Phase Difference Microscopy

I HAVE read with much interest the description by Mr. O. W. Richards of his own and his colleagues' recent work on Zernike's phase contrast method. Everyone who is interested in the microscopical observation of living cells should be grateful to him for having once again directed attention to its value as applied to microscopy. It possesses the advantage over ordinary trans-illumination that fine unstained structural detail is seen in greatest contrast by focusing exactly *on* the specimen, so that we may expect a closer geometrical correspondence between the appearance seen and what is 'really there'.

During the past eight years, Zernike's method has been regularly used in this Laboratory by Dr. C. R. Burch and by others whom he has interested and helped, both as a test for the accuracy of mirrors intended for astronomical and other purposes[1], and as applied to microscopy, including the microscopy of living cells[2].

Interesting new possibilities in the preparation of phase-contrast configurations, for example disks and strips, have lately been opened up by the development of the modern technique of controlled evaporation *in vacuo*. By this process, a transparent layer can be deposited on a thin glass plate of such a thickness as to increase by one quarter of a wave-length the retardation of yellow light passing through the plate. By drawing a fairly sharp stylus across this layer, we can remove the soft coating from a narrow strip of the glass without damaging the glass surface. The result is a 'phase-advancing strip' which can be used for phase-contrast testing in the same way as the phase-retarding disks and strips so ingeniously prepared by Dr. Burch.

A relatively easy way of producing such coatings is to leave the glass plate in a lens-blooming chamber, such as is now used by some optical firms, during five or six consecutive runs. This builds up a layer of approximately the desired thickness.

In an investigation into phase-contrast diffraction theory which I hope to publish shortly, I have shown that considerable variation can be allowed in both the thickness of the layer and the width of the strip without seriously reducing the efficiency of the method. No doubt this is one reason why the method is so successful in practice.

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[1] Burch, C. R., "On the Phase-Contrast Test of F. Zernike", *Mon. Not. Roy. Ast. Soc.*, **94**, 384 (1934). "On a Zonal Zernike Test for Paraboloids", *Mon. Not. Roy. Ast. Soc.*, **95**, 548 (1935).
[2] Burch, C. R., and Stock, J. P. P., "Phase-Contrast Microscopy" *J. Sci. Instr.*, **19**, 71 (1942).

Age of the Saline Series in the Salt Range of the Punjab

OUR evidence for the post-Cambrian age of the Saline Series, based upon microfossils in the rock-salt and marl, was already clear and ample[1,2]. It has since been greatly reinforced by the discovery, both at Khewra and Warchha, of similar fossils in dolomites, dolomitic limestones and shales belonging to the Series, which do not admit of the remotest suspicion that any foreign matter was washed in, faulted in or caught up by later earth movements.

Some of these more recent finds were reported to *Nature* in a communication dated July 21, but on the receipt, soon afterwards, of the issue containing the interesting note by Dr. G. M. Lees[3], we withheld publication until we should be in a position to offer fuller data, if possible after examining the Persian material kindly sent by him. These specimens have not yet arrived, but meanwhile the *in situ* nature of our Khewra and Warchha material has been fully confirmed by Dr. H. L. Chhibber, who very kindly accompanied us to the Salt Range early in October this year, and who proposes to write a geological note on the localities in question.

(*a*) *Rock-salt and kallar.* Of the samples of rock-salt plus kallar newly collected, only two have yet been examined (coll. Sahni, Oct. 3, 1944, Mayo Mine Khewra): *K*4, from the Middle Pharwala seam in Chamber 19, showed several pieces of conifer wood with well-defined bordered pits, and some woody fibres; *K*5, from the Buggy seam in Pillar 47–48, 43 Incline, 2nd Sub-level North, brought forth a cuticle with two stomata, several shreds of wood and some chitinous remains.

The winged insect from the Warchha marl, mentioned in a previous communication[4], has since been identified as a new extinct species of *Chironomus*, *C. primitivus* M. S. Mani[5]. This genus of Diptera had not so far been found in the Indian strata.

(*b*) *Dolomites and dolomitic limestones.* From the Warchha mine Mr. B. S. Lamba had sent to one of us a specimen of compact saline dolomite (Lamba, No. 7, Warchha, July 1944) taken from a stratum within the Saline Series as exposed in the New Low Level Tunnel, at least 1,500 ft. from the entrance. Treated with dilute hydrochloric acid, it released numerous shreds of pitted woody tissues, among them two pieces of conifer wood with bordered pits and medullary rays. A little dilute safranin placed on a thin slice of the rock at once picked out numerous specks of organic matter scattered through the crystalline matrix. During our recent visit the position of this dolomite within the Lower Gypsum Stage of the Series was confirmed. Specimens collected by ourselves are now being examined.

A piece of compact dolomitic limestone collected for us by Mr. Lamba from a stratum exposed in the New Low Level Tunnel at Khewra, 1,335 ft. from the entrance (Lamba No. 3, Khewra, July 1944), has yielded carbonized pitted tracheids and other woody tissues. We have, as before, been able to confirm the position of this stratum within the Saline Series.

A specimen of compact grey dolomitic limestone (coll. Sahni, Oct. 5, 1944, *W* 15) from the main body of the Warchha valley Oil Shale group exposed in the section figured as an 'anticline' by Reed, Cotter and Lahiri[6] has revealed several woody fragments.

A finely laminated but compact grey dolomite collected last year from the outcrop of the Oil Shale group near the confluence of the Jarhanwala and Jansukh streams (Sahni, Oct. 13, 1943, *S* 21/1) was specially rich in angiosperm remains; for example, a beautifully preserved grass cuticle, shreds of wood, several types of pollen and a stellate hair, besides organic membranes of unknown affinity. This dolomitic band is an integral part of the Oil Shale series, with a dip and strike conformable with the rest of the strata in the group. Further specimens, taken last October, are being analysed for their fossil content.