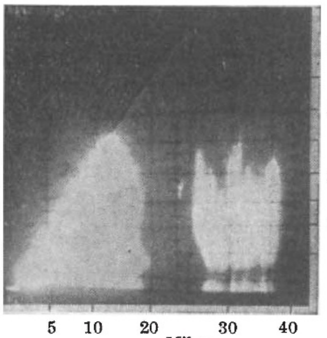

Fig. 3. June 10, 1948, at 0923 G.M.T.; bearing 176° T.

Fig. 3 relates to two extensive thunderstorms, one going on overhead and around the station, the other some 25–36 miles distant. The small isolated echo between at a height of about 17,000 ft. is from the observing aircraft, which is about to enter the second thunderstorm. In this case the accelerometer records from the aircraft appear to indicate that the peaks of the vertical columns were associated with strong upcurrents, the troughs with down-draughts.

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R. F. JONES

Meteorological Office,
East Hill,
Nr. Dunstable.

Frictional Electrification of Dust and Pre-ignition in the Hydrogen Engine

THE experiments on the frictional electrification of sand described by E. W. B. Gill[1] are of interest in respect of the pre-ignition and combustion knock generally observed when hydrogen is used as the fuel for an Otto-cycle internal combustion engine. Pre-ignition in the hydrogen engine is defined as ignition occurring during the induction stroke, that is, before the inlet valve closes.

Engine experiments by R. O. King, W. A. Wallace and B. Mahapatra[2] demonstrated that the effects mentioned were not obtained in the absence of carbon dust derived from pyrolysis of the lubricating oil even at a compression ratio of 10 : 1 and when using hydrogen–air mixtures in any ignitable proportion.

The engine experiments were resumed in September last, when the laboratory atmosphere was heavily impregnated with dust arising from the breaking up of part of the concrete floor. Pre-ignition was so severe that they could not be continued.

An air cleaner from an 85-h.p. motor-car engine was then fitted to the air intake of the C.F.R. experimental engine, which aspirates about 1/15 as much air. There was then no pre-ignition, and combustion knock was reduced sufficiently to permit completion of the experiments. The cleaner was of the type in which, on change of direction of the air stream, the particles of dust are thrown on to a sticky surface. In view of the oversize of the cleaner, it may be assumed that the larger particles only were removed from the air stream.

The engine experimental results, if interpreted in the light of those described by E. W. B. Gill, indicate that pre-ignition in the hydrogen engine when aspirating dust-laden air is due to discharges of electricity as between larger particles carrying negative charges and small ones carrying positive charges, remembering that potential differences would be increased by the friction between particles due to the air–hydrogen mixture passing the restriction of the inlet valve at high velocity. The air cleaner removes the large particles and pre-ignition is prevented accordingly.

R. O. KING
W. A. WALLACE
EDWIN J. DURAND

Department of Mechanical Engineering,
University of Toronto.
Nov. 12.

[1] *Nature*, **162**, 568 (1948).
[2] *Can. J. Research*, F, **26**, 264 (1948).

The 'Complex Indicatrix'

IN discussing the application of Drude's 'complex indicatrix' for reflected light, M. Berek[1,2] originally extended the use of this term to include the two sheets representing the separate values for n and k. Thus he says, "The [cubic] complex indicatrix consists of concentric spheres with radii n and k". Strictly, the cubic complex indicatrix is, as he states elsewhere, a sphere with the complex radius n-ik, and is not itself geometrically representable. The n and k surfaces are representable for the more symmetrical crystals though not for the general case, and in some ways these surfaces take the place of the indicatrix of a transparent crystal. Nevertheless, this use of the term 'complex indicatrix' seems too wide, and I think this is Berek's opinion, for on looking through his later summary (1937)[3], I have not been able to find the term so used, though there is no direct reference to the question. No special designation is used for the curves there plotted (pp. 59, 60) and I have recently cited these under Berek's former nomenclature[4]. A term such as 'representative surfaces' for n, k, R, etc. would, however, appear to be more satisfactory.

As often happens, differences in notation have arisen in the accounts given by different workers. Berek consistently employs k for absorption coefficient, $\varkappa$ for absorption index ($k = n\varkappa$). In the English translation of Drude[5] (p. 360) $\varkappa$ is termed the coefficient of absorption, but later (p. 371) it is called the index. L. Capdecomme and J. Orcel[6] use χ in place of Berek's k and term it the "indice d'extinction". R. Galopin[7] uses k in place of Berek's $\varkappa$ and terms nk the "coefficient d'absorption". I understand that a further discussion from the mathematical side may be available in the new edition of the "Lehrbuch der Erzmikroskopie", Bd. I.[1].

A. F. HALLIMOND

Geological Survey and Museum,
Exhibition Road,
South Kensington,
London, S.W.7.
Oct. 26.

[1] Berek, M., in Schneiderhöhn, H., and Ramdohr, P. "Lehrbuch der Erzmikroskopie", 1 (Berlin, 1934), see p. 130.
[2] Rinne, F., and Berek, M., "Anleitung zu optischen Untersuchungen . . .", 16 (Leipzig, 1934).
[3] Berek, M., *Fort. Min. Krist. Petr.*, **22**, 1 (1937).
[4] Hallimond, A. F., "Manual of the Polarizing Microscope", 91 (York, 1938).
[5] Drude, P., "The Theory of Optics" (English trans. by C. Mann and R. Millikan, London, 1902).
[6] Capdecomme, L., and Orcel, J., *Rev. optique théor. et instr.*, **20**, 47 (1941).
[7] Galopin, R., *Bull. Suisse Min. Petr.*, **27**, 190 (1947) (see p. 197).