

quenching in brine and quite a distinct further change after cooling in the helium bath.

The study of the hardness of the above-named carbon steels after heat treating by tempering was the next step in the present work. Two sets of specimens have been investigated: in the first set, the samples were water-quenched and afterwards subjected to consecutive temperings; in the second set, the specimens were water-quenched, immersed in liquid helium, and afterwards subjected to consecutive temperings. The tempering process of all specimens was identical: (i) at 100° C. in boiling water for 75 hr.; (ii) at about 430° C. (melting point of a salt mixture) for 76 hr.; every effort has been made to avoid any decarbonizing process⁶.

In both sets of carbon steels, there was a quite distinct fall of hardness after tempering at 100° C. and a very large hardness decrease after subsequent tempering in the salt bath. The effect of carbon contents apparently plays an important part in the behaviour of the hardness; the changes in the case of 0.1 per cent carbon content were very small; but in the case of 1.25 per cent carbon quite appreciable. The noteworthy feature of the present results is the fact that the influence of cooling in liquid helium is appreciable after every heat treatment; this is analogous to the influence of cooling in liquid air⁷.

A full report on this work will be published elsewhere in due course. I wish to thank Prof. C. W. Dannatt for providing the laboratory facilities and for his constant interest in the work. Thanks are due also to Dr. D. Shoenberg for facilities accorded to me in the Royal Society Mond Laboratory, Cambridge, and to Dr. S. Mocariski for very careful preparation of the carbon steel specimens.

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¹ Desch, C. H., "Metallography", 231 (London: Longmans, Green and Co., 1944).

² Honda, K., *Archiv für das Eisenhüttenwesen*, 1, 527 (1928).

³ Kurdjumow, G., and Sachs, G., *Z. Phys.*, 64, 325 (1930).

⁴ O'Neill, H., "The Hardness of Metals and its Measurement", 90 (Chapman and Hall, Ltd., London, 1934).

⁵ Lysaght, V. E., "Indentation Hardness Testing", 115 (Reinhold Publishing Corp., New York, 1949).

⁶ "Metals Handbook", 317 (American Society for Metals, Cleveland, Ohio, 1944).

⁷ Szewandzin, E., and Mironczik, M., *J. Tech. Phys.*, 7, 2275 (1937) (in Russian).

A Modified Form of the Christiansen Filter

THE great shortcoming of the Christiansen filter¹ is that, in principle, it is transparent for all wave-lengths. Every wave-length, after having passed through the filter, has its maximum intensity in the direction of the incident light. Although it is possible to construct a Christiansen monochromator in which the width, in wave-lengths, between the points on each side of the transmitted band at which the intensity is reduced to one-half, or even one-tenth, is small, the corresponding distance for the reduction of intensity to one-thousandth is of considerable size.

This mixture of weak intensities of light of all the wave-lengths emitted from the light source renders the Christiansen monochromator inapplicable to investigations in which weak intensities of 'undesired' light (particularly the shortest wave-lengths) produce

effects of the same order of magnitude as those produced by strong intensities of the filtered light.

By fairly simple means it is possible to combine the Christiansen monochromator with the ordinary prism monochromator so that one gets a type of light filter, which retains essentially the advantages of the Christiansen filter, and, at the same time, emits light of the same degree of purity as does the prism monochromator. In a glass cell with parallel faces small, identically orientated prisms with small refracting angles are piled as closely as possible. The spaces between the prisms are filled with a suitable liquid, the prisms taking the place of the powder in the Christiansen filter. The slits and lenses are arranged in the same way as in the prism monochromator. With methyl benzoate and prisms of ordinary crown glass, the light of two wave-lengths can easily be given, if prisms and glass cell are of reasonable size, just as great an angular difference by passing through the filter as it would in an ordinary prism monochromator. Hence the same intensity of light of the same degree of purity is obtained.

The prisms need not be nearly so accurately ground as the prisms of the prism monochromator, and the demands concerning the optic properties of the prism glass are very moderate. A filter of this type will therefore be much cheaper than a prism; moreover, it can be of a far greater area (and, consequently, give greater intensity of light) than a prism. Independently of the area, it is also possible to increase the thickness of the filter, and thus, at any rate theoretically, to obtain very great angular variations of the light transmitted at varying wave-lengths. With such a fairly primitive filter, the widths for reduction of intensity to one-half, one-tenth and one-hundredth were measured and found to agree with the theory, the half-width distance equalling the change of wave-length which displaced the transmitted light a distance corresponding to the width of the emission slit, and the hundredth-width distance being double the half-width.

For an ordinary Christiansen filter the width for reduction to one-hundredth is much greater. Schott und Gen.^{2,3} do not record directly the width for reduction of intensity to one-hundredth, but from the curves it may be estimated to be about seven times that for reduction to one-half, and that for reduction to one-thousandth is much greater.

A more detailed account of these investigations will appear elsewhere.

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¹ Cf., for example, McAlister, *Smithsonian Misc. Coll.*, 93, No. 7 (1935).

² Berger og Klemm, *Zeiss Nachrichten*, 2 Folge, Heft 2 (1936).

³ Geffcken, *Kolloid-Z.*, 86, 55 (1939).

Surface Effects in the Creep of Cadmium Single Crystals

THE effect of immersing oxide-coated single crystal wires of cadmium in an electrolyte such as cadmium chloride is to increase the creep-rate many times. This effect was first noted by Andrade and Randall¹. However, Andrade² afterwards found that if the surface of the crystals was cleaned by the evaporation of the outer layers this effect no longer existed. Similar results were obtained independently at the Cavendish Laboratory on crystals electro-polished in