

### Carriers of Foot-and-Mouth Disease

THE highly sporadic character of the occurrences of foot-and-mouth disease in Great Britain and its apparently repeated importation from the Continent have naturally caused much speculation about possible vectors, though the special difficulties of the case have prevented the direct demonstration of carriage.

Birds have often been incriminated, and Prof. A. C. Hardy, in his letter in NATURE of April 2, further suggests that insects may be carried far enough by air-currents even over the sea, to be considered also as possible carriers.

Neither birds nor insects can, however, be regarded as primary vectors, since neither group, so far as is known, can harbour the virus systemically, and viruses do not survive extra-cellularly for more than short periods. They can only be secondary carriers of the true agent of transmission. This might take the form of skin or hair particles or excreta of infected animals, adherent to the carrier, though the probability of birds, at any rate, becoming heavily contaminated in this way is not very great. It is not even necessary, in such circumstances, to assume the need for any vector, since the carrier material may equally well be disseminated by wind.

In this connexion it is perhaps worth while to direct attention to the work of L. A. Silber and his co-workers<sup>1,2</sup> and of Poppe and Busch<sup>3</sup> on the symbiosis of viruses and yeasts. The former have shown that smallpox and vaccinia viruses enter the yeast cells and form a close union with them, of an enduring character. The virus-yeast complex is passed intact from cell to cell during proliferation and the virulence may apparently be retained for an unlimited period. Variola virus has been propagated in this way through more than a hundred cell-generations. Poppe and Busch showed that the same is true of the foot-and-mouth virus, which also remains viable with the yeasts in serial sub-culture.

Yeasts of many kinds, *Torulopsis*, *Rhodotorula*, *Mycotorula*, *Candida*, *Sporobolomyces*, etc., abound in the soil and in the atmosphere, in which latter they sometimes outnumber the bacteria. In the air they seem to have a random distribution, considered as a population, but this is not the case for particular species, which are often to be found in local concentrations, strongly suggesting, as Trillat<sup>4</sup> claimed, that they can multiply in the air.

The possible importance of the aeroplankton yeasts as virus carriers is not, of course, limited to the case of foot-and-mouth disease, but it cannot be overlooked in any case. If it can be proved that yeasts carrying viruses of any type occur naturally in the free atmosphere, then the impossibility of precluding chance infection must be manifest and the importance of immunity in the subject is correspondingly enhanced.

The suggested role of yeasts as carriers is not limited to animal viruses. It may also provide the

clue to the apparently vectorless outbreaks of tobacco necrosis recorded by Smith and Bald<sup>5</sup> and to Smith's observation of an air-filter contagion<sup>6</sup>.

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<sup>1</sup> Silber and Wostruchowa, *Z. Bakt.*, Abt. 1, Orig., **132**, 314 (1934).

<sup>2</sup> Silber and Timekow, *Z. Bakt.*, Abt. 1, Orig., **133**, 242 (1935).

<sup>3</sup> Poppe and Busch, *Z. Bakt.*, Abt. 1, Orig., **136**, 385 (1936).

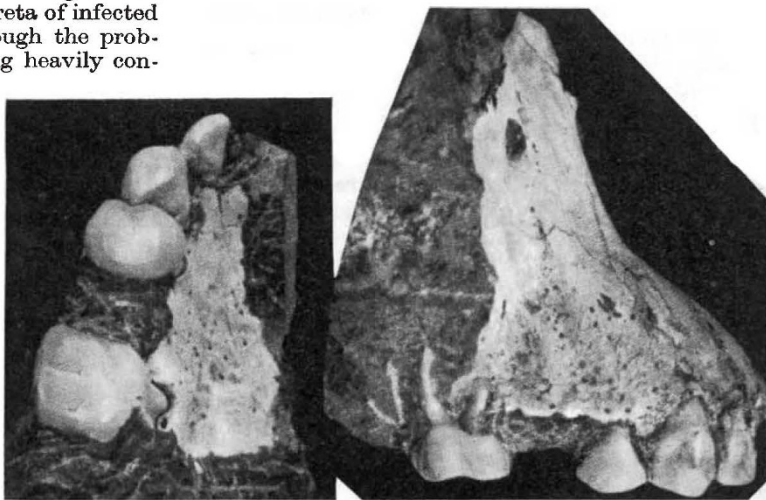
<sup>4</sup> Trillat, *Comptes rendus*, **170**, 1291 (1920).

<sup>5</sup> Smith and Bald, *Parasitology*, **27**, 1 (1935).

<sup>6</sup> Smith, NATURE, **139**, 370 (1937).

### More Discoveries of *Australopithecus*

A FEW months ago I sent an account to NATURE<sup>1</sup> of the discoveries of a number of teeth of *Australopithecus*. The principal of those was a beautifully



(a) *Australopithecus transvaalensis* BROOM. (a) OCCLUSAL VIEW OF RIGHT UPPER TEETH AND PART OF PALATE; PART OF THE BACK OF THE CROWN OF THE FIRST MOLAR HAS BEEN DAMAGED BEFORE FOSSILIZATION. (b) SIDE VIEW OF RIGHT MAXILLA; NOTE THE REMARKABLY HUMAN-LIKE INCISOR AND CANINE. NATURAL SIZE.

preserved third lower molar, but I also had found a new third upper molar and much of a first incisor.

Since then nothing more was found until two weeks ago, when a fairly well-preserved lower canine was discovered. This is so like a human canine that I hesitated to describe it in case it might prove to be human. The whole length of the tooth is about 32 mm., but as the tip of the crown is lost the exact length is uncertain. The crown cannot have been more than 10.5 mm. in height. The base of the crown measures 9 mm. by 6.3 mm. It is like the human lower canine, but the face of the crown is in *Australopithecus* directed more outwards than forwards. It bears no close resemblance to that of the chimpanzee either in size or shape.

Then last week I made a much more important discovery—a nearly complete right maxilla in good condition and with the second incisor, the canine, the first premolar and first molar in position. The premolar and the molar agree so closely with those of the type as to leave no doubt that the jaw is of the same species—*Australopithecus transvaalensis*.