wild-type (that is, recombinant) *i* excluded the order *fla*—*D*–*R*–, where *D* and *R* are the sites of mutation within *H1*^{i} of the donor and the recipient, respectively. The inferred order of the mapped sites is *fla* 50–*fla* 58–*fla* 57—*M*10–(*M*5, *M*12)–*M*11–*M*6—*fla* 52–*fla* 55. Iino[3] attributed the locomotor deficiency and short wave-length of the 'curly' phase 1 flagella of *S. typhimurium* strain *SW* 577 to mutation within the *H*1 locus; crosses of strain *SW* 577 with *fla*$^{-}$ forms of our serological mutants confirmed this, and indicated that the 'curly' site is probably between the *M*11 and the (*M*5, *M*12) sites.

Thus mutation within *H1*^{i}, the gene determining the structure of flagellin *i*, may cause a change in the serological character of antigen *i* (and in some mutants a non-specific agglutinability also) without impairment of locomotor function; or a loss of locomotor function without antigenic change[3]; and the sites of mutation can be mapped linearly within the gene. Some of our mutant *i* flagellins have now been shown to give tryptic-digest peptide maps different from that given by wild-type flagellin[7]; the amino-acid sequence in flagellin being unknown, it is not possible to compare the genetic map with the order of the corresponding amino-acid changes along the polypeptide chain.

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MISCELLANEOUS

Tsetse in the Environment of Ancient Man in Southern Rhodesia

Summers[1] in Southern Rhodesia has examined the distribution of prehistoric sites (that is, containing traces of ancient man), and the historic routes followed by invaders and pioneers since 1823, and concluded that there was throughout the whole prehistoric and historic periods "a marked aversion to Mopane woodland" (that is, deciduous woodland dominated by *Colosphermum mopane* and now occurring especially in the Zambezi and Limpopo valleys). He suggests that this aversion was because of the presence of the tsetse *Glossina morsitans* in *mopane* areas.

It is generally agreed (for example, Hornby[2]) that tsetse, before modern drugs came into use, kept out all kinds of domestic stock except poultry from their areas, and that consequently they excluded any men who could not or would not live without their stock. Historical examples of this exclusion embrace the alignment of the roads used by the ox-drawn wagons of European pioneers, as noted by Summers[1]. However, Summers's hypothesis requires that tsetse should exclude also Stone Age men who had not yet acquired any domestic animals. If tsetse had any effect on the distribution of such primitive men, it must have been wrought through the human disease, sleeping sickness, and of course Rhodesia is the type-locality of the organism, *Trypanosoma rhodesiense*, which causes the acute form of sleeping sickness. It should be noted, however, that sleeping sickness as we know it to-day does not exclude hunters and food gatherers. In the first place, although sleeping sickness cannot occur in the absence of tsetse, tsetse can occur in the absence of sleeping sickness; in fact sleeping sickness is very localized, and the areas in which it is found are but a small fraction of the areas occupied by its vectors. Secondly, even in places where sleeping sickness occurs, hunting and food gathering go on. A well-known instance is the Malagarasi River system in the Western Province of Tanganyika, which is almost uninhabited during the wet season, but is visited by hunters, fishermen and collectors of honey during the dry season. During 1953, 1954 and 1955 this area produced more than half the cases of *T. rhodesiense* sleeping sickness diagnosed in all Africa (Ashcroft[3]). It is, of course, possible that in the past *T. rhodesiense* sleeping sickness was a more widespread and more easily contracted disease than it is to-day, and that it totally excluded man in the same way that animal trypanosomiasis (nagana) totally excluded cattle from all tsetse areas in the recent past. But it is also possible that *T. rhodesiense* sleeping sickness is a modern disease which did not exist at all in prehistoric times. In the absence of any evidence either way it does not seem legitimate to postulate alterations in the properties of a trypanosome to explain archæological observations.

It is suggested that, while the alignment of the European pioneers' roads to avoid tsetse areas is a historical fact, an alternative explanation must be sought for the aversion to *mopane* areas of peoples not known to have domesticated animals.

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A Radioactive Marking Ink

When autoradiography is used to detect labelled compounds on paper chromatograms, a radioactive ink is a useful adjunct. With this ink, a visible mark can be made on both the paper and the X-ray film in order to assist their re-alignment after the film has been developed. For radioactive components of such ink, non-volatile compounds of carbon-14 or sulphur-35 have been suggested, but suitable materials are expensive so that a cheaper alternative was sought.

A satisfactory ink has now been made incorporating promethium-147, which emits β-particles (0·27 MeV) and has a half-life of 2·6 years. I thank Dr. J. C. Charlton of the Radiochemical Centre, Amersham, for the suggestion that this inexpensive isotope might be useful.

The promethium-147 was supplied as the chloride 1 mc. in 0·25 ml. N hydrochloric acid. This solution was diluted with 1·5 ml. water and N ammonia solution was added to make it neutral to phenol red; it was then added dropwise to 56 ml. 'Mandarin' indian ink (Winsor and Newton) with thorough mixing after each addition. If the isotope is supplied in a larger volume of acid, or for other varieties of ink, it would be advisable to check first that the ink will tolerate the addition of the calculated amount of ammonium chloride.

Marks made with the ink mixture gave intense images on Ilford 'Ilfex' film after overnight contact. For use on chromatograms which required some weeks' contact to detect compounds of low activity, the mixture was further diluted 1 : 20 with indian ink.

The radioactivity in the ink marks on ordinary filter paper or on filter paper impregnated with silicic acid was not removed by repeated washing with water; it was, however, leached out by N hydrochloric acid.

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