Further information on future developments is given in No. 17 of *The B.B.C. Record* (February 1963), which emphasizes the value of the two television services. Moreover, it outlines the first year's proposals for adult education in television, and in the Sixth Bishop Bell Memorial Lecture, "Future Prospects in Broadcasting", delivered by H. Carleton Greene, the director-general of the Corporation, on April 30, and now published as a pamphlet; Mr. Greene stresses the complementary functions of the Corporation and the importance of concerning itself with the whole of the national life, with mass interests and with minority interests. He suggests that if broadcasting planners do their jobs properly they can create and stimulate cultural and educational demands as well as meet them. He directs attention to the use of television programmes in teaching and to the introduction of experimental programmes for use in technical colleges and colleges of further education. Furthermore, he urges that it would not be right to make an educational channel a charge on licence revenue: it should receive a separate grant-in-aid, as do the External Services.

SOILS AND LAND USE IN NORTH WALES

A SURVEY of the soils of North Wales was started by the late Prof. G. W. Robinson and his colleagues, who published several reports and maps in the *Welsh Journal of Agriculture*. The work has been completed recently with a memoir, and accompanying maps, which covers an area of 240 sq. miles, stretching from Pentraeth, in Eastern Anglesey, and Llandudno in the north to Waenfawr and Bettws-y-Coed in the south*. The Conway valley and most of the high land of Snowdonia are included.

The climate is maritime and its most important influence in soil development is the rainfall, which increases steeply from some 30 in. on the coast to 120 in. on the mountains in the south. The parent materials of the soils include acid and basic igneous rocks, schist and shale and their derived drifts, non-calcareous clay and limestone, peat and various mixed drifts from igneous and sedimentary rocks. The soil mapping and classification follow the custom of the Soil Survey and profile description includes information on site, drainage, parent material, horizons, colour, texture and structure. Soils of five major soil groups have been recognized, namely, brown earths, calcareous, gley, podzolized and organic soils, but there is also a considerable area of immature soils occurring on youthful sands and alluvium. Each is described and sub-divided into sub-groups and soil series, and again grouped into lowland, marginal and mountain soil zones.

The larger part of the memoir is naturally taken up with detailed descriptions of the soil series and with appendixes on particular profiles and analytical data, but there is a chapter on land use, compiled with the assistance of G. Edwards, H. E. Roberts and W. A. Lindsay-Smith. This opens with a historical review of the area from the time of the disappearance of the valley glaciers, with inferences to be drawn from studies on pollen grains and dating by radioactive carbon, on changes in climate, flora and human settlement. Recent agricultural statistics show the variation in size of holdings and the changes in crops and livestock between 1935 and 1955. An interesting aspect is the continuous rise in sheep production, but there has also been a pattern of technical improvement and change in farm economy to meet the seasonal fluctuations in demand. This is discussed in relation to the five regions of the area. There are about 12,000 acres of woodland, about half planted by the Forestry Commission—largely conifer high forest. Many factors, of course, determine tree growth, but it seems clear that good oak and elm are to be found on freely drained slopes of soils derived from mixed drift although falling short of conifers in yield production.

Numerous figures and tables are of great assistance in assimilating the information presented, and several excellent photographs illustrate the outstanding features of the area in question. A. M. SMITH

* Agricultural Research Council. Memoirs of the Soil Survey of Great Britain—England and Wales. *The Soils and Land Use of the District Around Bangor and Beaumaris*. (Sheets 94 and 106.) By D. F. Ball. Pp. ix+182+13 plates. (London: H.M.S.O., 1963.) 35*s*. net.

COMPARATIVE BIOCHEMISTRY OF THE LEGUMINOSAE

A SYMPOSIUM on "The Comparative Biochemistry of the Leguminosae", organized by the Plant Phenolics Group, was held at the John Innes Institute, Bayfordbury, Hertford, during September 10–11. The aim of the meeting was to bring together workers in diverse scientific fields but sharing a common interest in this group of plants. The Leguminosae, which contains some 550 genera and 12,000 species, is, in economic importance, second only to the Gramineae, and members of the family contain a remarkably large number of interesting and unusual chemical constituents. In his opening paper, N. W. Simmonds (John Innes Institute) reviewed the systematics of the family and summarized the many uses legumes are put to as foods, forages, timbers, gums, resins and tannins. Dr. R. Cooper (Rothamsted Experimental Station), in dealing with root nodulation, pointed out that 90 per cent of the fixed nitrogen in the world had come from leguminous root nodules. His review of the conditions required for successful nodulation by *Rhizobium* showed that many factors, including the occurrence of the correct host-symbiont specificities and the presence of the right kind of polysaccharide in the host roots, were involved.

Chemistry may well be, in the future, of considerable value to the systematists dealing with legumes. Its present contribution is slight, mainly because very few taxa have been thoroughly surveyed chemically. Dr. R. E. Alston and his colleagues in the University of Texas are therefore concentrating their efforts on a single genus, *Baptisia*. Dr. Alston illustrated his talk on this genus with pictures of the phenolic spots obtained on two dimensional chromatograms of leaf and flower extracts. The patterns so obtained can be used not only to distinguish most of the eighteen or so species but also many of the interspecific hybrids. Compounds which, at the moment, show more promise as taxonomic markers than the phenols are the free amino-acids. Besides having the common protein amino-acids, legume seeds contain a range of unusual ninhydrin positive substances, such as canavanine, homoarginine, γ-hydroxyhomoarginine and lathyrine. Dr. A. E. Bell (King's College, London), in the next paper, showed that most species of *Lathyrus* could be divided into four groups, depending on their characteristic amino-acid patterns; species of *Vicia* could be divided in a similar manner.

Few systematic surveys of alkaloids have been carried out in the legumes, so that no taxonomic inferences can yet be drawn from their distribution. However, three series of characteristic bases (the quinolizidines, the pyrollizidines and the *Erythrina* indoles) are present and, according to Dr. M. F. Grundon (University of Belfast), who provided the next paper, they could all arise from the same two precursors, Δ^1-piperideine and α-keto-glutaric acid, by similar biosynthetic pathways. In the last paper on nitrogenous constituents, Dr. D. Boulter (University of Liverpool) described recent progress on the separation of legume proteins. By using acrylamide-gel electrophoresis, he had been able to separate the albumin fraction of the field pea into more than twenty distinct components.

The second day of the meeting was devoted to phenolic constituents. One group of phenols, the isoflavonoids, occurs far more abundantly in the Leguminosae than in any other family, so that it was fitting that the first paper dealt with chemical studies on some recently discovered members of this group. Prof. W. D. Ollis (University of Sheffield) provided a fascinating account of the use of nuclear magnetic resonance spectroscopy for elucidating the structures of the complex phenols present in *Derris robusta*, *Piscidia erythrina* and species of *Dalbergia*. Dr. H. E. Nursten (University of Leeds) then described the hydrolysable and condensed tannins present in such plants as *Acacia melanoxylon* and *Robinia pseudacacia*. The legumes are an extremely rich source of flavonoids with unusual substitution patterns, and Dr. J. B. Harborne (John Innes Institute), in the next paper, summarized the various structural types present. He then referred to variability in glycosidic pattern, making the point that this sometimes showed correlation with systematics, as illustrated by surveys of the anthocyanins and flavonols of *Lathyrus*, *Pisum* and *Vicia*. Chromatographic patterns of phenolics in flower petals are also of interest at the variety level; Miss J. J. Corner and Dr. D. G. Rowlands (Unilever, Bedford) have found that broad bean varieties can be divided into two groups on the basis of their flavonol content. Beans are rich sources of oligosaccharides of the raffinose series, and Miss M. Walters (Royal Holloway College, London), in the last paper, described work on the biosynthesis of raffinose from uridine diphosphogalactose and sucrose in *Vicia faba*.

The meeting ended with a summary of the chemical aspects by Dr. E. C. Bate-Smith (Low Temperature Station, Cambridge) and of the taxonomic aspects by Dr. B. L. Turner (University of Texas). There was much lively discussion of these and other papers presented at the symposium. This was the first meeting of the Plant Phenolics Group to be held since the group decided to extend its scope to cover other plant constituents besides phenols, and its success underlined the fact that there is a very real need in Britain for an organization broadly devoted to phytochemistry. J. B. Harborne

THE MOON'S PHOTOMETRIC FUNCTION

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In the general case, for a flat diffuse-reflecting surface of a given normal albedo (ratio of true brightness to that expected from a non-absorbing Lambert scattering surface under the condition that the direction of illumination and observation are both perpendicular to the surface), the specification of surface brightness, B_λ, in units of the power of the illuminator is obtained with the knowledge of the three remaining degrees of freedom in the problem. These are the azimuthal angle between the illuminator and the observer, the angle of incidence, and the angle of observation, shown in Fig. 1 as μ, i and e respectively. In the case of the Moon an equally valid set of parameters would be the phase angle, α, the angle of elevation of the Sun, $A_\odot$, and the elevation angle of the Earth, $A_\oplus$, which are also shown in Fig. 1.

It follows that all lunar photometric data, when plotted in the four-dimensional space (B_λ, α, $A_\odot$, $A_\oplus$), should, within the observational error, define a 'surface'. Any tendency to abnormally large scatter about a 'surface' in such a plot could be due only to a non-unique scattering law (photometric function) for the lunar surface, or one which was 'polarized'. The latter possibility would derive from an anisotropic surface, that is, the scattering law would not be invariant to a rotational transformation of co-ordinates about the μ axis, and one additional degree of freedom would be introduced.

That the Moon's photometric function is fairly unique is suggested by previous photographic photometry; however, that ray material is a somewhat better back-scatterer than most of the rest of the Moon is well known.

This article presents an additional simple observational test, in the case of the inner slopes of crater rims, of the double assumption that: (1) the general photometric function of the lunar surface applies to the inner walls of crater rims; (2) the functional form of the photometric function which has been fitted to previous photographic data is correct.

In a review paper, Minnaert[1] has discussed comprehensively the history of photometric observations of the Moon. Except for photoelectric investigations of the integrated light (whole Moon), by Rougier[2] and Bullrich[3], the most widely accepted observations have been by pure photographic photometry, the susceptibility to systematic error of which leaves their reputation open to question, regardless of the skill of the observers involved.

It has been universally concluded that the strongest source of variation of the brightness of a given lunar feature is the variation in phase angle, which conclusion is not seriously questionable. It has also been concluded, however, that the form of the residual dependence on $A_\odot$ and $A_\oplus$ is in the form of a dependence on $h = f(\alpha, A_\odot, A_\oplus)$, and in particular that h is an angle defined locally on the lunar surface as the projection of angle e on the plane containing the vectors pointing toward the Sun and the Earth. h is shown in Fig. 1. This assumption follows from the conclusion by Minnaert[1] and Fessenkov[4] that, making allowances for differences in normal albedo, isophotes tend to coincide with lunar meridians. For a smooth spherical Moon, when the selenographic latitudes of the sub-solar and sub-Earth points are both zero, h equals the selenographic longitude of the particular point on the lunar surface. Hence the name 'brightness longitude' for h, even though h will vary with local strike and dip, regardless of the constancy of selenographic co-ordinates.

Eimer[5] has determined the Moon's photometric function, assuming it to depend only on a and h, from the photographic data of Fedoretz[6]. The result is a function, which, for a given phase angle other than zero, is a monotonic function of h over the range given.