

was highly active in the prevention of pellagra. When the fraction was purified and concentrated, the concentrate was practically colourless, but the vitamin B₂ activity was retained. The flavine was removed from another fraction by irradiation and extraction of the lumiflavine with chloroform. The remaining solution was again active.

A complete survey of the literature has been made and we find no decisive evidence which would prevent us from concluding that vitamin B₂ and flavines are two separate and distinct chemical entities. We wish to retain the term vitamin B₂ for the antipellagic factor, and suggest a reclassification of the flavines.

C. A. ELVEHJEM.
C. J. KOEHN, JR.

Department of Agricultural Chemistry,
University of Wisconsin,
Madison, Wisconsin.
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¹ Kline, O. L., Keenan, J. A., Elvehjem, C. A., and Hart, E. B., *J. Biol. Chem.*, **99**, 295; 1932.

Production of Ethylene by Some Ripening Fruits

It was observed by Elmer¹ in 1931 that the presence of ripe apples and pears—but not oranges or bananas—caused abnormalities in the sprouting of potato tubers; and Huelin² pointed out that the effects were similar to those produced in potato sprouts by exposure to ethylene. Later, Smith and the writer³ showed that the growth of pea seedlings was affected by an active substance produced by ripe apples, again with results which were paralleled by ethylene.

Kidd and West⁴ had previously noted that a substance produced by ripe apples would stimulate the so-called 'climacteric' in unripe apples; and the writer had shown⁵ that an active substance generated in traces by ripe bananas has corresponding effects on the rate of respiration and the ripening of green bananas and on the growth of pea seedlings. In each case, similar results could be produced by exposure to a trace of ethylene.

Analogies between the biological behaviour of ethylene and the active substance, particularly in relation to the epinasty of leaves, have been accumulated in more recent work by the writer⁶; but the purpose of the present note is to record chemical identification of the active substance.

An air-stream containing the whole of the gaseous products of metabolism from some 60 lb. of Worcester Pearmain apples was led, during a period of 4 weeks, through Newth collecting tubes containing bromine at -65° C. 0.85 gm. of oil was obtained, which on fractional distillation yielded 0.65 gm. boiling below 140° C. Heated with aniline this gave a solid which crystallised from dilute alcohol as lustrous plates, melting at 62.5° C. A mixture, with a prepared sample of *N. N'* diphenyl ethylene diamine (melting point 62.5° C.) also melted at 62.5° C.

The particular interest of this identification lies in the definite linking together of two lines of research in the metabolism of fruits—the well-established effects of ethylene on ripening, and the relations between one fruit and its neighbours which were brought to light by Kidd and West.

The amount of ethylene produced is very small—perhaps of the order of 1 cubic centimetre during the whole life-history of the fruit⁶; and the cause of its prodigious biological activity in such small concentrations is a problem for further research. Its

production by apples ceases or is very much reduced in the absence of oxygen. Further experiments are in progress.

R. GANE.

Low Temperature Research Station,
Cambridge.
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- ¹ Elmer, O. H., *Science*, **75**, 193; 1932.
² Huelin, F. E., Report of the Food Investigation Board for 1932, p. 53. H.M. Stationery Office.
³ Smith, A. J. M., and Gane, R., *ibid.*, p. 156.
⁴ Kidd, F., and West, C., *ibid.*, p. 55.
⁵ Gane, R., *ibid.*, 1933, p. 122.
⁶ Gane, R., *ibid.*, 1934 (in the press).

Introduction of Hindu-Arabic Numerals into Western Europe

EVIDENCE is sometimes adduced to indicate that the Hindu-Arabic numerals, or closely allied forms of them, were known in western Europe before this knowledge could have passed through Muslim Spain. For example, Alcuin of York (735-804) is said to show at least partial knowledge of the numerals. If this is so, whence did the information come?

In this connexion Smith-Karpinsky ("The Hindu-Arabic Numerals", p. 103) point out that adventurous scholars must have gone with ambassadors, travellers and merchants to seek learning in other lands. Reference is also made to a cruciform brooch in the British Museum, perhaps dating from the time of Alcuin, and bearing the Muslim inscription in Kufic characters: "There is no God but God." Smith-Karpinsky ask: If these Kufic characters reached England at that time, why not the numeral forms as well?

When making some notes on the history of money, I collected from various sources fragments of information which may reinforce the implications of the cruciform brooch, and at the same time indicate a route by which some knowledge of the numerals may have reached western Europe in the eighth century.

(1) There is a gold dinar of Offa, King of Mercia, bearing in Latin the words "Offa Rex", and in Arabic the inscriptions: "Mahomet is the messenger of God. . . In the name of God. This dinar was struck in the year 157" (A.D. 774). It may be noted in passing that Alcuin was in touch with Offa on several occasions. An illustrated description of Offa's dinar will be found in Kenyon's "Gold Coins of England", 1884. It is possible that Offa, who, like Charlemagne, was interested in coinage reform, employed Arab moneyers; Arabs being more highly skilled in the arts associated with coining than his own people.

(2) From the eighth century onward, for several centuries, there was a very large volume of trade between north-western Europe and the Orient. We know this because huge quantities of Arabic and Persian coins (Sir T. W. Arnold says upward of ten million) have been found in Scandinavia and other north European countries. The earliest of these is dated 79 A.H. (A.D. 699). Many were minted at Samarkand and at Bagdad. There can be no reasonable doubt that a great number, if not all, reached Europe by the Baltic-Volga-Caspian trade route, along the Russian portion of which many similar coins have been found. As further evidence of Oriental influence, note that the earliest Swedish coinage was based on the Persian weight system, the coins weighing half a Persian drachma. Also, as indicating the far-reaching scope of the trade, note that in the museum at Oslo-Christiana, besides other Oriental coins, there are specimens of early porcelain