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SCIENTIFIC AMERICAN SUPPLEMENT

No. 818.

**For the Week Ending September 5, 1891.**

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## THE ARTIFICIAL PRODUCTION OF RAIN.

At the instance of the Hon. Charles B. Farwell, Senator from Illinois, an appropriation of $10,000 was made by the last Congress for experimental purposes relating to the artificial production of rain by firing explosives.

Senator Farwell has given an amusing account of how the appropriation was secured and his reasons for urging it. He makes no pretensions as a scientific man; he never, like Espy and others, made a complete study of the meteorologic laws and phenomena, but he learned that in the high regions above the earth there were air currents charged with moisture, and became impressed with the thought that by means of a sufficient number of first-class bangings the said moisture might be condensed and precipitated as rain. "This idea," he said, "is old enough. I've been convinced of its practicability for twenty years, and probably other people have. It's just a question of applying what you know. Everybody knows there's a certain amount of moisture in the air all the time. The people see their corn burn up and their cattle die for lack of moisture. They know the required moisture is passing right over their heads all the time—going off, may be, to rain itself down some place where they're already drowned out.

"Even the Senate Committee on Appropriations laughed at me about this. When the Appropriation bill came over from the House, I went around to my colleagues of the Senate committee and said to them, 'I want you to put $10,000 in there for rain.' They laughed at me, but they put in the $10,000 just as a personal favor. When the bill went back to the House that $10,000 amendment was knocked out. I was one of the conference committee to whom the bill was referred. I went to the other members and asked them to put in the rain appropriation just as an accommodation to me. The items in the Appropriation bill are numbered, so when the conference committee reported favorably on No. 17, nobody in the House cared to see what No. 17, a little appropriation anyhow, was, and it passed."

PRECIPITATING RAIN BY EXPLOSIVES.

In accordance with this appropriation the Department of Agriculture has lately instituted the required experiments, the same being under the immediate charge of Gen. R. G. Dyrenforth, assisted by Professor Carl Meyers, the balloonist, Professor Powers, author of "War and the Weather," Mr. John T. Ellis, and George E. Casler, balloonist.

The place selected for the experiments was the cattle ranch of Mr. Nelson Morris, a few miles distant from Midland, Texas, a quiet and far out of the way place, where the experimenting party were offered unlimited space and facilities for the undisturbed execution of their peculiar enterprise. Moreover, it is alleged this was a particularly dry spot, where little or no rain had fallen for three years. To this thirsty region came the rain makers, bringing with them a strange paraphernalia, consisting of several dozen balloons, kites, retorts, acids, iron filings, chlorate of potash, sulphuric acid, manganese, rackarock, dynamite, fuses, pipes, electrical wires, dynamo machines, electric exploders, etc. It was August 5 when the party reached the ranch, and from that time onward they were very busy. After much toil their explosive supplies, gas apparatus, balloons, kites, and electrical devices were got into working order, and used as follows: By means of retorts charged with chlorate of potash and manganese, oxygen gas was produced; hydrogen was generated by means of iron filings and sulphuric acid. With these gases forming a highly explosive mixture, the balloons were filled and time fuses applied.

It required four hours to charge the first balloon, and when it was ready, a dispute arose as to who should light the fuse. The chemist said the balloonist should do it, and the latter said it was the duty of the chemist. Finally the chemist touched off the fuse and the balloon sailed away and exploded at about two miles from the point of ascension. A few sticks of rackarock were exploded on the ground, and that night rain fell at Midland and Stanton, twenty-five miles away.

This was regarded as a triumphant result. After that Gen. Dyrenforth gradually increased the number of explosives until during the last week of the experiments an almost continuous cannonading was maintained.

The last of these rain-making experiments took place Aug. 26 and is thus graphically described by the correspondent of the New York *World*:

"Aug. 26.—The night was beautifully clear, and not a cloud could be seen. The heavens were dotted with stars, and from all indications it was safe to predict that no rain would fall within forty-eight hours at the least. A strong gale was blowing towards the west. Five balloons were sent up and exploded, and 200 pounds of rackarock powder and 150 pounds of dynamite set off on the ground. There was, of course, no immediate result. The barometer was rising and the needle was pointed at fair.

"By 3 o'clock in the morning a bank of clouds appeared on the western horizon at the point toward which the smoke and noise had blown. The sky rapidly became overcast, and by 4 o'clock there was rain, accompanied by thunder and lightning. When the sun rose, it was seen that the storm had come directly out of the west, and on the horizon the clouds rose in a funnel shape, like the smoke from a volcano. There was a beautiful rainbow visible at sunrise. It ceased raining at about 8 o'clock."

After hearing this news, "I think the experiments have now demonstrated the soundness of my theory," said Senator Farwell to the *World* correspondent. "For twenty years I have had no doubt rain could be produced in that way, and quite expected the experiments to be successful."

"What are your plans respecting the practical application of the invention?"

"Why, I think they could be stated in this way: The secretary of agriculture, you know, gets annual appropriations for the general purpose of advancing agriculture—that is, he gets money for eradicating diseases among cattle and for inspecting hogs, and for this and that similar thing. Well, when Prof. Dyrenforth makes his official report of these experiments, I expect that Mr. Rusk, the secretary of agriculture, will ask for $1,000,000, may be, or $500,000 any way, for rain making."

"The Department of Agriculture has its inspectors and employes in the West, and when an inspector reports that rain will be needed at a certain time in a certain region, the secretary will send on his men and appliances and make the rain. That's my idea of how it will be practically applied. Of course, I seek no control of any sort over the invention. If any State or other community wants to make rain on its own hook, there could be no objection to its doing so."

To us the most practical result likely to follow from these experiments is the extraction of money from the public treasury. We have seen how easy it was to obtain the first ten thousand dollars to aid the chimera. "I asked them to put in the rain appropriation just as an accommodation to me," says the senator, and they did it. "Nobody in the House cared to see what No. 17, a little appropriation anyhow, was, and it passed."

The idea that rain can be precipitated by cannon firing is almost as old as gunpowder; but while there are many curious coincidences, there is no satisfactory evidence that rain was so produced. It is on a par with the Chinese mode of conquering the enemy by making a loud noise.

It is true a downpour often follows a clap of thunder; but this does not prove the rain was produced by the concussion. On the contrary, we know that rain probably results from the cooling of moisture-laden air, and simultaneously electricity may appear. Hence in thunder storms the aerial concussions are most probably the results, not the cause, of rain formation.

Nature works on a vast scale in producing rain; and it is idle to suppose that the burning of a little explosive matter can materially affect the boundless atmosphere of the skies.

In a certain sense it may be claimed that rain always follows an explosion; since all atmospheric changes are successive. If to-day is fair, fire a gun, and it will rain either to-morrow, or some following day. If to-day is rainy, fire a gun, and it will be fair either to-morrow or afterward. There appears to be just as much sense in appropriating public money for explosives to produce dryness in Alaska as to make rain, by similar means, in Texas.

In conclusion, we would warn Senator Farwell and his coadjutor rain makers that they have infringed upon a patented article, and are liable in damages. The precipitation of rain by firing aerial explosives is the invention of Mr. Daniel Ruggles, of Fredericksburg, Va., and was patented by him eleven years ago, to wit, on July 13, 1880, patent number 230,067 His patent claim is as follows:

"The mode herein described of producing rainfall, said mode consisting in conveying and exploding torpedoes or other explosive agents within the cloud realm substantially as described."

Mr. Ruggles' invention was illustrated and described in the SCIENTIFIC AMERICAN of Nov. 27, 1880. We here reproduce the engraving and description then published. "Novel Method of Precipitating Rain Falls. A patent has been recently issued to Daniel Ruggles, of Fredericksburg, Va., for a method of precipitating rainstorms, which, judging from a well known precedent, is not entirely chimerical. It has been frequently noticed that heavy cannonading is followed by a fall of rain. Profiting by this suggestion, Mr. Ruggles has invented a method of producing a concussion or a series of concussions in the upper regions of the atmosphere which he believes will induce rain."

The invention consists, in brief, of a balloon carrying torpedoes and cartridges charged with such explosives as nitroglycerine, dynamite, gun cotton, gunpowder, or fulminates, and connecting the balloon with an electrical apparatus for exploding the cartridges.

"Our engraving represents an individual in the act of bringing down the rain."

Mr. Ruggles' patent is still in force, and if the invention has anything like the value which Senator Farwell places upon the obtained results, then the million dollars the senator speaks of should go to the patentee. Let justice be done to inventive genius.

For the convenience of our readers and the further elucidation of the subject, we reprint the article we published a few months ago.

[From the SCIENTIFIC AMERICAN of Dec. 20, 1890.]

### "THE ARTIFICIAL PRODUCTION OF RAIN.

"The question as to whether rain can be produced by artificial means is to be tested by the United States government. On motion of Senator C. B. Farwell, of Illinois, a clause was added to the appropriation bill which provides that, under direction of the Forestry Division of the Department of Agriculture, $2,000 shall be expended in experiments having for their object the artificial production of rainfall by the explosion of dynamite.

In a communication from Senator Farwell the following theories are advanced: "My theory in regard to producing rain by explosives is based partly upon the fact that after all the great battles fought during the century heavy rainfalls have occurred. This is historical and undisputed. Senator Stanford, one of the builders of the Central Pacific Railway, informed me lately that he was compelled to do a great deal of blasting through a part of the country where rain had never been known to fail in any useful quantities and where it has never rained since, and that during the period of the blasting, which was nearly a year, it rained every day. I feel almost convinced that rain can be produced in this way. The dynamite could be exploded on the ground or up in the air, and I think I would prefer the latter. The experiment should be made in eastern Iowa, Colorado, or in western Kansas, somewhere along the railway, and my own idea would be to commence early in the morning and explode continuously for seven or eight hours."

The subject of rain production by means of concussion has been frequently disussed during the last twenty-five years. A great number of instances were stated by Francis Powers, C.E., in a volume entitled "War and the Weather, or the Artificial Production of Rain," 1871. Many cases are cited in which great battles have been followed by speedy rain. Six occurred during our war with Mexico in 1846 and 1847; nine cases of battles or skirmishes are given which occurred in 1861 in the war of the rebellion, and which were followed by rain at no great interval; forty cases are cited in 1862; thirty for 1863; twenty-eight for 1864, and six for 1865. Eighteen similar cases are also cited from among the great battles which have occurred in Europe during the past century, making a total of 137 cases. In a criticism of Mr. Powers' theory, *Silliman's Journal* said: "To this argument it may be replied that throughout the region from which his examples are mainly drawn rain falls upon an average once in three days, and probably a little more frequently; so that from the conclusion of one rain to the comencement of another, the interval is on an average but little over two days. Now, battles are not usually commenced during a period of rain; generally not till some hours after the conclusion of a rain. Rain, therefore, ought to be expected in about one day after the conclusion of a battle. Now, the argument of Mr. Powers is lame in this point. He takes no precise account of the length of the interval between the conclusion of a battle and the commencement of rain; nor does he show that the interval is less than it should be if the battle had no influence in the production of the rain; and in particular he takes no account of the cases unfavorable to his theory, in which rain follows a battle only after a very long interval."

Some of the cases, however, which may be cited where the fall of rain seems to have been caused by the discharge of cannon are very striking. During the siege of Valenciennes by the allied armies in June, 1793, the weather, which had been remarkably hot and dry, became violently rainy after the cannonading commenced. Two hundred pieces of heavy artillery were employed in the attack and one hundred in the defense of the city, the whole of which were frequently in action at the same time.

At the battle of Dresden, August 27, 1813, the weather, which for some days had been serene and intensely hot, during the progress of the battle suddenly changed. Vast clouds filled the skies, and soon the surcharged moisture poured itself in a torrent of rain. At Waterloo, according to Siborne, the weather during the morning of June 17, 1815, had been oppressively hot. It was now a dead calm; not a leaf was stirring, and the atmosphere was close to an intolerable degree, while a dark, heavy, dense cloud impended over the combatants. The 18th Hussars were fully prepared and awaited the command to charge, when brigade guns on the right commenced firing for the purpose of breaking the order of the enemy's advance. The concussion seemed instantly to rebound through the still atmosphere and communicate like an electric spark with the heavily charged mass above. A violent thunder clap burst forth, which was immediately followed by a rain which has never probably been exceeded even in the tropics. In a few moments the ground became perfectly saturated.

Humboldt says that when a volcano bursts out in South America during a dry season, it sometimes changes it into a rainy one. It is well known that in very hot calm weather the burning of woods, long grass, and other combustible materials produces rain. Very extensive fires in Nova Scotia are so generally followed by heavy floods of rain that there is ground for believing that the enormous pillars of smoke have some share in producing them.

Captain James Allen, acting signal officer of the War Department, in reply to interrogatories recently addressed to him regarding the probability of producing rain by artificial means, said: "One fact would seem to be easily admitted, that an attempt to explode gunpowder in order to practically demonstrate the advisability of attempts in rain production should at first be made after most careful consideration of the atmospheric conditions. For example, if these explosions should be made in the center of a high area, as shown by our weather maps, or even after a low area has passed any point, we may be absolutely certain no rain will follow. The first experiments should be undertaken to the southeast or east of a low area, and 300 to 600 miles from the center.

"Observing stations should be established every 5 or 10 miles for 200 miles to the eastward of the point of explosion. If the explosions are made in a comparatively clear sky, and after that unmistakable clouds are observed to the eastward and not to the westward, some connection may be surmised. It must be said, however, that even if the production of rain be practicable, it can only be for a very limited area, and it is believed that any benefit which can possibly arise from such rain can never amount to the expense of the enterprise."

The opinion of Captain Allen is similar to that of President H. C. Russell, of the Royal Society of New South Wales, contained in an anniversary address delivered in 1884. He says: "It would seem unreasonable to look for the economical production of rain under ordinary circumstances, and our only chance would be to take advantage of a time when the atmosphere is in the condition called unstable equilibrium, or when a cold current overlies a warm one. If under these conditions we could set the warm current moving upward, and once flowing into the cold one, a considerable quantity of rain might fall, but this favorable condition seldom exists in nature."

The experiment of producing rain by exploding dynamite is about to be tried, and the result will be awaited with much interest."

### THE WEATHER DEBATING SOCIETY.

There are now so many cloud compelling rain producers turning up that any opulent person who is interested in the weather can hire one of them for his own convenience. But suppose a man who would like to enjoy a shower on a warm afternoon orders his cloud compeller to produce one at a time when his next door neighbor desires to take a walk in his garden under the sunshine, what will ensue? Will the rain producer be liable to be sued for damages by his neighbor, or will the case be settled by arbitration?

These questions are fit to be taken up by the Weather Debating Society, now that so many rain producers are offering their services at a low price.—*N. Y. Sun.*

### Meeting of the American Association.

The American Association for the Advancement of Science adjourned on Tuesday, August 25, to meet again at Rochester, N. Y., on the third Wednesday of August, 1892. The president for next year is Prof. Joseph Le Conte, of California. Secretary Putnam reported that 653 members had been enrolled at the Washington meeting, of whom 371 were new, the latter number alone exceeding the total attendance for last year. Addresses, papers and memoirs were offered and read upon 291 distinct subjects, these communications varying in length from five minutes to an hour each. Most of these were read in one or another of the eight sections into which the association is subdivided. From a programme members learn what is going on.

In our columns it will be impossible to give more than an epitome of the proceedings, beginning with brief abstracts of the addresses made by the vice-presidents in opening the sections of which they are the chairmen.

Prof. Nipher addressed the Section of Physics on the "Functions and Nature of the Ether of Space." It was once taught that light was an elastic pulsation in an incompressible medium. Then the theory found favor that it was an electrical displacement at right angles to its line of propagation. Then the elastic and electric theories were ingeniously put on the same logical basis by suggesting for the former a rigidity zero for the compression wave—an audacious idea that created pleased surprise. Light in matter must be either more dense or less elastic than that in free space. Ether at the earth's surface moves with it, being dragged along as if it were a vivid liquid. Ether in water seems to be condensed to $\frac{3}{16}$ of its volume in air. Yet after all the fine theories and beautiful experiments, it remains an open question whether ether or any part of it is at rest in space, or whether it sweeps through the interior of bodies as the wind sweeps through the leaves and branches of a tree.

"The Evolutions of Algebra" was Prof. E. W. Hyde's topic in opening the Mathematical Section. He traced the progress of algebra from its rhetorical form in India, Egypt, Arabia and Greece, through the syncopation stage of the middle ages, to the modern purely symbolic form. These three stages were explained as being originally mathematical reasoning by words, next by abbreviations, and finally by signs altogether, by which the amazing progress of the past 200 years had been made possible, and the ultimate value of which remains to be determined by its future.

President J. M. Coulter, the newly elected President of the Indiana University, addressed the Biological Section on the "Future of Systematic Botany." Many who style themselves systematic botanists have only pigeonholed plants for study; and too often regard the temporary pigeonholes as more important than the facts. Three distinct lines of work are to be recognized as of equal importance, each of which should turn over its completed product to the next. Field work comes first; which, instead of being sporadic, or ending in a mania for new species, should make the collection and description of plants as distinctly a biological survey as any made by topographical engineers. It should be done by men trained and equipped for it. Nothing requires a broader grasp of facts than the proper discrimination of species. Each true species is highly composite, being made up not only of gross organs, but of those that are microscopic. The best field work is but preliminary to the further study of the life history of plants, noting the development of each organ at every period, thus obtaining cumulative evidence for safe generalization. The last and highest expression of botanical work is the construction of a natural system based on an accurate description of species and a thorough study of life histories; and this calls for a complete command of botanical literature, together with the finest powers of generalization.

Prof. Stevenson addressed the Geological Section on the "Relations of the Chemung and Catskill on the eastern side of the Appalachian Basin." After tracing historically the studies made of these groups, he concluded that the series from the beginning of the Portage to the end of the Catskill form but one period, which should be designated as the Chemung, and be divided into three epochs, Portage, Chemung, and Catskill; that the disappearance of life from this area was due to the fact that the deposits were made, not in a closed sea, but by the influx of great rivers loaded with debris in which life could not exist, and that we are not justified in including the Chemung period in the carboniferous age.

"The Natural History of Analogy" was discussed by Prof. Jastrow before the Section of Anthropology. Though cautiously used by modern scientists, analogy was the main argument of primitive man, and explains savage customs and beliefs, popular superstitions, folk-lore, magic, astrology, and all pseudo sciences. The serious reasoning of our forefathers only amuses us; yet historically there is a connection between modern civilization and the primitive culture from which it is largely an outgrowth.

*(To be continued.)*