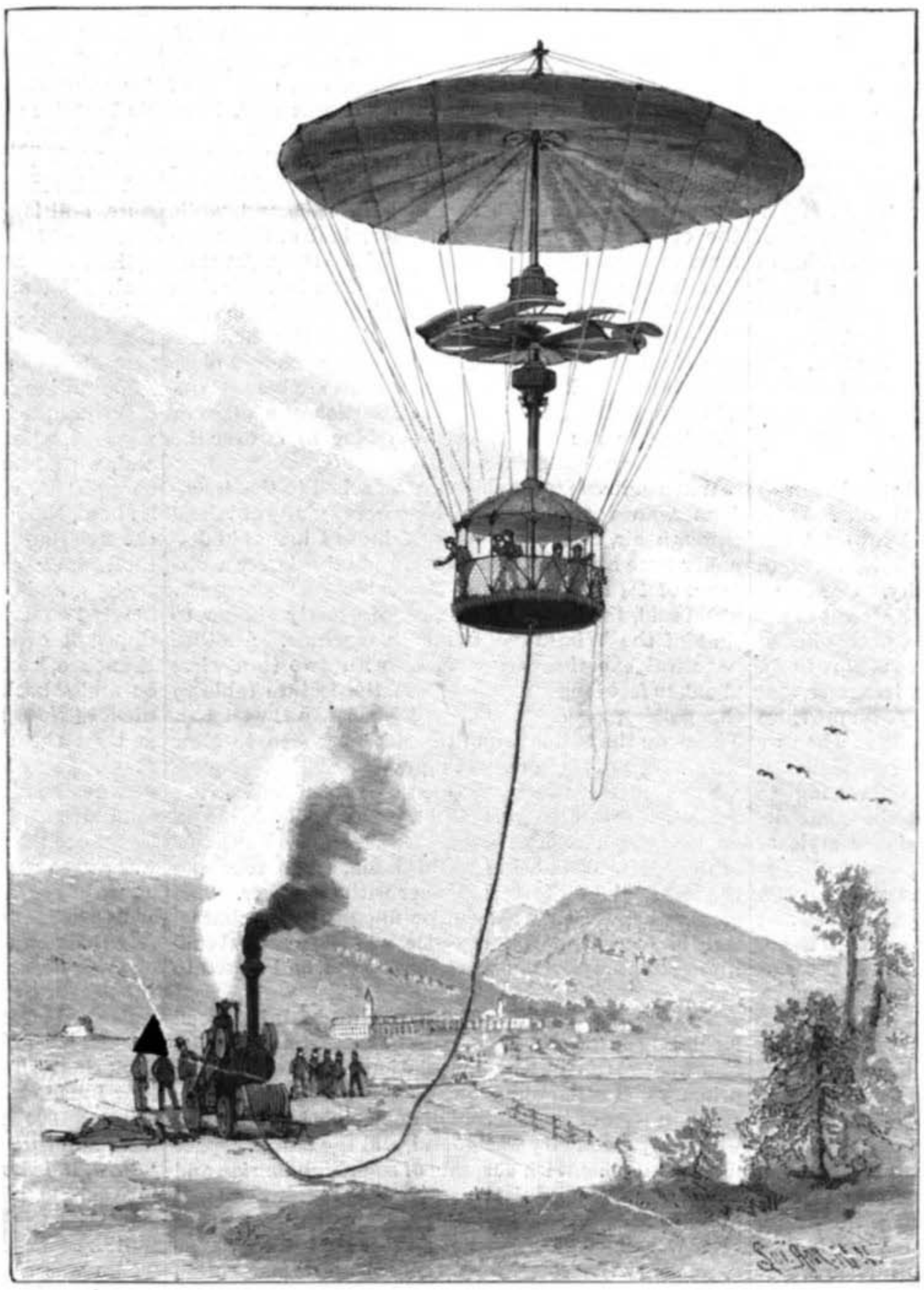
APPARATUS FOR AERIAL ASCENSIONS.

BY J. HENRY SMITH.

The original drawing of this cut was made as long ago as 1849, when the writer was a pupil of and mechanical assistant and draughtsman to Professor Henry, at Princeton. Many experiments were made with aeroplanes and on the lifting power of screws of various forms revolving in a horizontal plane. After the great electrical discoveries of Faraday and Henry, came the dynamo electrical machines of Pixi and of Gramme, on which many dynamos and dynamotors have since been built up and patented and placed upon the market.

The steam engine and dynamo and a winding drum and boiler are mounted on a carriage, and a wire, wound on the drum, leads up to and holds captive dynamotors and screws free to revolve on the vertical shaft, or tube, which supports the car. The car and staff do not revolve and no torsion is put upon the wire. At the upper end of the staff is a parachute, of large diameter, which is provided for safety in case of the stoppage of the upward flow of the current from the dynamo on the carriage. The current passing from the motor by the upwardly extending wire is sufficient to turn the screws at a high speed. For military use the elevation at which the field glass could be used, with the aid of this apparatus, would permit the disposition of the camps and forces of an enemy to be seen at a great distance, while on the water an approaching ship could be sighted at a like distance. Meteorological observations could be taken in all the various strata of the air, from the earth to the highest altitudes.



APPARATUS FOR AERIAL ASCENSIONS, DESIGNED IN 1849.

Military Ballooning.

Lieutenant H. R. Jones, R.E., read a paper recently at the United Service Institution, dealing with the practical working of balloons in military operations. First noticing the question of gas, the lecturer pointed out that, in spite of its cost, hydrogen, from its great lifting power (*i. e.*, from 60 lb. to 68 lb. per 1,000 cubic feet), effects economy in transport, and is specially suited to the plan, first adopted by England, of carrying gas ready made in tubes of about 70 lb. weight, each containing 120 cubic feet of hydrogen. The advantages of the system are:

(1) Rapidity of filling, a balloon being prepared in from fifteen to twenty minutes, instead of four hours; (2) purity and greater power; (3) independence of a large water supply, otherwise necessary; (4) the power to immediately replenish a partly wasted balloon, according to requirement. The English military balloon contains 10,000 cubic feet, lifting 650 lb., including two very light men, 1,500 ft. of rope and the balloon, with the necessary fittings. After discussing the fittings in detail, the lecturer spoke of the mobility and use of balloons. In a light breeze, he said that a balloon can be towed so as to travel as fast as infantry, often even much faster. In England the laws of trespass, as well as telegraph wires and trees, present exceptional obstacles to balloons, yet during the last three summers good work has been done at Aldershot. Communication is kept up between the balloon and the ground by telephone on the Siemens-Halske system; plans and papers are sent down the line in a small bag. Observation from a balloon naturally suggests itself as a matter of course. It requires special practice, however. The country looks like a map, but hills are all flattened, and it is often wrongly assumed that movements seen from the balloon must be visible below and need not be reported. Practice is required also to estimate the magnitude of bodies of troops. At Aldershot, after the first summer's work, the working of the balloon was reported as satisfactory, but the reports furnished by the balloon as unsatisfactory. Subsequently examples were given of the value of balloons; for instance, a cavalry force was enabled to avoid all outposts and get right into camp on one occasion, by balloon direction. Again in 1890, a balloon, from a mile and a half distance, made a sketch of an enemy's camp, showing all the dispositions of the troops and outposts, and even identifying regiments. During the last French maneuvers General Gallifet actually commanded from a balloon, sending orders by telephone. In the direction of artillery fire a balloon offers great advantages. The question of the liability of the balloon to destruction by artillery fire naturally arises. At Lydd a balloon was fired at by a 13-pounder gun, at 4,000 yards range. The balloon was raised and lowered by paying out or hauling in line. It was struck the seventeenth shot, and as it slowly descended struck again by a shrapnel. Nevertheless, it reached the ground so gently that no appreciable shock would have been felt. The damage consisted of two holes torn by shell fragments, and some bullet holes, two of which were through the car. The balloon could have been made fit for use again in about two hours. As to foreign powers, the French adopted the English tubes for carriage of hydrogen, fill in about the same time, and have used balloons in their maneuvers as well as in Tonkin on active service. Germany at present prepares gas, but the English method is under trial. Russia and Italy have both adopted balloon equipments.

Motive Power only a Small Item.

The popular notion that with cheap motive power—water power, for example—we might have cheap electrical lights and motors, was dispelled the other day, at Buffalo, by Mr. Charles L. Huntley, in his presidential address before the National Electric Light Association. In view of the approaching completion of the works at Niagara Falls for the utilization of that gigantic water power, some very great expectations have been indulged, in Niagara and Buffalo, respecting the electrical advantages which those cities would probably enjoy. With the great cataract close at hand to turn the dynamos, it was supposed the electric currents, for lights and motors, might be supplied to every shop and dwelling at a cost of but little above nothing. But Mr. Huntley, who is celebrated for having a very level head, sweeps away this pleasing illusion without the least compunction. He says:

"Whether we are engaged in the distribution of electric light by arc or incandescent lamps, or in generating current for stationary or railway motors, or for heating, we are essentially engaged in generating, distributing, and converting power into its various forms; hence, any method by which the initial power can be obtained in a manner or from a source of greater economy, deserves our most serious consideration.

"The question may, therefore, naturally be asked, What would be the effect of the utilization of Niagara or other large water powers, so far as concerning outlying cities? How far will it be possible to transmit this power, not theoretically, or in an experimental way, but commercially, so as to insure a fair dividend to the investor? At what point does it become cheaper to carry current than to carry coal? Now, these are large questions. They are, in fact, the largest problems in modern engineering. When you come to deal with such an immense and incalculable source of power as Niagara, our previous plans and methods and successes sink into nothing, as indicative of final results and realizations. Our attitude toward such a taming of nature is very much the same as that of the first electrical experimenters when they interrogated her with the help of pith balls and little chips of amber. Even the late demonstration at Frankfort teaches us little, for there we had the utilization of only such a water power as a well-to-do American citizen puts in his back yard for ornamental purposes; and the experiment was tried in summer time, when winds are light and skies are clear. Moreover, that plant was run as an exhibition, with the Emperor of Germany and other dignitaries lending a patriotic hand and subscribing patriotic dollars. Now, gentlemen, when you and I who operate stations come to use such water powers, or distant coal beds, we shall not be able to fall back on kindly emperors for timely donations. Some of our fellow citizens will be quite ready to help us, but with the instinct that is born in every American, they will want the dollar they pay out to bring another back with it.

"Our field of work, in short, with its newness and rawness, is one in which experience must always moderate enthusiasm. To me, perhaps, more than to many of my fellow members, this question of long distance power transmission is fraught with large possibilities and grave responsibilities. It is imperative that I should know the truth and the facts; and if ever the time comes when I can be humbly instrumental in giving Buffalo a sparkling midnight firmament created by yonder falls, I shall ask no grander task. I have ventured to make this momentous subject one of the leading topics here, and my call for information has been responded to by some of the most authoritative workers and thinkers in this direction. To them I shall leave the exposition of its details, with the conviction that you will forgive me if, under a sense of duty, I have indicated the practical limitations that must govern every man of affairs.

"In this connection I cannot help pointing out again that, after all, the cost of coal to operate an electric plant is only one among many items, and frequently a small percentage of the total cost at that. For instance, in electric railway work the cost of coal comes to about 10 per cent of the total operating expenses, while in electric lighting it probably does not exceed from 15 to 20 per cent. In these days, when municipal plants are the subject of frequent discussion, these facts are generally lost sight of, and the cost of electric lights is calculated by reference to the amount of coal burned under the boiler, thus ignoring the fact that firemen, engineers, linemen, trimmers, etc., are required; that carbons require daily renewal and globes break; that, like all other machinery, engines, boilers, dynamos, and lamps are subject to depreciation, require repairs, that the building must be insured, and that a sinking fund must be established for renewals.

"Cheap power in itself would, therefore, influence the cost of electric lighting very little, even if the electric current is distributed in the immediate vicinity where it is generated; while its distribution to any considerable distance in large power units on a commercial basis seems to be awaiting its demonstration here rather than in Europe. Hence I would recommend a study of the facts pointed out, which ought to make any community falter before investing in a municipal plant simply because it may happen to have what is supposed to be a cheap source of power around the corner."

WHEN a belt gets saturated with waste oil, an application of ground chalk will soon absorb the oil and make the belt workable.

Tesla at the Royal Institution.

So great was the interest and enthusiasm with which Mr. Tesla's first lecture and experiments were received at the Royal Institution that he complied with the urgent request to repeat the same, and at the close of the second meeting Lord Rayleigh arose and spoke as follows: Sir Frederick Bramwell, ladies and gentlemen—Although it is not our custom here to follow the lecture with remarks from anyone else, I think you will agree with me that this is no ordinary occasion. At the request of the managers of the institution, and for the delectation of its members, Mr. Tesla consented to repeat the labors of last night, labors which, though small to him, would have completely exhausted any one else.

I wish our great electrician, whose name appeared before us in letters of fire, in one of Mr. Tesla's experiments, were here to propose this motion. There is only one respect in which I have any qualification to speak, and that is that I have made attempts myself to experiment with currents of a high degree of frequency. I was tolerably satisfied when I had a discharge rate of 2,000 per second, but we have had to-night ten or twenty thousand per second. My apparatus was on a very smal scale indeed. Mr. Tesla has taken us into some of the dark—metaphorically dark—places in nature. These fields have been but little trodden. Mr. Crookes and Mr. Tesla alone have had the *entree*. In what has been put before us to-night, there has been matter which will afford food for intellectual contemplation for a long time to come. I think, at the same time, it will be obvious to you that Mr. Tesla has not worked blindly or at random, but has been guided by the proper use of a scientific imagination. Without the use of such a guide, we can scarcely hope to do anything of real service. I do not think there is anything I need add; it does not require any great capacity to see that Mr. Tesla has the genius of a discoverer, and we may look forward to a long career of discovery for him. His labors will be followed with admiration by all men of science of England, and especially by those in this institution to whom he has done the favor of lecturing to-night. I thank Mr. Tesla for his lecture.

Sir Frederick Bramwell: Ladies and gentlemen—I believe it is usual to second the vote of thanks. I, for one, should be very glad for Lord Rayleigh to put the motion to you. It is the duty of myself, however, to second this vote, which I do most heartily. Our treasurer is not here to-night; he foresees, as the result of the lecture, that the whole of our apparatus, in this line of study, is antiquated, and we shall have to begin afresh. This has evidently been too much for our treasurer, and he has consequently stayed away. In my own province of mechanical engineering, there was a time when we were content to have boilers which would be ridiculed now; and turning from mechanical engineering to electrical science, we have seen to-night the same development from the slow-going, old-fashioned style of phenomena, as that which I have referred to in the case of the steam boiler. I can only regret that Mr. Tesla has kept within the limits of time, and has had to refrain from giving us that which we so much liked. I wish he could give us another evening, and show us more of the experiments. I put the vote to the meeting.

Mr. Tesla: It would be difficult for me to find words to express the thoughts I feel; I have been so kindly received and generously treated. Whatever I have shown you here is not my own; it is the outcome of the work of English scientific men, whose names we delight to hear, and whom every one loves and admires. To-night my aspirations are fulfilled in having my labors appreciated by some of the foremost men in the world, and I cannot tell you how highly I esteem your thanks, and how much it will encourage me to further work. There is one thing I desire to tell you—I am not a speaker, nor did I prepare to speak at all, and these two considerations should disqualify me at once—but this I want to say:

We have worked before with the problems that are at hand until they have been perfected. The water wheel, the gas engine, the steam engine, thanks to the great spirits which your country has produced, are brought to a high state of efficiency. In these departures we have come, so to speak, to the limit. We have now a possibility opened to us of accomplishing things we never dreamed of before, and in this lies the whole aspiration of scientific investigators. These contrivances are but in an imperfect state; they have consumed many years of my incessant thought; some other experimenter will start where I have stopped, and so the world goes on; but the same advantage which another will have from my work, I have already had myself from those who have gone before. The foremost scientific men of this country agree that there is a way of producing the electric light by fluorescence as the result of oscillations of a certain frequency. I will not dare to speak of what they have achieved in this direction, for if I do my discourse would be the praise of their work; it is, therefore, out of place. You will believe that these words are sincere, even if they are not put forth in the expressions of a good orator. We have a start. We can set up in a room the oscillations, and the only difficulty with which we are confronted is the perfecting of the apparatus. Thus we can have a light which will not need any leading wires, which will be a good luminant, and will never be destroyed—it will last for any length of time. This will be a great advancement over present methods. These difficulties are nothing compared to the problems English scientific men have opened up before. For instance, in the production of power. We are able to produce power at any point in the universe, and when this great work is finished, what an effect it will have upon the whole human race! I wish to say that the results I have shown you to-night are the outcome of the work of others, and I do not want to impress you as though I was displaying any discovery of my own. If any one can reap the benefit of it, my desire is fulfilled. I am only paying a duty which any lover of science must pay to those who have been before in the field. Others have arrived at results. We are younger, and we go on from them, climbing the stairs; or, rather, we younger ones are taking the "lift"—we are using the "elevator." The older ones were content with the stairs. I thank you most heartily, and express the hope that I may be able to bring before you some better work than I have shown you to-night.

For the purpose of the experiments, says the *Practical Engineer*, Mr. Tesla employed an alternating current dynamo of special construction, and capable of producing alternations amounting, it was said, to as many as 20,000 in a single second.

The current was controlled by a switch on the lecture table, and the first experiment consisted in holding an exhausted glass tube, 3 feet long, in one hand, while the other was placed upon the terminal of the transformer; the tube then appeared lighted throughout its length with a brilliant blue light. The lecturer then showed a glass bulb lighted in a similar way when attached to one wire only, and also showed the phenomenon of a Crookes' shadow. On attaching a copper plate to each terminal of the transformer, an arc being formed between them, and upon the insertion of a plate of ebonite, the arc gave place to a blue light over the faces of the opposing plate.

When suitable terminals were attached to the transformer, lines of light 7 inches long were readily obtained through air, and when balls of brass 4 inches in diameter were attached, sparks were obtained over a distance of 1¼ inches. Under favorable conditions, Mr. Tesla said, this discharge appeared exactly similar to that of the Wimshurst influence machine. Another beautiful experiment was made with two thin wires about 10 feet long stretched from the lecture table to the gallery, at a distance of about 9 inches apart. These, on the extinction of the gas, were seen to glow with a blue phosphorescent light.

Some Geissler tubes, provided by Professor Crookes, were then exhibited; one of these contained yttria and another sulphate of calcium. Attaching a wire to one of these, Mr. Tesla held it in his hand, while touching the terminal of the transformer with the other. The glass vessel was then seen to be filled with the characteristic colored phosphorescence, and the material continued to phosphoresce after the current had ceased to flow.

Referring to the difficulties found in obtaining good insulating media, Mr. Tesla said the transformer used by him was provided with oil insulation, the exterior of the primary coil being about one-quarter inch less in diameter than that of the internal diameter of the tube upon which the secondary was wound, and the annular space filled with oil. With currents of such high tension and frequency, solid insulation, according to Mr. Tesla, is quite useless, and is absolutely certain to break down after working for a short time, a fact he adduced as the reason why the costly induction coils now made often become useless after a short period. His transformer had, he said, sometimes broken down twelve times a day, yet, owing to the fluid insulation, it was never permanently injured. For the production of the effects shown with yttria and sulphate of calcium tubes, alternations amounting to the almost inconceivable number of 100,000 per second are, according to Mr. Tesla, essential. One of the most remarkable effects observed in connection with these currents of high frequency is, that no matter how great their intensity, they have no effect on the animal system, and thus appear to be perfectly safe. As an illustration of this, he took an iron bar in one hand and a vacuum tube in the other. On making his body a portion of the circuit by placing the point of the bar upon a terminal, emitting sparks several inches long, the vacuum tube glowed brilliantly, while the lecturer remained wholly unaffected.

The most striking experiment, however, was one designed to show the possibility of illuminating a room by making the space itself electric. Above the head of the lecturer was hung a plate of zinc about 8 feet long by 1 foot wide, a similar plate being hung upon the wall at a distance of about 10 feet, and parallel to the first. Between these two plates an intense electrical field was then produced, and exhausted glass tubes placed anywhere in the field at once glowed with phosphorescent light. The lecturer took in his hand a glass wand, 3 feet long, and, with no special connection of any sort to his body or to the glass, when waved in the magnet field it shone like a flaming sword. If such an electric field were produced in a room, it is manifest that it could be illuminated by merely hanging suitable glass globes without connection of any kind.

We have not been able to more than faintly describe a portion of Mr. Tesla's experiments, but it will be evident that the phenomena disclosed were of no ordinary kind. On the possibilities of their immediate application it would be almost rash to speculate, and we shall look forward with excited curiosity to the further experiments and lectures which we understand Mr. Tesla has promised to give on the subject.

Felling a Washington Gigantea.

FOR THE SCIENTIFIC AMERICAN.

About 1856 I had some business with William W. Hanford, who owned a saw mill a few miles from the famous Mammoth Grove. in California. I rode from his mill, some ten or twelve miles, to see the monsters.

Mr. Hanford was the gentleman who had the big tree, as it is called, cut down, and related to me his experience as follows. Said he: "I thought there would be a speculation in stripping the bark from the ground up about twenty feet, taking it off in sections, and shipping it to New York, and then setting it up for exhibition, the bark being about two feet thick. So I set five good men at the work, and in a few days we had the bark off, ready to ship. Then an idea struck me to fell the monster before taking the bark off. I had measured with a long tape line around the butt, and it was a few inches over 96 feet in circumference—33 feet across. I then had some pump augers spliced out, and set four men to boring through from each side; and I put long handles into mortising chisels, and set the fifth man to cutting off the wood left between the auger holes, so, after some weeks, we saw light clear through the center of it, which was sound to the core. I left a portion on each side, north and south, to be cut off with chopping axes. I selected my men, who chopped right and left hand foremost, and, with four light chopping axes, we soon had it chopped off, so that it settled down about an inch on its base, the top being light, and little or no wind, and the tree standing so erect that it did not fall over. I then made hard wood beetles and got some iron wedges and very large wooden wedges, and, after nearly two days of hard work of five good men, we tipped it over. I then sent my 20 feet of bark to San Francisco, loaded them on a steamer, and packed them on mules' backs across the Isthmus, and finally got them to New York, hired a large hall on Broadway, and set them up. Men would come in and pay their 25 cents, and look at it and say: 'Mister, where did you get that?' I would tell them the truth. Then some of them would say: 'Oh, my! you can't make us believe that that ever come off a tree; there never was a tree on earth the size of that.' I was determined not to be beat. So I sent back, had my men dovetail four or five long crosscut saws together, and saw about one foot thick off the butt of the tree, showing the borings on one side, and hewed off so as to leave a piece with the heart of the tree in the center and 12 inches wide, smoothed off the sawed side with a carpenter's plane, packed it and took it to New York, and fitted it into my bark shell. Then I said: 'Now, look at that, and see how I made it.' By that time I was out of pocket between $3,000 and $4,000, so I sold out to some Englishmen, and they took it to London. Said Mr. Hanford: "Now, if I should find a mermaid with 3 tails, I would not exhibit her in New York." They hewed off and smoothed the upper portion of this fallen tree, and built a roof over it, and used it for a bowling alley. There was a staircase of 23 steps up the side of this tree, near the large end, which reached a little above the center; then notches were cut in for the feet to walk up to the top. To look off the butt down was like looking off the stern of the Great Eastern. There were about 70 of these monsters in the grove of about 70 acres, variously named the Twin Sisters, Father and Son, Mother of the Forest, Father of the Forest, etc., etc. The Prostrate was the largest in circumference, and hollow for 72 feet.

In Trenton, N. J., some twenty years ago, I was in a lumber office, and some lumbermen sat there on a work bench, telling of some of the big trees they had seen up the river. I heard a number tell their yarns, and said: "Boys, you don't call them big trees, do you? Why, I saw an old hollow tree in California that a man could ride 70 feet through on horseback, and ride out through a knot hole."

One of them got down and took off his old slouched hat, and said: "Say, mister, that ain't the best of a hat, but it is all I've got, and you are welcome to it." The gentleman in the office said that, after I went out, one of the men said: "That was an almighty good liar."

I had actually told the truth, but could not blame the man for calling me a liar. J. E. EMERSON.

THE mean annual temperature of the globe is 50° Fahrenheit.