

DIRECT MAMMOGRAPHY IN COLOUR BY THE DOUBLE EXPOSURE METHOD

G. PIAZZA, C. DI MAGGIO

Institute of Radiology, University of Padua

Why use colour in radiology?

Because information from the external world has various properties, among which colour is very important; furthermore because, an image in colour has three parameters (light, shade, saturation), while an image in black and white has only one (light): it follows that the range of colours perceptible to the human eye [at least 100 (²)] is much more extensive than the range of greys, and thus the informative possibilities of a colour image are certainly superior to those of the analogous image in black and white. Then the psychological effects of colour are important; by means of them the capacity for perception is markedly stimulated.

There have been many attempts to introduce colour into radiology: *indirect methods* have been suggested, based on the photographic elaboration of black and white images, and *direct methods*, based on the direct exposure of colour films to X-rays.

We have used the direct method, with the double exposure technique [a method proposed in 1955 (¹) and applied to various parts of the body in 1975 (³)].

The transparency film, after being exposed to the X-rays, is partially developed and then re-exposed to yellow light, which exposes chiefly the areas of emulsion that were not exposed to the rays the development is then completed in black and white and colour development is then proceeded with. Exposure to X-rays determines the blue dominant, and already in this phase the informative content of the image is complete (fig. 1), since all the structures of the radiographed object are represented, in different shades of blue. The introduction of yellow during treatment sets up a colour contrast and a light contrast that are very favourable to perception: in fact, the radio-opaque elements, which are scarcely visible in the blue image, since they are dark blue, become very evident on account of the yellow colour that they take up in the final image.

SUMMARY

The Authors, having justified the reasons of their research of a radiological image in colour, briefly explain the technique of the method.

In this note the Authors report the first results obtained in mammography: observing 30 examined cases and comparing the colour images with the corresponding images in black and white, the Authors believe they can draw the following conclusions: good definition, wide latitude of exposure, accentuation of perception of large details (still insufficient perception of low contrast) and an agreeable psychological contrast.

The final image is thus made up of two dominants, blue and yellow, among which there are intermediate colours that represent the area where the colour changes: the structures more opaque to X-rays will be yellow, those more transparent will be blue.

We can now give the first results we have obtained in mammography.

Thirty cases were examined, of which 14 could be used either for making an absolute judgment, or for comparison with the traditional test in black and white.

The exposure data were similar to those we have used for mammography in black and white.

A few tests were also carried out with the mammographic tests suggested by Gros.

The results (figs. 2, 3, 4) can be summarized as follows:

1) As regards definition in general, this was satisfactory both in the tests and in the mammographic images.

2) Certain structures, such as the skin and the pre-mammary fat, were more evident in the colour pictures.

3) At high contrast the colour image was better than the black and white, since the chromatic component helped to set up the contrast.

In fact, some structures (large nodes, masses, peritumoral halo) often did not show up well enough in traditional radiography, also because of the superposition of other shadows that caused disturbance.

But in colour these structures were more visible, despite the superposition.

4) As regards minimal contrast, black and white radiography does at present have several points to its advantage. In particular, minute calcification was well evident by both methods, but minimal calcification with a dust-like appearance was better visible in black and white radiography.

This fact seems to refer to the poor perceptibility of the intermediate tones present in the area where the colour changes from blue to yellow.

At the present time, in order to overcome this handicap, our efforts are being directed towards increasing selectivity, setting up a colour contrast for smaller and smaller variations of absorption.

In conclusion, we think that even though we cannot predict the possible practical development of this method, it is worth while persevering with our research. From the results obtained it seems, in fact, that the informative contribution is retained in the colour image, and in addition perceptive capacity is improved and stimulated by virtue of the psychological effects of colour.

Translated by Samil-Pabyrn foundation.

BIBLIOGRAPHY

- 1) Bryce A.: *Brit. J. Radiol.*, 28, 552, 1955.
- 2) Deriberè M.: *La couleur dans les activités humaine*, Paris, Dunod, 1968.
- 3) Piazza G.: *Fot. Rad. Med.*, 37, 1, 1975.

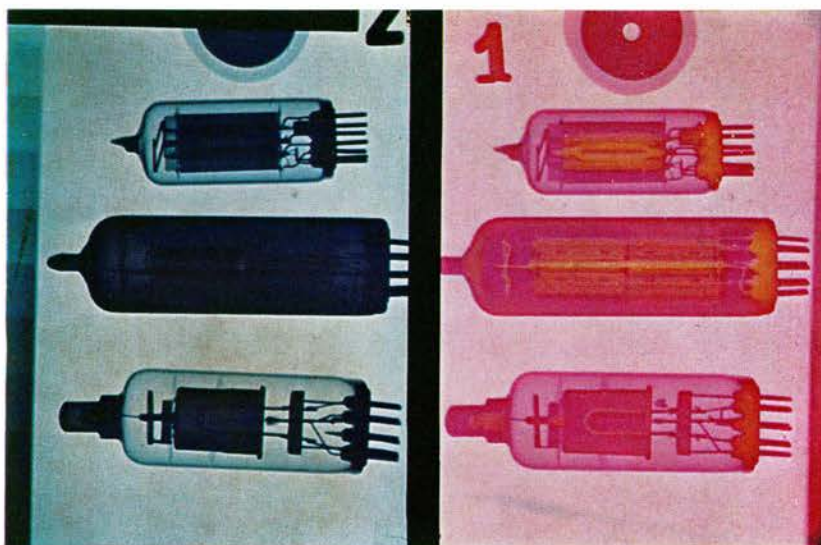


Fig. 1. — Practical illustration of informative capacity and improved perceptive capacity of colour images. *Above*: direct colour radiograph developed by traditional technique, after exposure to X-rays alone. *Below*: images of the same subjects exposed to the same dose of X-rays after development by the double exposure method. 1) X-rays; 2) yellow light; (1: X-rays; 2: yellow light). The internal structures of the valves, which are denser, have acquired a yellow colour, more luminous than the blue, and are thus more easily recognizable; there is a sensation that the valves have first been extinguished, and have become bright.

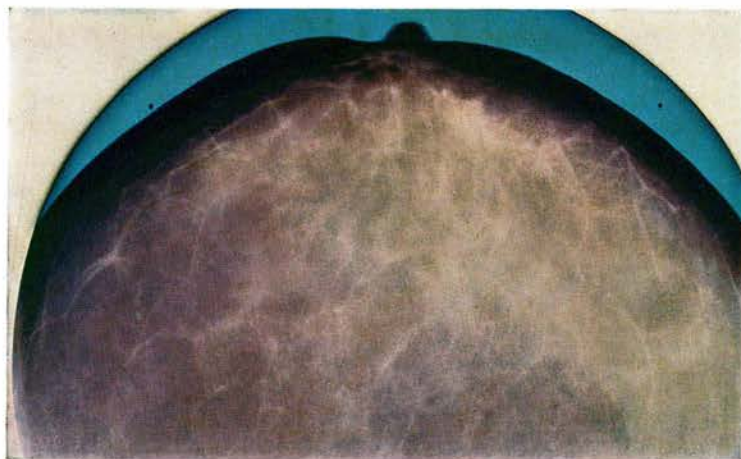
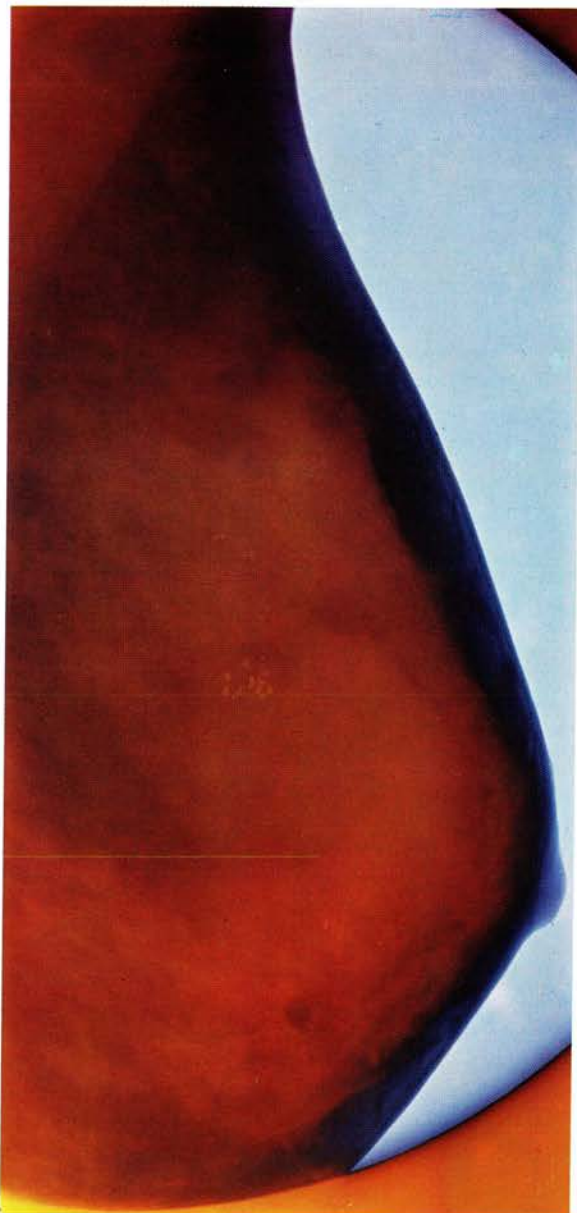


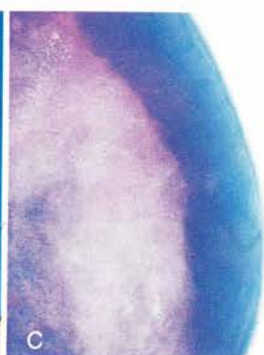
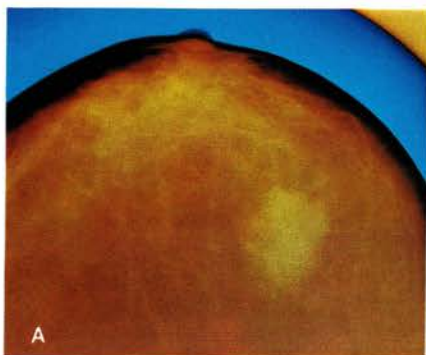
Fig. 2. — Normal breast; structures well represented, with good definition and contrast.

Fig. 3. — Both the denser structures and the skin and anterior adipose layer are well demonstrated. The calcifications are striking, due to the intense yellow colour.



3)

Fig. 4. — A: malignant node; B: benign node; C: diffuse microcalcification due to intraductal carcinoma. The colour improves perception of the pathological images without significantly modifying the definition.



4)