of a volume distribution of charge in the water. The positive potential observed in the experiment described was due to positive charges in the ice which had not time to leak completely away before melting commenced, and which entered the water as the ice melted. (There had been a slight leakage over the insulators of the negative charge in the water.) Melting does not, therefore, put the water at a positive potential to the ice unless the ice has a positive charge initially.

The obvious applications to meteorology are these :

(1) If a small water drop impinges on an ice particle and part freezes on and the remainder rebounds, then a large negative charge is carried away and a corresponding positive charge is left in the outer layers of the ice. The actual magnitude of the charge depends on the size of the drops and their velocity of impact ; but the very moderate velocity and comparatively large drops from a common Boots's sprayer give the order of 1 electrostatic unit of charge per cubic centimetre of distilled water sprayed on ice.

(2) If the conditions are such that the impinging water causes part of the ice particles to melt, then the melted portion will take away a positive charge, but only if the ice had originally a positive charge, as, for example, ice which had undergone process (1).

(3) The magnitude of the effect depends very much upon the purity of the water. Possibly certain impurities might even reverse the signs in (1) and (2).

Lord Cherwell, as always, has given every facility for these experiments.

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[1] *Phys. Rev.*, **78**, 254.

Rainfall in a 'Cloudburst'

APART from an apocryphal record of 12·48 in. at Portree, Isle of Skye, on December 5, 1863, the largest amount of rain known to have been collected by a rain-gauge within a single day in the British Isles is 9·56 in. at Bruton, Somerset, on June 28, 1917. It has long been recognized, however, that the occurrence of far greater falls than this within much shorter periods than twenty-four hours must be invoked to account for the observed effects of those extremely heavy localized downpours which go by the name of 'cloudbursts'. Raindrops cannot fall through air rising at a vertical velocity exceeding 8 m./s. Upward currents having a higher order of magnitude of ascent than that are often engendered during severe convectional storms, and thus it may happen that, under conditions of prolific condensation in a well-developed cumulo-nimbus cloud, large quantities of water are carried to an altitude far above their level of origin. If for any reason the convectional movement suddenly ceases or diminishes rapidly, as it may do when the storm system reaches an escarpment of hills, the water accumulated aloft descends more or less *en masse*. At such times the surface soil beneath may either be washed away to rock level or be deeply excavated and heaped as by a giant plough over areas ranging from a few thousand square yards to 100 acres or more in extent.

Many meteorologists were sceptical when, in 1893, G. J. Symons[1], founder of the British Rainfall Organization, expressed his belief that a cloudburst (or 'so-called waterspout', as he put it) which wrought havoc at the Yorkshire village of Langtoft, near Driffield, during the evening of July 3, 1892, might have deposited not less than 100 in. of rain on a neighbouring hillside. But support for Symons's opinion has since come from the calculations of water engineers called upon to investigate the erosion effects of cloudbursts.

Although some five thousand rain-gauges are now maintained in the British Isles, the total area covered by all their receiving apertures combined is only of the order of 100 square yards ; furthermore, a large majority of the gauges have a capacity of less than 10 in. Prospects of securing an instrumental measurement of a short-lived deluge localized over a few score acres and amounting to perhaps 50–100 in. are thus extremely small. It therefore seems desirable to direct attention to an occasion in bygone times when a cloudburst left, by chance, a rough quantitative record of its yield. While searching recently through seventeenth-century climatological archives, I found a scarce 12-page pamphlet entitled "Strange relation of the suddain and violent tempest which happened at Oxford, May 31 anno domini 1682". This publication, issued by the Oxford bookseller Richard Sherlock later in the year 1682, appears to have been overlooked hitherto by students of climatology.

There can be little doubt that the storm described justified the anonymous author's prefatory remark that its severity was such as "former ages have been seldome acquainted with". It broke early in the afternoon and was accompanied by "deadly, ruinous lightning", "frightful thunder", "a huge blustering and boisterous wind" and intense darkness. The rain, we are told, "seemed one continued spout or stream ; so that in less than half a quarter of an hour these pouring cataracts raised the water in a round and uniform vessel of about 4 foot diameter near two foot higher than before, without the assistance of any other interfluent rivulet or commixing water". Bridges were borne down and houses demolished by the resulting floods.

It seems reasonable to suppose that by "near two foot" the chronicler of the cloudburst may have meant 1 ft. 9 in. or so, and that his "less than half a quarter of an hour" might have been about seven minutes at most. On these assumptions we get an average rate of approximately 3 in. per min. for the storm's yield of precipitation. This far surpasses such classical records of torrential rain in other parts of the world as the 1·02 in. measured in one minute at Opid's Camp, on the west front of the San Gabriel range, California, on April 5, 1926, and the 2·47 in. in three minutes at Porto Bello, Panama, on May 1, 1908. For comparison it may be added that the greatest observed rainfall for a half-hour period in the British Isles since instrumental data first became available is 2·90 in. at Cowbridge, Glamorganshire, on July 22, 1880. The length of the English 'foot' did not differ appreciably in the seventeenth century from its present value.

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[1] Symons, G. J., "British Rainfall 1892", 105.