Condensation of Water in the Atmosphere

AT the meeting of the British Association in Leicester a number of papers were read on September 12 in Section A† (Department of Cosmical Physics) relating to different aspects of the problem of condensation of water in the atmosphere. Dr. G. C. Simpson, in his opening remarks, dealt mainly with the question of the size-distribution of droplets in cloud, fog and rain. A number of workers, notably Defant, Köhler and Niederdorfer, claim to have shown that the volume of droplets in the atmosphere are most frequently integral multiples of some standard minimum size. Köhler also states that the chloride concentrations of samples of cloud or rain water are all integral multiples of the smallest concentration ever found in such water.

If this is true, then first, the original nuclei must all have masses related to one another in the same series as the final drops; secondly, after the drops reach a certain specified size, condensation on them ceases and thereafter they may only grow by collision; thirdly, only drops of the same size may unite; and fourthly, only drops with the same salt concentration may unite. It is obviously difficult to see how all these conditions can be satisfied simultaneously and on all occasions, though mechanisms have been suggested to account for some of the processes involved. For example, Schmidt has explained the tendency for drops of the same size to unite by the fact that they would fall through the air at the same rate. Two equal drops may therefore find themselves side by side for a sufficient time for the hydrodynamic attraction between them to result in their union. It should be noted, however, that the different experiments do not agree as to the fundamental size from which it is supposed the bigger drops are built up; and that there is an element of doubt in the physical interpretation of the statistical analysis of the data. In these circumstances, the final conclusions should be regarded as suspect, until further information is available.

Mr. H. L. Green dealt with the problem of measuring the size and number of particles in the atmosphere. Both the size and number may vary over enormous ranges; the size from 10^{-8} cm. in the case of ions to 10^{-3} cm. in the case of gross atmospheric pollution particles; and the number from one or two per cubic centimetre in certain mists to several millions per cubic centimetre in some smokes. Further, the particles may be solid or liquid. It is not surprising therefore that many different methods of measurement have been developed to deal with different parts of the range and that few are efficient except for the job for which they were designed. For example, the Owens jet dust counter has an efficiency of more than 80 per cent for atmospheric pollution particles between 10^{-5} cm. and 10^{-4} cm. radius, but it only counts about 40 per cent of mineral dust particles of radius between 10^{-4} cm. and 10^{-3} cm. On the other hand, the circular konimeter and the Greenburg-Smith impinger is more efficient for dust than for ordinary atmospheric pollution.

Workers have been handicapped by the absence of means for testing the efficiencies of their instruments, but with the advent of the ultramicroscope and sedimentation methods, this difficulty should disappear. One would like to know how reliable were the various methods used for measuring the droplets discussed by Dr. Simpson.

Some experiments were described by Prof. J. J. Nolan showing the behaviour of a drop of water in an intense electric field, such as exists in a thunder cloud. The drop becomes pulled out and, at a certain value of the field, begins to discharge, the ions produced attaching themselves to nuclei (if any are present), thus becoming large. The critical field is given by $F\sqrt{r} = 3600$ (F, the field, in volts/cm., and r the radius). A similar law has been found for bubbles. In pure air, free from nuclei, no large ions are detectable, even if the field is made so intense that the drop is broken up. It therefore seems that the low mobility ions required by C. T. R. Wilson's theory of thunderstorm electrification are not directly produced by discharge from raindrops.

Meteorologists, both in Germany and England, have found that when a hair hydrograph is sent up into the air, the hair frequently elongates beyond the 100 per cent relative humidity mark. One has been reluctant to infer from this that the atmosphere was, on these occasions, supersaturated, particularly as the phenomenon often occurs inside a cloud. Mr. L. H. G. Dines reported to the meeting many cases of this apparent supersaturation, many of them occurring above the freezing point. Further, he has observed a small momentary superelongation of a hair in the laboratory, when it was subjected to (presumed) supersaturation in a type of Wilson expansion chamber. It is therefore becoming increasingly difficult to explain the experimental results in any other way than by supersaturation.

An occasion of apparent supercooling (as implied by a temperature record) seems to support the view that the atmosphere can be so clean as to permit both supercooling and supersaturation; but, as Dr. Simpson pointed out, we know so little about the behaviour of a hair in varying circumstances, and, in the case of the temperature record, it is so difficult to believe that supercooled water could have existed on the thermograph, that we must await further evidence before making up our minds definitely on this point.

M. G. B.

New Science Laboratories at Bedford School

THE new science laboratories at Bedford School, which were visited by the Prince of Wales on November 8, were designed by Mr. Oswald P. Milne, who is an old boy of the school. A detailed account of the architectural features of the building is given in the *Architect and Building News* for November 17.

The Physics Department is on the ground floor and consists of a senior laboratory (28 ft. × 25 ft.), two junior laboratories (44 ft. × 24 ft.), two lecture rooms (25 ft. × 25 ft.), dark room, electrical control room, preparation room, book room and offices. The corridors run approximately magnetic north and south. The laboratories have been designed so that all students' tables may be moved into any desired position. This has been made possible by fitting a shelf about a foot wide at table height all round the room except where there are store cupboards, sinks, or doors. All pipes, cables, etc., are fitted below the