A MASKING TECHNIC FOR PHOTOGRAPHIC REPRODUCTION OF ROENTGENOGRAMS

Preliminary Report

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ROENTGENOGRAPHIC detail that ordinarily cannot be reproduced by conventional photographic methods may at times be preserved by means of a masking technic. The method described here is not entirely original, but is a modification of several previously described technics aimed at development of a simple yet effective process.

The basic problem with which radiologists and medical photographers are faced is the difference in contrast between roentgen film, which is viewed in transmitted light, and photographic paper, which is viewed in reflected light. The brightness range of a roentgenogram may run from 1 to 1000 or more; whereas, that of a photographic print may run from less than 1 to 50.[1] To offset this wide difference in contrast ranges, it has been common practice in making prints of roentgenograms to use a *dodging* or *blocking* procedure that decreases the exposure of the less dense areas of the roentgenogram. Dodging usually is accomplished by passing the hand or other opaque object between the source of light and the printing easel. Dodging is a type of masking procedure; in photographic terminology a *mask* is a device for screening light to secure visualization of details of contrast that otherwise would be lost in the process of reproduction. We currently are using a *positive film mask*. Exposure is made simultaneously through both a negative film and a positive film (mask) of the roentgenogram. This preserves details that otherwise would be beyond the range of contrast of the paper.

The technic of using a positive mask, according to Frantzell,[2] was in use in 1929: Laurell[3] used positive film masks but he did not publish his procedure. Other workers [4-9] used a similar procedure.

Laurell[3] apparently encountered difficulty in precisely matching the negative and the positive for printing; even a fraction of a millimeter of displacement produces an effect of depth. Theobald,[4,5] and Secord, Moss, and Diamond[6] utilized the effect of depth by deliberately shifting their films slightly off register. Even earlier, in the days of glass plates, a similar result was achieved by Holland.[9] By printing through positive and negative plates placed back to back,

with a light source inclined at an angle of about 45 degrees, he obtained striking relief effects. However, none of these investigators reported attempts to diffuse the image of the positive, which is an essential step of our technic.

Frantzell[2] tried to obscure the effect of depth by exposing the positive out of focus; Maurer, Yule, and Cornwell[1] used two separate masks: a sharp "highlight" mask, and a diffuse "area" mask. All of the previous authors have reported making contact (same-sized) reproductions only—a procedure that entails using films up to 14 by 17 inches—and their technics, therefore, are not suited to our large volume of work. We find that copies that are reduced in size are more conveniently processed and are less expensive.

Technic

A small-sized negative of the roentgenogram is made in the conventional manner.* It is a copy of the roentgenogram but with the densities reversed. The dry negative is placed emulsion side down on a contact printer and a sheet of unexposed film is placed emulsion side down over the negative (Fig. 1). The second film is exposed; it is processed in a normal developer and is dried. It is a *positive mask* film and its densities are homologous to those of the roentgenogram.

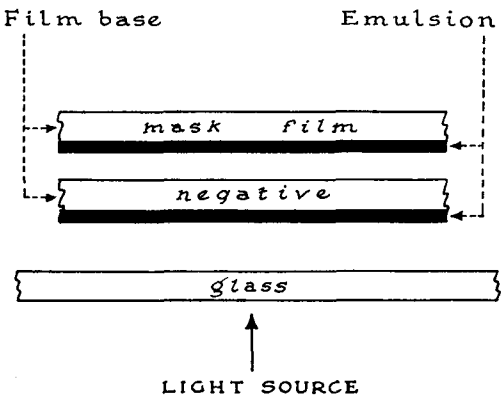


Fig. 1. Diagrammatic cross section of arrangement of negative and mask for contact printing.

The negative and the positive mask then are positioned in as exact alignment as possible (the emulsion side of each is down) and they are taped together. Reproduction is made by printing through the two films (Figs. 2 and 3).

Comment

We use a very light positive film as the mask. The density range of the positive should be approximately one third to one half that of the negative. A mask that has a range of density that is too high tends to overcorrect the final print and produces a flattening of tonal range; a mask of lower density values is

* *Kodak Commercial Ortho Film is satisfactory, but any film of similar characteristics may be used.*

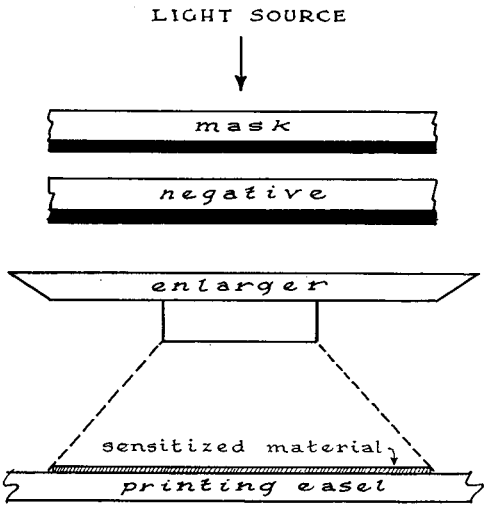


Fig. 2. Diagrammatic cross section of arrangement of negative and mask for printing with an enlarger.

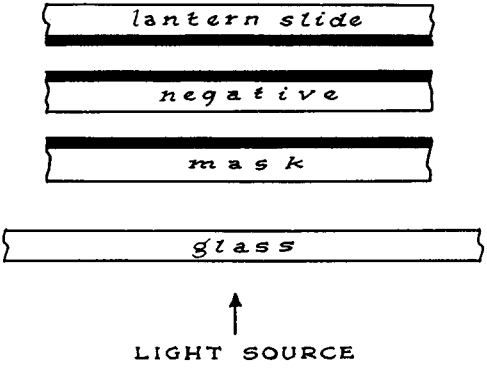


Fig. 3. Diagrammatic cross section of arrangement of negative and mask for contact printing of lantern slides.

preferable because undercorrection produces better results than does overcorrection.

In making the positive, the image is diffused to the proper degree during the passage of light through the film base of the negative. The diffusion in the positive does not interfere with the sharpness of the final reproduction; it facilitates proper registering of the mask with the negative, and detail from the negative appears sharper in the reproduction than in one made by conventional printing[8] (Figs. 4-9). The improvement is based on the fairly uniform deposit of silver that covers the edges of the fine details in the mask. Thus, when printing through the mask, the dense areas of the *negative* can be given the proper exposure without overexposing the finer details. The prints made by this method are, in respect to sharpness and clarity, rather comparable to those obtained by xeroradiography.[10] (Xeroradiography is a method of producing

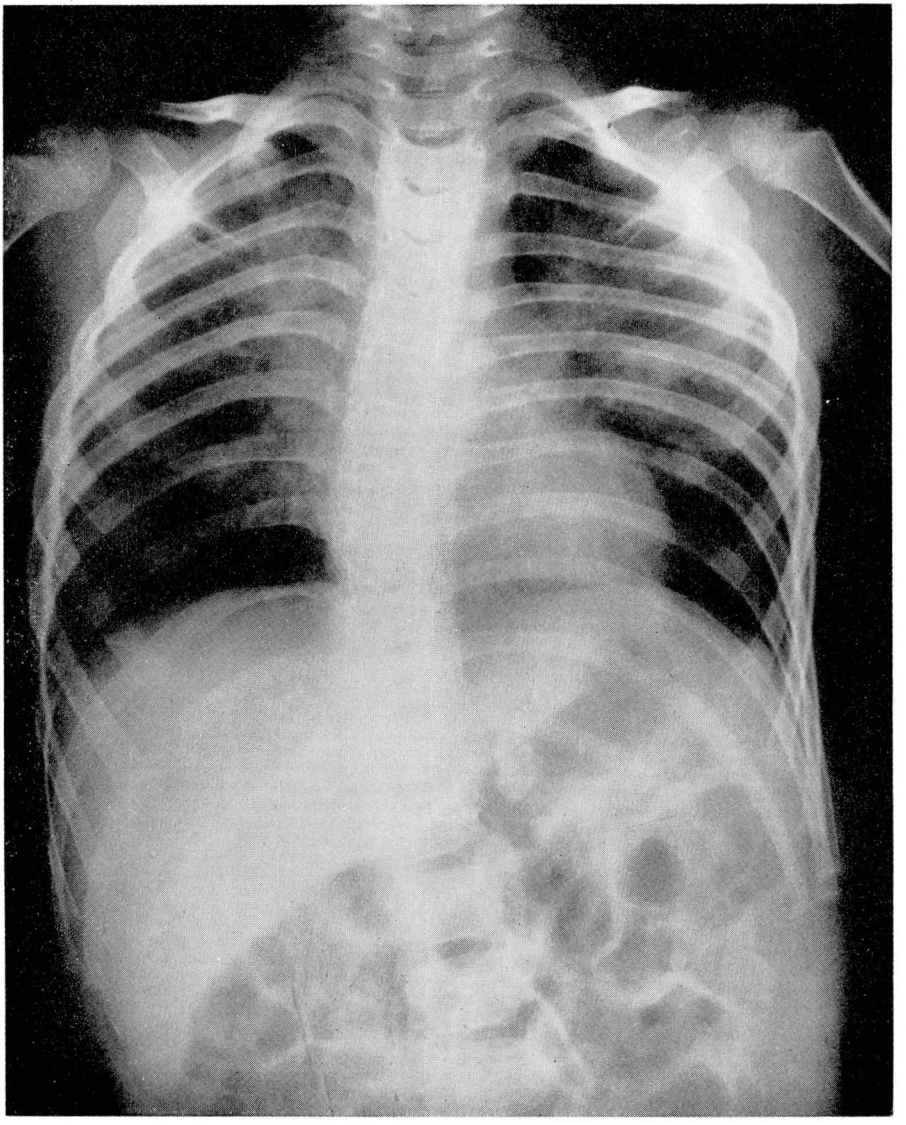


Fig. 4. *Conventional print*

Fig. 4. Two reproductions of one roentgenogram of patient having bronchopneumonia. The masked print has clearer visualization of the pathologic condition, more detail of the bony thorax, and strikingly more detail of the soft-tissue shadows of the shoulders.

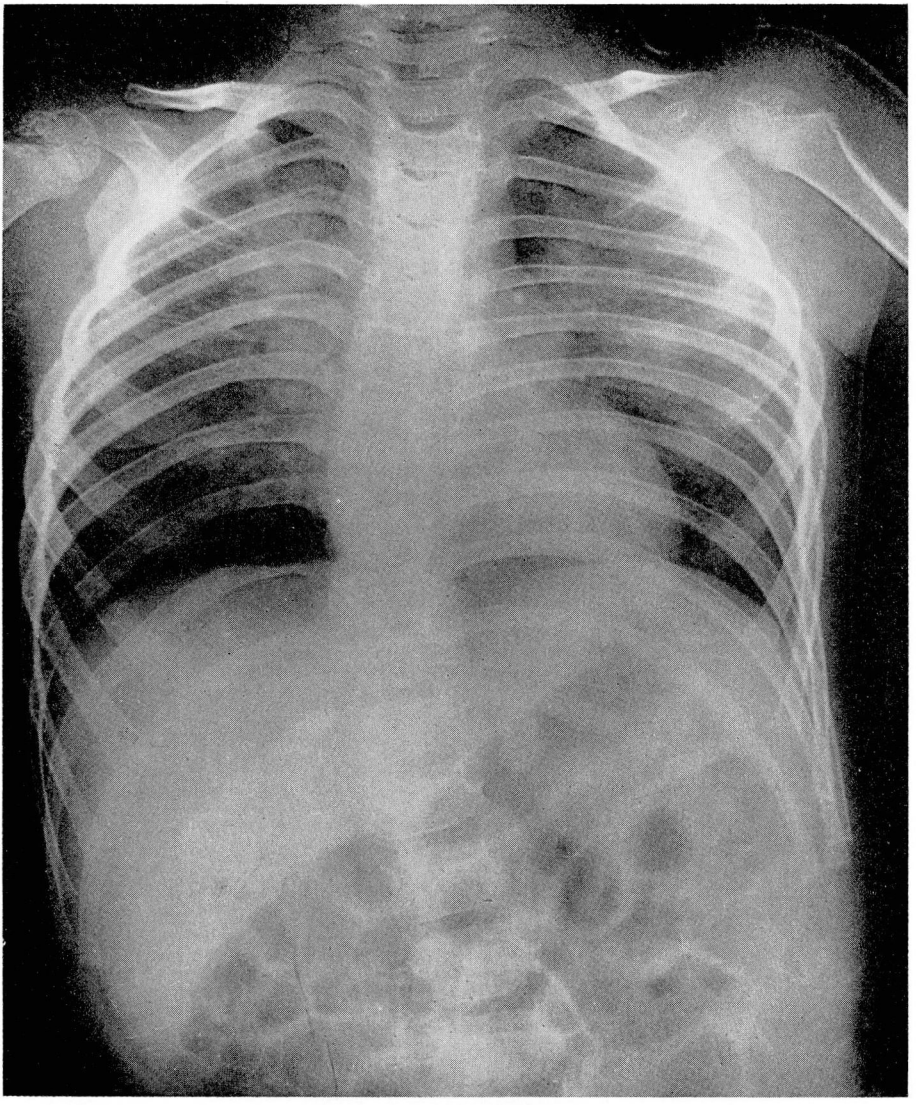


Fig. 4. *Masked print*

roentgen images without using processing solutions. Xeroradiographic prints are made by transfer of the powdered image from the metal plate.) Our prints also possess many of the features that are provided, at considerably greater cost, in roentgenographic copies made by an electronic process that controls the exposure for each minute region within the printing area.[11]

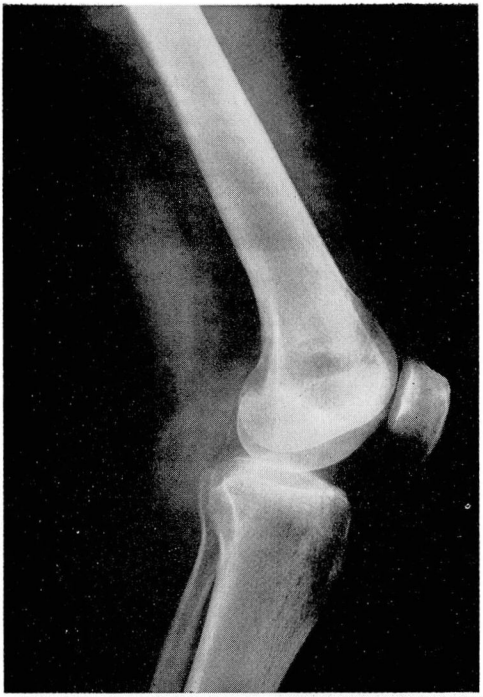


Fig. 5. Two reproductions of one roentgenogram of a knee. The masked print shows more detail than does the conventional print, not only in the bones but also in the soft tissues.

Fig. 5. *Conventional print*

Fig. 6. *Conventional print*

Fig. 6. Two reproductions of one roentgenogram of a pelvis. The conventional print shows extreme range of contrast densities that are softened in the masked print.

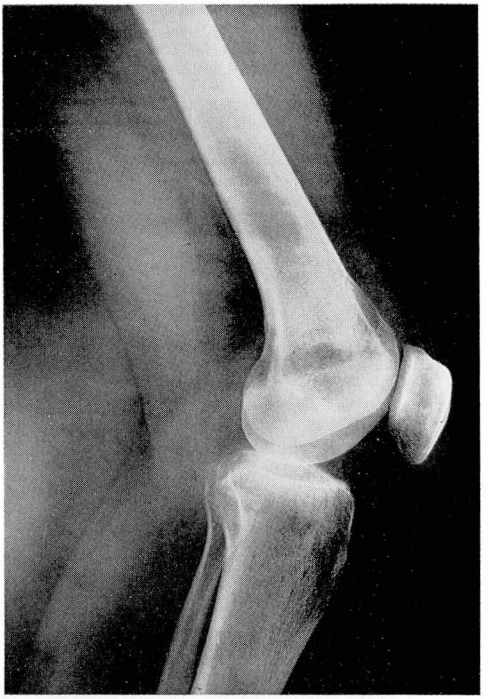
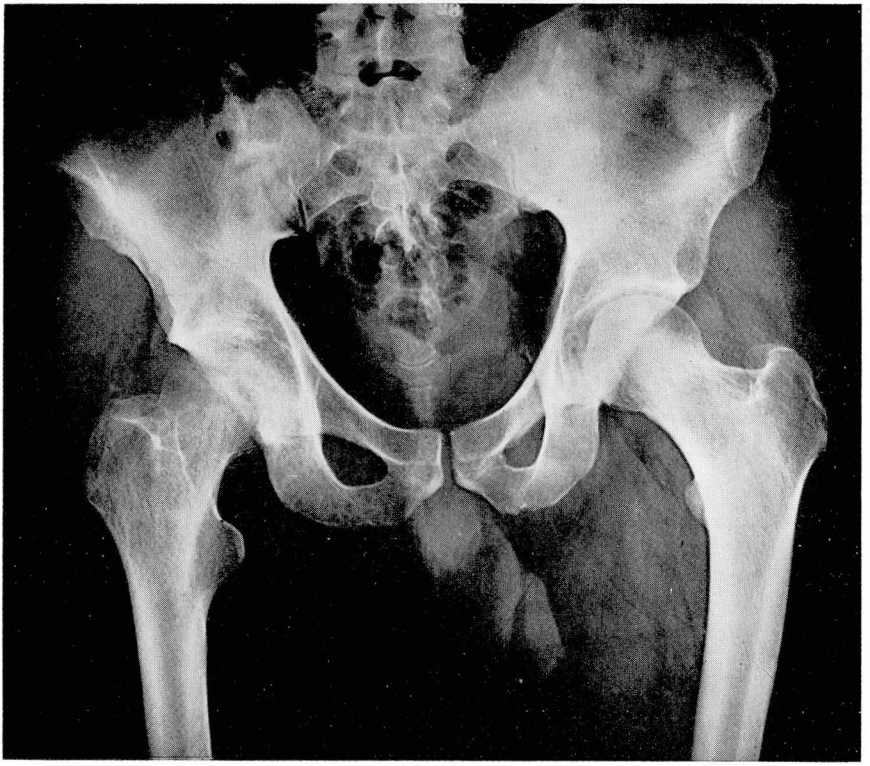


Fig. 5. *Masked print*

Fig. 6. *Masked print*



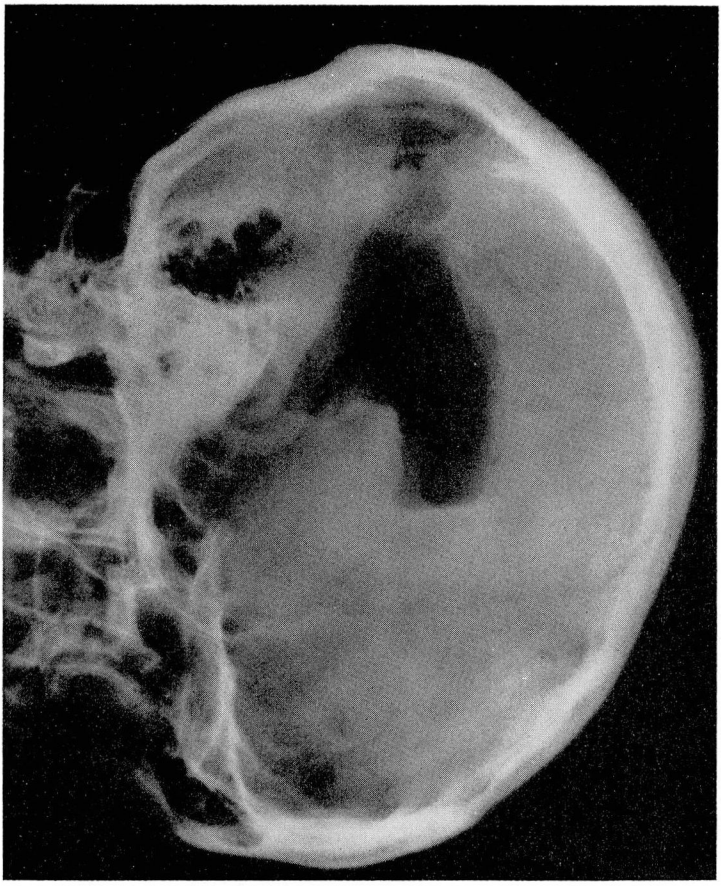


Fig. 7. *Conventional print*

Fig. 7. Two reproductions of one ventriculogram. Both prints have about the same visualization of the air outline of the ventricles, but the masked print shows more clearly the diploic spaces of the skull and more detail in the first cervical vertebra.

Roentgenograms having a great range of contrast are the most suitable for making prints by our method. The technic is even more effective in making transparencies or lantern slides, in which details are seen by transmitted light.

Summary

A simple, inexpensive, positive masking technic is described which improves the quality of photographic reproduction of roentgenograms.

Fig. 7. *Masked print*

References

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Fig. 8. *Conventional print*

Fig. 8. Two reproductions of one femoral arteriogram showing considerable arteriosclerotic disease in the superficial femoral artery. Detail of the portion of the artery overlapping the bones is better on the masked print than on the conventional print.

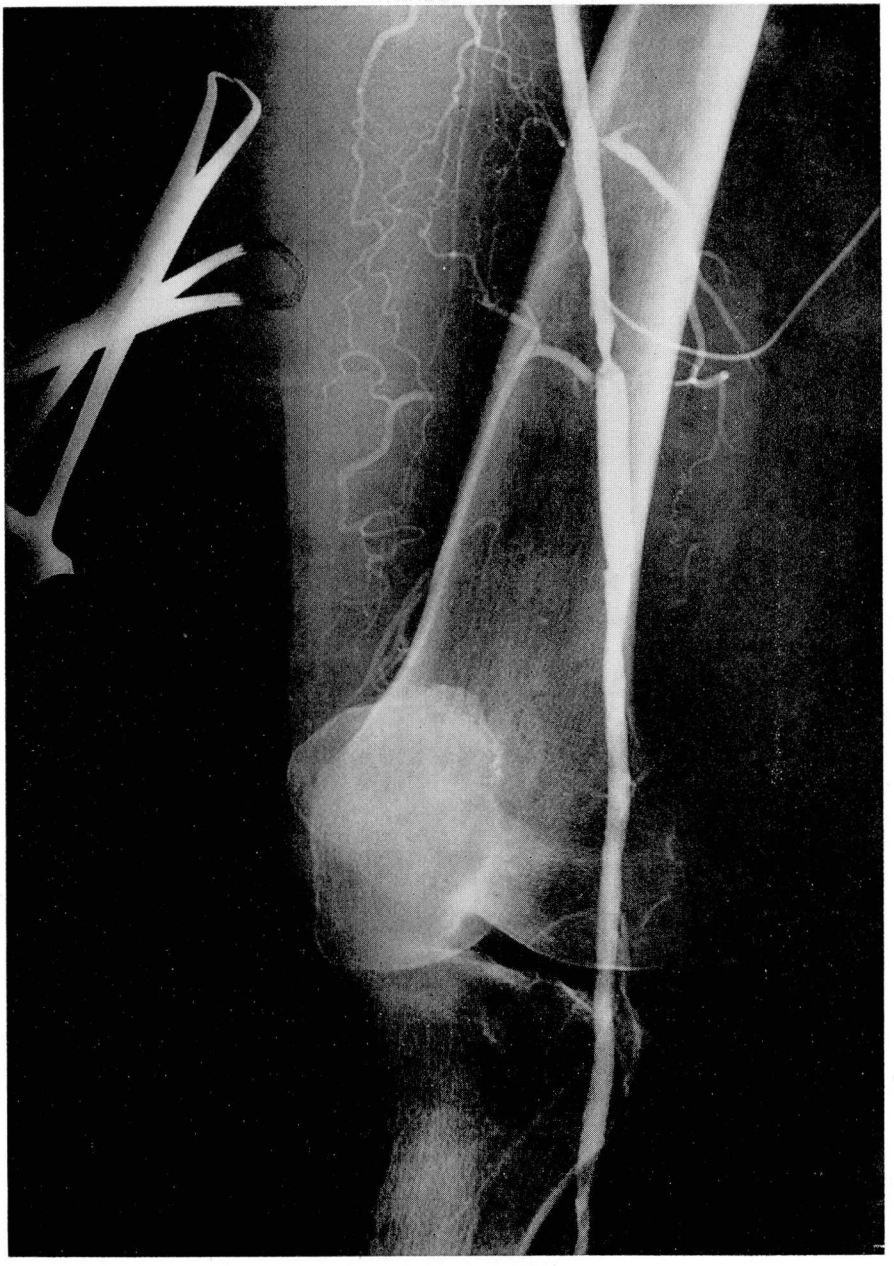

Fig. 8. *Masked print*

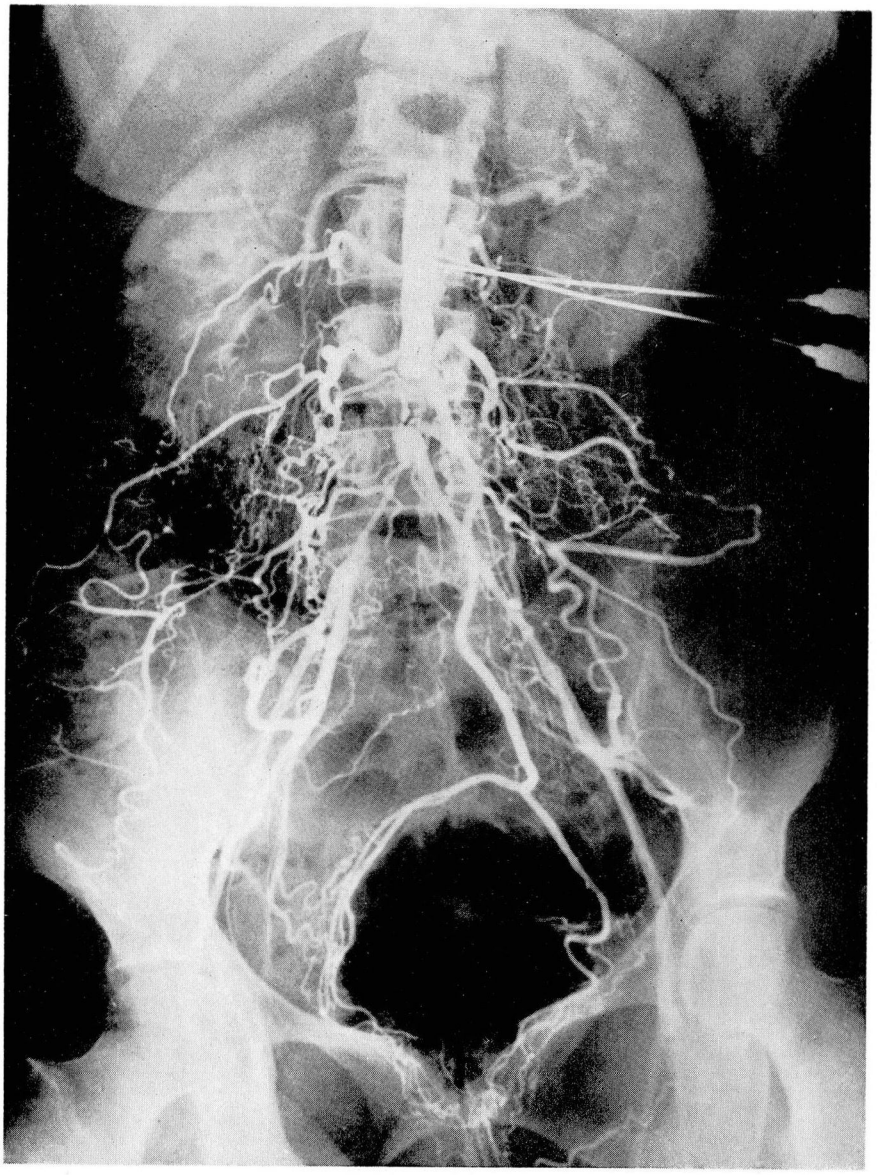

Fig. 9. *Conventional print*

Fig. 9. Two reproductions of one roentgenogram of a patient having thrombosis of the aorta. The multiplicity of collateral channels is more evident on the masked print than on the conventional print.

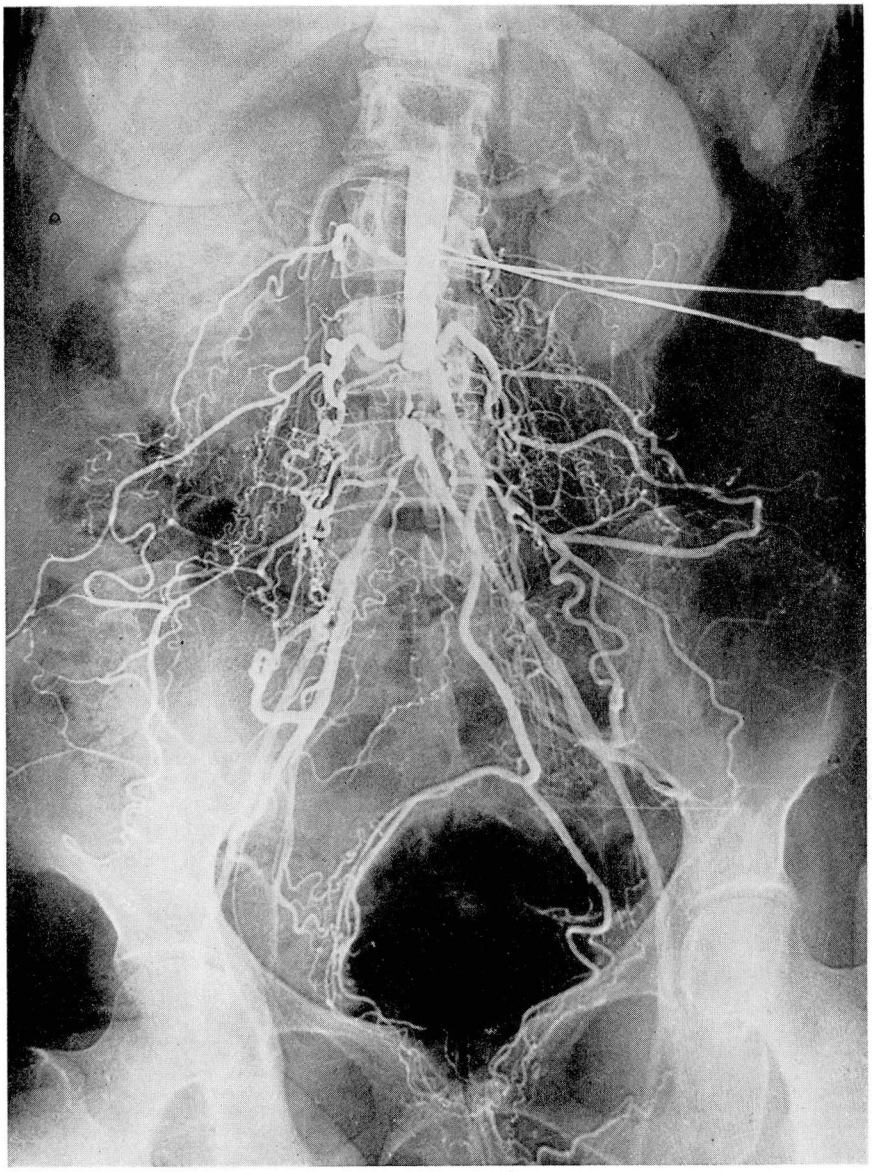

Fig. 9. *Masked print*

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