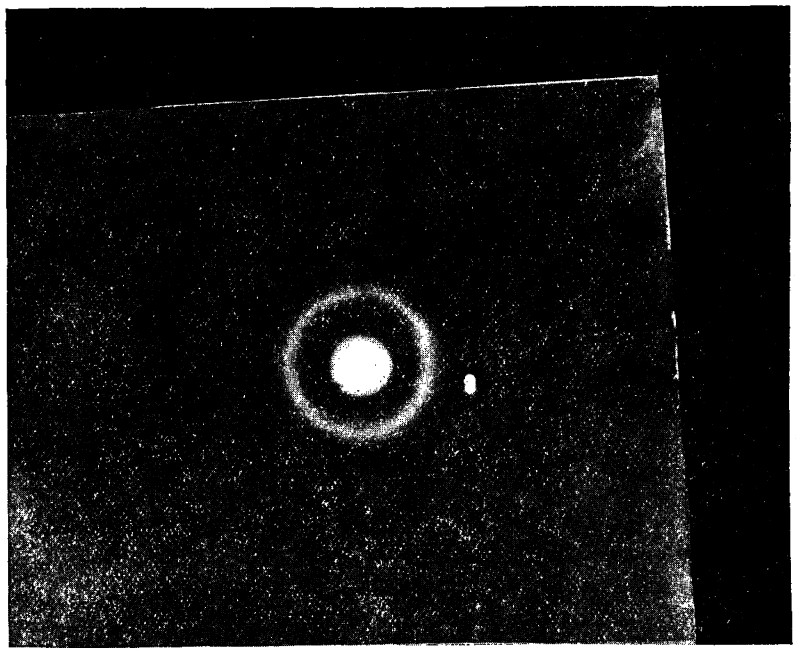

FIG. 4.

from A and cast a shadow, moderately well defined, of the plate B.

3. B was made the cathode and C the anode. An iron washer was placed in contact with the thin aluminum window at B. The resulting photograph is given in Fig. 4. it shows that the X-rays radiate from A exactly as in (2), casting a shadow of the aluminum disc and the iron washer in front of it.

Now, while it is possible to explain experiments (1) and (2) by considering that the X-rays radiate from the *anode*, no such explanation will account for experiment 3, in which the undoubted source (A) was unconnected with either terminal of the secondary coil which furnished the discharge.

On the other hand, not only are all three experiments consistent with the statement given above, but the origin of the X-rays at the place where fluorescence is excited on the glass walls of the common form of Crooks tube is also thereby accounted for.

While it may be true that the effects may be enhanced by making the anode the first object encountered by the cathode rays, the result of these experiments is to show that the anode does not play an important rôle in the phenomenon.

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CURRENT STUDIES IN EXPERIMENTAL GEOLOGY.

THE COLOR OF WATER, AS AFFECTED BY CONVECTIONAL CURRENTS.

PROF. W. SPRING, of Liège, has just added a new and interesting contribution* to our knowledge of the causes of illumination of deep waters. Pure water is actually blue when seen through sufficient thickness. Spring showed in 1883 that perfectly colorless particles in suspension would form a turbid medium, giving passage to

* Arch. des Sciences phys. et nat. Geneva, March, 1896.

the red and yellow rays, but reflecting the rays of shorter wave-length, *i. e.*, the blue and violet. Hence, light reaching the observer by *transmission* appears greenish, the original blue of the water being added to the transmitted orange rays. The blue of reflection is largely absorbed, or but slightly augments the color of the water. Blue water should contain no turbid elements, but deep water absolutely free from turbidity should absorb all rays and appear black. Contrary to this, the Mediterranean and the Lake of Geneva in their deeper portions are intensely blue. Hence, even the most limpid waters are not optically void. Tyndall and Soret believed that even the purest water might contain particles in suspension which account for the *illumination* of the blue waters in nature. This is contradicted by the evidence from experiments with polarized light, and by the fact of the absorption of the rays of minimum wave-length by a turbid medium.

As a further test, however, Prof. Spring has prepared an elaborate apparatus to prove whether loss of illumination by absorption through a great thickness of water be accompanied by a loss of *transparency* due to the presence of particles in suspension, as in the case of the atmosphere. A tube of glass was constructed, 26 meters long and of 15 mm. internal diameter, mounted at a slight inclination on a scaffold and straightened with hand vises until its axis coincided with the optical axis of a telescope adjusted at one end. Heavy black paper covered the tube throughout its length, and the ends were sealed with glass plates, the one nearer to the source of light bearing 'cross-hairs.' Glass tubes were fitted at each end for the introduction of the water, which was distilled with the utmost care in platinum retorts. Either daylight or the Auer incandescent burner could be used as illuminants.

A column of water 26 m. long appeared deep blue; with the illumination of the Auer lamp, the telescope revealed the cross-hairs *as sharply defined* as though the tube were empty; hence the presence of foreign particles is improbable. Small apertures pierced in the paper wall of the tube gave evidence of emission of light laterally only at a distance of 2 meters from the lamp. This suggested some influence of the heat rays; to test this, water 12° C. warmer than the tube was introduced and produced complete opacity, which gradually passed off as the water regained the normal temperature. The minimum difference of mean temperature which would produce opacity was determined to be only 0.57° C.

A shorter tube 6 m. long was constructed of metal with a view to testing the local application of heat. On applying a flame at one point in the side of the tube, the sharply defined opening at the farther end appeared to enlarge, became blurred and finally disappeared, leaving an evenly illumined field. The effect suggested a cloud passing before the sun. Continued application of heat produced complete darkness.

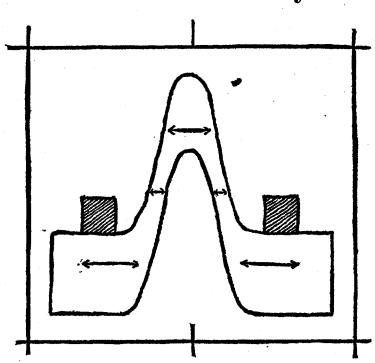
These experiments show that bodies of water are not optically homogeneous when traversed by convectional currents, even though the latter are caused by very slight differences in temperature: the warmer portions have the properties of a turbid medium. Hence less absorption and greater emission of light, making apparent the blue color of the water. Cooling increases transparency, hence the differences of color produced by the cooling shadow on the water's surface, of a cloud or a mountain; a dry wind, cooling the water's surface by increased evaporation, will at the same time increase its transparency. Conformable to this explanation is the fact stated by Forel, that fresh water lakes are more transparent in winter than in summer. The facts described are not held by the author to preclude the operation of other agencies, for

doubtless the illumination and color of water are frequently due to combined causes.

THE PLASTICITY OF ICE CRYSTALS.

Dr. O. Mügge has recently published the account* of a series of experiments on he deformation of ice relative to its crystalline structure. McConnel's experiments have shown that permanent deformation by *bending* may be induced in an ice slab only when the pressure acts in the direction of the optic axis; the optic axis remains normal to the curved basal surface after bending.

Mügge shows that plastic translation without bending is possible only in a plane perpendicular to the optic axis. To the middle of a small bar of ice placed across two supports, the latter as near together as possible, a heavy weight was attached by a strap. The optic axis lay horizontal. A portion of the ice, about as wide as the strap, was gradually drawn down until completely detached. (See figure.) The temperature remained below freezing. The stretched portions were optically oriented exactly like the main bar, the axis lying everywhere horizontal as indicated by the arrows.



The plane of the base was determined to be the only plane in which such translation could be induced; pressure oblique to a basal slab was found to produce torsion that tended to bring the optic axis into coincidence with the direction of pressure.

These experiments prove that plastic deformation and flexibility are important components of the movement of glaciers. The parallel position of the optic axes of associated 'Körner,' or glacial granules, has been observed, at least locally; this is undoubtedly due to the fact that by translation on planes parallel to the base and simultaneous bending, the optic axis is forced into parallelism with the direction of pressure. Observations on plates of ice cut from the Aletsch Glacier show that where its bed sharply slopes, the optic axis lies at right angles to the lower surface of the ice. It is probable also that the increased purity of the ice at a glacier's lower extremity is due to the gradual liberation of 'air bubbles' in migration along definite planes.

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*Neues Jahrbuch für Min., Geol. und Pal., 1895, Bd. II., Heft 3, p. 212.

NOTES UPON AGRICULTURE AND HORTICULTURE.

THE POTATO SCAB.

Several Experiment Stations are making tests of various remedies for the potato scab. This trouble of the potato is due to a fungus closely related to the bacteria.

Bulletin No. 33 of the Rhode Island Station gives a somewhat lengthy report of experiments that cover three years with various chemicals. Dr. Wheeler and Mr. Tucker, the authors, state that air slaked lime, wood ashes and calcium carbonate, calcium acetate and oxalate all increase the scab; while calcium chloride prevents it, but likewise injures the potato plant. Calcium sulphate (land plaster) is the only form of lime not harmful to the potato which fails to increase the scab. Common salt reduces the amount of scab, and this explains why sea weed is healthful to potato land when used for manure. Barnyard