phloem transport and root/shoot relationships, and leaf efficiency and internal competition.

In so wide and varied a field it is difficult to select outstanding aspects, but one general point of interest was that there seemed less tendency than usual to attempt to explain all features of plant behaviour in terms of the production and distribution of growth substances or hormones. There was, of course, much discussion and argument on the role and mode of action of growth regulators in plant differentiation and general physiology, but organic metabolites seemed to come back more into their own, as it were, in the debates. Many speakers stressed that growth substances had important effects in mediating the distribution of assimilates and there seemed to be an undercurrent of feeling, not specifically expressed, that local concentrations of assimilates were involved in determining tissue behaviour, especially differentiation.

An interesting suggestion, which might well have been followed up, was that since virus infection in some plants (for example, apples) may alter the balance between flower initiation and vegetative growth, viruses might possibly be very useful tools in physiological investigations.

The contrast in outlook of the forestry worker, concerned primarily with the maximum production and quality of the woody parts of the plant, and the pomologist concerned with the maximum production and quality of fruit, led to interesting comparisons of experimental techniques and interpretations, undoubtedly of great value to both groups.

The visitors were the guests of members of the staff throughout the week and this proved a particularly happy feature of the gathering, which, despite the informality of its proceedings, clearly owed much of its undoubted success to careful preparations in advance. The news that it was planned to arrange further group discussions of this nature at East Malling in the future was warmly welcomed by all the guests who had shared in this experiment.

R. H. STOUGHTON

THE ART OF CALLIGRAPHY

THE real meaning of the word calligraphy is 'beautiful' handwriting, not just 'handwriting' as often interpreted. Handwriting is essentially a medium of recording and transmitting information. As such, in various guises, sometimes readable, often decipherable with difficulty, it has evolved with history throughout the ages, reflecting contemporary styles, motives, the basis of literature, learning and culture, such as we now accept as a natural heritage. Much modern handwriting is of necessity hasty, essentially individual, executed with little, if any, regard for appearance or consideration of its impression on the recipient at the time, or on posterity if worthy of such survival. It is a rather frightening thought that, to-day, illegible signatures appended to important official and business correspondence (by no means confined to the professions most commonly criticized for this fault) have increasingly to be translated into block letters to establish identity. Not so in the Arab world, where calligraphy is, and always has been, something a great deal more, "... an art—indeed the chief form of visual art—with a history, a gallery of great masters and hallowed traditions. It is an art of grace and elegance which inspires wonderment for its appearance alone. What distinguishes calligraphy from ordinary handwriting is, quite simply, beauty".

The quotation comes from Kamel al-Baba, one of the contributors to *Aramco World*, a bi-monthly publication of the Arabian American Oil Company (15, No. 4; July–August 1964, New York). "To the Arab world calligraphy is more than handwriting. It is a 'spiritual technique' that reaches out with grace and elegance to engage the eye, mind and soul . . ." This article, well written and beautifully illustrated, clearly shows how throughout the centuries the Islamic religion has dominated both thought and actions of the Arab world. The Koran (or properly Qur'ān), "as the word of God revealed to Muhammad in the Arabic tongue", has been the inspiration of generations of calligraphers seeking to present its words down the ages with an ever-increasing perfection of style worthy of its contents. From relatively crude graphic representations of human beings and animals, to spread the divine message, the creative energies of Muslim artists tended towards more and more decorative work, thence to calligraphy in the real sense. The Koran is probably the most widely owned and widely read book in the Muslim world. Hence beautiful transcripts of this book are, as Kamel al-Baba says, powerful and constant.

The finding and winning of oil in Arabia have brought about revolutionary changes, not only in economic and political evolution of this hitherto little-known territory, but also equally in our knowledge of its people, their history, traditions, and modern reactions to a new life which, only a matter of a decade or so ago, would, to them, have appeared unreal and mythical. But one thing will certainly not change fundamentally: the art of expression of deep-rooted doctrines, simple beliefs, and a code of existence which only the hand in painting or writing can convey. Calligraphy may be a dying art in the Western world, but this is certainly not so in the Arab world.

Aramco World, concerned as it is with the modern Arabian scene, is doing a great service in teaching us all the facts as they are in the background, not just simply as we would perhaps like to imagine them.

A MOON GLOBE

PART of the value of a well-prepared globe of the Moon is that it emphasizes the overall distribution of maria, walled plains, craters, ray systems and other surface features. It also shows them in rectified form instead of by the standard orthographic projection used in most major lunar maps. As a result, features on the far side, photographed by *Lunik* 3, can be seen in topographic relationship with those near the Moon's limb. Of course, the value of a globe for investigations of this kind will depend on how precise it is with regard to positions, dimensions and content.

The Pergamon moon globe*, 33 cm in diameter, has a latitude–longitude grid at 10° intervals, and on average the position of a crater is accurate to about ½°. The maria are grey-green in colour, the highlands and craters greenish-white, with shading to give an additional semblance of relief. Unfortunately, the shading is used so freely as to make it well-nigh impossible in many cases to distinguish small craters from hills, ridges from mountain ranges and bright rays from ridges. The remarkable Triesnecker-Hyginus-Ariadaeus rill system, for example, is reproduced as a single, broad sinuous line, the crater Bessel in Mare Serenitatis looks like a lofty mountain, while Plato, Fra Mauro, Cassini, Archimedes and several other craters possess what appears to be central mountain peaks. Many craters are difficult to identify since they bear little or no resemblance to their counterparts on standard maps and photographs. This is a serious defect

* The Pergamon Moon Globe. (Oxford: Pergamon Press, Ltd., 1964.) 200s.

in the south polar and other regions where the density of large craters is high. One notices, for example, that Lyot (a small crater in Ptolemaeus) is shown equal in size to Herschel, and that a large and unidentifiable walled plain lies midway between Aristarchus and Euler. Some features have their names printed alongside, but altogether there are only about 110 named formations, 18 of which refer to objects on the far side. With a map of higher standard many more names and interesting features could have been included without causing over-complication.

The globe is therefore a rather disappointing addition to selenography and does not give a very good impression of our present knowledge of the Moon's main surface features. Yet it should be successful since it is the only Moon globe in Great Britain to show the near side and part of the far side. It is strongly constructed, looks impressive at first glance and carries the legend that its map material was prepared by the Central Research Institute of Geodesy, Aerial Photography and Cartography together with the Shternberg State Astronomic Institute of the U.S.S.R. H. C. KING

MOLECULAR STRUCTURE OF α-KERATIN

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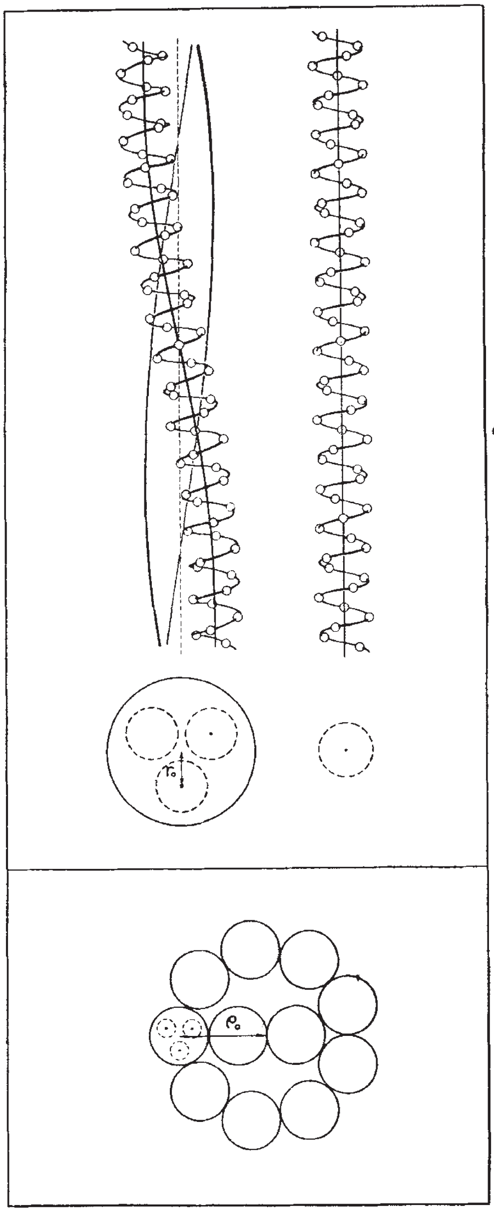
IN previous communications evidence has been presented which supports the conclusion that the fibrous protein α-keratin contains rod-like microfibrils about 70 Å in diameter embedded in a cystine-rich matrix[1] and that these microfibrils are composed of yet finer fibrils about 20 Å in diameter, termed protofibrils[2]. Evidence from electron micrographs of densely stained cross-sections suggested that each microfibril contains a '9+2' arrangement of protofibrils[3], as in Fig. 1c, and qualitative studies using an optical diffractometer showed that the broad features of the X-ray pattern were consistent with the protofibrils containing α-helices distorted into coiled-coils[4]. Since that time these views have been criticized by Johnson and Sikorski[5] and Swanbeck[6] and greatly elaborated by Lundgren and Ward[7]. More recently Wilson[8] calculated the Fourier transforms of several assemblies of coiled-coils for the equatorial layer line and claimed that there was substantial agreement between certain of the calculated patterns and the observed pattern although the available data were at best only qualitative.

We have independently calculated the Fourier transforms of various protofibril models for a number of layer lines and in addition have obtained quantitative intensity data for the equatorial and near-equatorial regions. Our calculations are in good agreement with those reported by Cohen and Holmes[9] and Wilson[8], but our conclusions differ from those of Wilson.

Protofibrils. The idealized coiled-coil modification of the α-helix described by Crick[10] is most easily visualized as a major helix of pitch 186 Å along which are distributed, at vertical intervals of 10·33 Å, units of seven residues which occupy two turns of the distorted α-helix and are related by an 18-fold screw axis as shown in Fig. 1b. The diffraction pattern is thus confined to layer lines for which $Z=\lambda/P+m/h$, where Z is a co-ordinate measured parallel to the meridian, $P=186$ Å, $h=10{\cdot}33$ Å and λ and m are integers. For equatorial and near-equatorial reflexions $m=0$, and for an n-strand rope λ must be a multiple of n. In a highly oriented paramyosin specimen Cohen and Holmes[9] were able to resolve three layer lines with Z values of 0 and $\pm 2/186$ Å^{-1}, thus indicating the presence of two-strand ropes. In the case of α-keratin the orientation even in the best specimens is much poorer, but none the less three layer lines may still be resolved. Previous visual estimates[4] of a pattern obtained from a dried *Coendou paraguayensis* quill tip gave $Z=0$ and $\pm 1/70$ Å^{-1}, that is, between $\lambda=2$ and $\lambda=3$, but careful microphotometry indicates that the splitting varies with R, where R is a co-ordinate measured parallel to the equator. This is probably due to disorientation in the specimen which acts in such a way as to increase the overlap between the layer lines and reduce the apparent splitting with increasing R. While this evidence supports the presence of a two- or three-strand rope it does not enable a definite choice to be made.

b a



c

Fig. 1. (a) Distribution of residues on a straight α-helix; (b) distribution of residues in the coiled-coil model of α-keratin described by Crick (ref. 10) in which three chains are wound together to form a three-strand rope. From the X-ray data a value of r_0 = 5·5 Å is derived for the hydrated material; (c) the '9+2' arrangement of protofibrils within a microfibril. A value of ρ_0 = 30 Å is derived for hydrated material