A Method of Taking Stereoscopic Micro-radiographs

By

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(Received August 10, 1934)

Abstract

A method of taking stereoscopic micro-radiographs by the aid of a new X-ray tube provided with two targets is described.

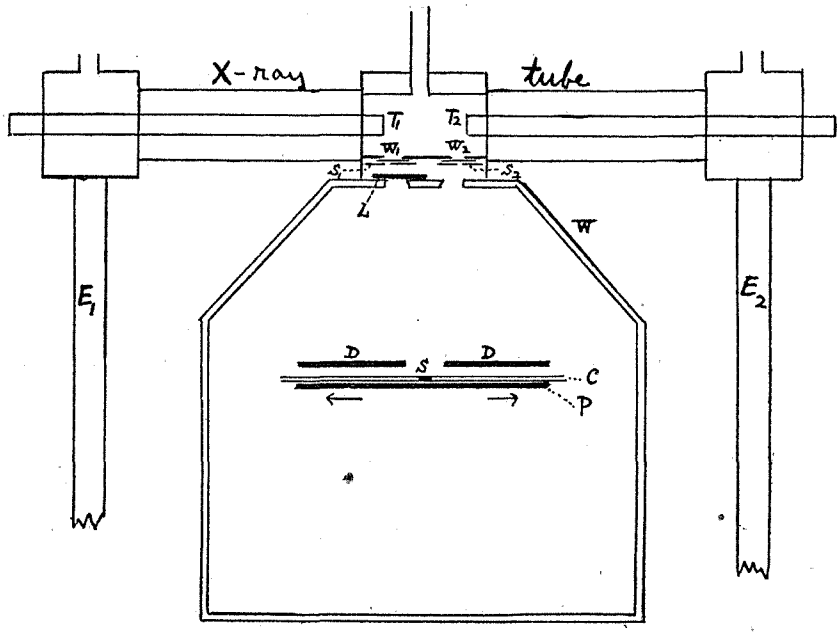
About two years ago the present writers, in conjunction with Mr. H. Shoji, devised a method of obtaining fine micro-radiographs.[1] The most essential part in that device was to make the circular window of a metallic X-ray tube very narrow, about 0.2 mm. in diameter, which acted as a very sharp focus for an X-ray tube. The main subsidiary precautions to be paid in that case were (1) to use fine grained photographic plate; (2) to avoid as far as possible any vibration of the apparatus; (3) to adjust properly the voltage applied to the X-ray tube according to the specimen to be examined; (4) to put the specimen as close as possible to the sensitive film of the photographic plate and to separate these two as far as possible from the narrow window; and lastly (5) to make the X-rays strike the photographic plate as normally as possible. With such precautions they succeeded in taking some micro-radiographs which could be magnified up to about 70 times without destroying much the fineness of the original plates.

Recently the writers[2] succeeded in constructing an X-ray tube which has two separate targets and is especially suited for taking stereoscopic micro-radiographs. Fig. 1 is a schematic representation

1. U. Yoshida, H. Shoji and H. Tanaka: Kwagaku, **2**, 405 (1932)
2. U. Yoshida and H. Tanaka: These Memoirs, **17**, 187 (1934)

of the X-ray tube. The tube is supported by two insulating ebonite pillars E_1 E_2 at both ends, and at the middle by a wooden case W whose height and inclination can be adjusted by three screws provided

Fig. 1



at its base. W_1 and W_2 are two alluminium windows for the X-rays, and two very narrow circular slits S_1 and S_2 0.3 mm. in diameter are provided just beneath the windows W_1 and W_2. These two slits act for two separate very sharp foci of the X-ray tube, and they are made to be slided along the alluminium walls of the windows, so that the optical angle of the specimen to be examined against the slits can be adjusted properly. This adjustment is necessary to make the stereoscopic micro-radiographs stand out in good relief. The X-rays starting at the separate targets T_1 and T_2, after passing through the slits S_1 and S_2 and two openings at the top of the case W, enter the case in which the micro-radiograph is to be taken; and they illuminate the specimen to be examined from two different directions.

The apparatus to obtain the photographic impression of the stereoscopic micro-radiographs is also schematically represented in the same figure. The specimen to be examined S is held tightly between two stretched thin cellophane sheets C, so that its position in space is

fixed firmly during the whole period of its exposure to the X-rays ; and these cellophane sheets are placed above the photographic plate P as close as possible without touching it. The radiographs of the fine structure of the specimen, which are obtained respectively by illuminating the specimen with the X-rays coming from separate slits S_1 and S_2, must be impressed on two different portions of the photographic plate. Thus the illuminations of the specimen from two different directions are done separately, one after the other, by screening off the X-rays coming from either one of the slits S_1 and S_2 alternately with the aid of the lead screen L. After the first illumination, the photographic plate P is displaced horizontally by driving the plate holder with a screw. A lead diaphragm D having a hole at its center is set in such a position as shown in Fig. 1, that it protects the photographic plate from being attacked by stray X-rays. The general aspect of the X-ray tube and the radiographic camera here described is shown by the photograph reproduced in Fig. 1, Plate I ; the X-ray tube above and the radiographic camera below.

With this apparatus stereoscopic micro-radiographs of various minute specimens were taken by paying the precautions necessary to obtain a fine micro-radiograph, as was stated before ; and some of them are enlarged and reproduced in Plates I and II. The respective micro-radiographs of the original size are shown for the sake of comparison at the lower middle part of each figure. Fig. 2 in Plate I is a stereoscopic micro-radiograph of a dead insect. Fig. 1 in Plate II is that of the fossil of *Globigerina bulloides*, which is a kind of Foraminifera. Fig. 2 in the same plate is that of the fossil of *Rectobolivina fibrous*, which is also a kind of Foraminifera.

Previous to the writers, P. Goby[1] tried to obtain stereoscopic micro-radiographs by means of an ordinary sharp focus X-ray tube, having the usual single target. He placed the specimen to be examined on a stretched thin collodion ribbon, and obtained two micro-radiographs of the specimen illuminated from two different directions by slightly changing the inclination of the collodion ribbon and consequently of the specimen in reference to the direction of the illuminating X-rays, instead of using two separate sources of the X-rays. However the process to change the inclination of the specimen itself is not desirable in the present case, where two finest micro-radiographs which have

1. P. Goby: C. R., **180**, 735 (1925)

a certain close correspondency to each other are wanted. Further, the micro-radiographs are much clearer in the present experiment because very narrow slits were used as the sources of the X-rays, than those of Goby's experiment carried out with an ordinary sharp focus tube.

In conclusion, the writers' sincere thanks are due to the Hattori Hoko Kai for their grant given to one of the writers (U. Y.) for carrying out this research. The writers also wish to express their hearty thanks to Professor J. Makiyama of the Geological Department for lending them some precious specimens of fossil Foraminifera for experimentation.

Plate I

Fig. 1

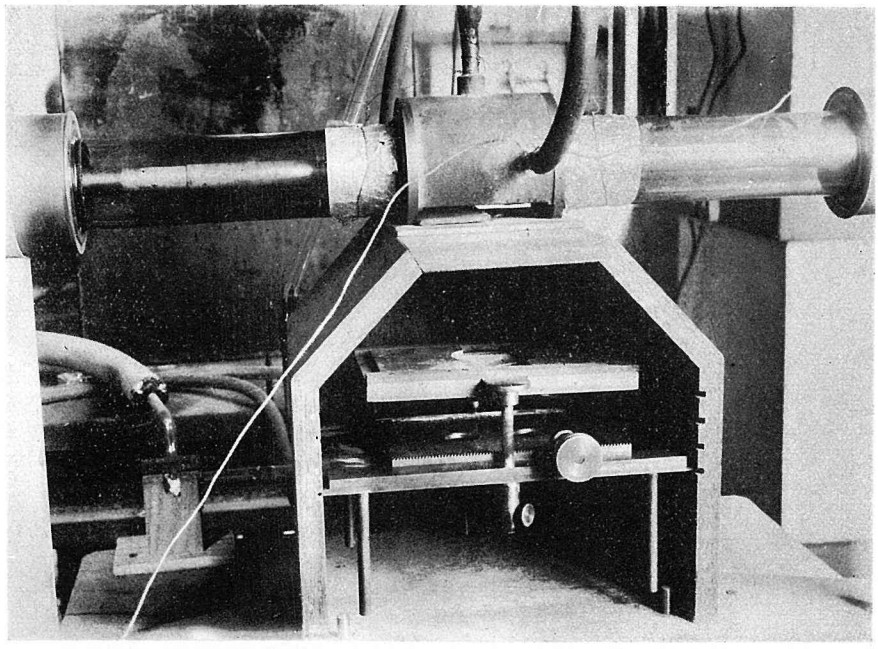
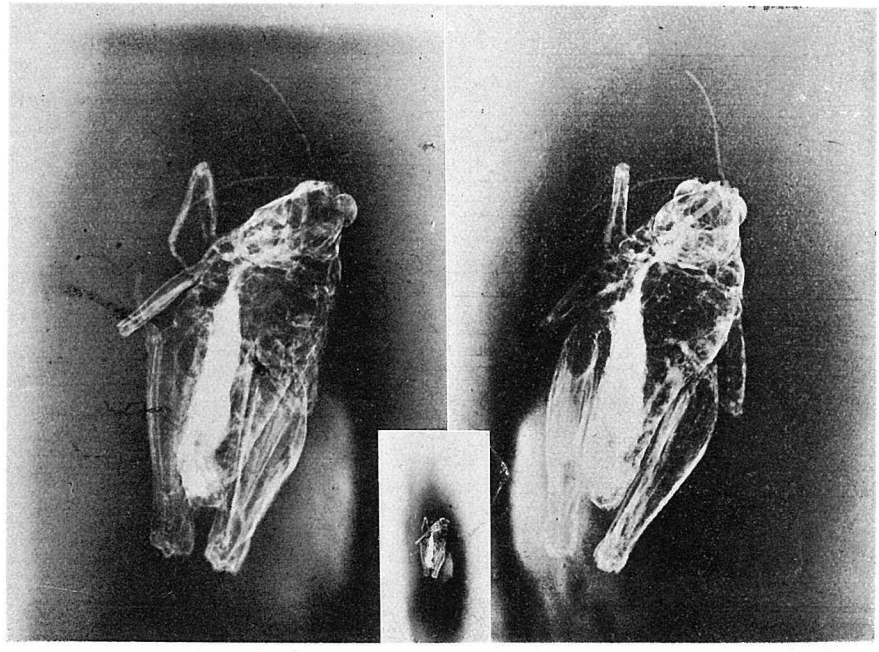


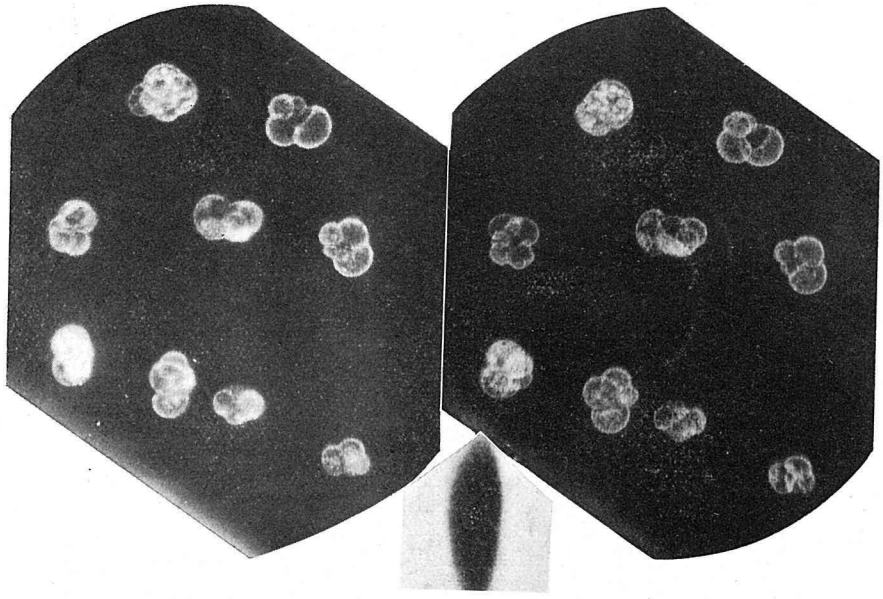
Fig. 2



A dead insect 7×

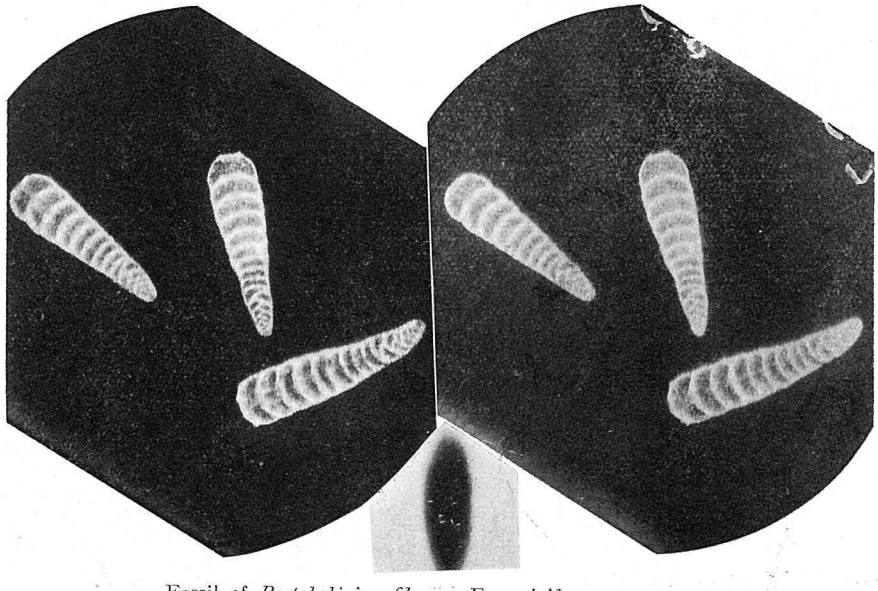
Plate II

Fig. 1



Fossil of *Globigerina bulloides*, Foraminifera. 30×

Fig. 2



Fossil of *Rectobolivina fibrous*, Foraminifera. 30×