represent data points, but use words to identify curves (for example, "solid," "dashed," "dotted," "dot-dashed," etc.). A better alternative is to label curves with letters (A, B, etc.) and to refer to them by letter in the caption ("Curve A represents...").

The notation used in graphs should be standard and consistent with the notation used in the text. Write 0.1, not .1, 0·1, or 0,1. Do not capitalize letters indiscriminately: write

in units of  $q/a$ , not IN UNITS OF  $q/a$

and

kinetic energy  $E_f$  (meV) not KINETIC ENERGY  $E_f$  (MEV)

Take care to preserve standard forms for symbols and abbreviations, as you would in text. Standard units should be well spaced off and enclosed in parentheses.

If possible, do not use powers of ten in axis labels: use instead the appropriate prefixes of the *Système International* (see Table IV). If powers of ten must be used, write for example

$$R(10^{-4}\Omega) \text{ or } 10^4R(\Omega).$$

Never write

$$R \times 10^{-4}\Omega \text{ or } R/10^{-4}\Omega,$$

because in these forms it is not clear whether the scale numbers have been or are to be multiplied by  $10^{-4}$ . Better still, attach the power of ten to the largest number on the axis:  $8 \times 10^{-4}$ .

Whenever possible, use integer numbers on the axis scales of figures (1, 2, 3, or 0, 5, 10, not 1.58, 3.16, 4.75 or 1.5, 3.0, 4.5). If this is not feasible, then there must be a number both before and after the decimal point: Use 0.5, not .5, and 5, not 5., etc. Do not use unnecessary decimal places: 1.0, 1.5, 2.0 is acceptable, but not 1.00, 2.00, 3.00.

Coordinate ruling should be limited in number to those necessary to guide the eye in making a reading to the desired degree of approximation. Ticks to indicate coordinate values, placed within all four sides of the graph, increase readability, and are recommended. Closely spaced coordinate rulings are appropriate only for computation charts. It is often impossible in a journal to make a graph large enough to preserve accuracy of the data beyond two significant figures. If that accuracy is not sufficient for your purposes, present the data as a table.

Graphs with large blank areas, or large areas containing only nongraphic material, are unacceptable; use only the ranges of coordinates for which there are data. If similar quantities are plotted several times, use shifted ordinate scales for each plot and enclose the plots in one large rectangle, not in separate boxes, thereby saving space. Isometric drawings giving the illusion of three dimensions to the family of curves are often better.

(4) In diagrams of electrical circuits, the values of resistances, inductances, etc. and component designations should be lettered directly on the diagram. A separate parts list in the caption is then unnecessary, except for special or unusual components.

(5) "Shading" (that is, various shades of gray) in line drawings does not reproduce well. Diagonal lines, cross-hatched lines, or arrays of dots the size of the periods used in lettering (or larger) reproduce well. Even more convenient are the commercial products for applying coarsely textured or "Benday" screened areas in line art by peel-off or rub-on methods.

(6) Computer-drawn figures can now be made equal in quality to those drawn by a skilled draftsman, and the same criteria should apply to them. In particular, lines should be dark, and of adequate width to survive reduction. Lettering should be simple, pleasing to the eye, in one typeface only and no more than two sizes. The slash through a zero to differentiate it from the letter O is unacceptable.

Joining every pair of adjacent experimental points is an easy solution but it may lead to curves that are too obviously a series of line segments or that are very "noisy." It is preferable to produce a curve by some smoother method, such as by the use of an analytical approximation, in which the calculated points may be as close as desired and only the lines joining them need appear.

(7) When correcting errors in a line drawing, either make the corrections on thin opaque tape (thick tape casts shadows that reproduce as spurious lines) or cover the error with paint, reletter, and cover both the paint and the new lettering with clear tape (exposed paint will flake).

### C. CONTINUOUS-TONE PHOTOGRAPHS

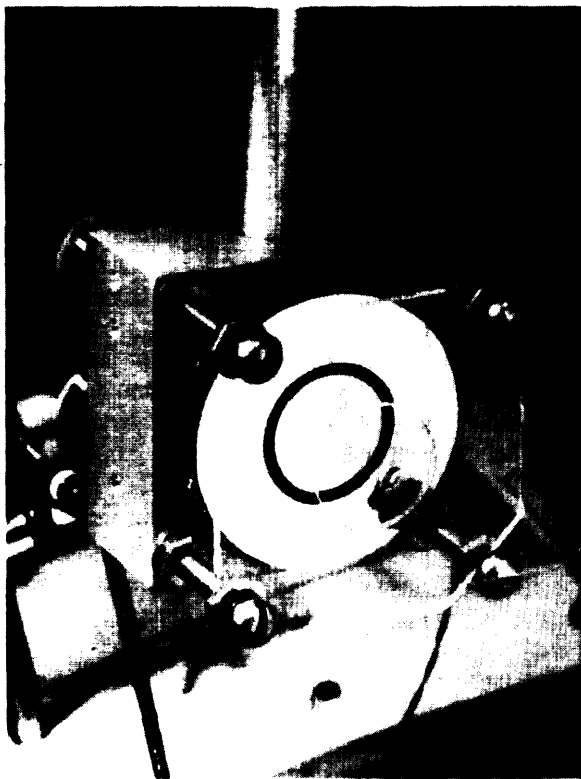
Continuous-tone photographs require half-tone reproduction. In this process the photograph is transferred to a printing plate as a pattern of dots. Variation of perceived tone is achieved by variation in the size of the dots; the largest dots produce the darkest areas and the smallest, the lightest. Naturally, the quality of the reproduction ultimately depends on the quality of the original.

(1) Submit photographs on glossy paper. Because contrast is often lost in reproduction, the photograph should be printed with rather more contrast than is desired on the printed page. Photographs that have already been screened are unusable; interference between the pre-existing screen and the one imposed for reproduction results in a moiré pattern.

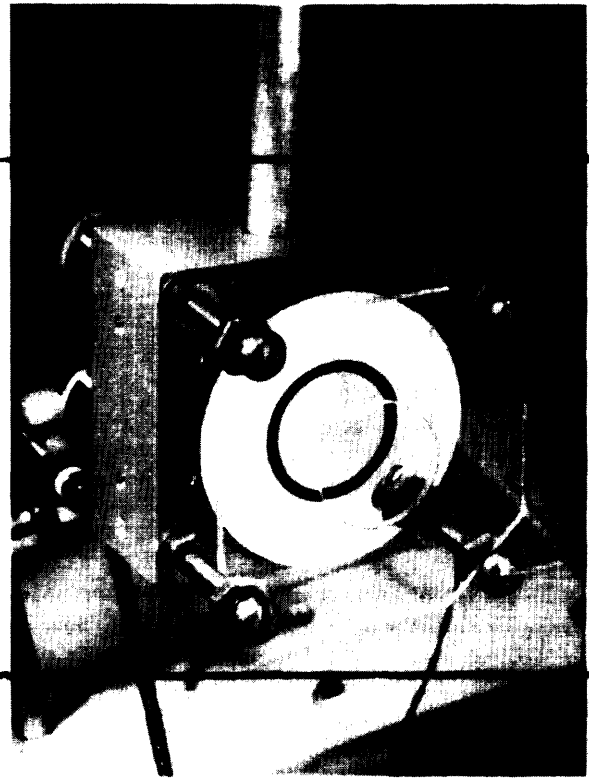
(2) As with line drawings, most photographs will be reproduced at the journal column width. For good results, submit original photographs of a larger size than this (say,  $200 \times 250$  mm).

(3) Lettering used to identify components of a photograph should be large enough that it will be legible after reduction. The lettering should contrast with the background; that is, black lettering on a light ground, white lettering on a dark ground.

(4) If a photograph is to be cropped, mark for cropping as shown in Fig. 4(a). That is, put crop marks on the margin or mount, not on the photograph itself.



(a)



(b)

FIG. 4. (a) Proper crop marking. Mark plainly at the edges of the photograph as shown, or on a transparent overlay. (b) Improper crop marking. Crop marks on the photograph itself force the printer to work inside the marks and thus to reproduce less of the photograph than was intended. The photograph is also unsuitable for future use.

(5) Photographs of apparatus in the laboratory are not usually instructive. A good line drawing of apparatus, amply and clearly labeled, is usually much more useful.

(6) Photomicrographs may carry an overlay sheet on which you indicate where the clearest reproduction is required. The printing process tends to collapse the scale of gray tones in a photograph, and without help of this kind the printer may choose to differentiate tones elsewhere in the photograph and lose contrast where you need it most. All such micrographs should carry an indication of the scale within the area to be reproduced. Designations such as "1000 $\times$ " are to be avoided because the size of the printed figure is generally different from that of the submitted photograph. Indicate the orientation desired, for example, by writing "Top" on one margin of the print.

It is unwise to submit a unique original micrograph, or any unique photograph that is the only record of an experimental result.

(7) Most journals published by AIP and its Member Societies will publish colored illustrations, but only at the discretion of the editor and usually with substantial additional costs to be borne by the author. Before submitting a

colored figure, consider whether the color adds significantly to the information that can be read from the photograph. Often a good black and white photograph is adequate. Consult the editor first.

Under suitable conditions it is sometimes possible to include microfiches, flexible sound recordings, or other material in pockets pasted to the inside of the back cover of the journal. Again, consult the editor beforehand.

#### D. COMBINATION FIGURES

A "combination figure" contains both a continuous-tone area and a line illustration. To prepare a combination figure for offset printing, two processes must be used, one for the halftone and one for the line art. Whenever possible, submit a simple continuous-tone photograph instead, with the line art drawn directly within its area.

If a combination figure must be submitted, then:

(1) Submit the linear material on an acetate overlay attached to the photograph.

(2) Prepare the original figure so that, after reduction, there will be at least 4.5 mm (3/16 in.) of white space between the line and tone areas.