was taken to refer to all cones. If it is assumed tentatively that the number of 'green sensitive' cones forms only half to a third of the total, the log R_Q values corresponding to small values of A will be reduced by 0·3–0·5 and those referring to larger test-fields by not more than about 0·2. Again, the value of N_c was assumed to be constant throughout the rod-free area of the fovea. The removal of this assumption would reduce the log R_Q values for log A greater than 2·6 by less than 0·2. Owing to some uncertainty regarding the exact variation of foveal summation with area for very small areas, the R_Q values for larger test-fields are certainly the more reliable of the two. The additional corrections lead, therefore, to log R_Q values equal to, or less than, zero.

There is no need to labour the point, beyond stating that a single cone may well be as sensitive as a single rod, if not more so. It would be a bold man, indeed, who would introduce into the argument morphological differences between the two types of receptor. Cones are sometimes said to have special light-funnelling properties; human foveal cones, however, have a more rod-like appearance than the rods themselves, and one can scarcely even speculate on funnelling in a vessel the dimensions of which are comparable with the wave-length of light, and the optical properties of which are virtually unknown.

The analysis shown in Fig. 1 contains all the relevant results known to me with but three exceptions: first, Riezler, Esper and Meurers's[13], who failed to immobilize the observers' heads to an extent which is generally considered a minimum requirement (cf. also ref. 14); secondly, Craik and Vernon's[3], whose R_I value is shown in Fig. 1, but who do not seem to have specified the retinal eccentricity at which the rod portion of their results was obtained; and thirdly, Pirenne's[15], which raise a point of great interest. Using a blue test-field at 10′ angular diameter, he measured the absolute threshold in the fovea and at various eccentric locations up to 4°. Now Brindley[10] has shown that p_c equals 1 for blue test-fields as large as 13′ in diameter, whereas p_c equals 0·5 for smaller test-fields, red or green in colour. Clearly, an attempt to express a foveal threshold measured with a blue 10′-field in terms of the maximal foveal sensitivity (yellow-green) leads to an inadmissible situation, analogous to the one illustrated earlier by reference to the dark-adaption curve. As the relative number of 'blue' receptors in the fovea cannot be even guessed at, the only point which need be made is that Pirenne's observed value log $R_I \approx 2{\cdot}1$ reduces approximately to 1·1 when the corrections, previously mentioned, are applied. R_Q cannot be estimated.

A Photo-chemical Correlate

The approximate equality of rod and cone thresholds raises the question of the relative visual pigment concentrations in these receptors. Although there is no *a priori* reason why there should be direct proportionality between threshold and light-absorption (evidence is accumulating that such a relation need not obtain), one would not expect the concentrations to be greatly different. The first piece of photo-chemical evidence regarding this point comes from *in vivo* bleaching measurements on the squirrel's pure-cone retina[16]; it shows that the visual pigment density changes on bleaching by an amount commensurate with that found in experiments carried out on rod-retinæ. Brindley's sensory experiments[17] lead to the same conclusion.

Night Flying

The fact that, at small visual test-angles, the fovea and the periphery are approximately equally sensitive may have a practical sequel. At present, Service personnel due for nocturnal look-out or flying duties are kept in a state of near dark or red adaptation. In so far as the visual demands are only the detection of point sources of light, the sensitivity factor of not more than 5 or 6 which prolonged dark-adaptation bestows would scarcely seem to be worth the price possibly paid for it in terms of reduced morale. If the visual task involves the detection of 'dark shapes on the horizon', prolonged dark-adaptation is unavoidable. But when the object is the detection of point sources, dark-adaptation of a few minutes may well be adequate. Stars appear, after all, little brighter after 50 min. than after 5 min. spent in the dark.

Note added in proof. Since this paper was submitted for publication, Pinegin[18] has shown that, for very small test-fields, rod and cone thresholds are comparable in magnitude.

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OBITUARIES

Dr. O. G. S. Crawford, C.B.E., F.B.A.

O. G. S. Crawford, who died on November 28, 1957, was one of the best-known British archæologists of his generation. Born in India in 1886, educated at Marlborough and Keble College, Oxford, where he turned from classics to geography, he soon began to make original contributions to archæology. He was impressed with the importance of studying the environment of early man, and the influence of geographical factors upon human affairs, ideas which found expression in his first book, "Man and his Past" (1921). His interests led him to undertake an archæological survey of an area near his home, which was published in 1922 as "The Andover District", and is still well worth reading. In 1913 he joined the Wellcome expedition to the Sudan, but this opportunity was cut short by the outbreak of the First World War. After a period in the infantry, he joined

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the Royal Flying Corps as an observer, being shot down and taken prisoner in 1918. There were few at that time who foresaw the special contributions that aerial survey could make to archæological studies, but Crawford's field-work on the chalk downs had shown him the use of shadows in studying complicated earthworks, and his war-time flying experience impressed upon him the value of the aerial view for the understanding of archæological sites.

At the time of the First World War archæological posts were few and offered little prospect of a career, but Crawford's appointment in 1920, as the first archæology officer at the Ordnance Survey, provided just the opening he needed. Until the time of his appointment, the archæological information embodied in Ordnance maps was largely in the hands of the field staff, who might have little knowledge of archæology, no matter how competent they were at surveying. The task confronting Crawford was immense; however, he found time not only for routine revision of archæological detail on the Ordnance maps, but also for the preparation of a series of 'period' maps, of which that of Roman Britain was the first and best known. The value of this work at the Ordnance Survey, undertaken with a minimum of assistance, may be seen in the official large-scale maps of the United Kingdom, which attain a standard in archæological cartography scarcely approached elsewhere. The results of Crawford's field surveys were published as individual papers or larger works, such as "The Long Barrows of the Cotswolds" (1925), an important account of a selected class of monuments.

It is probably as the pioneer of archæological air photography and as the founder-editor of the quarterly journal *Antiquity* that Crawford will best be remembered. His achievement in the first sphere culminated in the publication, with Alexander Keiller, of "Wessex from the Air" (1928), a splendidly illustrated account of an archæological air reconnaissance of Salisbury Plain and adjacent areas, which sets a new standard in archæological research. In 1928, Crawford visited the Middle East, in an attempt to secure the preservation of air photographs taken by the Royal Air Force, and to direct attention to the unique possibilities open to air photography for research in that region. He was ever keen to foster the development of the subject in Britain, either publishing discoveries himself or making known the work of others in the same field. Much of his later work appeared in *Antiquity*, over which he took great pains, making several special journeys to Europe and North Africa. If the first dozen years of that journal represent its best period, it has always provided a forum for review and criticism and for exchange of ideas on all branches of archæology.

As an archæologist Crawford had a flair for field survey, which served him well when studying earthworks, either on the ground or from the air. He was a marked individualist, gifted with considerable powers of expression, to which the pages of *Antiquity* bear witness. For such a person, relations in an official department cannot always have been easy, but he had a great capacity for friendship, and was able to awake in others something of his own immense enthusiasm for his chosen subject. He was created C.B.E. in 1950, elected Fellow of the British Academy in 1949 and awarded honorary degrees by the Universities of Cambridge and Southampton.

J. K. S. St. Joseph

Prof. W. J. Jongmans

The sudden death of Prof. Jongmans, at Heerlen on October 13, robs the world of one of its most active palæobotanists. Willem Josephus Jongmans was born on August 13, 1878, at Leyden, where he received his early education. A student of the University of Leyden and later of the University of Munich, he was awarded a D.Phil. of the latter University in 1906. In the same year he was charged with palæobotanical research in one of the Dutch Government Services concerned with fuel resources, and the following year, 1907, was appointed a curator at the Rijksherbarium in Leyden. In 1919 he was released from the post at the Herbarium to become head of one of the departments in the Government Geological Service. While holding this position Jongmans was nominated head of the office at Heerlen, which led directly to his appointment as director of the Geological Bureau of the Netherlands Mining District at Heerlen, a post which he held from 1924 until his retirement in 1946. In addition to being director of the Bureau he was, from 1932 onwards, extraordinary professor of palæophytology in the University of Groningen.

Throughout his career, Jongmans's interest was directed towards the study of the flora of the Carboniferous period, and his extensive knowledge led to the publication of many authoritative papers on the plants from such widely distant places as Limburg and Sumatra, North America and Anatolia, Peru and Egypt, Spain and the U.S.S.R. But perhaps he is best remembered in Britain for the excellent "Monograph of the Calamites of Western Europe", written in collaboration with Kidston (1915–17), and the monumental "Fossilium Catalogus", published in twenty-two parts between 1913 and 1937. Jongmans's interest was not, however, confined purely to the plants, but extended over the floral assemblages of which they had been members. Early in his life he made a specialist study of the stratigraphic relations of the Carboniferous floras and he was responsible for many publications on this aspect of palæobotany. We should remember also his very important opinions on the nomenclature of fossil plants.

Though he officially retired in 1946, Jongmans carried on active research until the very last, and he was often to be seen in the Geological Bureau, which was only a short distance from his home at Heerlen. Time was always found to welcome and encourage a visiting palæobotanist who had come to see the magnificent collections and discuss problems with the master who had done so much for the furtherance of his subject. In recognition of his services to his country and science, Jongmans had been elected an Officer in the Order of Orange-Nassau and a Knight of the Order of the Netherlands Lion.

Alan Wesley

Mr. C. T. Gimingham, O.B.E.

Through the death of Conrad Theodore Gimingham on November 16, agricultural entomologists and plant pathologists have lost one of their pioneers and dearest friends.

Gimingham joined the staff of the Ministry of Agriculture's Plant Pathology Laboratory at Harpenden, as entomologist in 1928, at a most important time in the development of agricultural entomology. The specialist biological advisory services in agriculture had started some years earlier when several young and enthusiastic biologists were stationed at

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