INTRODUCTION.

The idea of organic matter and particularly of living things raining down from the sky, on first thought, is hard to entertain. There have been recorded in all periods of historic time, however, showers of one kind or another of animals and plants or their products—showers of hay, of grain, of manna, of blood, of fishes, of frogs, and even of rats. In ages past, these phenomena, actual or supposed, were all given supernatural significance; the blood rains terrified the people, the manna rains inspired poems of thanks; they were miracles. In latter days, the tendency among intellectuals who have given the matter no particular attention, has been to assume that since preternatural explanations had usually been invoked (and they certainly were incredible) therefore the showers themselves probably never occurred.

However, so many wonderful things occur in nature that negation of any observation is dangerous; it is better to preserve a judicial attitude and regard all authentic information that comes to hand as so much evidence, some of it supporting one side, some the other, of a given problem.

The evidence that counts the most is that which comes from those we have learned to respect and trust. I may say that two small bits of testimony as to living things falling in rain, given me by my father, and by my friend, Mr. A. N. Caudell, of the United States Bureau of Entomology, did more than all I had ever read to arouse my interest in the phenomena of organic showers. Mr. Caudell relates that at his former home in Oklahoma, on one occasion after a brief shower during an otherwise dry and hot period, numerous earthworms were found on the seat of an open buggy standing in the yard. Mr. Caudell's mother was reminded by this occurrence that years before, in their former home in Indiana, a live minnow was found after a rain in water held by the hollow in the top of a chopping block. The experience of my father that bears on this subject is that when in North Dakota some years ago on coming indoors during a rain he found several earthworms on the brim of his hat. Here are facts vouched for by persons in whom I have every confidence, proving to a certainty that living animals do rain down.

How potent are such small phenomena, once fixed in the mind as well authenticated, to give faith in the larger ones; but, on the other hand, how important is the conviction that some extensive, some really great happening of the same class really has occurred. When, therefore, I came upon the statement by the famous French scientist, Francis Castlenu, that he had seen fishes rain down in Singapore in such numbers that the natives went about picking them up by the basketful, I was ready to believe almost all the tales, both great and small, relating to showers of organisms.

And why should we not believe them? Surely not from any doubt as to the capacity of the wind to lift up, to transport, and to drop again, at more or less distant places, objects of the character and size usually mentioned as falling in organic showers. All strong winds have some lifting powers; we see papers carried into the air, blown litter and thistles, and sometimes carried for long distances. Sheets of paper have been identified as falling at places 20 to 50 miles distant from their starting point. Through experiences, sometimes saddening ones, most of us have learned that the wind can very dexterously lift and transport such objects as hats, and I have known of a silk hat being taken from a dignified gentleman's head as he was walking in front of the Post Office Department in Washington and carried up, up, and away over the Star Newspaper Building (10 stories high). In the same city during the thunder squall of July 31, 1913, tin roofs were torn from many houses and blown into the streets.

These are things which straight blowing winds can do, but when winds begin to whirl, their lifting and carrying capacity increases enormously. The little dust whirls we see seem inoffensive things, but they have surprising power. I saw one travel down a row of shocks in a cornfield, lift every one of them, and scatter the stalks to the four quarters, doing in a minute work it would take a man a day to do or undo. Of course this whirl was larger than those we frequently see on hot summer days, but whirlwinds, waterspouts, dust storms, and tornadoes are essentially the same thing differing principally in dimensions. Wind whirls which may be said to be practically artificial in origin develop surprising power. Thus Theodore Dwight, of Stockbridge, Mass., states that those created by the burning of wood piled in a clearing had sufficient force to lift trees 6 to 8 inches in diameter to a height of 40 to 50 feet.

All wind whirls are characterized by a more or less strong inflow of air along the surface from all directions to the base of the whirl, where the inflowing currents ascend. The gyrantry velocity of a tornado may be as much as 310 miles per hour. This would give at the earth's surface an effective force in moving an object of about 300 pounds for each square foot of surface exposed to the wind. The velocity of the ascending currents also runs high, but if put at 176 miles per hour would yield a lifting power of more than 90 pounds to the square foot. That these forces are actually exerted is shown by some of the remarkable doings of tornadoes. By the tornado at Beauregard, Miss., April 22, 1888, the solid iron screw of a cotton press, weighing 675 pounds,
was carried 900 feet. During the tornado of April 16, 1875, at Walterborough, S. C., a piece of timber 6 inches square and 40 feet long, weighing 600 pounds, was carried a distance of 440 yards, and a chicken coop, 4 by 4 feet and 75 pounds in weight, was transported 4 miles. In the tornado at Mount Carmel, Ill., June 4, 1877, a piece of tin roof was carried 15 miles and a church spire 17 miles.

These examples are quite as marvelous as some of the seemingly miraculous showers recorded of old. The children of Israel believed in their manna because they gathered it with their own hands and ate of it, but surely their credulity would not have stood the test had some prophet told them that in years to come, in a land across the sea, chicken coops and church spires would rain down from the skies.

There is then, we must admit, no reason for general suspicion toward the accounts of organic showers. Like other records, they must be inspected and the good sifted from the mass. We may separate at once certain classes of alleged organic showers as spurious.

SPURIOUS SHOWERS.

Insect larvae.—The rains of insect larvae that have been investigated have proved to be merely the appearance in large numbers on the surface of the ground or upon snow of the larvae of soldier beetles (Telephorus), or sometimes caterpillars, which have been driven from their hibernating quarters by the saturation of the soil by heavy rains or melting snow.

Ants.—Accounts of showers of ants have usually been founded on incursions of large numbers of winged ants, which of course need no assistance from the elements to follow out their habit of swarming forth periodically in immense numbers.

Honey; sugar.—Showers of honey and of sugar are popular names for what scientists know are exoductions of certain plants, or of plant lice which feed on a great variety of plants and whose product is often known also as honey-dew.

Grains.—Showers of grain, usually considered miraculous, have in most cases been determined to be merely the accumulation by washing during heavy rains of either the seeds or root tubercles of plants of the immediate neighborhood.

Black rain.—Black rain is due to the precipitation from the atmosphere by falling water of soot, or in some cases of black dust. These showers are of interest, however, as illustrating the carrying power of the wind; a rain of soot observed in Ireland and over the Atlantic Ocean to the westward is pretty definitely known to have been carried by the wind from Wales.¹ The showers of mud resulting from the precipitation of dark-colored dust or dirt are closely related to the organic showers discussed further on, as the material must have been derived from the earth's surface, transported and deposited in the same way, and in fact it is probable that all such rains bring with them some proportion of small organisms. In the case of a black snow, observed in New York in 1889, it was found that the color was due to “finely divided earth and vegetable mould.”² In this case it is certain that small organisms were included among the debris, for it would be impossible for the wind to sweep up enough vegetable mould to discolor a snowfall without at the same time taking up a considerable number of spores, seeds, fruits, and small animals.

Blood rains.—The most frequently reported showers that are spurious, at least in name, are the so-called blood rains. In all times the phenomena going under this name have frightened the people and have been taken as portents of terrific calamities. One of the famous plagues of Egypt was a bloody rain which prevailed throughout the whole land, continuing three days and three nights. Homer and Virgil both allude to blood rains, and, in fact, the general subject of preternatural rains was a favorite with the older writers.

But scientific investigation has done away with the element of mystery in these phenomena and has explained, with the others, the rains of blood. Some blood rains have been found to be the meconial fluid ejected by large numbers of certain lepidoptera simultaneously emerging from their chrysalides; other red rains are due to the rapid multiplication in rain pools of algae and of rotifers containing red coloring matter; “red snow” results from the presence of similar organisms. But in no case have they rained down, except in the sense that there has been eggs haeve at some time been transported, probably by the wind. The precipitation of moisture furnishes favorable conditions for their rapid development and multiplication.

There are several summaries of information relating to the anciently recorded showers of miscellaneous matter. Among them is that of Valentin Alberti, “Dissertatio historica physica de Pluvia prodigiosa,” Leipzig, 1674; one by P. J. Hartmann, published as an appendix to the Miscellanea Curiosa.³ * * * Academiae Imperialis Leopoldinæ.⁴ * * * Jens, 1639; another by J. C. Haebler, entitled “Dissertatio de pluvia prodigiosa,” published at Erfurt in 1895, and also one by C. G. Ehrenberg in 1847 (Abh. Kgl. Preuss. Akad. Wiss. Berlin).


Manna.—An account of manna “rains” certainly pertains to the discussion of showers of vegetable matter, for the substance manna consists of lichens of the genus Lepidodiscus. Thus recorded instances of manna “rains”¹ is there any direct evidence that the substance really fell from the sky. These lichens form, small, round bodies that are easily blown over the surface of the ground and accumulate in depressions; they are very buoyant also and hence easily drifted into masses during the run-off of rain water. Manna “rains” have not occurred except in countries where these lichens are common, and as for statements of their falling down upon roofs or upon people, or for any other proofs that they really rained down, I have seen none.

TRUE SHOWERS.

Red rains; dust.—Other red rains are caused by the bringing down in rain water of atmospheric dust of a reddish color. This hue usually is noticed in rain falling in southern Europe at a time when the air is charged with sirocco dust. The composition of this dust has been extensively investigated and it has been found to contain spores, pollen grains, confervoid algae, diatoms, infusoria, and rotifers. In 50 samples of sirocco dust from various parts of Italy pollen, spores, etc., were found in every one.¹ In sirocco dust collected at Lyons, Ehrenberg claims to have found 111 different species of infusoria, and the total number of organisms enumerated by him from samples of such dust is 320.² In the Lyons instance organic forms made up one-eighth of the entire mass of the dust. Since various estimates place the

¹Pynchon's nat. mag., February, 1899, 42: 2-4.
²MONTHLY WEATHER REVIEW, October, 1901, 27: 480-490.
amount of sirocco dust in a fall at from 5½ to 9 tons to the square mile, it will be seen that a fall of a ton of microscopic organisms per square mile is within the bounds of possibility.

It is not only the hot and dry sirocco that is laden with dust containing organisms, for indeed they are in the air everywhere at all times. The researches of MM. Miquel and Boudier in France, particularly have elucidated the nature of atmospheric dust. The atmosphere always is charged with a large number of organic entities. The vegetable constituents are chiefly bacilli and the spores of cryptogams, as of fungi, lichens, mosses, and algae. There are also hairs of plants, fibers of cotton, flax, and hemp, pollens of every form, and starch grains. The animal remains include epithelial cells, hairs, shreds of feathers, bits of down and wool, scales of lepidoptera, and the eggs of infusoria. The quantity of suspended matter in the air is high in summer and low in winter, and less at high altitudes than in lower areas nearer the source of the bodies found.

Special forms of aeroscopes have been devised to collect samples of atmospheric dust. In one form described by L. Hubert Airy, dust was caught in the city of London, the following additional to those just named: Living mites, entamoebas, and diatoms.

It appears, therefore, that a great variety of small organisms or their spores are present in the air at all times, that they are freely carried about by the winds, and are constantly being precipitated either in dust or in falling moisture. The possibilities for the distribution of these minute forms are practically unlimited, for dust clouds travel indefinite distances. In the United States a dust storm and mud shower was observed on the same day in Illinois, New York, Pennsylvania, and New Jersey. This shows transport of the material over a third of the breadth of the United States, if indeed all of it did not come from the western plains. A dust cloud a thousand, perhaps two thousand miles in length was observed at sea by J. Milne when 200 to 400 miles distant from the coast of China, from whose loess plains it was probably derived. This dust contained shreds of plants. At times of great volcanic activity, dust clouds have encircled the world. There is, therefore, no limit to the distribution of atmospheric dust, and therefore probably none to that of the minute organisms that are one of its constant components.

Shower of plants and invertebrates.

Pollen falls, sulphur rains.—Pollen of various plants, as previously noted, is one of the most common constituents of atmospheric dust; for instance, Miquel found that there are often a thousand pollen grains to each cubic meter of air. But pollen deserves more extended notice because it is really showers of pollen that have been so often reported as showers of sulphur. The yellow color suggested sulphur; pollen, especially of pine, is highly inflammable, the imagination supplied the smell of brimstone, and superstition jumped at the conclusion that the devil had been busy. The occasional phosphorescent appearance of pollen falls at night also has encouraged preternatural speculations.

The following is extracted from an account of a pollen shower in England in early June, a fall of fine yellow dust which coated the surface of rain water in barrels and pools, was taken by the uneducated for a fall of sulphur. It was said by the imaginative to smell “awful like brimstone” and to presage the end of the world. Examination of the dust under a microscope at once showed it to be the pollen of pine. Another writer adds: 14 As this mystery, if it is not explained, may prove serious to the nervous, supersensitive, or credulous part of the community, we may as well add that at this season districts in the neighborhood of fir (Pinus sylvestris) plantations run the risk of a thorough dusting of this powder if there is the slightest breeze, as the cones of the young Scots fir are thickly coated with yellow powder or pollen, which will give out a blinding saffron cloud on the slightest disturbance.

The appearance of a conspicuous movement of pollen has been well described by Dr. D. P. Thomson. On the afternoon of June 11, 1847, the wooded part of Morayshire appeared to smoke, and for a time fears were entertained that the fir plantations were on fire. A smart breeze suddenly got up from the north and above the woods there appeared to rise about 50 columns of something resembling smoke, which was wreathed about like waterpouts. The atmosphere now was myrrh, and for a time fears were entertained that the smoke was in reality the pollen of the woods.

The ease with which pollen is taken up into the air together with the prodigious profusion with which it is produced makes it easy to understand the frequency of the so-called sulphur rains. In March, 1879, several instances of yellow rain or snow occurred in the United States. Prof. W. H. Chandler of Lehigh University, South Bethlehem, Pa., writes that during Saturday night, March 16, 1879, there was a slight fall of snow in that section, and on Monday morning when the snow had melted, a yellow deposit was found covering the ground more or less. Upon examining the deposit, it was found to be the pollen of pine trees. The United States Signal Corps observer at New Orleans, reports light showers on the 17th of the same month, and states that “a peculiar feature of the rain was its yellow color, which was due to large quantities of the pollen of the cypress tree floating in the atmosphere. The United States Signal Corps observer at Lynchburg, Va., forwarded on March 21, 1879, a sample of the yellow deposit which had fallen with the rain the preceding night and it was found to be entirely of the characteristic triple-grained pollen of the pine.” A pollen shower at Pictou, Nova Scotia, in June, 1841, was so heavy that bucketfuls were swept up on a ship. This material was entirely the pollen of pine trees. As showing how far pollen may be transported by the wind, it is noted that “A shower of this kind fell at Lund in the south of Sweden, which M. Agardh (Nova Acta, 12) found to contain the pollen of Pinus sylvestris or Scotch fir, borne on the wind from a forest about 35 miles distant.”

Hay.—The vegetable substance, which, after pollen, figures most frequently in the accounts of actual showers of organic matter, is hay. This should not be surprising, since the material is comparatively light and is available at the time of year when wind whirs are most frequent. The first step in the development of a shower of hay was observed by Prof. E. E. Nipher, who describes a whirlwind that picked up hay and carried it in the form of an

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1 Ann., L'Observatoire de Montsuzir, 1879, pp. 451-512.
2 Journ. plantz. chim., 46 Ser., 1876, pp. 545.
8 The spores of cryptogams may be 30 times as numerous. It is stated that on Reunion Island, the spores of Lepidoptera sometimes are present in the air in such quantity as to make breathing difficult.
11 Thomson, D. P. Journ. of Botany, Edinburgh, etc., 1845, p. 151.
14 Thomson, D. P. Journ. of Botany, Edinburgh, etc., 1845, p. 151.
inverted cone about 200 feet high and 150 feet in diameter at the top. The whirl was followed for about half a mile when it disappeared over a hill. The complete phenomenon, on a small scale, is described as follows by Sir Francis Galton:

We had a curious sight yesterday (July 26, 1891). It was a dead calm, but in a field just below the garden a large mass of hay was whirled up high into the sky, below, and in the course of the evening we found great patches of hay raining down all over the surrounding meadows and our garden. It kept falling quite four hours after the affair.

On June 30, 1892, a large quantity of hay was taken up by a whirlwind at Nether Priors, Essex, England, and fell at Belchamp, about 3 miles to the north. In two other cases noted, one in London, the other in Ireland, the hay was seen floating at a great height in the atmosphere and then to fall.

Wheat.—In my introductory remarks I stated that most of the so-called showers of grain were spurious. However, in 1804, a real rainfall of wheat took place in Andalusia, which had been carried by a hurricane across the Straits of Gibraltar, from a threshing floor at Tetuan. Meteoric “paper.”—A substance which has fallen from the sky, and has been called “meteoric paper,” was proved in one case at least to be vegetable matter of terrestrial origin. Ehrenberg who investigated the case says, “On the 31st of January, 1887, a great mass of paper-like, black substance fell with a violent snowstorm near the village of Rauden in Courland.” Some of the substance was preserved and it was 152 years later that Ehrenberg examined it and found it to consist “of a compactly matted mass of Convera crispata, traces of Nostoc and of about 29 species of infusoria.” This material was undoubtedly the crusts of dried algae which form on the surface of the ground exposed by the evaporation of the water of shallow ponds. This paper-like substance could easily be lifted up by the wind and carried a long distance. Jelly or flesh.—Manna is the bread of organic showers; but what is the meat? Showers of flesh have often been recorded and they have proved to be precipitations of a glairy substance, which upon partial drying formed enough of a skin on the outside to induce people to call it flesh. When found fresh, this material has been compared to butter. Probably most if not all of it is the material known as zoogae formed on the surface of water where bacteria are actively multiplying. The substance known as zoogen or zooidin is probably the same. An extensive shower of such jelly-like material occurred in Bath County, Ky., in 1876, and was referred to as the dried spawn of fishes or of some batrachian. Such showy rains has remained down also, if we may believe the account of M. Moron de St. Mery, relating to an observation in San Domingo.

From November, 1875, to the 5th of May, 1876, there was experienced a terrible drought. The last day, viz May 5, 1876, there fell during a strong east wind, in several parts of the city of Port au Prince a great quantity of black eggs, which hatched the following day. M. Ozard preserved about 50 of these small animals in a flask half full of water, where they shed their skins several times. They resembled tadpoles.

Other jelly rains have proved to consist of the egg masses of midges, and of colonies of infusoria. A shower of the latter is described as follows by L. Jevens in his article on a so-called storm of insects at Bath, England:

There had been a sudden squall of wind before there came a heavy rain, and my idea is that these organisms must have been lifted up by the force of the wind, acting in a gyrratory manner, from some shallow pools in the neighborhood. A boy at the station first noticed them (that is, the spherical masses in which the organisms were grouped) falling on his coat; as the rain fell more heavily the platform was covered with them.

Insects.—The popular designation of these infusoria as insects of course was due to the very wide misuse of this term. I have noted previously that the alleged showers of insect larvae also were not genuine, but there have been apparently a few real rains of insects. Two which occurred in Germany are described as follows:

At Szentes, August 14, between 9 and 10 p.m., a deep-black cloud suddenly appeared in the evening sky. Soon thereafter began a downpour, not of rain, but of winged insects, which in a few minutes covered the ground a foot deep. At St. Catherine a. d. Lamming (Obersteiermark), on the 10th and 11th of August, insect rains also occurred, which while not so remarkable, still were very annoying. The insects were in part small neupriocidae and in part winged ants.

Accounts of three other showers which have been gleaned from French publications are circumstantial, and clearly show sustained transport of insects by the wind and their falling from the skies after the manner of rain:

Toward the end of May, M. L. Audé, while returning from Montagne to Heribes, was caught in a violent storm from the north-east, during a heavy rain, and gleaning from French publications clearly show sustained transport of insects by the wind.

Mollusces.—Before leaving the consideration of invertebrates we may note that: A shower of mussels, some weighing about 2 ounces, fell during a severe storm, on the 9th of August, 1834, in the United States. The following year another shower of molluscous animals, Bulinina troncata, took place at Montpellier [France].

Falls of vertebrate organisms.

The fall of vertebrate animals from the skies like rain is, of course, the most interesting of all the showers of organic matter, and—it must be admitted—the hardest to believe. Yet there cannot be the slightest doubt that there are genuine phenomena of this character, though perhaps not so numerous as the recorded instances. These occurrences, if observed by man, naturally make profound impressions and in the olden times especially, the tales of showers of fishes and the like were improved.
by each teller, so that soon they reached the stage of the unbelievable.

Frogs, toads.—I quote only one of the older writers, Athenæus, who flourished about 200 A.D. He is the author of a polyhistorical work called the "Deipnosophistæ," in which he quotes about 800 authors, whose works he collected at the Alexandria Library, 200 or 300 years ago, who would have been unknown except for the fortunate preservation of Athenæus' work. In a chapter entitled "De pluvius piscium," he says: 23

I know also that it has very often rained fishes. At all events Phænias, in the second book of his Eresian Magistrates, says that in the Chersonese it once rained fish uninterruptedly for three days; and Phylarchus in his fourth book, says that people had often seen it raining fish, and often also raining wheat, and that the same thing had happened with respect to frogs. At all events Heracles Lembus, in the 21st book of his history, says: "In Peonia and Dardania, it has, they say, before now rained frogs; and so great has been the number of these frogs that the houses and the roads have been full with them; and at first for some days the inhabitants, endeavoring to kill them, and shutting up their houses endured the pest; but when they did no good, but found that all their vessels were full with them, and at first for some days the inhabitants, endeavoring to kill them, and shutting up their houses endured the pest; but when they did no good, but found that all their vessels were filled with them, and the frogs were found to be boiled up and roasted with everything they ate, and when besides all this they could not make use of any water, nor put their feet on the ground for the heaps of frogs that were everywhere, and were annoyed also by the smell of those that died, they fled the country."

For numbers of frogs and the far reaching effects of their fall 24 this tale can scarcely be surpassed, but it will be well to recount some later instances, especially some of the more circumstantial ones. Holinsword informs us that in Great Britain—

frogs fell in Anglesehire during the time of Agricola. Frogs were reported to have descended, during the summer of 1846 over the Humber, upon the decks of vessels in the river and on the coast near Killinghorne lights.

A later account 25 recites that—

During the storm that raged with considerable fury in Birmingham (England) on Wednesday morning, June 30 [1892], a shower of frogs fell in the suburb of Moseley. They were found scattered about the ground. On arriving at the presbytery, we found the floor of one of the rooms in the presbytery, we were soaked, but what surprised me was to see frogs falling from the skies, we have been far afield, for the very good reason that I have not found any cases reported for the United States. But for fishes, there are several reports. Before giving these accounts, allow me to introduce a few statements that tend to show how fishes get started on the aerial journeys that terminate in fish rains.

Fish.—For reports of the falling of frogs and toads from the skies, we have been far afield, for the very good reason that I have not found any cases reported for the United States. But for fishes, there are several reports. Before giving these accounts, allow me to introduce a few statements that tend to show how fishes get started on the aerial journeys that terminate in fish rains.

To show the tremendous power of waterspouts, we may quote M. Oersted's declaration 28 that "At Christiansø a waterspout emptied the harbor to such an extent that the greater part of the bottom was uncovered." Naturally under such circumstances fishes and any other organisms in the water may change their habitat very abruptly. Waterspouts have been observed to accomplish the comparatively insignificant tasks of emptying fish ponds and scattering their occupants.

A prodigy of this kind is recorded to have occurred in France, at a town some distance from Paris, during a violent storm. When morning dawned, the streets were found strewn with fishes of various sizes.
The mystery was soon solved, for a fish pond in the vicinity had been blown dry, and only the large fish left behind.43

So, during a storm on December 28, 1845, at Basenthwaite, England, fish were blown from the lake to dry land.44

Proceeding now to the United States records, Mr. Thomas R. Baker45 states that—

During a recent thunderstorm at Winter Park, Fl., a number of fish fell with the rain. They were sunfish from 2 to 4 inches long. It is supposed that they were torn up by a waterspout from Lake Virginia, and carried westward by the strong wind that was blowing at the time. The distance from the lake to the place where they fell is about a mile.

In the Monthly Weather Review for June, 1901 (p. 283), is the note "Mr. J. W. Gardner, voluntary observer at Tillors Ferry, S. C., reports that during a heavy local shower about June 27 [1901] there fell hundreds of little fish (cat, perch, trout, etc.) that were afterwards found swimming in the pools between the cotton rows."

In all, I am acquainted with four records of falls of fishes in the United States, two in South America, eight in Great Britain, two in France, and six in India and neighboring countries. These are all well vouched for, or fairly modern and circumstantially related instances. The older, chiefly traditional, records would make a long list.

One of the most ancient records of fish having fallen from the atmosphere in Great Britain is the following: About Easter, 1666, in the parish of Stanstead, which is a considerable distance from the sea, or any branch of it, and a place where there are no fish ponds, and rather scarcity of water, a pasture field was scattered all long strip of small fish, in quantity about a bushel, supposed to have been rained down from a cloud, there having been at the time a great tempest of thunder, rain, and wind. The fish were about the size of a man’s little finger, and of several kinds, others like sprats, and some smaller, like smelts. Several of these fish were sold publicly at Maidstone and Dartford.46 A shower of herrings is recorded to have taken place near to Loch Laven, in Kinross-shire, about the year 1835, the wind blew from the Frith of Forth at the time, and doubtless the fish had been thereby carried from the sea across Fife-shire to the place where they were found.47 In 1828, similar fish fell in the county of Rosse, 3 miles distant from the Frith of Dingwall.48 On the 9th of March, 1830, in the Isle of Ula, in Argyleshire, after a heavy rain, numbers of small herrings were found scattered over the fields; they were perfectly fresh, and some not quite dead. On the 30th of June, 1841, a fish measuring 10 inches in length, with others of smaller size, fell at the Isle of Cumbrae, and on a thunderstorm on the 8th of July, in the same year, fish and ice fell together at Derby.49

A convincing statement of personal experience with a rain of fishes is that of John Lewis, of Abderdare, who says that while working, February 9:

I was startled by something falling all over me—down my neck, on my head, and on my back. Putting my hand down my neck I was surprised to find they were little fish. By this time I saw the whole ground covered with them. I took off my hat, the brim of which was full of them. ** ** They covered the floor two or three deep, and about 80 yards by 12 yards, as we measured afterwards. ** ** We gathered a great many of them ** ** and threw them into the rain pool, where some of them now are. It was not blowing very hard, but wind. ** ** The person who took this testimony adds that he secured about 20 of the little fish, some of which were 4 and 5 inches long. A number of these fishes were exhibited for several weeks in the aquaria house of the Zoological Society in the Regent’s Park, London.

The accounts of rains of fishes in South America are by Alexander von Humboldt,50 whose language relating to them is as follows:

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43 Rees' Cyclopaedia.
44 Thomas, W. Introductory to Meteorology, 1869, pp. 163-164.
45 Science, June 10, 1868, p. 335.
46 Besant, History of Rain, cited by Thomson.
48 Inverness Courier, April 8, 1868, cited by Thomson.
49 Thomas, W. Introduction to Meteorology, 1869, p. 163.

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When the earthquakes, which precede every eruption in the chain of the Andes, shake with mighty force the entire mass of the volcano, the cavernous vaults are opened and emit at the same time water, fishes, and tufa-mud. This is the singular phenomenon that furnishes the fish Pimelodocyclopa, which the inhabitants of the highlands of Quito call "Preudallis," and which was described by me soon after my return. When the summit of the mountain Coropisa, to the north of Chimborazo and 18,000 feet high, fell, in the night between the 19th and 20th of June, 1898, the surrounding fields, to the extent of about 43 English square miles, were covered with mud and fishes. The same, which enraged in the town of Ibarra seven years before had been ascribed to a similar eruption of fishes from the volcano Imbabura.

There are several well authenticated reports of falls of fish in India, and this has given rise to the belief that the phenomenon is more frequent there than elsewhere. This may be true on account of the favoring circumstances of extensive river flood plains, numerous shallow water tanks, a fish fauna rich in shoal water forms, and a hot, whirlwind-breeding climate. Certainly the descriptions of fish rains in that part of the world are numerous, specific, and astonishing as to the magnitude of the phenomena.

One of the oldest reports, brief but with a humorous touch, I quote first. It is by Lieut. John Harriott,51 who says:

In a heavy shower of rain, while our army was on the march a short distance from Fondicherry, a quantity of small fish fell with the rain, to the astonishment of all. Many of them lodged on the men’s hats. ** ** They were not flying fish, they were dead and falling from the well-known effect of gravity; but how they ascended or where they existed I do not pretend to account. I merely relate the simple fact.

A very valuable account of a shower of fishes is that by J. Prinsep, editor of the Journal of the Asiatic Society of Bengal. He writes:52

The phenomenon of fish falling from the sky in the rainy season, however incredible it may appear, has beenattested by such circumstantial evidence that no reasonable doubt can be entertained of the fact. I was as incredulous as my neighbors until I once found a small fish in the brass funnel of my pluviometer at Benares. I have now before me a note of a similar phenomenon, on a considerable scale, which happened at the Nokulhatty factory, Zillah Dacca Jedalpur, in 1800.

Mr. Cameron, who communicated the fact, took the precaution of having a regular deposition of the evidence of several natives who had witnessed the fall made in Bengal and attested before the magistrates. The deposition is printed in the Journal of the Asiatic Society of Bengal. ** ** The shower of fish took place on the 19th of February, 1830, in the neighborhood of the Surbundy factory, Ferdpoor (p. 650).

There are depictions of nine eye witnesses, of which I quote two:

Shekh Chaudari Ahmed, son of Mutuillah, inhabitant of Nagdi, relates in his deposition: "I had been doing my work at a meadow, where I perceived at the hour of 12 o’clock the sky gather clouds, and began to rain slightly, then a large fish touching my back by its head fell on the ground. Being surprised I looked about, and behold a number of fish likewise fell from heaven. They were small, sale, gusul, mirgal, and picul. I took 10 or 11 fish in number, and I saw many other persons take many."

Shekh Suduruddin, inhabitant of Nagdi, was called in and declared in his deposition saying: "On Friday, at 12 o’clock p. m., in the month of Phalgun ** ** when I was at work in a field, I perceived the sky darkened by clouds, began to rain a little and a large fish fell from the sky. I was confounded at the sight, and soon entered my small cottage, which I had there, but I came out again as soon as the rain had ceased and found every part of my hut scattered with fish; they were boduli, mirgal, and nouchi, and amounted to 25 in number."

The large number of fishes that may rain down is illustrated by another Indian instance which was reported as follows:53

On the 16th or 17th of May last a fall of fish happened in monza Sonare, persuans Dhatu Eckullah, Zillah Puttepper. The semidans
of the village have furnished the following particulars which are con-
formed by other accounts. About noon, the wind being from the west
and a few distant clouds visible, a blast of high wind, accompanied
with much dust, which changed the atmosphere to a reddish yellow
hue, came on; the blast appeared to extend in breadth about 400 yards.
** * * When the storm had passed over, they found the ground south
of the village to the extent of two biggles strewn with fish, in number
not less than three or four thousand. The fish were all of the Chalwa
species (Clupea cultrata), a span or less in length, and from ½ to ¼
seen in weight; when found they were all dead and dry. Chalwa fish
are found in the tanks and rivers of the neighborhood; ** * * the
nearest water is about half a mile south of the village.

For the number of fishes that fell this account is not
surpassed, but for all-around interest, and credulity inspired
by the name of its distinguished author, the testi-
mony of Francois de Castelnau, mentioned at the
beginning of this paper, is supreme. The note is entitled
"Shower of Fishes; earthquake at Singapore," and was
published in 1861.**

We experienced here an earthquake at 7:34 p. m., February 16, that
lasted about two minutes; it was followed by hard rains, which on the
20th, 21st, and 22d became torrential torrents. The last day at 9 a. m.
the rain redoubled in fury, and in a half hour our inclosed plot became
a sea of water. At 10 o'clock the sun lifted and from my window I saw a
large number of Malays and Chinese filling baskets with fishes which they picked
up in the pools of water which covered the ground. On being asked where from, the natives replied that they had taken
from the sky. Three days afterwards, when the pools had dried up, we
found many dead fishes.

Having examined the animals, I recognized them as Clarias batra-
eckus, Chuwarr and Valenciennes species of catfish which is very
abundant in fresh water in Singapore, and the near Malayan Islands,
in Siam, Borneo, etc. They were from 25 to 30 centimeters long, and
therefore adult.

These animals, the same as Ophicephalus, etc., are able to live
a long time out of water, and to progress some distance on land, and I
thought at once that they had come from some small streams near by;
but the yard of the house I inhabited is inclosed in

*.* * * * *

The dryng of the water

that during one of

the wind. Batrachians also often

and if not, usually must be carried for short
distances only; the chances are also that they will reach
an unfavorable environment and perish for that reason.

Fishes, most of all, are fated to fall where they can not
survive, and their inability to live long out of water
strictly limits the possibilities of their deriving advantage
by wind transport. In addition, it must be remembered
that all these groups instances of their being carried by
the wind are really rare. All in all, we must conclude
that the wind is a very unimportant factor in the distri-
bution of vertebrate animals.

Other vertebrates.—Showers of vertebrates other than
frogs, toads, and fishes are rare indeed. It was recorded
in 1873 that a shower of reptiles fell in Minnesota,** and
from the description it is evident the creatures were larvae
of a salamander, probably of Amblystoma tigrinum. The
Monthly Weather Review for May, 1884 (p. 215) states
that during a severe hailstorm "at Boving, 8 miles east
of Vicksburg, Miss., a gopher turtle 6 by 8 inches and
entirely incased in ice fell with the hail."

This is a most remarkable occurrence, but what shall
we say of a shower of birds, in which hundreds dropped
dead in the streets of a Louisiana city? In the Baton
Rouge, La., correspondence of the Philadelphia Times,
some time in 1896, it is stated** that—

On Friday morning last early risers in the little capital (Baton
Rouge, La.) witnessed a peculiar sight in the shape of a shower of birds
that fell from a clear sky, literally cluttering the streets of the city.
There were wild ducks, catbirds, woodpeckers, and many birds of
strange plumage, some of them resembling canaries, but all dead,
falling in the thousands as the shower continued, attracting many spectators
and causing much comment.

The most plausible theory as to the strange windfall is that the
birds were driven inland by the recent storm on the Florida coast,
the force of the current of air and the sudden change of temperature
causing death to many of the feathered creatures when they reached
Baton Rouge. Some idea of the extent of the shower may be gathered
from the estimate that out on National Avenue alone the children of
the neighborhood collected 200 birds.

This seems clearly not to have been a case of migrants
becoming confused by city lights, nor killing themselves
by flying against obstacles, mishaps which rather fre-
quently occur to bird travelers. The phenomenon of mi-
igration among mammals gives rise to the only story of a

** Comptes Rendus, 1861, 52:290-291.
** Quoted by Prof. Charles H. Stimpson, in the National Academy of Sciences.
** Chap. 3, sec. 4, p. 136.
produce their encysted forms. The bottom is crusted with matted algae bearing their own spores or oogonia, resting stages which long retain their vitality and which are ready at any time to profit by wind transport. Among the algae there may be flagellates, bacteria, diatoms, the spores of aquatic mosses, of horsetails, of club mosses, and quillworts, and the minute seeds of rushes. There may be also cysts of protozoa, gemmules of fresh-water sponges, the statoblasts of bryoza, and the eggs of worms, leeches, crustacea, insects, and molluscs, all of which may be minute enough to be carried readily by the wind and resistant enough to survive the process. Untold numbers of these reproductive bodies may be gathered up by the wind and carried long distances. This goes far to explain the extremely wide, often cosmopolitan distribution of fresh water microorganisms.

It is not only aquatic organisms that have spores suitable for carriage by the wind, but also a long series of terrestrial ones including bacteria, algae, fungi, mosses, liverworts, ferns, and club mosses. Dust-like seeds as those of orchids, broom-rapes, pyrolas, live-for-evens, etc., are almost as well adapted to wind transport as are spores. Perhaps the best illustration that can be given of the potency of the wind in distributing these plants is the part it played in the revegetation of the isolated volcanic island Krakatoa from which all life was extirpated by the 1883 eruption of almost unparalleled violence. From 16 to 30 per cent of the phanerogams established on Krakatoa 25 years after the catastrophe of 1883 were carried there by winds, as were all of the ferns (16 species) and lower cryptogams, almost without exception (more than 30 species). Between 49 and 55 per cent of its flora, therefore, is wind-borne. The first recolonization of the island in 1886 was entirely by wind-distributed species as algae, bacteria, diatoms, liverworts, mosses, and ferns.1

The distribution of spores and other light reproductive cells does not depend on sporadic gusts of wind that suddenly pick up a quantity of these objects to later drop them as showers of organisms; there seem to be a certain number of them always in the atmosphere. In fact, aeroscopes reveal a steady fall of atmospheric dust, including minute organisms, that must be a far more important element in the distribution of such life than the more impressive but sporadic showers.

CONCLUSION.

It would appear, therefore, that the more spectacular the shower of organic matter the less its importance in the distribution of life. The rains of larger animals have attracted much attention and excited wonder, but in many cases the animals have been dead; in others they were doomed to die because of falling in an unsuitable environment. Not often are all the conditions propitious for the species to secure a new foothold.

The unobtrusive, but steady and widespread movement of minute eggs and spores by the atmosphere, however, is of great importance in distribution because these organic bodies are adapted to survive such transport; their numbers are so great and their dispersal so wide that some of them will necessarily fall in favorable places. The chances are, in fact, that every suitable environment will be populated. So far as mere preservation of species is concerned, we see here, as in other phases of biological investigation, the superiority of the pigmy over the giant, of insignificance over conspicuousness, of passivity and adaptability over strenuous effort. “Blessed are the meek, for they shall inherit the earth.”

1 EMAT, A. The new flora of the volcanic island of Krakatoa (Engl. transl. by A. C. Seward, 1885), pp. 92-95.