engine makers of San Recco, near Trieste. The designs were made by Eduard Mellier, director of machine construction.

The ship is built according to the newest double bottom system, and is divided into more than one hundred water tight compartments. The powerful steam pumps are capable of pumping out 1,200 tons of water in an hour, thus greatly diminishing the danger of sinking.

The arch armored deck, which is 4 ft. below the water line, closes the lower part of the vessel hermetically and protects the machinery, magazines, etc., from heavy shot. A strong belt of cellulose is fastened to this deck at the sides of the ship, to prevent inflow of water through openings caused by the shots of an enemy. The vessel is built entirely of steel. Its chief dimensions are: Length over all, 341 ft., and 321 ft. between perpendiculars; greatest breadth, 49 ft.; draught, 19 ft. 6 in.; and it has a displacement of 4,060 tons. The twin screws, each of which is 14 ft. 3 in. in diameter, are driven by two horizontal, triple expansion engines, that can develop 9,800 H. P., working at a speed of 120 revolutions per minute; that is, 2 1/4 H. P. per ton, a power that has never been attained by any other vessel of this class except the Kaiser Franz Josef. The speed is 19-20 miles per hour. (The engraving gives a correct idea of the mass of water displaced by the bow, for it is taken from a drawing made from nature.)

The cool water for the condensers is supplied by two powerful centrifugal pumps. There are four double cylindrical boilers, each provided with six arched fire boxes, which, together, open into 2,664 fire tubes. The boilers are fed by four two-cylinder double action pumps. Besides these boilers there is a special cylindrical high pressure boiler for operating the electric lighting plant, the hydraulic pumps for the artillery service, the deck pumps, fire apparatus, ventilators, the capstan, etc. The ship can carry 670 tons of coal, which will take it over a stretch of 4,500 nautical miles.

A large plant is provided for the electric lights. There are three dynamos, each of 13,000 volt-amperes, which supply the four search lights each of 20,000 candle power. For lighting the interior of the vessel there are 350 incandescent lights of 10, 16, and 32 candle power. There is also the Sellner night signaling apparatus. Besides this plant there is a portable Gramme light machine, which supplies an arc light of 3,000 candle power, and besides the two principal engines there are, in all, 38 independent machines on board.

The armament of the vessel consists of two Krupp 24 centimeter breechloaders of 35 caliber length. They are mounted on hydraulic carriages and fire in barbettes, with a range of from 260° over the bow and stern to 130° over each side. There are also six 15 centimeter Krupp guns 35 calibers long, that are arranged at different levels on the sides; and then there are two 7 Uchatius guns for the boats and for field service. Besides these there are 11 rapid firing guns of 47 and 57 millimeter caliber on board. And finally, there are a number of torpedo projectors which can operate in all directions. This vessel can command a wide expanse of sea, both above and below the water level, and, on account of its great speed, the ease with which it can be controlled, and its buoyance, it is a formidable opponent.—*Über Land und Meer.*

PRESENT AND FUTURE DEVELOPMENTS OF ELECTRICITY.

By Dr. W. W. JACQUES.*

ELECTRICITY as a science dates back for centuries.

Electricity as an art has been developed within the memory of men still living.

The study of electricity as a science, that is, the study of electric phenomena and laws for their own sake, independent of the uses to which they may be put, began when Stephen Gray, nearly two hundred years ago, divided bodies into conductors and non-conductors, and thus made the conception of an electric current possible.

For a hundred and fifty years after that investigators in the field of electrical science, working largely in the laboratories of the grand old German universities, were busy finding out how electricity might be produced, what were its laws of action, how it could be measured and what it was capable of doing.

Thus was the science of electricity built up. Thus was the knowledge gathered together that later should be put to use. This was the time of plowing and sowing. During the last few years the harvest has begun to come. Now is the time of gleanings.

In the brief half hour allotted to us this evening, I want to view with you the harvest that is being gleaned, and particularly with the aid of the lamp that electrical science places in our hands, and look forward into the future and see what the fuller harvest is likely to be.

Electricians are very fond of telling us that nobody knows what electricity is; that, though we know perfectly well many different ways of making it, ways of bottling it up and storing it, ways of measuring it with greater accuracy than we can measure anything else, and though we now use it so generally that it enters into the daily life of us all, they tell us that nobody knows what electricity is.

And yet, recent investigations, carried out in part in those domiciles of scientific investigation, the German universities, and carried out in part in our own country, enable us to say with as much accuracy what electricity is as we can say what those other great forces of nature, sound and light and heat, really are.

When we speak of light, or sound, or heat, we feel that we are dealing with familiar things—things so familiar to our every day life that it seems useless to try to define or describe them. Every day the sunlight fills all space; it dazzles our eyes; it falls upon the objects around us and makes them visible; and though through the evening, when the sun is gone, we substitute for awhile a gas flame, or a candle, or an electric light, we have then through the day had so much of it that at night we are glad to be rid of it and have darkness for our hours of repose.

So, too, from babyhood to old age, all day long and every day, we are listening to one or another sound, whether the voices of friends, or the busy hum of city life, or the delights of music, or the ticking of the

clock at night. Indeed, so constantly are our ears filled with sounds that when we go alone on to a high mountain, or a desert plain, where there are no trees to rustle with the wind, the silence is painful and oppressive and awful.

Heat, too, is equally familiar, perhaps even more so, for what is more familiar than the warmth of sunshine? And is not the fireside the very center as well as emblem of our home?

When, however, we speak of that other great force of nature, *electricity*, we feel that we are departing from familiar ground. It is shrouded in mystery; it is something we cannot see or hear, something we cannot easily describe or define. We speak of it in the same breath with spirits and with ghosts. The reason, I take it, is because the human body has no organ especially adapted to recognize electrical phenomena. While the eye receives the ray of light, the ear the ray of sound, the presence of electricity cannot be detected by either of these senses.

Electricity cannot be seen or heard; it is tasteless and odorless.

Subjectively considered, then, electricity eludes our grasp.

Objectively, however, electricity is as familiar to us as light, or sound, or heat. Its phenomena have been as carefully studied, and its laws are as accurately known.

Let us for a moment recall the physical explanation of light and sound. Let us picture to the eye of the imagination the mechanics of a ray of light.

When we stand out of doors on a cloudless night and look above us, we see a multitude of stars. The telescope tells us that some of these are suns, some are moons, and some are other worlds than ours.

The nearest of them is distant millions of miles, and yet we can see them. There is a chain of something linking the star at which we are gazing to the eye. This chain we call, familiarly, a ray of light. Physicists tell us that along the pathway from the star to our eyes there are chasing each other with enormous speed a multitude of waves of light.

If we turn our eyes to another star, it too sends to our eyes its waves of light. If we go to a distant part of the earth, the same stars send rays of light to us there. And so we find that each of the multitude of stars is radiating ceaselessly in all directions multitudes of waves of light.

Between us and the stars, and between the stars extending everywhere through visible space, is the medium that transmits these waves, crossed and intercrossed continually with countless waves of light—a medium rarer than the rarest gas—the medium that is still left in space when we remove from it all solids and liquids and gases—the *ether*.

Objectively considered, then, light is a wave motion of the ether that everywhere surrounds us and fills all space. By a similar wave motion, but in a coarser medium, the air sound is transmitted from place to place.

By means of his vocal organs, a public speaker moulds the current of air that issues from his lungs into waves of sound. These waves of sound are radiated in all directions and fall upon the various listeners' ears.

Something analogous takes place when we drop a pebble on to the surface of a placid lake. From this center of disturbance waves of water are radiated in all directions until they reach the shore. Waves are likewise radiated downward to the bottom of the lake, and fishes have organs, like our ears, that enable them to take cognizance of these vibrations.

In the case of waves of water, or waves of sound, or waves of light, we know there is no bodily transference of a particle of water, or air, or ether, from the center of disturbance to the shore, or ear, or eye. Each particle moves at the most only through a minute fraction of an inch; but each pushes the next, and this the next, so that motion, and not matter, is what is transmitted to a distance. Indeed, this propagation of motion, in contradistinction to propagation of matter, is the essential characteristic of wave motion.

Who has not seen a wave pass over a field of grain? Each particle bows its head but for a few inches, yet the wave passes on to the utmost limit of the field.

Sound, then, is a wave motion transmitted through the air. Light is a wave motion transmitted through the ether. But both of these media are also capable of having set up in them currents in which there is an actual bodily transference of the medium from place to place through considerable distance.

In the case of air, we call this motion the wind. In the case of the ether, we call it a current of electricity.

As wind is the bodily forward motion of the medium whose vibratory motion we call sound, so a current of electricity is the bodily forward motion of the medium whose vibratory motion we call light.

We may, perhaps, best get a realistic conception of electric currents, whether flowing through open space or confined to a specially provided metallic conducting path, by first picturing to ourselves the phenomena of air currents, with which we are more familiar, and then mentally transferring these phenomena from the air to the more subtle medium, the ether. The analogies are very striking, and will materially aid the imagination in picturing electrical phenomena.

In the islands of the Pacific Ocean there is almost always a breeze, either from the land to the water or from the water to the land. In the daytime the island is heated by the sun, its air is rarefied and rises, and the cooler breeze rushes in from the ocean to take its place. At night the island cools, the air descends, and an outward breeze is produced. There is always a breeze from an area where the air is condensed, and toward an area where it is rarefied. This local condensation and rarefaction of the air are the cause of breezes and winds and hurricanes. The maps issued by our weather bureau show areas of high and areas of low barometer, and the direction of the wind is always from the one to the other.

If, instead of allowing the wind to blow freely through space, we confine it to a narrow channel, if, for instance, we produce an air pressure at one end of a long iron pipe, we get through the pipe a strong current of air, as, for example, in pneumatic tubes, in which the current of air carries along small carriages, in the tin pipes used to convey the hot air currents from our furnaces to the registers, and in the pipes used for distributing illuminating gas from the central

gasometer to the houses about the city where it is burned.

The wind blowing through space is made evident to our eyes by its scattering of a handful of dry leaves, or dust, or bits of paper. It bows and bends the branches of the trees. A candle flame exposed to it is distorted, or instantly blown out. Its direction is more accurately indicated by the familiar weather vane, and its strength is measured, if we will, by the anemometer.

As with the wind of nature, so too with the electric wind. If we substitute for our Pacific island a metal ball suspended in mid-air by a silken cord, and let the ocean be represented by the surrounding atmosphere on a moist day, and produce upon the ball an area of electric condensation, or, as an electrician would say, a positive electric charge, we shall have an electric breeze blowing outward in all directions, which will last so long as the electrification of the ball is above that of the surrounding air. This may be made evident to the eye by placing upon the ball a handful of bits of paper, or dry leaves, or dust, any of which will be instantly blown away and dissipated in all directions. If a lighted candle can be brought near the ball, its flame will be bent by the breeze, and possibly be blown out.

If, instead of allowing this electric wind to blow away in all directions, we confine it to a narrow path; if, for instance, we connect the ball to the earth by a metallic wire, we get through the wire a strong current of electricity, whose direction may be determined by the electric weather vane, a magnetic needle, and whose strength may be measured, not with the anemometer, but by the galvanometer.

It is in currents flowing along metallic wires that the phenomena of electricity have been most carefully studied, and it is the phenomena of such currents that have therefore been for the most part utilized in electrical inventions.

Nature's wind is used to waft our ships across the seas, and it is perhaps not a wild idea to conceive of electric repulsion utilized to support and propel heavily laden air ships through the space above our heads; but it is with electric phenomena as they have been investigated and utilized up to the present time that we have to deal in this lecture, and this, as we have seen, means the phenomena of electric currents flowing through metallic wires.

What are some of these phenomena?

Electricity, or what is the same thing, a current of ether, passes readily through a copper wire. To the ether current the wire is hollow; in electrical terms, it is a good conductor. It also passes quite readily through an iron wire, but not so readily as through copper. It passes still less readily through a wire of carbon. It passes more readily through a large wire than through a small wire. In all wires there is more or less ethereal friction or electric resistance.

In virtue of this ethereal friction or electric resistance, the current heats the wire through which it passes, of course heating a small wire more than a large one, and heating an iron wire more than one of copper, and a carbon wire most of all. We see this in our household system of electric lighting. The current passes from the central station and throughout our houses to the lamps over comparatively large wires of copper, which it warms only slightly, but coming to the lamps it passes through a fine wire of carbon, in which the friction and consequent heating is so great that the filament becomes white hot, and were it not contained in a glass globe from which the air has been removed, it would take fire and disappear.

Again, an electric current flowing in a wire coiled around a bar of iron converts the bar of iron into a magnet, so that it may attract an iron armature placed near its end, and thus do mechanical work. The converse of this is equally true, and if we move an iron armature to or from the end of an iron bar around which a wire is coiled, an electric current will be set up in the same coil; and by means of the connecting wires may be carried to a distance and utilized. On this latter principle depends the dynamo machine which furnishes electricity to be used for light or power. On the former depends the electric motor that propels our street cars and furnishes power to many of our industries.

Again, the electric current flows through wires with enormous velocity, and consequently it offers an excellent vehicle for the rapid communication of intelligence, for telegraphy. A telegraph wire between two cities is merely a path through which the current may readily flow. At one end is a reservoir of electricity. The "key" is a device by which electricity may be allowed to flow into the line. By allowing small quantities of electricity to flow into the line at intervals of time in accordance with a prearranged code, and noting at their distant end their arrival, we may communicate any ideas that are capable of being expressed in such a code.

The arrival of these little currents of ether may be manifested to the eye in various ways. In the so-called needle telegraph, the current passing by a magnetic needle causes it to point in a given direction, just as the wind passing a weather vane causes it to point in a given direction.

If it were possible to have on one hill-top a reservoir of air under pressure, or wind, and a key by which small puffs of air could be let out at intervals in accordance with a prearranged code, and on a neighboring hill a weather vane, we might thus have a wind telegraph operated exactly as is the electric telegraph. But such a telegraph would be slow and cumbersome in operation, and is not likely to come into general use.

The most modern conception of electricity, then, is that of a fluid lighter and more subtle than the thinnest air.

An electrified body we conceive to be one in which more than a normal amount of this fluid is condensed. We conceive of an electric current flowing in a wire as a movement of the electric fluid along that wire, exactly as water flows along a pipe.

Electricity has sometimes been called a fourth state of matter; that is, matter may exist in the solid state, like ice; in the liquid state, like water; in the gaseous state, like steam; and in the ethereal state, electricity. As water is more mobile than ice, and as steam is more mobile than water, so electricity is more mobile and subtle than steam.

As an illustration of the enormous velocity with which the electric current moves, let me tell you of a message

* Lecture delivered before the Deutsche Technische Verein, October 6, 1892.—*Electricity.*

that was sent from this city to Australia some years ago. Leaving Boston, it went overland to Nova Scotia, thence under the ocean to the Irish coast, thence across Ireland, under the Irish sea, across England, under the English channel, across the whole continent of Europe, and much of that of Asia, again under the ocean to Australia, from which point an answer was returned, and all inside of a single second.

But the telegraph, the telephone, the electric light, and the electric railway are old stories to us now. Let us look at some of the things that have been more recently accomplished, and some of the things we may expect electricity to do in the near future.

One evening, not many weeks ago, I was invited to witness some experiments in sending photographs over a wire by means of electricity. You may imagine that I went with a good deal of interest to the laboratory of my friend. The laboratory consisted of two rooms. In one was an ordinary photographic camera, a small developing closet, and on a table in the middle of the room a cubical box, in one side of which was a slit of sufficient size to receive a postal card.

From this box two wires stretched across the room to the partition wall and, passing through this, extended to a similar cubical box standing on a table in the middle of the adjoining room.

I was given an ordinary postal card and asked to write a short note upon it, and wrote "Good morning," "How do you do?" My friend then took the card and placed it about six inches in front of the camera, where it was well illuminated by an electric lamp. Then he pressed the button of the camera, then took the plate holder to the developing closet, and presently reappeared with a hastily made negative which he dropped into the slit in the cubical box on the table in the middle of the room. I then went into the adjoining room and there, issuing from the corresponding box on the table in the middle of the room, was a piece of thin paper the size of a postal card, on which appeared in fac-simile the words I had written, "Good morning," "How do you do?" There would seem to be no reason why the sending and receiving boxes, instead of being in adjoining rooms, should not be placed one at one end of the wires in Boston and the other at the other end in New York, and thus letters written in the one city could be instantaneously photographed to the other, and beat the United States mail by six or seven hours.

Another experiment, in which I have taken part only this last week, was to sit in my office in Boston and talk by long distance telephone with friends in Chicago, more than a thousand miles away. And this, too, as easily as if my friends had been sitting with me in the same room.

During the Centennial Exhibition in Philadelphia, Prof. Bell exhibited his then undeveloped telephone, which, though it whispered only feebly and imperfectly, was declared by Sir Wm. Thomson to be "the greatest marvel hitherto achieved by the electric telegraph."

At the Columbian Exhibition, soon to be held in Chicago, we shall see that invention grown so big that it will talk loudly and clearly between that city and New York.

Another invention that must soon come—an invention whose underlying principles have been already worked out—an invention that is only waiting for some ingenious inventor to make, is a good method of electric signaling between two vessels approaching each other in the midst of a thick fog at sea.

Let us imagine such a device applied to two ocean greyhounds approaching each other with a combined velocity of forty miles an hour through a heavy fog in a dark night. The lights are useless, for even an electric search light will not be visible a mile away. The steamer's whistle is useless, for the fog soon absorbs the sound, and yet these two vessels may be rushing immediately toward each other with a force and velocity that in case they meet shall mean total annihilation.

But there is no need of such danger. Means of producing electrical signals on the one vessel already exist. The ocean is an excellent medium for conducting these signals to another vessel many miles away, and means on the second vessel for detecting and recognizing such signals may easily be contrived.

Let us see how electricity steps in and points out a simple way by which such collisions may be avoided.

Suppose each vessel to be equipped with an insulated wire running from bow to stern, but dipping into the ocean at each end. Suppose one vessel to have included in this wire means for producing strong and rapidly alternating currents of electricity. Suppose the second vessel to have connected to its wire an ordinary listening telephone.

Electrical undulations will be radiated from the first vessel through the water in all directions until, reaching the second vessel, many miles away, they will be heard in the listening telephone.

By equipping each vessel both with means for sending out electrical undulations and for listening for any that might be received, each vessel would be made aware of the approach of the other, and the danger of collision avoided.

But the greatest electrical harvest to be gleaned in the near future will come when some inventor or engineer devises a method of converting the energy stored up in coal directly into electrical energy.

At present we burn coal under a boiler and produce steam, then we pass the steam through an engine and produce power, then the power of the engine turns a dynamo and produces electricity. We thus have a long chain of expensive machinery, at each link of which there is so great a loss that of 100 pounds of coal burned under a boiler only about five pounds appear as electricity—a clear waste of 95 per cent.

Some day there will be devised an electric generator in which coal is shoveled in at the bottom and electricity taken out at the top, thus using only one piece of mechanism instead of the whole chain used at present, and thus possibly converting the energy of the coal into electrical energy without this enormous waste.

It is thus theoretically possible to get twenty times as much electricity out of a ton of coal, and consequently twenty times as much power, as we do now.

Let us see some of the results that would follow.

A transatlantic steamship that now burns 300 tons of coal per day would then burn but fifteen; or, with the present coal consumption, she would be able to cross the ocean in less than two days.

An electric locomotive carrying its own supply of coal and generating its own electricity would be able to haul a train of cars from Boston to New York in less than two hours.

The machinery of our great manufactories, which now requires to move it work equivalent to that which could be done by 2,000,000 men, could then be operated for one-twentieth of the present cost.

In order to get an idea of the value of such an invention, let us see what the steam engine has done for us, and then imagine what an invention twenty times as efficient could do.

"Some time before his death in 1819, while resting from labor in his old age, James Watt, the inventor of the steam engine, when asked to allow his fellow citizens to honor him with a seat in Parliament, refused, saying that he had given employment to the better part of a million of men, and had earned the right to rest from work. To how many millions of men since then has his invention given employment?" How immensely has the working power of our people been increased, and how enormously have the comforts and luxuries of life been multiplied by the aid of the steam engine.

The steam engines of the world to-day are doing work that to be accomplished without them would require 1,000,000,000 of men.

In Massachusetts alone there are to-day on our railways 2,000 locomotives doing work equivalent to that of 2,000,000 horses, or 40,000,000 men. In our factories are steam engines engaged in spinning and weaving and forging, and great marine engines moving our commerce, that do the work of many millions more.

I have estimated that were the 60,000,000 people in our country all slave holders and all the rest of the world their slaves, each could not have, without the steam engine, the comforts and luxuries he has to-day.

Attempt now to conceive the benefits of an invention twenty times as efficient as this, and the figures become such that the imagination staggers under their weight.

THE INVENTOR OF THE LIGHTNING ROD.

BY JOSEPH J. KRÁL.

WHEN the newspapers lately announced the names of eminent electricians which are to adorn the Electrical Building at the Columbian World's Fair in Chicago in 1893, we were surprised, nay, disappointed, to find that the respective officials left out the name of a man of science whose merits would fully entitle him to that honor. We mean Prokop Divis, the man who, before Franklin, discovered the identity of lightning and electricity, and the issuing of electricity from metallic points—two important truths which led him to construct a lightning conductor. But his modesty (he was a Catholic priest and a thorough scholar) and the ignorance of others combined caused his name nearly to be forgotten. The "Encyclopædia Britannica" knows nothing of him, while the German "Conversations Lexicon" of Brockhaus (vol. v., page 406) disposes of his two great discoveries exactly in two sentences. The only mention of him we find in English literature is a short sketch in the *Historical Magazine* for February, 1868 (page 93, article xii.), which is a translation from a French periodical. As the life of Divis is of itself sufficiently interesting, we hope to be justified in presenting a few more details of his life to the readers of this magazine. Our article is based chiefly upon a sketch in the Bohemian Encyclopædia of Rieger and Maly (vol. i., pages 209, 210, and vol. iii., page 941).

Prokop Divis (Dyiv'ish) was born on the 1st of August, 1696, in the town of Zamberk (its German name is Senftenberg), in Northeastern Bohemia, of Bohemian parents. At the gymnasium of Znojmo he received the rudiments of higher education, and afterward entered the Premonstratensian order at Luka. On November 30, 1720, he bound himself with the three monastic vows, and six years later took the holy orders. On account of his high scholarship, he was soon after appointed Professor of Philosophy in the Lyceum of Luka. A special feature of his lectures were various experiments in physics, with which, contrary to all precedents, he liked to illustrate the subjects discussed. It will be remembered that the Church has never looked with favor upon natural sciences. After a year had passed, Divis was obliged to change his subject and lecture on theology. He distinguished himself also in this new field, and accordingly, on the 5th of August, 1733, the University of Salzburg conferred upon him the degree of doctor of divinity.

He had been longing for an opportunity to devote himself to scientific research. His wishes seemed to be fulfilled when he was ordained parson of the parish of Prendice (Pren'dyitsch), a small village in Southern Moravia, near the city of Znojmo (Znaim on English maps). Here all his leisure was given to physical experiments; with especial care he studied the properties of water and fire (oxidation). In 1741 he became prior of the Lukan Convent, and consequently had to discontinue his scientific labors for a few years, as the duties of the new office required all his time. Besides, the Austro-Prussian war had just broken out,* and a double care devolved upon the shoulders of the new prior. Throughout the war Divis faithfully performed his duties, but as soon as peace was restored to Moravia he resigned his dignity and returned to Prendice to resume his favorite work. His parish was a small one, and thus Divis was enabled to spare time enough for scientific inquiries. He now entered upon an examination of electricity. Pursuing the safe empiric method, Divis based all his conclusions and estimates upon careful experiments. His observations of thunder storms led him soon to a discovery that lightning was but an electrical spark—that in his laboratory he could imitate thunder and lightning on a small scale—and he resolved to try if it were possible to make thunderbolts harmless. How thorough his studies were may be gathered from the fact that he worked out a complete theory of atmospheric electricity, a treatise on which was published from his papers after his death.

Another important discovery followed soon after. Divis found out that metallic points would both at-

*Charles VI., King of Bohemia and Hungary and Emperor of Germany, died in 1740, leaving his dominions to his daughter Maria Theresa. Frederick the Prussian thought this a good opportunity to rob the queen of some of her territories, and he immediately, without any right, and without even a declaration of war, invaded Silesia.

tract and discharge electricity more speedily than anything else, and proceeded to make a practical application of the newly discovered truth. About the same time Franklin, on this side of the Atlantic, was receiving his first lessons in electricity from Dr. Spence.

The fame of the electrical experiments of Divis soon reached the imperial court of Vienna, and the Emperor Francis Stephen, who was somewhat of an amateur naturalist himself, invited Divis to Vienna, to repeat his experiments in the halls of the imperial castle. These performances were also honored by the presence of the Empress Maria Theresa. The imperial couple were highly pleased with the experiments, and, to show their esteem for Divis, they presented him with two heavy golden medals with their busts engraved upon them.

In 1750 Divis demonstrated his superior knowledge of electricity in an amusing way. Father Francis, a learned Jesuit, was about to make some experiments with his electrical machine at the Vienna court. While he was making some preliminary remarks, the Bohemian scholar, who had concealed a number of small

FIG. 1.—THE TOP OF THE LIGHTNING ROD OF DIVIS.

iron nails in his periwig, approached the machine and viewed it closely from all sides, as though he were going to make a critical examination of it. His true intention was, however, to take away all electricity stored on the metallic balls, in which he succeeded without touching the machine. Imagine the horror of Father Francis when he finally came to perform his experiment, and found that, although his accumulators were well insulated, all his electricity was gone!

In 1753 Prof. Richmann, of St. Petersburg, while observing a storm from a hut, was killed by lightning descending an insulated iron bar specially erected for the purposes of the study. Upon learning of the fate of that martyr of science, Divis drew up a memoir on that unhappy occurrence, in which he demonstrated that the iron bars, as used by Richmann, were both unsafe and dangerous, and clearly showed how, in case of a storm, the danger of a lightning stroke could be averted by means of a conductor, the idea of which had already matured in his mind. This treatise he sent to the famous mathematician and naturalist, Euler, then President of the Berlin Academy of Sciences, asking for his judgment. But his application was in vain; the academy failed to understand his reasoning. This is one of the numerous instances which go to show that it is always the individual workers to whom we have to look for any advance in science rather than learned societies. When Franklin's account of his discovery was read in the British Royal Society, it was laughed at by the connoisseurs.

Divis was not discouraged by the cold reception with which his work had met in Berlin, but went on to construct his lightning rod. After all that was necessary had been prepared, the conductor was erected on the 15th of June, 1754, near the residence of the parson, for Divis, in order to avoid all risks, gave up the idea

FIG. 2.—A HORIZONTAL VIEW OF THE CROSS BARS.

of placing the lightning rod upon the building, but built it separately in the free field near the building. The lightning rod of Divis was constructed as follows:

A pointed, slender iron bar formed the main part of the machine. Fastened to it were two cross bars, thus making four arms, across each of which, in turn, a shorter bar was laid. And each of the twelve extremities so effected bore a box filled with shavings of iron in which twenty-seven brass needles were stuck, mak-