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PRODUCTION OF RAIN BY ARTILLERY-FIRING.

JUNE 23, 1874.—Recommitted to the Committee on Agriculture and ordered to be printed.

MR. CAIN, from the Committee on Agriculture, submitted the following

REPORT:

The idea that rain can be produced by human agency, though sufficiently startling, is not one which, in this age of progress, ought to be considered as impossible of practical realization. When numerous observers, each independently of the others, arrive at an identical conclusion, in reasoning from facts which they have separately noticed in widely different fields, such conclusion is certainly worthy of respect, and may be assumed to contain the elements of truth. Of this nature is the idea under consideration—the belief that rain has been, and can be, brought on by heavy discharge of artillery.

If it should be conceded—as it must be from the facts that will be presented—that battles have produced changes in the weather, it would seem to be an eminently proper subject for legislative action to provide for an investigation of the conditions under which these changes can be made.

If lightning and thunder and rain have been brought on by the agency of man, when bloodshed and slaughter only were intended, this surely can be done without these latter concomitants. And when we consider the grand results that would flow from an assumed power and well-defined method of causing rain to fall at will—the mighty step that would thereby be made by man toward the complete control over nature to which he aspires—the bare possibility that such a power, heretofore considered as a prerogative of the Deity alone, is within his reach, ought to be sufficient to lead to an earnest inquiry into the truth of the matter, and to an investigation as to the most economical and effective means of applying it, if it should be found to exist. That there is the strongest reason for believing that this achievement is possible there can be no doubt, and to determine its limits and conditions can only be done by a well-regulated series of experiments with powder and cannon and other appliances.

Before submitting the evidence by which we propose to show the connection between artillery-firing and rains, or endeavoring to present a reasonable theory for the assumed direct relation between the two, it may be well to offer a few remarks in regard to the commonly accepted theory of rains in general.

The air, as is well understood, is the great reservoir in which is collected and stored up the water from which all storms are formed. Extending around the earth to the height of forty or fifty miles, it is capable of holding in suspension a vast amount of this fluid, which it receives

from evaporation from the ocean, from lakes, rivers, pools, and from all portions of the earth's surface when any moisture is present.

The water, which is so evaporated, passes into the air in the form of transparent and perfectly invisible vapor, and the warmer the air the greater the amount of this vapor it is capable of absorbing.

Rain is caused by the condensation of this vapor and its precipitation to the earth; a partial condensation first forming clouds, and rendering the vapor visible. This condensation is supposed to be caused by the cooling of the air in which it occurs, whereby the amount of vapor which it is capable of holding is lessened.

Thus a warm current of air saturated with moisture meets a cooler current, and the cold of the latter condenses a portion of the aqueous vapor contained in the former, and clouds and rain are the result.

Electricity no doubt plays an important part in all storms, though it may not always manifest itself to the senses; and in a thunder-storm it is as reasonable to suppose that the lightning (or the electricity of which it is formed) is an agent in causing the rain, as that the rain causes the lightning; or the process that produces the one produces the other.

But dismissing for the present the subject of theories, let us proceed to facts—facts, but few of which, perhaps, would be of great significance if they stood alone and unsupported by others; but which, taken in the aggregate, furnish the strongest evidence that heavy artillery firing has an influence on the weather and tends to bring rain.

The first instance that we shall mention of rain as a direct result of a battle, occurred at the battle of Buena Vista, Mexico, fought 22d and 23d February, 1847. This was in the dry season in that country; there had been no rain for several months before the battle, and there was none for several months after.

Three showers, however, followed the first day's engagement, two of which were remarkable. On the 23d, about one or two hours after the severe cannonading that took place between 8 and 10 a. m., there was a most violent rain-fall for ten or fifteen minutes. Again, in the afternoon, at about the same interval, after another spell of heavy cannonading, another violent shower of rain fell. The fact before stated, that no rain had fallen for months before the battle, and that none fell for months after at that place, is almost proof positive, not only that the cannonading caused the rain, but that cannonading will bring rain when the atmospheric conditions are in the highest degree unfavorable to the production of that phenomenon through the ordinary operations of nature.

During the late war of the rebellion, the occurrence of the phenomenon under discussion was frequent.

The first battle of Bull Run was fought on the 21st of July, 1861. The day of the battle was bright and clear, but the next day was one of drenching rain.

The storm commenced about six o'clock in the morning, and continued all day and through the following night; the rain during the afternoon and night especially falling in torrents.

The battle of Pittsburgh Landing, or Shiloh, was fought on the 6th and 7th of April, 1862, and in the night of each of those days there was a storm of terrific violence.

The battle of Fair Oaks was fought May 31 and June 1, 1862. On the 2d of June it began to rain, and such tremendous rains fell on that and the next two days that the surrounding country was rendered almost impassable.

The battle of Malvern Hill was fought July 1, 1862, and a heavy storm commenced before daylight on the morning of the 2d, and continued through the day and during most of the succeeding night.

The second battle of Bull Run, fought August 29 and 30, 1862, was also followed by rain in the morning of the 31st. The next day, September 1st, was fought the battle of Chantilly; and it is stated in Greeley's History of the American Conflict, that during the engagement such a violent thunder-storm broke out that ammunition could with difficulty be kept serviceable.

The battle of Fredericksburgh, fought December 13, 1862, was followed by a heavy storm in the night of the 15th.

The battle of Stone River, Tenn., was fought December 31, 1862, and January 1 and 2, 1863. The first day was bright and clear, but on the last a heavy rain set in.

The battle of Chancellorsville, fought May 2, 3, and 4, 1863, was followed by such a heavy rain that there was a great flood in the Rappahannock River.

The battle of Gettysburgh was fought July 1, 2, and 3, 1863, and a tremendous storm of rain followed, causing a flood in the Potomac, and delaying the retreat of the confederate army.

Similar rains occurred after the battles of Spottsylvania Court House, Cold Harbor, Nashville, and many others of the war. The occurrence was not confined to battles fought on the land, but was witnessed in connection with naval actions, bombardments, and engagements between gun-boats and shore-batteries, on the Mississippi River, and the Atlantic and Gulf coasts. The same thing took place after the battles of the war between France and Prussia, the battle of Solferino, and many other European battles of modern times.

The battle of Waterloo, as all know, was fought in the mud caused by a rain which was brought on, without doubt, by the battles of Ligny and Gemappe, which preceded it.

The foregoing facts, showing that in different parts of the world, and in all seasons, heavy artillery firing is almost invariably followed by rain, are believed to be sufficient to establish the proposition, that to produce this phenomenon at will is within the reach of human power.

These facts have a significance that cannot be lightly set aside; and if they do not establish the positive proof, they fully warrant the belief, that artillery firing always tends to bring rain, and is often the actual cause of its occurrence.

But the question will naturally arise, why is not every battle followed by rain; why is it that an amount of artillery firing that in one case brings rain will sometimes fail to bring it in another?

This question can be better answered after a further consideration of theories as to how cannonading produces rain at all. But it may be remarked here, that it is by no means certain that heavy cannonading does not invariably cause rain somewhere, even if it does not at the spot where the firing occurs.

In twelve instances of heavy firing by the naval and military forces operating against Charleston that we have investigated, occurring from January 31 to September 5, 1863, ten were followed by rain, and each of the others by an overclouded sky. In one of the latter cases the sky became overclouded for sixteen hours on the second day after the engagement, and in the other case for twelve hours on the day after; from which facts it may fairly be surmised that it rained in both cases at some place not far distant.

We have suggested that electricity may be an active agent, as well

as a result of the condensation of the invisible vapor of the atmosphere into clouds and rain. If this conjecture is correct, we can in part understand why cannonading brings rain, by supposing that one of the primary effects of the cannonading is to develop the electricity in the air, or cause some peculiar form of electric action.

Electricity is regarded as one of the forms of force, and certainly in the discharge of a battery of artillery an immense force is brought into action. Friction is one of the means by which force is converted into, and made to produce, electricity; and if two batteries of artillery are placed opposite to each other, and at suitable distance apart, and fired simultaneously, can it be doubted that friction will be produced by the particles of the air moving each other, and that electricity will be developed?

It is frequently the case that the first phenomenon following a battle is a dense fog. We have given but little prominence to this circumstance in the foregoing statement of facts, but it would seem to show that concussion, by producing electrical action, or in some other unknown way, may operate directly to cause condensation of aqueous vapor.

But it is likely that, in the actual accomplishment of rain, a more complicated process takes place than in the production of fog, and in this process motion is probably one of the chief factors. If, as Hutton's theory maintains, that condensation of vapor into clouds is caused by the mixing of two bodies of air of different temperature, motion is requisite to effect such a union. Motion is also, in any case, necessary for an accumulation of vapor in sufficient quantity to make any considerable amount of rain. To produce clouds dense enough, the air which supplies the vapor must deposit it within a much smaller space than itself occupies, which can only be effected by such a motion as will bring different portions of it in succession to the place where the clouds are forming, and carry it off again as fast as each precipitates its vapor. Motion is also necessary to bring the watery particles into contact with each other, so as to collect them into drops of rain.

The foregoing conjectures as to the manner in which artillery firing operates to bring rain, may be summed up as follows: That the effect is due principally to concussion, and that the operation of concussion is twofold, producing electrical action and change or communication of motion. The fact that we cannot see a spiral motion in the clouds does not show that there is not such a motion in the air immediately above the clouds. When they commence forming they probably also commence falling to a lower and denser stratum of the atmosphere, and this hides from our sight the process that is going on.

The question, however, as to whether rain can at all times be produced, and whether or not it can be made to pay, can only be settled by experiments.

These experiments ought to be conducted near arsenals, where there is an ample supply of cannon, so that the number and weight of ordnance that could be most economically used to produce the greatest effect could be determined. In conducting the experiments, the first and most obvious arrangement for the guns would be to place them in two lines, some distance apart, the guns in each line pointing toward each other. They should be connected by an insulated wire and all fired at once by means of electricity.

We do not propose that the Government should establish stations through the country, and proceed to furnish rain in different sections as it is needed; far from it. What is known of the subject is entirely insufficient as yet to warrant such a procedure.

When the power of steam was first discovered, the world was not ready to build steamships and railroads; nor when the first electric battery was made was it ready to lay telegraphic cables across the Atlantic. But from small beginnings, that promised much less than this, how much has the world accomplished!

Yet it has only been done through experiments, patient and persistent; experiments which, had they been as costly as those which are now proposed, would never have been made, and man would have remained to this day unconscious of half his power. But the proposed experiments, though costly, considered as an individual undertaking, would be but a trifle to a great nation like ours.

We have the powder, and we have the guns, and the men to serve them, and we ought not to leave to other nations and to after-ages the task of solving the great question as to whether the control of the weather is not, to a useful extent, within the reach of man.

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