

so that the rays converging from the mirror traverse the block and form the image on its outer surface. The principle is the same as that of the correction of the aberration of a microscope objective by using a coverslip of the correct thickness. But the thickness required is very much greater. By piling up plates, I find that 4.8 cm. of crown glass,  $\mu_D = 1.51$ , is just right for an old naval mirror marked "5.25 ins. optical focus". The block does not make the coma worse, and only slightly increases the colour aberration. In a photograph taken with this system working at a numerical aperture of 0.5, point-objects appear as disks 1 mm. in diameter. This holds over an area of about 1.5 cm. diameter on the photograph. The merit of this arrangement of a mirror and block is its cheapness. Better, but presumably costly, lenses for photographing faint objects have been described by Rayton<sup>2</sup>, also by McLennan and Ireton<sup>3</sup>.

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<sup>1</sup> A. C. W. Aldis, *Trans. Optical Soc.*, **21**, 113; 1920.

<sup>2</sup> W. B. Rayton, *Sci. Abs.*, A 3987; 1930.

<sup>3</sup> J. C. McLennan and H. J. C. Ireton, *Proc. Roy. Soc.*, A, **129**, 31; 1930.

### Constitution of Vitamin C

IN a recent communication<sup>1</sup> Micheel and Kraft have proposed a structure for ascorbic acid of a furane-carboxylic acid type. This structure was considered by us some months ago, and although attractive as explaining many of the chemical properties, we did not put it forward, principally on the ground that it would not satisfy the crystallographic requirements; these are, briefly<sup>2</sup>, that the pseudo-symmetry, optical properties and the thinness of the molecule demand a structure which is almost completely flat. Unless the disposition of the carbon valencies in ascorbic acid is entirely novel, a molecule of the structure proposed by Micheel and Kraft would certainly not meet these requirements. These objections, which were considered in detail by us before the publication of our previous note<sup>3</sup>, still hold, and they apply also to variants of Micheel and Kraft's structure containing ethylene oxide or pyranose rings.

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<sup>1</sup> NATURE, **131**, 274, Feb. 25, 1933.

<sup>2</sup> NATURE, **130**, 205, Aug. 6, 1932.

<sup>3</sup> NATURE, **130**, 888, Dec. 10, 1932.

### Substituted $\beta\gamma$ -Diphenyladipic Acids and Derivatives of Chrysene

PROF. R. ROBINSON and Mr. G. R. Ramage in a recent letter<sup>1</sup> state that they are engaged in the synthesis of certain substituted  $\beta\gamma$ -diphenyladipic acids and of certain derivatives of chrysene. I have been working in this field for some years and work in progress, or projected, in part in collaboration with research students, includes the synthesis of substituted  $\beta\gamma$ -diphenyladipic acids derived from *o*-, *m*-, and *p*-chloro-, bromo-, iodo-, hydroxy-, methoxy-, nitro-, amino- and dimethylamino- benzaldehyde and from veratrole and piperonal via the benzylidene malonic esters<sup>2</sup> and cinnamic esters<sup>3</sup> with the object of

(a) effecting the optical resolution of both forms, (b) their conversion into derivatives of chrysene<sup>4</sup>, and (c) their conversion into derivatives of possible therapeutic and industrial value. The research on the reduction of substituted cinnamic esters has been assisted by grants from the Chemical Society in June 1930 and 1931.

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<sup>1</sup> NATURE, **131**, 205, Feb. 11, 1933.

<sup>2</sup> Vogel, *J. Chem. Soc.*, 1014; 1928.

<sup>3</sup> Oommen and Vogel, *J. Chem. Soc.*, 2148; 1930; Oommen, Ph.D. Thesis, London, 1929; compare Henle, *Annalen*, **348**, 16; 1906.

<sup>4</sup> Compare von Braun and Irmisch, *Berichte*, **64**, 2461; 1931.

### Wave Equations and the Conservation of Energy

IN Dirac's "Quantum Mechanics" the "equation of motion" satisfied by any observable  $\xi$  not involving the time explicitly is

$$(i\hbar/2\pi)\dot{\xi} = \xi H - H \xi$$

where  $H$  is the Hamiltonian. The conservation of energy, when  $H$  does not involve the time explicitly, is deduced from this by putting  $\xi = H$ , giving  $\dot{H} = 0$ .

Another fundamental assumption of Dirac's theory is his form of wave equation, which imposes another condition on  $H$ . He points out that it is legitimate to assume the quantum conditions only for one particular time and then investigate whether they hold for all time, but a similar limitation, which appears to hold for the wave equation, seems to have been overlooked. The condition that the wave equation may hold for all time leads to an equation which expresses the conservation of energy. We thus have two conditions that it seems desirable a wave equation should satisfy, leading to the conservation of energy and charge.

It is known that the second condition is satisfied by Dirac's linear equation and also by Schrödinger's non-relativistic equation, but not by the second-order relativistic equation. I have proved (in the course of work not yet published) that the first condition also is satisfied in the same two cases. These facts seem to provide a stronger reason for rejecting the second-order relativistic equation than those usually given.

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### Band Spectra of Barium Oxide (BaO)

IN the flame of the arc between carbon electrodes containing barium chloride or nitrate, a class of red-degrading bands appear between  $\lambda$  4300 -  $\lambda$  8000. These have been attributed to the oxide of barium and analysed into two systems with their (0,0) bands at 17,713  $\nu$  and 16,060  $\nu$  respectively. The rotational structure analysis of (0,1), (0,2) and (1,1) bands for the less refrangible system and (1,0), (0,0), (0,1) bands for the more refrangible system have been done. The two systems have a common lower level, and are due to  $^1\Sigma$ ,  $^1\Sigma$  transitions. In the lower state,  $B'' = 0.3075$  cm.<sup>-1</sup>. The detailed account of the analysis will appear elsewhere.

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