Now putting $k = 1/50$ (equ. 3), $K = 1/30$, $\alpha = 1$, the equation requires $T'(E') \sim 2.0$. This value is reasonable; it is obtained from (5) by putting $E_1 \sim 6,000$ MeV. Thus the experimental findings are roughly in accord with $K = 1/30$; that is, $m_h \sim 6m_e$. The above consideration is very rough; but it seems to show that the heavy electron hypothesis is not incapable of accounting for the experimental findings.

We are greatly indebted to Prof. W. Heitler for detailed discussions, and we are also indebted to Dr. T. Nevin for help during the experiments.

Note added in proof. After submitting this communication a photograph purporting to be that of a particle of mass $10 m_e$ has been reported by Cowan (*Science*, November 12, 1948).

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⁶ Fretter, *Phys. Rev.*, **73**, 41 (1941).

⁷ Jánosy, Rochester and Broadbent, *Nature*, **155**, 142 (1945).

⁸ Cocconi, Loverdo and Tongiorgi, *Phys. Rev.*, **70**, 852 (1946); *Rend. Cont. Sci.*, **77**, 1 (1943).

SIMULTANEOUS MEASUREMENT OF THE OPTICAL CONSTANTS OF METALS OVER A WIDE WAVE-LENGTH RANGE

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THE optical constants of metals can be calculated from a knowledge of the ellipse of vibration which results from the reflexion of plane polarized light usually at an azimuth of 45° by a plane metallic surface. In the present method, this ellipse is determined by finding the ratio of the major and minor axes and the orientation of the major axis to the plane of incidence. It differs, however, from other methods using this principle in that the data from which the ellipse is obtained are produced on a photographic plate in the form of a thin vertical strip of variable intensity for each wave-length. A continuous source and a dispersing prism enable a record to be obtained simultaneously for the whole of the spectrum-range required.

The essentials of the optical system are shown in Fig. 1. The reflected elliptically polarized light passes through the rotator T , which consists of two prisms of right- and left-handed quartz in optical contact. Above the central plane the ellipse will be rotated clockwise; below, counter-clockwise. Fig. 2 indicates the relative orientations of the ellipse in the light emerging from the rotator. If the analysing

Fig. 1. Optical system

A, C, F, minima; B, E, G, maxima; $BC = AC$
Fig. 2. Relative orientations of the ellipse

nicol N is adjusted for plane polarized light, the vibration direction of which is vertical, then in the positions ACF the intensity will be a minimum, and in positions BEG a maximum. The square root of the ratio of these intensities gives the ratio of the axes. DD is the central plane, so that the orientation of the ellipse is given by

$$\theta = \frac{CD}{CF} \times 180^\circ.$$

A fiducial line consisting of a very fine wire W is placed immediately after the rotator and adjusted to be in the central plane. A plano-cylindrical lens L_1 produces at its conjugate focus P an image of the pattern of Fig. 2, modified by the analyser, and of the fiducial line, magnified in the vertical plane only. A second plano-cylindrical lens L_2 converges the light horizontally into a vertical strip of variable intensity in its focal plane P . Using white light and a prism, a spectrum crossed by a system of dark and bright bands together with the horizontal fiducial line is obtained on a photographic plate placed at P . By removing the rotator and analyser, which are mounted together, and placing in position a triangular aperture with base horizontal and its plane coincident with the fiducial line W , an exposure of graded intensity is obtained. In front of the photographic plate P , which can be moved horizontally in its own plane, a grid G is placed, consisting of alternate opaque and transparent strips. This enables the crossed spectrum and the comparison spectrum of graded intensity to be obtained, adjacent strips being of the same wave-length.

Fig. 3 shows the pattern obtained with aluminium, the exposure time for each spectrum, taken consecutively, being 40 sec. Microphotometric comparison of the maxima and minima against the adjacent graded intensity enables the ratio of the axes to be determined, while the distance between the fiducial line and the various maxima and minima gives the orientation of the ellipse. Since the time involved in obtaining the data for a wide wave-length region is so short, the method is clearly advantageous in that deterioration or change of the surface while observations are being made is avoided. So far as we are aware, all existing methods of measuring the optical constants of metals require the use of monochromatic light, making the determination of a dispersion curve a lengthy process.

Fig. 3. (a) Fiducial line; (b) vertical bands of variable intensity; (c) adjacent graded intensity

Experiments have so far been carried out in the wave-length range $0.35\text{--}0.7\mu$ with gold and aluminium specimens of known dispersion (measured on the senior author's photo-electric apparatus¹), and good agreement was obtained. The estimated accuracy is about 2 per cent, but improvements now being made are expected to increase the accuracy and reduce the exposure time.

One of us (B. G. C.) is indebted to the Department of Scientific and Industrial Research for the award of a maintenance grant.

¹ Bor, *Nature*, 139, 716 (1937). Bor, Hobson and Wood, *Proc. Phys. Soc.*, 51, 932 (1939).

GROUND SUBSTANCE OF THE MESENCHYME AND HYALURONIDASE

A CONFERENCE devoted to the "Ground Substance of the Mesenchyme and Hyaluronidase" was organised by Dr. F. Duran-Reynals with the co-operation of Dr. E. D. Goldsmith and was held during December 3-4 under the sponsorship of the New York Academy of Sciences.

The programme concerned itself with all phases of current research pertaining to acid mucopolysaccharides and hyaluronidase, the most important of the group of substances known as spreading factors. Histochemical, electron microscope, biochemical, bacteriological, endocrinological and clinical findings were reported.

Hyaluronidase is widely distributed in Nature. It is found in male germ cells, in pathogenic bacteria, such as streptococci and pneumococci, in insects, in fishes, and in the poison glands of several venomous reptiles. Although produced by such diverse organisms, the function of the enzyme is the same in all cases; but the results are totally different. The function of hyaluronidase is to attack the cementing mucoid substance of the connective tissue. By attacking this cementing substance, the enzyme 'dissolves' it and opens the way for any material which may penetrate the body with it.

Thus, the spreading factor associated with the male germ cells dissolves the cementing material surrounding the female germ cells and makes fertilization possible. (The adhesive quality of mucopolysaccharides of ovarian follicular fluid clumps the granulosa

cells around the discharged ovum until acted upon by hyaluronidase from the sperm.) When the factor comes from a bacterium it facilitates invasive infection, and when hyaluronidase is injected with a therapeutic agent, it speeds and enhances the action of such agents.

The study of the action of the enzyme on the cement substance has served to explain an important factor in the mechanism of infection, namely, spreading in the organism of poisons or infectious agents. Equally it has provided a tool for the clinician, since it promotes the spreading of therapeutic substances in the organism. Infections may thus be fought with their own weapons.

The following papers dealing with more specific aspects were read at the conference.

The enhancement of the capacities for growth and invasion of a mouse transplantable squamous cell carcinoma by the local injection of hyaluronidase from testis (W. L. Simpson, Detroit Institute of Cancer Research).

The facilitation of absorption of subcutaneously injected lactate-sodium-glucose solutions with a diminution in pain. It should prove to be extremely useful in hypodermoclysis (C. L. Burket and P. Gyorgy, University of Pennsylvania).

Hyaluronidase enhances the penetration as well as the spreading of drugs. Further, it exhibits very low toxicity (J. Seifter, Wyeth Institute of Applied Biochemistry).

Hyaluronidase reported to be effective in the spreading of the anaesthetic action of local anaesthetics. Certain difficulties encountered in nerve block techniques in regions like the mandible may be overcome by the addition of hyaluronidase to the procaine-epinephrine mixture (C. H. Kirby, J. P. Looby and J. E. Ekenhoff, School of Medicine and Dentistry, University of Pennsylvania).

Dr. D. H. Sprunt (University of Tennessee) and Dr. M. Lurie (Henry Phipps Institute) emphasized the importance of the connective tissue ground-plasm in infection (tuberculosis, D. Lurie). Female sex hormone increases the turgidity of the connective tissue elements and reduces capillary fragility. Oestrogens retard the progress of tuberculosis, chiefly by reducing the permeability of the connective tissue, whereas gonadotrophin enhances the progress of the disease, primarily, by increasing the permeability. It is noteworthy that some years ago Thomas and Duran-Reynals accelerated the progress of tuberculosis with hyaluronidase.

Additional findings by Drs. F. Duran-Reynals, G. Van Wagenen, H. Bunting and J. Opsahl (Yale University School of Medicine) pertaining to the relationship between the oestrogens, adreno-cortical hormone and the ground substance and hyaluronidase were reported.

Drs. C. Ragan and K. Meyer (College of Physicians and Surgeons, Columbia University), in their report on the possible connexion between hyaluronidase and rheumatic diseases, disclosed that the pathogenesis of the rheumatic diseases is obscure. Apparently, the disease process is localized in the connective and particularly in the interfibrillar material, which is composed in part of one or both of the mucopolysaccharides—chondroitin sulphuric acid and hyaluronic acid. Many micro-organisms produce hyaluronidase; but only two, Group A and C haemolytic streptococci, produce hyaluronic acid. The highest concentration of hyaluronic acid in the mammal is found in the synovial fluid (in the joint). In normal human joint