of the proton-electron system. For, it is the very form deduced by Schrödinger for the quantum levels of the rotator with free axis.

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Cystine and Wool Production

IN 1928 Marston and Brailsford Robertson emphasised the importance of cystine in the biology of the sheep.[1] They considered that since a typical fodder protein such as that of lucerne contains 0·93 per cent of cystine and the keratin of wool fibre contains 13·1 per cent, cystine might well be a limiting factor in the production of wool. Three assumptions were made by them, namely, that the cystine content of pasture lies within certain limits, that cystine cannot be synthesised in the animal body, and that the cystine of wool fibre is relatively constant.

As regards the first point, Evans[2] and Aitken[3] have shown that the cystine of pasture grass is of such a small order, about 0·01 per cent, by weight, of dry matter, that, as pointed out by Rimington and Bekker,[4] the amount of cystine present in the grass consumed by a sheep cannot be made to account for the amount of cystine present in the fleece. The argument of Rimington and Bekker depends upon the correctness of the figures of cystine analysis of grass, which, as pointed out by Marston,[5] is one of extreme difficulty and complexity, and it is probable that the figures must at present be accepted with caution.

The results of a recent experiment performed in collaboration between the Rowett Institute and the Wool Industries Research Association, Leeds, which are to be published fully at a later date, throw light on the matter at a new angle. During the course of the experiment, a group of twenty sheep received 503 lb. of digestible protein. The crude weight of the wool produced during the same period was 72 lb. Allowance has to be made for grease, impurities, and moisture content. Thus:

	lb.	lb.
Crude weight of wool	..	72
Grease and impurities	15·5	
Moisture content	10·4	
		25·9
Estimated weight of clean dry wool	..	46·1

The weight of the clean dry wool, therefore, corresponds to 9·2 per cent of the weight of the digestible protein fed. Accepting the figure of 13 per cent as an approximate value for the cystine content of wool, the 46·1 lb. of clean dry wool would contain 6·0 lb. of cystine, corresponding to 1·19 per cent of the weight of digestible protein food. Making the generous allowance of 40 per cent of the ingested cystine retained as wool, the cystine content of the protein fed would correspond to the figure of 2·88 per cent given for blood albumin by Brailsford Robertson and Marston.[1] The proteins actually fed were those of turnips, oat straw, maize, bran, oats, and distiller's dried grains. Since the cystine content of such vegetable proteins is much lower than that of blood albumin, it is difficult to avoid the conclusion that some synthesis of cystine took place.

Finally, in a series of important papers, King, Barritt, and their colleagues at Leeds have shown quite conclusively that the cystine content of wool fibre is not constant, but that it fluctuates within fairly wide limits.

It follows that the evidence available in contradiction to the hypothesis of Marston and Brailsford Robertson suggests that the cystine content of pasture is so low that it cannot be conceived as being a possible limiting factor in wool production, that synthesis of cystine very possibly occurs in the sheep, and that the cystine content of wool fibre is not constant.

The experimental evidence cited by Marston in a recent communication[5] is unsatisfactory. An experiment by Lines is quoted in which casein was contrasted with yeast (containing 3·5 gm. cystine a day) as a source of nitrogen superimposed on a protein-deficient basal diet. The yeast gave very much better results, but the vitamin, mineral, and other factors present in yeast were apparently ignored, and were certainly not controlled.

In a field experiment in Central Queensland, blood meal (containing 2·7 per cent cystine) was fed *ad lib.* to ewes and lambs, the maximum intake of 6 oz. a head a week being reached under drought conditions. Unfortunately, the experiment was not controlled, since a cystine-poor concentrate of equal caloric value was not fed to the control group. It is therefore impossible to say how much, if any, of the beneficial effect was due to cystine or even to protein.

The bulk of the evidence is thus in favour of the synthesis of cystine within the sheep, and the question of the possible mode of synthesis arises. Rimington and Bekker suggest the decomposition of symbiotic intestinal bacteria as the source. On this hypothesis, sheep reared from birth on sterilised foodstuffs (suitably supplemented with vitamins) should grow little, if any, wool. It is therefore a hypothesis capable of critical test. The fact that wool growth is at its maximum before the lamb's rumen has fully developed is against this view.

It seems to us possible that cystine is formed during keratinisation, and that cystine synthesis is a function of the wool follicle itself. The amount of cystine produced in a fleece would then depend upon the number and activity of the wool follicles, and not upon the cystine content of the food or the bacterial population of the intestines. It appears to us that this hypothesis accords more closely with the great diversity of weight of fleece grown by different breeds under the same environmental conditions.

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Diffraction of X-Rays by Liquid Metals

WHEN a beam of monochromatic X-rays is passed through a liquid, the intensity of scattered radiation does not, in general, fall off uniformly with scattering angle. One or more regions of maximum intensity are usually observed, and these may appear as bands or diffuse rings on a photographic plate placed to receive the rays. These facts are well known. Nevertheless, it is probably true to say that no completely satisfying explanation of such effects has yet been produced. One of the most attractive proposals has been put forward by G. W. Stewart in a series of recent papers.[1] Stewart suggests that temporary groupings of considerable numbers of atoms or molecules in the liquid would account for the observed