1910-03-19

Letter from Alexander G. McAdie to John Muir, 1910 Mar 19.

Alexander G. McAdie

Address correspondence to
Official in Charge
Local Office, Weather Bureau

Answered

U. S. DEPARTMENT OF AGRICULTURE

LOCAL OFFICE OF THE WEATHER BUREAU

Merchants Exchange, Rooms 1500-5 SAN FRANCISCO, CAL.

March 19, 1910.

Mr. John Muir,

Martinez, Cal.

Dear Mr. Muir:-

I have not forgotten your request regarding the number of water drops in a cloud; but I find it hard to get down to definite statements. I'd much rather talk it over with you, and yet that wouldn't do either, for we'd get off on other matters of equal and everlasting interest.

First, as you look up into the sky, remember that the seemingly limitless ocean of air, at the bottom of which we waddle, is not much deeper than the distance from one great peak in the Sierra to another. When you stood on Whitney you were up nearly four-tenths of the way, that is, nearly half of the so-called homogeneous atmosphere is below one at a height of 5,500 meters (3½ miles). At an elevation of six miles nearly two-thirds of the atmosphere is below us. At this elevation you are above what we may call "the muddy" or dirty part of the atmosphere. It is clean mud, almost entirely water. Most people call it clouds; but it is none the less a sediment of water and fine dust. Below the level named, the air is in a turbulent condition as a rule, convectional currents rising, falling and in fact swirling in every direction. I sometimes

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think the clouds resembles humans. They are just as restless, seem never quite at ease and often surge hither and thither like an excited populace. Again, some rise steadily and some fall. Some are joys forever to the eyes below, beholding them; some are but confused and uncertain wanderers; and some, when most is expected of them, fade away, casting only a shadow, when a thirsty land ~~looks~~ Loped for rain.

The water vapor condenses, it is thought, only when minute ~~nuclei~~ nuclei are present to serve as centers of condensation. It is claimed that in a perfectly dust-free air no drops will form; but light may ionize air that we would otherwise consider dust-proof, and the necessary ~~nuclei~~ nuclei in this present. Out in the open, probably there is never a time that cloud particles could not form provided the supply of water-vapor is present. The average size of a rain drop is from two to four millimeters. The largest drops are about seven (1/5 inch) mm. Fine drops fall at varying rates and drops take on various sizes with facility. With very fine drops the viscous resistance of the air prevents falling. Professor Lenard of Kiel, about five years ago, published a paper on his experiments with rain drops. He produced vertical currents of air which could be regulated and measured, and drops of various sizes falling

~~on~~ in these currents were made to float, or rest in equilibrium. So he found out a great deal about the way in which drops fall and measured their velocities. The greatest velocity was about 8 meters per second, say 26 feet. The first effect of the current of air on the shape of the drop was to flatten it, then he was able to cause circulations or vortex movements around the drops (I have seen the same thing happen in a drop of dew, which was slowly evaporating. A speck of dust ~~just~~ whirlled round and round the equator of the drop. I am working on this now with a microscope and may get some illustrations later ~~with a microscope~~). Lenard found that the fine drops are far in excess of large drops, and they don't change in a regular gradation; but gather in groups. Sometimes the intermediate sizes are missing. Now what happens within the cloud mass. Something akin to the smallest rain drops evidently forms and floats with others of ~~its~~ this kind. There can be in one cubic inch of cloud mass, a million and more of these little drops, trying to get away; but too light and too small in their own proper selves to have much motion. Physicists think that under certain conditions an electrification of the drops occurs, and by a series of strong attractions and repulsions

larger individual drops are formed and these spread out in space, forming the cloud mass. If the necessary fall in temperature occurs, the cloud drop becomes a drop of water, bound for earth.

I have tried to put the process of cloud building before you in simple language. We know very little about it. Some day men will know a great deal about it; but always there will be more yet. It has always been a wonder to me that men were content to know so little about clouds.

I remember spending one night with Campbell in the Dome of the Lick Observatory. He plugged along until early morning getting stellar spectrograms, on a problem that he has been at work on for years. It is all to try to find out how the solar system is moving in space. And I remember thinking that if as much effort could be put into the study of a drop of rain or a drop of dew, the results would be just as marvelous and of as great value to mankind. Some day I hope there will be a big observatory for the study of ~~the~~ a dew drop.

I don't know if I have met your wishes. I have a great many photographs of clouds and want you to see them whenever you can find time.

With warmest regards, Sincerely, Alexander G. McAdie

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