In healthy sheep the species: *Cooperia curticei*, *Nematodirus filicollis*, *N. spathiger*, *Strongyloides papillosus*, *Trichostrongylus colubriformis*, *T. vitrinus*, have each a normal frequency distribution which retains its identity throughout the period of infection; probably other species normally parasitic in sheep have a similar form of distribution. The position of the peak numbers of each species may vary in different animals, but its relation to those of other species in mixed infections is constant. For example, the peak of infection of *N. filicollis* always occurs at a shorter distance from the abomasum than that of *N. spathiger*, while those of species of different genera tend to array themselves along the intestine in the following order: (1) *Trichostrongylus*, (2) *Strongyloides*, (3) *Nematodirus*, (4) *Cooperia*. With increase of the distance of peak numbers from the abomasum there is a correlated increase in the area of distribution of the greater numbers of a species. Generic differences in this connexion are marked.

From the constancy of the form of distribution in sheep of various ages, under various conditions, at different times of the day and at different seasons, it is concluded that:

(1) Neither active nor passive migration on the part of adult worms takes place.

(2) The site of infection is determined during the larval stage.

(3) The stimuli causing larvæ to take up their station are present in the contents of the small intestine, and arise in the duodenum at the point of entrance of the bile and pancreatic juice.

(4) Specific differences in distribution are due to inherent dissimilarities in rates of reaction to the stimuli.

(5) *Trichostrongylus* spp. respond to stimuli in the abomasum as well as in the jejunum. *T. axei* is sensitive to these, but *T. colubriformis* and *T. vitrinus* are less so, with the result that the populations of the latter two species become divided between the abomasum and the small intestine. Other species found in the small intestine in their passage through the abomasum apparently do not remain there long enough to enable stimuli to have effect upon them.

There is evidence that in unhealthy animals distribution is erratic.

C. oncophora, *C. punctata* and an unidentified third species of *Cooperia* are normally parasitic in cattle. In sheep they have an erratic distribution, and this, I believe, is an expression of their inadaptability to this host.

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Aug. 8.

Fibre Forms in Animal Hairs

UNDER the above title Mr. H. J. Woods¹ proposes three alternatives to the 'weathering' hypothesis tentatively advanced by me² to account for super-normal curvature in the apical region of certain guard hairs. Of the opposing evidence, it will suffice to point out that, in the light of a previous communication by Woods³, the fibres should, if his views are correct, easily acquire permanent set. If the phenomenon is due to extensive oxidative degeneration, this should be impossible. Straightening the fibres and steaming under various strains for periods up to one hour, then releasing and re-steaming

resulted only in further contraction. Moreover, differential super-contraction does not follow strain in saturated sodium bicarbonate solution, which has a considerably higher pH than the maximum recorded for suint.

However, Woods's suggestion that asymmetry of lateral bonding may exist is very interesting—at least, as a contributory factor—although there is no record of super-contraction being produced in chemically sound α -keratin by the action of steam alone. Structural asymmetry of some kind is probably a widespread phenomenon, occurring in sound as well as in damaged fibres. Experimental evidence in support of this view will appear in due course.

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¹ NATURE, 136, 262, Aug. 17, 1935.

² NATURE, 136, 28, July 6, 1935.

³ NATURE, 132, 709, Nov. 4, 1933.

Flying Fishes

DURING a voyage down the west coast of Africa, I have been watching the flying fishes, moved partly by vague recollections of the contradictory opinions that have been published regarding their flight. Without the literature I cannot make specific reference to the controversies, but a brief summary of what seem to me the most obvious facts about the 'flight' of flying fishes may be of interest.

(1) The motive power is the same in the air as in the sea: it is that of the tail-shaft musculature exerted through the tail against the water.

(2) The flight is usually started by a swift rush at a low angle up to and through the surface. But if this fails, for example, through jostling in a crowd, the fish is easily able to make a 'standing start' from the surface itself; a quivering vibration of the tail launches it almost instantaneously into full flight.

(3) The same manoeuvre is regularly used to prolong the flight. At the end of the initial skim the fish often abruptly dives, but almost as often it dips the lower blade of the tail into the water instead and drives itself on for another stage. This may be repeated up to five or six times. It is perhaps the easiest thing to observe about the actions of a flying fish, and it is a never-failing surprise to see how short is the duration of the quivering dip and what a vigorous fresh impulse is derived from it.

(4) There is never the slightest sign of any impulse being derived from any other source. The fins during the flight are stiffly spread; they are used with great skill as planes, but never as wings.

(5) The flight is not a blind rush; while its way lasts, the fish can steer and turn up and down the waves and along them as gracefully as a petrel.

(6) The usual end of a flight is a sudden dive with shut 'wings'. But sometimes the dive is preceded by a sailing action with slightly up-tilted body and planes, like a seagull gliding to rest on the sea—one of the prettiest things a flying fish does.

(7) The flight is made at all angles to the wind, and in any wind from a calm to half a gale. Naturally the most difficult direction is down-wind, because the fish must push off at a considerably greater speed than that of the wind in order to rise at all. For the same reason a down-wind flight is made in a noticeably tilted-up position; it is in the nature of a prolonged sailing to rest.