11 or 12, when a severe frost began; by the 18th the Thames was full of ice; on the 20th it was "troublesome" to cross by boat; on the 22d "the river is frozen," though Pepys visited the Duke of Albemarle by water on the 24th. On the 27th a thaw had set in, though there was still much ice on the river.

1666. On January 24 there was a very great gale. February and March seem to have been dry; on March 18 "all cry out for lack of rain." There was another drought later, for on June 26 we read of rain "after a long drowth." Several thunderstorms are reported during the summer, but there was another drought in August, for when the great fire began on September 2 Pepys says that everything was combustible after so long a drought. The general wind direction during the fire is seen from the entry for February 3, 1667, where it is recorded that pieces of burnt paper were carried by the wind as far as Cranborne near Windsor, which makes the wind direction between east-northeast and east. The drought continued till September 9. After this date the weather seems to have been very changeable; probably a westerly type prevailed till about December 10, after which it was frosty till the end of the year.

1667. The frost continued and the Thames was covered with ice on January 1. On January 9 it thawed. February seems to have been warm till about the 25th, when a cold spell began which lasted till the middle of March; on March 6 the King said that it was the coldest day he had ever known in England, and the 7th seems to have been still colder. The end of March and the first three weeks of April seem to have been dry and warm; on April 21 it rained, "it not having rained for many weeks." There seem to have been a good many days of easterly wind in June and July, which helped the Dutch when they came up the Thames;. the month of July was dry till the 27th. The rest of the year calls for no special remark, except that no frost is mentioned, though November 10 was "mighty cold."

1668. There seems to have been no hard frost or snow this winter. March was mostly fine and dry with a drought that ended on April 4. On May 22 there was a heavy rain in London and to the north, but none at Newmarket; the rainfall must have been very heavy, as it caused floods near London, at Cambridge, and at Brampton in Huntingdonshire. The end of September and the beginning of October seem to have been exceptionally fine and warm, "as good as summer in all respects." There was frost on December 7, but it seems to have been unusually warm during most of December, as Pepys says that he only put on a waistcoat at night on December 24, "the first winter in my whole memory that ever I staid till this day before I did so."

1669. The early part of January was frosty and there was snow on the 13th. There are no weather entries for February, but the end of March was cold, with several falls of snow.

The diary ends on May 30 of this year.

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The Duke of York, afterwards James II, seems to have been something of a meteorologist, for on April 4, 1668, he told Pepys his rules for knowing the weather, and he apparently made a very good forecast on that day, but Pepys does not tell us what his rules were.

It may be interesting to note that the sounds of distant gunfire were frequently heard in London. On the first four days of June, 1666, guns were plainly heard in London when the English and Dutch fleets were engaged off the North Foreland. On June 2 Pepys went "into the parke, and there we could hear the guns from the fleete most plainly," and later in the day he told the King and the Duke of York, and they also went into the park to hear the guns. But though heard in London they were not heard on the coast; the *Katherine* yacht saw the Dutch fleet on May 29, ran from them, and came up the Thames on June 2, having heard no firing at all. Evelyn heard the guns near London and went down to the coast, but found that nothing had been heard at Deal. On June 4 Pepys writes: "So walking through the parke we saw hundreds of people listening at the Gravell-pits, and to and again in the parke to hear the guns, and I saw a letter, dated last night, from Strowd, governor of Dover Castle, which says that the Prince [Rupert] come thither the night before with his fleete, but that the guns which we writ that we heard, it is only a mistake for thunder; and so far as to yesterday it is a miraculous thing that we all Friday, and Saturday and yesterday, did hear everywhere most plainly the guns go off, and yet at Deale and Dover to last night they did not hear one word of a fight nor think they heard one gun. This added to what I have set down before the other day about the *Katherine*, makes room for a great dispute in philosophy, how we should hear and they not, the same wind that brought it to us being the same that should bring it to them; but so it is." All this is quite in accordance with the audibility of gunfire in recent years.

On July 25th the fleets met again in the North Sea, and when Pepys went to Whitehall he was told that in the park "the guns are heard plain." Many went into the park, and the King and the Duke of York went into the bowling green and upon the leads, to hear the guns; Pepys joined them, and "it was pretty to hear how confident some would be in the loudnesse of the guns, which it was as much as ever I could do to hear them."

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EXTRAORDINARY DUST STORM IN NORTH DAKOTA.[1]

By LEONARD P. DOVE and OTHERS.

[Abstract.]

That wind is a major agent [2] in moving material and fashioning the present earth features would seem self-evident, but seldom does the process intrude itself in a such a striking way as in the recent (Jan. 18–19, 1921) storm in North Dakota.

The storm in question, which apparently originated in Nevada and eventually covered an approximate area of 400,000 square miles, reached Grand Forks, N. Dak., on the 18th of January. On that morning the ground in North Dakota was partially snowcovered. During the afternoon clouds of dust began to arrive and soon collected in thick layers on the snow surface. A thaw set in during the next morning and by 10 a. m. was followed by a light rain which cleared the air and preserved the dust from further removal. On the night of the 19th another light snowfall occurred, and this in turn was followed by a slight thaw. Thus it became an easy matter to collect very complete dust samples. These samples were screened and then examined under a microscope. The greatest bulk of the material was probably of local origin. The finer particles were probably kept in suspension by the wind and brought down by the rain mostly to the eastward. The cinders are no doubt from the

[1] The dust storm of 1921. *Quarterly Jour. of the Univ. of N. Dak.*, vol. xi, No. 3, April, 1921.

[2] Keyes, Charles Rollin. Competency of wind in land depletion. Mo. WEATHER REV., Feb., 1917, 45: 57–58.

railroad tracks and yards. Fibers of plants and considerable humic material were mixed with the dust. The amount of dust in the caked mud would increase the total that would pass the 200-mesh screen to approximately 90 per cent. Assuming these samples to be representative the amount of dust deposited on each square mile would equal the astonishing total of 801 tons.—*H. L.*

RAIN-MAKING AGAIN!

[Reprinted from *Nature*, July 21, 1921, p. 659.]

The popular fallacy that explosions can precipitate rainfall found expression in the question asked by Maj. Morrison-Bell in the House of Commons on July 13 as to whether the Government would be prepared to initiate experiments which might possibly have the result of precipitating a downpour of rain. The answer given was to the effect that from past experiments meteorologists were of the opinion that explosions would not induce a fall of rain, and rightly so; for experiments were conducted on a vast scale, not, it is true, with that particular end in view, on the western front during the Great War. The collation of statistics of rainfall with the gunfire failed to show any certain connection. The only way in which the water vapor in the atmosphere can be condensed into clouds is by cooling. Unless an explosion can produce a cold current, or cause to any appreciable extent such a disturbance in the atmosphere as will bring about the mixture of a stratum bearing a cold current with that carrying a warmer current, it can not produce rain. The compression in the air produced by a bursting shell is propagated as a sound wave. The amplitude of the motion, therefore diminishes as the square of the distance from the origin, so that at the distance of a quarter of a mile it would probably be no greater than one ten-thousandth of an inch. In 1917 M. Angot, Director of the French Meteorological Office, showed that in the extreme case of two equal masses of saturated air, one at 0° C. and the other at 20° C., it would be necessary, in order to produce rain of even so small an amount as 1 mm. (0.04 inch), for the two masses rapidly and thoroughly to mix throughout an atmospheric layer of 6,850 meters (about 4 miles) in thickness. Nor are dust particles and ions, which form the nuclei of raindrops, sufficient of themselves to cause precipitation unless there be a concomitant reduction of temperature.

CORRECTION OF A MARINE BAROMETER FOR ERRORS DUE TO SWINGING.

By W. G. DUFFIELD and T. H. LITTLEWOOD.

[Abstracted from *London, Edinburgh, and Dublin Philosophical Magazine*, July, 1921, pp. 166–173.]

A swinging barometer, such as is used in gravity determinations and for meteorological purposes on shipboard, is subject to two sources of error as a result of the swinging. First, the effect of small oscillations about the point of support tends to make the reading too high. Second, the swinging about the point of support tends to make the reading too low because of the action of the centrifugal force in the mercury. The purpose of the investigation was to so arrange the barometer that these two errors, which are of opposite sign, would exactly neutralize each other. This adjustment may be made either by keeping the point of suspension fixed, which will keep the distance from the center of oscillation to the center of gravity constant, and make such adjustments to the barometer as will change the length of an equivalent simple pendulum; or, by altering the point of suspension, thus changing both of the lengths mentioned above. In the latter case, the point must be found where the required relationship is attained. In a marine barometer upon which tests were made, it was found that practice agreed closely with theory, and, for that particular instrument, the error was zero when the period of oscillation was about 1.66 seconds (first method); and (second method) when the center of oscillation was 21.5 cm. below that used in the first method. The authors recommend that all marine barometers, whether they are to be used merely for meteorological purposes or for more precise gravity work, should be so constructed as to permit of these adjustments.—*C. L. M.*

CLOUD FORMATION BY SUPERCHARGED PLANE.[1]

[Reprinted from *U. S. Air Service*, July, 1921, p. 13.]

An altitude flight was made in the morning at McCook Field [Dayton, Ohio] recently, by Lieut. J. A. Macready in a La Pere with supercharged Liberty. When the airplane reached a height of 26,000–27,000 feet at 11:50 a. m., a long feathery white streamer was observed forming behind a rapidly moving dark speck. The cloud was of the cirrus variety, well defined at its edges and apparently 10 to 15 times the width of the plane. The sky behind the first portion was clear blue with no other clouds in the near neighborhood. The first streamer seemed perhaps 2 miles long. Then a gap of one-quarter mile. The second streamer formed with a background of light cirrus cloud and after 2 or 3 miles the plane seemed to go into the cirrus background, for the streamer formation ceased while an apparent path of blue continued beyond for a way in the cirrus cloud. The whole streamer may have been 3 miles long. After 20 minutes the streamer had drifted and spread until it merged indistinguishably with the other cirrus clouds visible. The weather conditions at the time were generally very clear, warm, with perhaps 0.1 of the sky in cirrus clouds.

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[1] *Cf.* Varney, B. M.: The Argonne battle cloud. MO. WEATHER REV., June, 1921, 49: 348–349, also Wegener, A.: Frost-supersaturation (Frostübersättigung) and cirrus. *Ibid.* p. 349.