## Conclusion

The above notes are intended as only a general survey of the main conclusions of the conferences, and a more detailed consideration of the various recommendations must await the publication of the proceedings of the meetings in the usual manner. Apart from the actual committee work leading to these results, the various conferences provided the usual informal opportunities for meeting contemporary workers in other countries. The meetings in Sweden also enabled delegates to visit certain research and manufacturing organisations in Stockholm and Gothenburg.

R. L. SMITH-ROSE

# LARGE-SCALE VERTICAL MOTION IN THE ATMOSPHERE

AT a meeting of the Royal Meteorological Society on February 16, the subject for discussion was large-scale vertical atmospheric motion. In opening, Mr. J. K. Bannon stressed the importance of the rising and sinking of large masses of air in atmospheric dynamics and explained the relatively small attention given to vertical motion by meteorologists by the fact that, so far, it has been impossible to measure directly the vertical velocities, which can only be inferred, and that with difficulty. He went on to describe a method of estimating up-currents from the rate of rainfall[1], depending on the approximate equality of the rate of release of precipitation from a mass of rising air and the rate at which the saturation vapour content of the same air decreases as the temperature falls due to adiabatic expansion (that is, neglecting the changing water content of the cloud particles, which is small except in convection clouds). This method can be applied in cases of steady rising currents over a wide area (thirty miles square or more), and examples of results obtained from rainfall records in the Hebrides show that up-currents in the lower and middle troposphere are of the order of 10–20 cm./sec. in typical disturbances of the North Atlantic.

Mr. J. S. Sawyer then gave a brief description of two other methods of deducing vertical atmospheric movement. The first, that of Graham[2], requires a network of upper air observations of temperature and wind at regular time intervals. The horizontal motion between consecutive times of upper air observations being known, temperature changes unexplained by horizontal movement are assumed to be due to changes in height, and to take place adiabatically; and hence the vertical motion in the period may be inferred. The method is quick and may be used by the weather forecaster; the results are consistent with other phenomena such as rain (up currents). The second method, which Mr. Sawyer has applied to several cases in the neighbourhood of the British Isles, depends on the relation between vertical motion and the divergence of the horizontal wind field (the equation of continuity), and between the divergence of the horizontal wind field and the rate of change of the vertical component of vorticity (the vorticity equation). Several approximations must be made, but even so the technique is rather laborious and the method is only suited to research. Notwithstanding the approximations, the results obtained agree qualitatively with expectations, up-currents being deduced over rain areas and down-currents over anticyclones; Graham's method gave comparable results. As emphasized later in the discussion by Dr. R. C. Sutcliffe, this vorticity method requires only knowledge of the pressure field—at more than one level, of course—and can be employed when wind observations are lacking.

Prof. P. A. Sheppard then gave a preliminary account of work being carried out under him in the Department of Meteorology of the Imperial College of Science and Technology by Mr. H. A. G. van Ufford and others. The eight radar wind-finding stations in the British Isles may be grouped to form seven triangles with sides of the order of 200–300 miles in length. The wind observations at the corners of these triangles (specially supplied by the Director, Meteorological Office, to the nearest degree in direction and the nearest knot in speed) were used to evaluate the horizontal divergence over each triangle, at 100 mb. intervals, between pressure-levels of 900 mb. and 200 mb., that is, approximately between 3,000 and 40,000 ft.; by the equation of continuity the vertical motion at each level was deduced from the horizontal divergence. The months December 1947–February 1948, inclusive, were investigated, and the large amount of data so obtained is still being analysed.

A few examples of results obtained were given. The weather of December 1947 was mainly anticyclonic over southern England, that of January 1948 very disturbed and cyclonic; frequency curves of the distribution of $\rho w$ (where $\rho$ is air density, $w$ is vertical velocity) for both the lower and upper troposphere reflect this, showing a preponderance of down-currents in the south of the British Isles in the first month; in the January, both in the north and the south of the country, almost equal numbers of up and down currents occurred, and larger vertical velocities were more frequent. Prof. Sheppard also demonstrated curves showing the distribution with height of the mean up and down velocities for January 1948 over central England. When there was general ascent below 500 mb. the maximum of just over 7 cm./sec. occurred between 600 and 500 mb., that is, about 16,000 ft.; with general subsidence in the troposphere, the maximum was between 6 and 7 cm./sec. and occurred between 500 and 400 mb. (about 20,000 ft.). It is noteworthy, he said, that in both cases the mean up and down currents, respectively, at tropopause-level are about 4 cm./sec. As well as the statistical results, which Prof. Sheppard stressed were the most important and significant outcome of the investigation, the distribution of vertical velocity was demonstrated for a few individual occasions, agreeing well with the general features of the weather (rainfall, development of ridges of high pressure, etc.). Velocities, both up and down, of up to 30–40 cm./sec. were deduced even in the lower stratosphere, though 10–20 cm./sec. were more usual maxima.

Mr. M. K. Miles said that, in using Graham's simple method, it is necessary to remember its limitations; as the author admits, it does not always lead to one definite value of vertical motion, and also the deduced velocity is an average over a considerable time, usually 6–12 hours. A comparison with Bannon's method, which tends to under-estimate the up current, and with a direct evaluation from horizontal wind observations, in one particular case, showed that Graham's method considerably under-estimates the vertical velocity.

Dr. R. C. Sutcliffe was enthusiastic of the results obtained so far by Prof. Sheppard. The network of upper air observing stations in the British Isles is the closest in the world, and this region should be used to determine the basic facts of the structure and working of typical weather situations. Atmospheric models, so determined, may then be applied to similar phenomena in other parts of the world where upper air information is scanty or lacking. Prof. Sheppard's investigation is an example of the use to which the British Isles observations may be put, to the great benefit of meteorology generally. Dr. Sutcliffe also pointed out that the horizontal scale of these vertical currents deduced by Prof. Sheppard is implicit in the dimensions of the triangles of observations used.

In reply to questions from Mr. C. S. Durst, Prof. Sheppard said that he had found no individual cases giving ridiculous values for the vertical velocities; since the radar wind observations are averages over depths of about 3,000 ft., such small variations in the wind as Richardson[3] feared would preclude any attempt at a numerical analysis of the wind field of a weather situation are probably eliminated. The time required to analyse each wind-finding ascent for all the various levels is about half an hour, using graphical methods. This indicates the large amount of work involved in producing the basic data for his investigation.

In concluding the discussion, the president, Sir Robert Watson-Watt, said that the results described showed exciting progress; as that most famous English meteorologist, Sir Napier Shaw, used to emphasize, measurements are as essential in meteorology as in every other branch of science.

[1] Bannon, J. K., *Quart. J. Roy. Met. Soc.*, **74**, 57 (1948).
[2] Graham, R. C., *Quart. J. Roy. Met. Soc.*, **73**, 407 (1947).
[3] Richardson, L. F., "Weather Prediction by Numerical Process" (Camb. Univ. Press, 1922).

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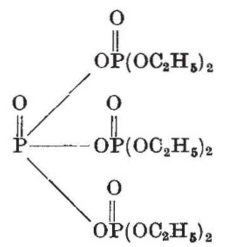
# INSECTICIDAL PROPERTIES OF CERTAIN ORGANO-PHOSPHORUS COMPOUNDS

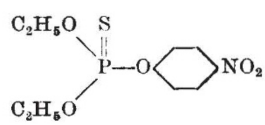
THE success of D.D.T. and benzene hexachloride insecticides has already shown the important part that synthetic chemicals can play in agriculture. Interest is therefore being shown in the organo-phosphorus group of insecticides, especially as certain of these compounds show high contact-activity and others are capable of rendering the plant systemically insecticidal. As these compounds have not yet been available in sufficient amounts for wide-scale investigations, and as little has been published on the subject, there is a considerable demand for accurate information. A meeting of the Association of Applied Biologists on November 5 sought to adjust this state of affairs by bringing together workers qualified to speak on various aspects of the subject.

Dr. H. Martin, of Long Ashton Research Station, introduced the proceedings. He referred to the classical work of Michaelis (1890–1915) on the chemistry of the organic compounds of phosphorus, and mentioned that Nylen[1] had described the tetraethyl ester of pyrophosphoric acid but had overlooked its toxicity towards insects. The discovery of, and information on, the insecticidal properties of these compounds was due almost entirely to Schrader[2]. He had shown that tetraethyl pyrophosphate is highly toxic to aphides, but had not carried forward his discovery to the manufacturing scale, as the substance rapidly lost its activity in contact with water. Instead, Schrader had investigated the reaction between phosphoryl chloride and triethyl phosphate and had obtained a product known as hexaethyl tetraphosphate (I), which he considered had the following structure:




(I)

This substance was shown to be as toxic to aphides as nicotine and to have sufficient water-stability to be of practical value; consequently, its manufacture was commenced in Germany in 1944. Dr. Martin mentioned that chemical evidence had recently been produced that hexaethyl tetraphosphate is probably a mixture of alkyl polyphosphates; but investigations at Long Ashton on the toxicity of samples prepared by different processes had revealed no differences. However, it is not sufficiently stable for use with alkaline spray material such as lime sulphur or for incorporation in dusts, consequently its usefulness to agriculture is limited. Schrader found that the thiopyrophosphoric esters were more stable to hydrolysis than the pyrophosphoric esters, yet retained their pronounced insecticidal action. In 1945 a series of thiophosphoric acid derivatives was investigated, with the result that the highly potent insecticide, diethyl-*p*-nitrophenyl thiophosphate *E*.605 (II), was discovered.

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*E*.605 was a marked improvement on hexaethyl tetraphosphate. It is more toxic to many species of aphides than nicotine, giving a complete kill at 0·005 per cent (Schrader), and is sufficiently resistant to hydrolysis to be used with lime sulphur or as a dust. It is also ovicidal, being about as toxic to *Aphis pomi* eggs as 3 : 5-dinitro-*o*-cresol. Claims had been made that *E*.605 was toxic to a wide range of insects. Schrader found that diethyl-*p*-nitrophenyl phosphate (*E*.600) was also highly insecticidal, but had not gone further with this compound on account of its toxicity to mammals.

Dr. Martin then referred to the discovery of the systemic insecticides by Schrader and Kükenthal[2]. Apparently these workers had included a soil-watering test in their routine examination for insecticidal properties, and had found that certain organic compounds could be absorbed by plants, which thereby became toxic to insects placed on them. Few of the systemic insecticides described by Schrader are available in Great Britain, but three have been examined at Long Ashton:

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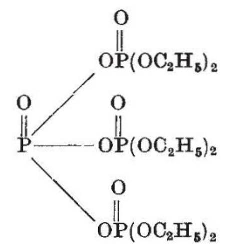
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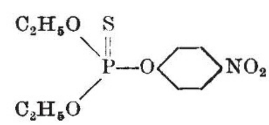
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