employing the regulation aerial wire for sending, the complementary apparatus using the horizontal wire.

The whole series of tests cannot here be cited in detail, yet the following will suffice to show in a measure the results secured. In one of the experiments the transmitter, having a spark length of about 2 cm. (¾ inch), was connected to a horizontal conductor 656 feet in length, supported at a height of 49¼ feet above the ground; the receptor was furnished with a wire of equal length 3¼ feet above the ground, and connected to one end of a magnetic receptor. Now, when the horizontal wires of both stations were in line, so that the maximum effects were obtainable, easily-read signals were heard at a distance of 25 km. (15½ miles). When the receiving wire was swung around to 12 deg., nothing could be heard even when the receptor was moved to within 12 km. (7½ miles) of the transmitter; and when placed within 5 km. (3.1 miles), the angles of the wires remaining unchanged, only weak signals were indicated.

In another trial the great Poldhu station with its vertical aerial was used for sending, and a receptor placed at Clifden, Ireland, 500 km. (310 miles) away, was provided with a horizontal conductor 754.6 feet in length, laid on the ground, and connected to one side of a magnetic receptor, the opposite side being grounded as previously explained. When the free end of the receiving wire pointed directly away from Poldhu, the signals were sharp and loud; but when the horizontal wire made an angle of more than 35 deg. with the line of Poldhu, the reception was absolutely *nil*.

In all of his experiments where the tests were made over considerable distances, Marconi employed his magnetic receptor; but where the distances were short, he utilized a Duddell thermo-galvanometer, since this delicate instrument permitted him to measure the current values of the electric oscillations set up in the receiving wires.

The horizontal wire, if it is proven to be anywhere nearly as effective as the usual aerial wire, will greatly reduce the expense of wireless telegraph installations, for the masts often cost as much or more than the instruments. The new arrangement will do much to further the commercial possibilities of this mode of transmitting intelligence if the mast can be eliminated, and the whole series of tests points to a new era of wireless telegraphy.

One of the noteworthy observations made by Marconi was that electric currents set up by distant atmospheric conditions can not only be detected, but the direction whence they originate determined; and this may mean that a new instrument is to be placed in the hands of the meteorologist. There are other aspects of the experiments which will be looked forward to with interest.

In the army and navy wireless telegraphy has proven an invaluable aid, and this has been due chiefly to the fact that messages could be sent and received over long distances, while the direction whence they came or whither they went was an impenetrable mystery to the enemy. Now all this is changed, and some extraordinary complications may be looked for. As a palpable problem it is a duplication of heavier armor plate, heavier guns; heavier guns, heavier armor plate, and so on to infinity.

THE MANUFACTURE OF TURPENTINE.

Turpentine or spirits of turpentine—to the old pharmacists everything volatile was a "spirit," thus "spirits of wine," alcohol—is a product of several varieties of pine tree, and the turpentines from the different species vary in their composition and properties. But in this country, or in the eastern three-fourths of it at least, we know but one kind, that produced from the yellow or long-leaf pine (*Pinus sylvestris*) of our southern seaboard and Gulf States.

When an incision is made through the bark of one of these trees at a season when the sap is flowing, a thick, clear, gummy juice exudes, and on exposure to the air gradually hardens into a friable but somewhat sticky mass. The odor of this juice, which in the trade is known as *gum thus*, or "virgin turpentine," is the characteristic turpentine smell, and its hardening is due to the evaporation of its contained turpentine, leaving behind its constituent gum resin or "rosin."

Formerly vast sections of all the States south of the Virginias and the Ohio and east of the Mississippi River were covered with immense forests of yellow pine, and during more than half a century these forests have been the chief source of supply for the turpentine and rosin consumed by the entire civilized world, with the exception of France, Russia, and eastern Europe, which are to some extent producers of turpentine for home consumption.

The effect of this immense drain upon our natural resources, coupled with primitive and criminally wasteful methods of production, has been to reduce the acreage of the pine forests from apparently exhaustless resources to a comparatively limited territory. A quarter of a century ago the principal center of the naval stores business ("naval stores" including turpentine, rosins, pitch and pine tree tar) was Wilmington, N. C. Later it gradually shifted to Charleston, S. C.; for a decade or more it remained at Savannah, Ga.; but during the past five years the Florida ports of Pensacola and Jacksonville have been slowly taking precedence. At the present time the "turpentine belt" is confined to the Gulf States. Though all the available territory in the adjoining States has not been exhausted, the end is plainly in sight unless the devastation can be checked.

The reason for this deplorable condition will be understood from a brief description of the methods commonly pursued by "turpentine farmers" in collecting the "crop."

The turpentine season opens in the early spring, when the sap begins to rise in the trees, and continues until late in the fall, when cold weather puts an end to the return flow. The turpentine farmer goes into the forest and selects a space containing the number of trees he proposes to work, and leases from the owner the acreage desired. Hiring the requisite number of negroes, he sets them to work "boxing" the trees. A few feet above the ground a shallow "box" or excavation is cut into the tree trunk, and above this box for some distance the bark is removed and the sap wood scarified. Often a second similar "box" is cut on the opposite side of the tree. The sap gradually exudes from the scarred surface or "face" and collects in the boxes, from which it is dipped out from time to time and collected at a central point. When the flow ceases or becomes sluggish, the face of the cut is scraped and rescarified to prevent the healing of the wound. During successive seasons the cuts are deepened and extended in height, until the tree dies from exhaustion or is blown over by a storm because of the weakening of the trunk.

Meanwhile, at some convenient central point in the "orchard," a crude still has been erected for the treatment of the collected sap. Into this still or series of stills the sap is charged, and live steam being passed through it, the turpentine passes over with the steam through a condensing "worm," and is collected as it drips from the condenser. The residue in the still is rosin, which after remelting and straining to remove twigs, leaves, and other impurities, is run while fluid into large rough wooden casks made on the spot. The sap from the first year's boxing produces the so-called "pale grades" of rosin, known in the trade as "water white" or "W. W.," "window glass" or "W. G.," "N.," "M," and "K" rosins. As the age of the "box" increases, the grade or color of the rosin deteriorates through the letters of the alphabet up to "D," "C," and "A" rosins, constituting the darkest and cheapest grades. This, roughly speaking, is the cause of the classification, though other influences help to determine the color and grade of the product.

Tar is made by a crude process of distillation applied to pine chips, twigs, etc., by direct heat, and is merely an occasional incident in the industry.

The product, both "spirits" and rosin, is sold largely to neighboring grocers and country storekeepers, either in exchange for supplies or for cash, and is by them shipped from time to time to the central markets, the principal "naval stores ports" being, in addition to those already named, Mobile, New Orleans, and Tampa. New York is also an important market, but the receipts at that port are all reshipments from southern ports.

From the foregoing outline of the methods pursued by the pine-forest devastators, with the added element of carelessness as to fires, it will be easily understood how the area of the long-leaf pine has in fifty years been reduced from millions of acres to hundreds of thousands. The government, through its Department of Agriculture, has lately intervened with an attempt to introduce more economical methods, by means of a simple device which is not only more efficient and cheaper than the old practice, but calculated to maintain the yield of sap indefinitely; but until the strict supervision of France, which enforces the replacement of the destroyed trees by new ones, is introduced, the extinction of our pine forests will be merely delayed, not averted.

Combinations of producers and factors or merchants have had some effect upon prices in recent years; but no combination, however effective, in an industry so widespread as this, could have raised the price of a product from an average level of from 25 to 35 cents to the present current prices for turpentine, which ranged in the past year from 55¾ cents to 79 cents per gallon; or of the pale rosins from an average of under $3 to $5 and $6; and of the low grades from a high limit of $1.50 to $3 or $4 or over. The end of American turpentine and rosins is in sight unless the waste be promptly checked.

The chief use of turpentine is in paints and varnishes, where it is employed as a volatile thinning agent. It evaporates very quickly, leaving no residue. It has the peculiar property of forming ozone, which is practically a condensed form of oxygen, and as oxygen is the cause of the drying of paints and varnishes, turpentine to this extent serves a double purpose. Its rate of evaporation also is slower than that of benzine and similar products, so that for most uses it is somewhat preferable on that account; but aside from purely technical advantages, it is doubtful if it serves any better purpose in paints and varnishes than is obtained from the use of benzine and similar volatile thinners. At any rate, a prepared paint or a varnish is not necessarily inferior because it is not thinned with turpentine, and it is becoming a very serious question with all manufacturers of such goods whether the time is not at hand when the consuming public will have to be educated to the use of benzine instead of turpentine in their products. The objection is in reality rather to the odor of the first-named product than to any lack of efficiency.

A NEW AND CHEAP PROCESS FOR GENERATING HYDROGEN.

Consul-General Frank H. Mason makes a report from Paris on a new process for producing hydrogen, as follows:

At a recent meeting of the French Academy the eminent physicist, Mr. Moissan, presented a report from Mr. Georges F. Joubert describing a new and thus far secret process for the manufacture of hydrate of calcium, a product which, by reason of its convenient fertility for the generating of hydrogen gas for ballooning and other purposes, is likely to play an important role in the field of applied chemistry.

It appears that the Société d'Electrochemie, at St. Michel de Marienne, has succeeded, like the Electrotechnical Company, at Bitterfield, Germany, in producing by electrical process calcium metal on a commercial scale and at a price so moderate as to permit its use for various industrial purposes.

The invention of Mr. Joubert consists in a process by which the reaction of metallic calcium upon a metallic salt produces the new form of hydrate of calcium, or, as it is commercially known, "hydrolithe." This resembles in appearance and qualities calcium carbide, with the difference that whereas the carbide with the addition of water evolves acetylene gas, the hydrolithe upon contact with water evolves hydrogen gas. When pure, 1 pound of hydrolithe will generate 18.46 cubic feet of hydrogen. When of the ordinary commercial grade of purity, 1 pound of hydrolithe will create 16.05 cubic feet of gas.

Its most ready and obvious use is thus far for inflating balloons for military and other purposes. It is safe and easy to handle, can be used for generating gas wherever water can be obtained, and for long flights can be carried as ballast instead of sand, and employed at will for refilling the balloon, which may thus be kept in flight almost indefinitely. As an illustration of the economy of weight that has been accomplished by the substitution of hydrolithe for the purposes of military balloon service, it may be stated that an ordinary field balloon contains, when inflated, about 17,657 cubic feet of gas, the generation of which by the means hitherto employed requires the employment of materials and apparatus which fill three wagons, each one of which weighs when loaded 3½ tons, and requires in a campaign to be drawn by six horses. All this cumbrous and costly equipment can now be replaced by a two-horse wagon carrying a ton of "hydrolithe," which, with the addition of water that can be obtained anywhere, supplies instantly and in controlable quantities whatever gas may be required.

A RUSSIAN GASOLINE-ELECTRIC TRAIN.

Experiments have been lately carried on at St. Petersburg with a train using a new system of gasoline-electric locomotive, in which a gasoline engine is combined with an electric motor outfit. The train is made up of six steel cars mounted on two double-axle bogies. The platforms are connected with the bogies by means of ball-bearing pivots. The gage of track is 30 inches and the wheel diameter 12 inches. The rails of the Vignole type weigh 12 pounds per yard. Each car weighs 0.7 ton, and the load is about 2 tons. At the head of the train is placed a car which is like the others on the outside, but it contains in the interior a generating set consisting of a German gasoline motor of 35 horse-power running at 800 revolutions per minute. To the motor shaft is coupled a Bergmann dynamo. The gasoline motor is of the four-cylinder type and has 5.6-inch bore and 6.4-inch stroke. Copper water jackets are used on the cylinders. Speed regulation is secured by varying the proportion of gas in the mixture. The dynamo is designed to furnish 142 amperes and 120 volts at a speed of 780 R. P. M. The weight of the gasoline motor is 0.4 ton, and that of the dynamo 0.8 ton, while the total weight of the locomotive car, including 40 gallons of water, is 2.3 tons. On each of the bogies of the cars of the train is suspended an electric motor, which drives the axle by a 1 to 5 reduction gearing. These motors weigh 110 pounds each, and they operate on a current of 60 volts which is furnished by cables from the dynamo in the locomotive car. The two motors of each car are connected in series. Their speed is 1,000 R. P. M. A four-conductor cable connects all the cars with the locomotive. The motorman can regulate the speed of the train by a controller placed on the front car. This new system is said to operate well.