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METEOROLOGICAL IMAGINATIONS and
CONJECTURES. By BENJAMIN FRANKLIN, LL.D F. R. S.
and acad. reg. Scient. Paris. Soc. etc. Communicated by Dr.
PERCIVAL. Read December 22, 1784.,
T H E R E seems to be a region higher in the air over all
countries, where it is always winter, where frost exists
continually, since, in the midf of summer on the surface of the
earth, ice falls often from above in the form of hail. Hailstones,
of the great weight we sometimes find them, did not probably
acquire their magnitude before they began to descend. The air,
being eight hundred times rarer than water, is unable to support
it but in the shape of vapour a state in which its particles are
separated. As soon as they are condensed by the cold of the
upper region, so as to form a drop, that drop begins to fall. If it
freezes into a grain of

ice, that ice descends. In descending, both the drop of water, and the grain of ice, are augmented by particles of the vapour they pass through in falling, and which they condense by their coldness, and attach to themselves. It is possible that, in summer, much of what is rain, when it arrives at the surface of the earth, might have been snow, when it began its descent; but being thawed, in passing through the warm air near the surface, it is changed from snow to rain. How immensely cold must be the original particle of hail, which forms the center of the future hailstone, since it is capable of communicating sufficient cold, if I may so speak, to freeze all the mass of vapour condensed round it, and form a lump of perhaps six or eight ounces in weight !

When, in summer time, the sun is high, and continues long every day above the horizon, his rays strike the earth more directly, and with longer continuance, than in the winter; hence, the surface is more heated, and to a greater depth, by the heat of those rays.

When rain falls on the heated earth, and falls down into it, it carries down with it a great part of the heat, which by that means descends still deeper.

The mass of earth, to the depth perhaps of thirty feet, being thus heated to a certain degree,

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continues to retain its heat for some time. Thus the first snows that fall in the beginning of winter, seldom lie long on the surface, but are soon melted, and soon absorbed. After which, the winds that blow over the country on which the snows had fallen, are not rendered so cold as they would have been by those snows, if they had remained. And thus the approach of the severity of winter is retarded; and the extreme degree of its cold is not always at the time we might expect it, viz. when the sun is at its greatest distance, and the day shortest, but some time after that period, according to the English proverb which says, "as the day lengthens, the cold strengthens;" the cause of refrigeration continuing to operate, while the sun returns too slowly and his force continues too weak to counteract them. During several of the summer months of the year 1783, when the effect of the sun's rays to heat the earth in these northern regions should have been greater, there existed a constant fog over all Europe, and great part of North America- This fog was of a permanent nature; it was dry, and the rays of the sun seemed to have little effect towards dissipating it, as they easily do a moist fog, arising from water. They were indeed rendered so faint in passing through it, that when collected in the focus of a burning glass they would scarce kindle brown paper.

Of course, their summer effect in heating the earth was exceedingly diminished.
Hence the surface was early frozen;
Hence the first snows remained on it unmelted, and received continual additions. Hence the air was more chilled, and the winds more feverely cold.
Hence perhaps the winter of 1783-4, was more feverely, than any that had happened for many years.
The cause of this universal fog is not yet ascertained. Whether it was adventitious to this earth, and merely a smoke, proceeding from the consumption by fire of some of those great burning balls or globes which we happen to meet with in our rapid course round the sun, and which are sometimes seen to kindle and be destroyed in passing our atmosphere, and whose smoke might be attracted and retained by our earth; or whether it was the vast quantity of smoke, long continuing; to issue during the summer from Hecla in Iceland, and that other volcano which arose out of the sea near that island, which smoke might be spread by various winds, over the northern part of the world, is yet uncertain. It seems however worth the enquiry, whether other hard winters, recorded in history, were preceded by similar permanent and widely extended summer fogs. Because, if found to be

fo, men might from such fogs conjecture the probability of succeeding hard winter, and of the damage, to be expected by the breaking up of frozen rivers in the spring; and take such measures as are possible and practicable, to secure themselves and effects from the mischiefs that attended the last.
Passy, May 1784.

Comments by the editors:

Franklin imputed the volcanic fog to Hecla Hecla erupted in 1768 but Lakigiger the long fissure in southeastern Iceland erupted the largest volume of lava in historic time in 1783. This was quite surely the culprit. The text of Franklin's article, which was scanned, was supplied to the editors by the Dartmouth College Libraries
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