

Letters to the Editor

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NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 583.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Carbon Dioxide Content of Atmospheric Air

DURING the last nine months of his life my father, Prof. J. S. Haldane, was engaged, in collaboration with Dr. R. H. Makgill, in the systematic analysis of atmospheric air. Owing to his death and the absence of Dr. Makgill in New Zealand, some time may elapse before the full results of their work are published. But certain of them are of enough general interest to warrant a preliminary note.

The apparatus used was an improved form of the well-known Haldane volumetric gas analysis apparatus, adapted for the estimation of carbon dioxide only. The measuring burette, control burette, and carbon dioxide absorption bulb are all immersed in the same water bath, and their connexions are greatly shortened. 20 c.c. of air is used for each analysis. If the proper precautions are taken, duplicate estimations of carbon dioxide always agree within 2 volumes per 100,000, and generally within 1 volume. A single analysis can be completed in ten minutes. The apparatus is made by Messrs. Siebe Gorman and Co., Ltd., 187 Westminster Bridge Road, S.E.1. About 1,500 analyses of atmospheric air have been made with it. It has also been used for experiments on photosynthesis and plant respiration, and on the gases in equilibrium with river, spring and sea water. In what follows the carbon dioxide content is given throughout in volumes per 100,000.

The amount of carbon dioxide in country air at heights from 4 ft. to 70 ft. above ground-level varied between 21 and 44 volumes. The diurnal variation due to photosynthesis was very marked from July, when systematic observations began, until October. But in December no definite diurnal periodicity was observed. Thus the average of 153 analyses made at Cloan (Perthshire) during August 1935 was 32.4 volumes, that of 15 made at night was 38.6. The maximum fall due to the photosynthesis was observed when bright sunshine followed rain. In dry weather, sunshine had but little effect. It seems likely that during drought the stomata of leaves are nearly closed so as to conserve water, and carbon dioxide is thus excluded.

The exhalation of carbon dioxide from the soil was very obvious. 23 pairs of samples were taken simultaneously at ground-level on bare tilled soil and at a height of 4½ ft. The carbon dioxide at ground-level was higher on 19 occasions, equal on one, and lower on three. The mean excess was 5.4 volumes per 100,000. Samples taken from holes about 3 cm. below the surface contained as much as 100 volumes. The carbon dioxide excess persisted even among grass during sunshine, though low values were found in a mass of creeper on a wall. The influence of combustion was equally clear. Eighteen samples taken during still weather in London, and analysed by Mr. W. J. A. Butterfield, ranged from 42.5 to 90 volumes of carbon dioxide per 100,000, averaging 65.

A possibly more important influence, at least in Britain, is that of the sea. Samples of air blowing inland off the sea on to the coast of Ayrshire in August and September averaged 37 volumes of carbon dioxide. On the other hand, samples taken by Commander G. C. C. Damant on the southern shore of the Isle of Wight in November during southerly breezes averaged 27 volumes. It is generally thought that the sea round the British Isles acts as a sink for carbon dioxide. The Ayrshire observations suggest that this is not always the case.

The carbon dioxide content of the air also varied for causes which are at present uncertain. Thus during October, the night air at Oxford generally contained 32-34 volumes. From October 31 until November 8 it ranged from 35 to 42, averaging 38. This was a period of successive cyclonic depressions.

It appears that this method, which is much more rapid than the gravimetric or alkalimetric methods, and at least equally reliable, while it only requires a simple portable apparatus, may prove of considerable value for three purposes. It may furnish new data for plant ecology. Thus grass appears to carry out photosynthesis in an atmosphere distinctly richer in carbon dioxide than tree leaves in the same area; and my father conjectured that, at least in the temperate zone in summer, the carbon dioxide concentration of the air might be considerably lower in the interior of continents than near the coast. It could probably be used for the investigation of stratospheric air. A similar apparatus could estimate oxygen with less absolute accuracy, but almost equal sensitivity to small differences. Finally, it might be of value to meteorologists in distinguishing between bodies of air of different origins.

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March 15.

Surface Layers of Crystals

THE explanation of pyro-electric excitation in crystals, obviously extending to piezo-electric, as strain of a natural internal polarisation after the manner of Poisson and Kelvin, is one of the beautiful basic ideas in polarised electrics.

A crystal consists of a series of layers of ions, parallel to a face, alternately positive and negative, whether they are free ions or the directed poles of atoms. Fifteen years ago, I set out the relevant analysis which had long been running in my mind, the main result emerging that if the layers are equidistant the resulting electric field for a plate is that due to half the first layer and half the final layer. According to the Kelvin idea, this field would become abolished by accumulation along the surface of foreign cancelling ions, of whatever kind, if of opposing sign; an equilibrium which thermal expansion would disturb, with pyro-electric results. The result as here stated is