The amount of iron extracted during this process is small, about 300 μgm. per gm. of hydroferrocyanic acid, as determined spectroscopically. Parallel experiments showed that this iron is not produced by irradiation, but is extracted also from unirradiated hydroferrocyanic acid. The specific activity of the Fe^{59} is therefore about 1·5 mc./gm. It is hoped to repeat and extend these experiments, and also to obtain higher specific activity, with samples irradiated in the bigger pile now in operation at Harwell.

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[1] Nat. Res. Coun. Canada Report, C.R.C. 351.
[2] Cf. Livingood and Seaborg, *Phys. Rev.*, **54**, 51 (1938). Deutsch, Downing, Elliott, Irvine and Roberts, *ibid.*, **62**, 3 (1942).

Distribution of Ice-Particle Nuclei in the Free Atmosphere

CWILONG[1] has determined the highest temperatures at which ice forms in the cloud produced by adiabatic expansion in a Wilson cloud chamber. He found a threshold temperature of $-41 \cdot 2 \pm 0 \cdot 2°$ C. for air which had been cleaned by repeated expansions, and of $-32 \pm 1 \cdot 0°$ C. for outdoor air at Oxford. He has since repeated the experiments with outdoor air on the Jungfraujoch[2], and on the Atlantic and Pacific Oceans[3]: he found the clean air threshold on all but one occasion.

During the past year an apparatus similar to that used by Cwilong has been fitted to a Halifax aircraft of the Meteorological Research Flight at Farnborough, and measurements have been made in flight on four occasions. On each flight the threshold temperature for the free air was determined at two or three levels. On two of the flights there were pronounced anticyclonic inversions at about 5,000 ft., while on the other two the *radio-sonde* ascents showed no marked inversions, though stratus cloud or a haze-top showed that the air was stratified.

The clean air threshold was found in all measurements above the inversions, the stratus, or the lowest haze-top, while the measurements below these levels gave $-33°$ C. to $-35°$ C. On one occasion two haze-tops were observed, and the clean air threshold was found above the lower. The greatest height at which the threshold has been observed to be above $-41°$ C. is 8,000 ft., while the lowest at which the clean air threshold has been found is 6,000 ft. These results were obtained in winter and early spring, and they suggest that the nuclei active at $-32°$ C. are only present in air which has recently been in contact with the surface.

The greatest height reached was 18,000 ft., and there the threshold was measured as $-44°$ C. Clean air from a compressed air cylinder was also examined at this height, and gave $-44°$ C. It is not certain whether this is a true variation of the threshold or an instrumental effect. The expansion ratios were controlled to give final temperatures accurate to $\pm 0 \cdot 5°$ C., and the apparatus will detect nuclei present in concentrations of 10/litre.

I am indebted to the Director of the Meteorological Office for permission to make the flights, and publish the results, and to Dr. Frith of the Research Flight for his unfailing helpfulness in the air and on the ground. Prof. G. M. B. Dobson suggested this research, and it is a pleasure to acknowledge his continued interest and many valued suggestions.

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[1] Cwilong, B. M., *Proc. Roy. Soc.*, **190**, 137 (1947).
[2] Cwilong, B. M., *Nature*, **160**, 198 (1947).
[3] Cwilong, B. M., *Nature*, **161**, 62 (1948).

Frictional Electrification of Sand

A VERY simple experiment seems to have a meteorological significance.

A small plate about one square inch in area was attached to the insulated quadrant of a Dolezalek electrometer. A cupful of fairly dry sand was then poured through a funnel and allowed to fall some three feet to the floor. The electrometer plate was three yards away from the dropping sand. The passage of the sand through the funnel took about half a minute, and while it was dropping there was no effect on the electrometer; but soon after, the electrometer began to show a deflexion which continued to increase for three or four minutes. This deflexion corresponded to the plate receiving positive charge. Having reached a maximum deflexion of a volt or so, the deflexion commenced to decrease, and continued to do so for a few more minutes and finally came to rest near its original zero position. In this stage the plate must have been receiving negative charge. That this decrease was not due to faulty insulation was checked by another experiment in which the plate was momentarily earthed when the deflexion reached its maximum, and it then charged up negatively in the last few minutes.

As the whole phenomenon occurs after the sand has ceased to drop, any explanation based on induction must be ruled out and the plate must have received positive charge through the air in the first few minutes, and an approximately equal amount of negative charge in the last few minutes. What is the source of these charges and why do the positive arrive first? The sand in its passage through the funnel gets charged negatively by friction, as is easy to show by letting a little of it fall into a metal cup connected to the insulated quadrant of the electrometer, and the question is therefore where does the positive charge come from? It was thought at first that the falling sand might, by friction, electrify the air, producing positive and negative ions which diffuse at different rates. There are several reasons against this, and the main one is that the kinetic energy of the ions would only be sufficient to charge up the plate to a very small fraction of a volt. The particles must, therefore, be very much larger, and one is driven to the conclusion that they are dust particles of the sand itself. Furthermore, they must be a mixture of small particles with a positive charge and larger particles with a negative, because the carriers of the positive diffuse, or are carried by convection, quicker than the carriers of the negative.

The frictional effect of the funnel always charges the sand negatively whatever the size of the particles, so the final conclusion reached is that the sand rubbing on itself must produce positive charges on the smallest particles and negative charges on the larger.

The electrometer had an approximate capacity of 50 E.S.U., and considering the smallness of the