Conjectures, at the causes of things I have observed, I beseech him to look upon them only as *doubtful Problems*, and *uncertain Ghesses*, and not as unquestionable Conclusions, or matters of unconfutable Science" (Robert Hooke, *Micrographia*, 1665 (Preface)).

CHARLES WALKER.

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May 4.

The Coat of Sheep.

THE letter under this title, by Prof. J. Cossar Ewart, in NATURE of Mar. 19, contains some observations so divergent from those we have made here that it seems desirable to contrast the two. He remarks: "From an investigation which has been in hand for some time on the structure of the fibre forming the coat of sheep, it has been ascertained that in sheep, as in man, the first coat consists entirely of simple pithless fine-wool fibres." In the course of investigations on South African sheep and wool, I have procured a fairly complete series of fœtuses of the Merino, blackhead Persian, Afrikander, and Karakul, as well as of the Angora goat; and in each case microscopic sections have been made of the different stages in the development of the hair and wool. In view of the statement that "the first coat consists entirely of simple pithless fine-wool fibres," a re-examination has been made of all this material.

Prior to the extrusion of any fibres, apart from the coarse stiff ones over the lips, eyelids, and tip of tail, the appearance of the fœtal skin in sections is much the same in all the types. The hair plugs vary much in depth within the dermis, and keratinisation first appears within the deeper and thicker follicles. Likewise the fibres from these are the first to reach the surface, and break through the outer cuticularised layer of the epidermis. For a short time after the extrusion only the tips are visible, and the degree of differentiation is so small that little distinction can be made between hair and wool. Later, when an external difference is apparent, the outer fibres are in every case the stronger and the inner are the finer. Moreover, in transverse sections of the skin the stronger fibres often reveal a medulla, while the fine fibres are solid. Fortunately, no uncertainty exists in the recognition of the medulla in sections, though its early stages are difficult in the extruded fibre. I have already shown (Duerden, J. E., and Ritchie, M. I. F., "Development of the Merino Wool Fibre," *S.A. Jour. Science*, vol. 21, 1924) that in the Merino it arises from the hair germ as a direct upward continuation of the basal layer of the epidermis, and its cells undergo keratinisation later than those of the cortex, cuticle, and inner root-sheath; stained in picro-carmine they are a brilliant red, surrounded by the clear yellow cortex.

On account of the evolutionary loss of most of the hairy fibres in such fine-woolled sheep as the Merino, and the feebleness of the medulla in those which remain, the distinction between hair and wool is not strongly marked. The blackhead fat-rumped Persian, now so plentifully farmed in South Africa for its superior mutton, however, has a covering altogether resembling that of wild sheep, namely, an outer hairy coat and an under woolly one; and it may therefore be taken as representative of the ancestral condition of all sheep. By the time differentiation of the fibres is established in the fœtus the coarse, hairy, medullated fibres are found to project much beyond the fine wool, and there can be no question of the coarser fibres having appeared first.

The long stiff fibres of the lips and eyelids remain for the most part non-medullated until towards the close of fœtal life when, with increasing diameter, a pith develops; so that these fibres, the first to protrude, are truly hair, not wool. The morphological value of a fibre can scarcely be estimated before its growth is completed.

The results may be summarised as follows. The coarse medullated hair of the sheep and the fine non-medullated wool appear on the fœtus at about the same time, the stronger fibres slightly in advance of the finer. In fine-woolled sheep the distinctions between the two sets of fibres are not pronounced in the early fœtus, and the entire coat may have a semblance of wool; but towards the end of fœtal life a medulla appears in the stronger fibres, thus marking them off as hair, and as representative of the ancestral outer hairy coat. In wild and coarse-woolled sheep the distinction between hair and wool is apparent much earlier, and the growth of the hair throughout is in advance of that of the wool.

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Chemical Formulæ of Mineral Compounds.

DURING the last decade I have accumulated some new facts which I believe are of fundamental significance. Certain theoretical considerations require that the chemical formulæ of *all* true mineral species composed of any of the first twenty-one elements of the periodic system should obey the following simple equation:

$$M = 2a + 8n,$$

where M is the molecular number (*i.e.* the total atomic number in the compound), a the number of atoms, excluding hydrogen, and n any integer.

My first notes, based on Dana's "Text-book of Mineralogy" (1912), recorded five exceptions to the above equation, disregarding four substances of organic origin. Later I verified that Dana (1922 edition) corrected the formulæ of aluminite and lazurite, leaving me with three exceptions only. Afterwards I obtained from other sources the corrected formula $(Na_2,Ca)O \cdot Al_2O_3 \cdot 5SiO_2 \cdot 10H_2O$ for faujasite and $CaMg_3(SiO_3)_4$ for tremolite, which left tavistockite as the sole exception for some time. Mellor's "Inorganic and Theoretical Chemistry" (1923) mentions the latter as $Al_2Ca_3(OH)_6(PO_4)_2$, which is in perfect harmony with my equation. Granting the correctness of this formula, my list of exceptions is now reduced to merely four organic minerals—whewellite, oxammite, mellite, and fichtelite. These, however, were expected and bear a theoretical significance which cannot be discussed here. I have been able to cover most of the remaining minerals by a modification of the above equation based on a new theory, the satisfactory completion of which involves difficulties which I hope to overcome.

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Mar. 25.

MR. TIBYRIÇÁ'S formula, which amounts to the statement that $M - 2a$ is divisible by 8, may be interpreted in the following manner. Every atomic number of the elements from 2 (helium) to 21 (scandium) may be represented by the expression $2 + 8d + v$, where d is an integer from 0 to 2 and v an integer from 0 to 4, equal to the valency of the element. This is supposed to be due to the arrangement of the electrons in layers; the first complete layer consisting of two, the second and third of eight electrons each; the valency being an excess above or a deficit below a complete layer. The elements with $+v$ are often