being connected with a single nerve fibre widespread on several muscle fibres) as to make it impossible that they could develop into the ordinary end plates. Incidentally, the new observations of Kutchitsky and Woollard that the medullated fibres end hypolemmally and the non-medullated epilemmally, settle once for all the old dispute of sixty years ago (Kuehne, Koelliker, Beale, Margo, Rouget, Naunyn, and Engelmann) as to whether motor nerve fibres did or did not perforate the sarcolemma. As some do and others do not, each group of controversialists had some evidence to support their claims.

The importance of Dr. Woollard's demonstration lies in the fact that it removes once for all the doubt as to the existence of this type of double innervation in mammals. It also proves that the two types of muscle fibres (and associated nerve fibres) are morphologically distinct one from the other. In his communication, however, Dr. Woollard lays particular emphasis on the fact that he has found this type of double innervation only in the case of the eye-muscles and not in any other part of the body.

It is important, however, not to lose a sense of perspective in estimating the meaning of this observation. In 1882, Dr. L. Bremer, of the University of Strasbourg, described (*Archiv. f. mikr. Anatomie*, Bd. 21) non-medullated nerves ending in the muscles of the tongue and limbs in the frog (see in particular his figures 13 and 20) in precisely the same manner as Dr. Woollard has depicted in the case of the eye-muscles of the rabbit. The coincidence is most striking and significant.

In view of these facts, especially when taken in conjunction with the difficulty Dr. Woollard himself experienced in discovering such endings in the eye-muscles, the failure to obtain satisfactory proof of the presence of such nerve fibres in other mammalian muscles should not be assumed to imply their absence. When they are found so widespread in the muscles of the trunk, limbs, and tongue of amphibia and reptilia and in the ocular muscles of mammals, there is a presumption that one is dealing with a morphological fact that applies to all striated muscles. But it remains for future research to provide conclusive evidence for or against this morphological inference —a problem that Dr. Woollard proposes to investigate in the University of Adelaide.

G. Elliot Smith.

University College,
London, W.C.1, July 20.

Banded Structure in Aluminium and Copper.

It is a well-established fact that copper, gold and silver, in the native state, exhibit twinning on the octahedral plane.

I have recently examined, by means of X-rays, structures in aluminium which resemble lamellar twinning, and a sample of native copper which contained large well-marked lamellar twins. Such structures are always to be found in copper and its alloys, as well as gold and silver, if the metal has been worked and annealed, but are rarely found in cast metals. In aluminium they are rarely met with, although this metal has the same crystal lattice. The orientation in both parts of the 'twin' were determined. Two samples of aluminium were investigated, which showed the same relationship existing between them. These appeared to have one dodecahedral plane in common, but the one could only be derived from the other by turning one upside-down and rotating through an angle of 60°. The plane of junction between the crystals had no relation to the crystal structure of either. This was also the case in the copper sample. Here there appeared to be no important crystal plane or direction which was common to both parts.

It has always been assumed that the banded structure in these metals represented twinning on the octahedral planes of the crystal, but the examples quoted above show that this is not always so. It will, of course, be necessary to compare a number of samples of all the metals mentioned with the view of arriving at any definite conclusions.

C. F. Elam.

Acarine Disease and the Muscles of the Honey Bee.

Three years ago, Dr. Rennie suggested to me that as a part of the research on acarine disease of the honey bee, I should attempt to describe certain pathological appearances in the indirect muscles of the wings, since visible pathological conditions of these muscles are often, but not invariably, associated with acarine disease. The results of the investigation will be published in two parts shortly, and this letter contains the announcement of some of the main conclusions with a plea to biochemists to study these particular muscles of the bee in detail, since they seem to lead to an exceptionally clear path to the cause of contraction of muscle.

Before the pathological appearance of muscle could be accurately described, it was necessary to know the appearance of muscles which were deemed healthy since they were removed from lively bees which showed no signs of any of the known bee diseases. A thorough review of the literature showed that on the histology of the muscles there was no work sufficiently detailed or accurate to be accepted as a basis on which to describe pathological conditions. In fact, the muscles have been greatly neglected, and no description exists which includes, with the appearance of the contractile elements, an account of the nuclei, sarcosomes (reserve 'food' material placed between the contractile elements), innervation, tracheation, attachment to integument, and blood supply of any of the muscles of the bee. The literature on the muscles is very incomplete, scattered, and often inaccurate, and even the somatic musculature has been so neglected that many of the most important muscles are not recognised.

The first part of my paper attempts to deal with the name, function, innervation, tracheation, method of attachment and probable blood supply of every muscle or system of muscles in the three castes of *Apis mellifera* L. of different races, and it includes histological descriptions of fresh and variously prepared fibres as well as a brief description of their chemical composition and a note on their appearance under polarised light. The course of air through the tracheæ and the physiology of the nervous system in regard to the musculature is also considered. The second part of the paper deals with pathological conditions of the muscles.

Histologically the muscles of the adult bee can be classified as either *fibrous* or *tubular*. Fibrous muscle is characterised by its fibre being very easily split into 1000-2000 sarcostyles (fibrils) which are the apparent contractile elements of the muscle. The nuclei are scattered in many rows throughout the thickness of the fibre. Corresponding to the transverse striation of the fibre, there occur layers of semi-fluid substance (sarcosome substance) which seem to be utilised directly during the contraction of the fibre. Fibrous muscle is confined to the four large muscles attached to the walls of the thorax. These muscles are called the indirect muscles of the wings, since by altering the shape of the thorax they raise and lower the wings for