very large quantities or intravenously in moderate quantities is partly excreted by the kidneys.

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THE ARTIFICIAL SYNTHESIS OF A 42-CHROMOSOME WHEAT

COMMON wheat, *Triticum vulgare,* and the related species, *T. Spelta* and *T. compactum,* form a natural group (usually called the *vulgare* group) which is believed to have originated by crossing between a wheat of the emmer type and a species of the related genus *Aegilops*. This origin was first suggested by Percival on purely taxonomic grounds. Later it received strong support from genetical and cytological evidence.

The different species of both *Triticum* and *Aegilops* have their chromosome numbers in multiples of seven. The emmer wheats are tetraploid (2n = 28) and the *vulgare* group hexaploid (2n = 42). Cytogenetic studies show that all the fourteen haploid chromosomes of emmers have homologues among the twenty-one of *vulgare* and spelt. The remaining seven in the latter must, if our hypothesis of the origin of *vulgares* is correct, have come from *Aegilops*. And cytological evidence is not lacking that some species of *Aegilops* contain a set of chromosomes which are homologous with these seven.

Crossing a species of wheat which has fourteen haploid chromosomes (emmer) with one of *Aegilops* which has seven, produces a completely sterile hybrid which has twenty-one. If doubling of the chromosomes were to occur in the sterile hybrid, the somatic number (42) of the *vulgare* group would be produced, fertility should be restored, and, if the hypothetical origin of *vulgares* is correct, the characters might be expected to resemble those of *vulgares*.

Accordingly, *T. turgidum* (n = 14) was crossed with *A. speltoides* (n = 7). The seedlings were treated with colchicine to induce chromosome doubling. A special colchicine technique involving repeated daily injections with a hypodermic needle proved successful. A considerable number of heads on two different plants were found to have the doubled number. These heads with forty-two chromosomes showed nearly normal chromosome behavior (twenty-one pairs). They were fully fertile.

Several offspring from these heads have been raised to maturity. Their chromosome number is that of the *vulgare* group of wheats; their chromosome behavior is nearly regular; their fertility is reasonably good. They also have some of the characters of the *vulgare* group; this is true with respect to laxity of head, pubescence of leaves, shape of glume, shoulder and tip of glume and development of keel. In certain respects spelt resembles some of the 28-chromosome wheats more than it does *vulgare,* and in some of these points the synthetic type resembles spelt, notably in form and fragility of head and adherence of glumes. In certain other characters, such as the diameter and solidity of the stem, the new type resembles the emmers rather than either *vulgare* or spelt.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN ANTIMONY ELECTRODE FOR THE CONTINUOUS RECORDING OF THE ACIDITY OF HUMAN GASTRIC CONTENTS*

THE pH of gastric contents has been determined *in situ* by Eyerly and Brenhaus[1] for human beings and by Flexner and Kniazuk[2] for dogs. In both investigations the glass electrode was used. The disadvantages of using this electrode lie in the serious difficulty of adequately insulating the leads from the electrode, since the resistance of this insulation must exceed that of the glass electrode and the large size and inflexibility of the tubes that must be passed into the stomach.

The method for measuring the pH of gastric juice described here overcomes these difficulties by substituting for the glass electrode an especially prepared antimony electrode. No elaborate precautions are required for insulation. The electrode is 5 mm in length and 1 mm in diameter and the rubber tube containing the leads, which are 3 strands of No. 43 copper wire, is only 1 mm in diameter and entirely flexible. The electrode is swallowed without any difficulty and can be retained in the stomach for a long period of time without the slightest discomfort to the subject.

The potential of the antimony electrode is measured against a calomel half cell connected to saline in a basin into which the subject places a foot. The pH is recorded with any convenient type of measuring apparatus; for the record given here, a Leeds and Northrup continuous recording potentiometer was used.

[8] Aided by a grant from the Dazian Foundation for Medical Research.

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[1] J. B. Eyerly and H. C. Brenhaus, *Am. Jour. Digest. Dis.*, 6: 187, 1939.

[2] I. Flexner and M. Kniazuk, SCIENCE, 90: 239, 1939.

The antimony electrode is extensively used in measuring pH in industrial processes,[3] but it is rarely used in physiological investigations. It does not function satisfactorily in strongly alkaline solutions[4] or in the presence of powerful oxidizing agents[5] as in the blood, but these limitations are not encountered in dealing with gastric contents. The antimony electrode is less sensitive than the glass electrode,[4] but is accurate to a change of 0.1 in pH, which is adequate for measurements on gastric contents. The greatest disadvantage of the antimony electrode has been the

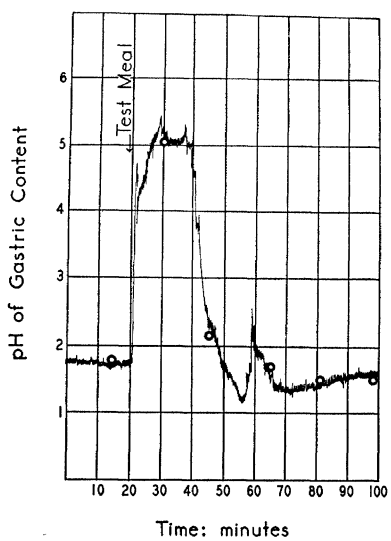

FIG. 1. Continuous record of pH of gastric contents obtained with antimony electrode before and after test meal. Dots represent values obtained with glass electrode on gastric contents withdrawn with Levin tube.

tendency for its current to drift and thus yield erratic and erroneous values.[6, 7] Many attempts have been made to overcome this defect by obtaining a surface coating of stable oxides.[5] We have succeeded in preparing an electrode which is stable in gastric contents by treating the metal with bromine water.

In preparation for use, the electrode is polished with fine emery paper and immersed for 30 minutes in a 1 per cent. solution of bromine in water; it is then washed in water and dried with a soft cloth but is not polished. At intervals of approximately one week during daily use, the electrode is polished with emery paper and treated with bromine water as described. The electrode thus prepared responds to change in pH within the range 1.0 to 7.0 without appreciable lag and without drift.

There is no danger of any toxic action from the antimony when the electrode is swallowed. None of the subjects, in whose stomach the electrode was retained for several hours each day for nearly a month, complained of any disturbance. As further proof, an electrode was carefully weighed and placed in n/10 HCl; after 24 hours of immersion the loss of weight was 0.2 mg; and after 48 hours, 0.3 mg.

The electrode does not function satisfactorily for one to two hours after a full-sized meal, presumably because it may become embedded in large masses of food. This difficulty is not encountered with any of the ordinary test meals used for clinical purposes.

Fig. 1 shows a tracing from a typical record of the pH of the gastric contents before and after a test meal. In this experiment a Levin tube was also passed into the stomach and specimens of the contents withdrawn; the pH of these specimens was determined in the usual manner with the glass electrode; the values obtained are shown as dots in Fig. 1. The agreement between the values found is within pH 0.15. In the record shown here the pH of the gastric contents reached a minimum value 36 minutes after the test meal was given. An abrupt but brief rise in pH then occurred. This momentary rise is characteristic of many records we have obtained.

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