THE DECOMPOSITION OF WATER AND ABSORPTION OF CARBON DIOXIDE BY CAUSTIC SODA.

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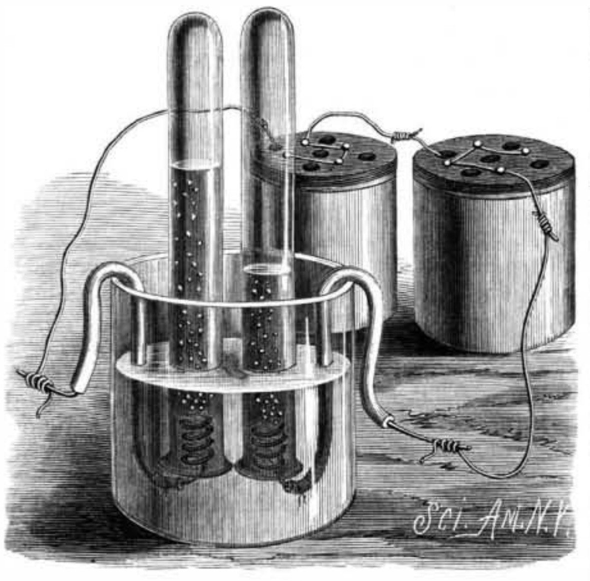
The apparatus generally used to illustrate the decomposition of water by the electric current consists essentially of two plates of platinum immersed in a vessel containing water acidulated with sulphuric acid. The object of the acid is to impart sufficient conductivity to the water, and platinum electrodes are used because they are not attacked by sulphuric acid. There are several objections to the use of this apparatus for general demonstrations. It is somewhat expensive, the platinum plates are extremely fragile, and are not easily connected with the wires from the battery. In the apparatus illustrated iron wire is used in place of platinum electrodes, and a solution of caustic soda is the electrolyte.



DECOMPOSITION OF WATER.

The two pieces of wire, which may be one-sixteenth to one-eighth inch in thickness, have one end bent into a spiral of about one-half inch external diameter. Over the rest of the wire a piece of India-rubber tubing is slipped, of such length as to leave about an inch exposed. At the end nearest the spiral the tube is tightly wrapped with a few turns of fine wire or even string, which is then secured. The electrodes are then bent as shown and hung over the edge of a suitable vessel. A couple of test tubes may be used to catch the gases evolved.

As caustic soda solution is an unpleasant substance when it comes in contact with the hands, the apparatus is best set up in the following manner: The cup is filled with water, and the electrodes are put in place. The test tubes are then filled, one at a time, also with water, and inverted over the electrodes in the usual way, their ends being closed by the experimenter's thumb. Next some of the water is removed by careful pouring, so as to leave the vessel but one-half full. Some strong solution of caustic soda is now poured into the vessel, and stirred or mixed with the water as well as possible. If the terminals of an active battery of sufficient voltage are now attached to the electrodes as shown, the water will be rapidly decomposed, and the hydrogen and oxygen gases evolved will rapidly collect in the tubes. In simplicity and cheapness this apparatus cannot well be surpassed, and on account of the very large surface of the electrodes its resistance is low, and the water is decomposed with very great rapidity. For purposes of demonstration it may be pronounced superior, all things considered, to the usual form with platinum electrodes passing through the glass.

A very interesting experiment illustrating the absorption of carbonic acid gas or carbon dioxide by a caustic alkali, and one that is susceptible of various modifications, is next illustrated. A strong bottle or a round bottom flask fitted with a tight perforated cork is required. A glass tube is arranged to pass tightly through the aperture in the cork, and a common India-rubber balloon is tied to the tube, the lower end of the latter passing within its neck. The tube now is in communication with the interior of the balloon. If one were to blow into the tube, the balloon would become inflated. A strong solution of caustic soda or potash is made, and when perfectly cold is poured into the flask. Some water is now poured very slowly and carefully down the side of the vessel, so as to collect upon and float over the heavy solution of alkali. This it will do in virtue of its lower specific gravity. The separation of the two fluids is evident on inspection. If, however, the experimenter is unwilling to risk this separation, he may use kerosene oil in place of water. The latter will inevitably float on the caustic alkali. The point to be attained is to have the solution covered with a second liquid which is without action upon carbonic acid gas.

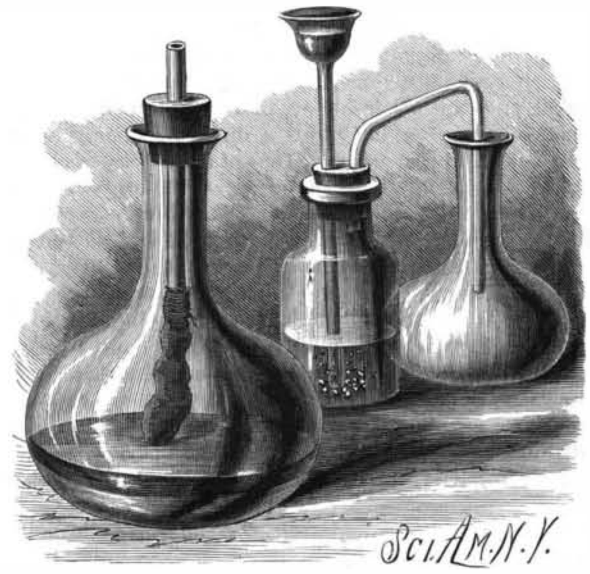
Carbonic acid gas is now evolved in the ordinary way from limestone and hydrochloric acid, or by any other method, and is conducted into the flask. Great care must be taken not to disturb the two layers of liquids in the manipulations.

When the flask is full, the conducting tube is lifted out, and the cork with empty balloon attached is placed in the neck as shown. The cork must fit accurately. Now the flask is shaken. The caustic alkali solution at once comes in contact with the carbonic acid gas and absorbs it. In an instant the absorption is complete, and under the influence of atmospheric pressure the balloon inflates and either fills the vessel or bursts.

It is not necessary to use a flask. Any transparent bottle may be used. It is necessary to have the alkaline solution cold before introduction, as otherwise it may crack the flask.

In general terms a chemical vacuum is thus produced, and it may be demonstrated by the height of a mercury column which it can support, or in many other ways.

The particular one described is particularly well adapted for demonstration, as it is very simple and demonstrative. The balloon should be so large that it will not burst, as the effect is better when it inflates and fills the vessel lying closely against its sides.



ABSORPTION OF CARBON DIOXIDE.

VIROT'S STEAM CARRIAGE.

The solution of no problem is more sought for than that of the mechanical traction of small vehicles on ordinary roads. Since the first reaction steam carriage, based upon the principle of the eolopyle, and proposed by Isaac Newton, in 1680, and the first steam carriage, constructed in 1769 by Nicolas Joseph Cugnot, and of which a second and improved model, constructed in 1770, still figures in the gallery of the Conservatoire des Arts et Metiers, at Paris, numerous experiments have been made with a view to the application of mechanical traction to ordinary carriages. The solutions proposed or experimented upon may be classed in two distinct groups. One of these includes apparatus in which the energy is produced by thermic generators, in measure as needed, by converting heat into work. This group includes steam apparatus in which the fuel is coal, coke or petroleum, and certain newer apparatus in which the heat of combustion is utilized directly without passing through the intermedium of the steam boiler. In a recent patent, Mr. Debriat even proposes, under the odd name of the "imponderable dynamophore," a powerful and light powder motor in which the explosion is produced by an electric spark!

The second group belongs to the class of reservoirs or accumulators, a system in which a supply of energy, known and prepared in advance, is carried under the form of compressed air, hot water, taut springs, or electric accumulators.

Compressed air, and, *a fortiori*, springs, constitute poor reservoirs of energy, as regards specific power, but the future seems open to electric accumulators, which have not yet had their last say.

Our preferences are for a powerful and light accumulator completed by a pile of great capacity, but of feeble discharge, that will keep the accumulator constantly charged, even during periods of rest. Two qualities, power and duration, which are not met with in combination in any known apparatus, would thus be united.

VIROT'S STEAM CARRIAGE.

Whatever be the solutions of the problem in the future, those of the present are oftenest made in view of the utilization of thermic motors, under the form of a furnace that heats a steam boiler which itself supplies the steam cylinder.

The annexed figure represents one of the most recent types of steam carriages. It was constructed by Mr. Virot, head machinist at the Central School of Lyons.

The carriage is actuated by two motors that drive the hind wheels through the intermedium of gearing. In front there is a steering wheel maneuvered through a hand lever. The boiler is of the Seguin type. Twenty minutes suffice to put it under pressure. The speed of the carriage is 9½ miles per hour, and it is capable of ascending gradients of 1 to 13 without difficulty. Behind, there is room for three persons, inclusive of the engineer. It is capable of hauling a load of 2,640 lb. As for the consumption of fuel, that does not exceed four pounds to the mile. With a tender supplied with water and fuel, the carriage is capable of making lengthy trips.

While we do not think that Mr. Virot's apparatus definitely solves the problem of the traction of small vehicles upon roads, it has seemed to us well to present this tentative to our readers, with the object of encouraging researches and of showing the state of the question.—*La Nature.*

The Colors of Twilight.

Prof. Constantini Rovelli has recently published, in the *Revue Scientifique Industrielle*, a study upon the colors exhibited at twilight, according to the state of the air.

Red and orange tints predominate when the air is dry. On the contrary, yellow, and especially green, characterizes air charged with vesicular vapor.

Prof. Rovelli studies the colorations of the air and their successive modifications in various cases and in the various parts of the crepuscular region, in measure as the sun disappears from the horizon. He likewise studies the same phenomena at the advent of "aurora with rosy fingers," and from them draws conclusions based upon the theory of the colors of the solar spectrum. Observation has already shown that the warmest colors of the spectrum predominate during a period of fine weather, while a yellow tint, followed by a greenish twilight, is the index of great humidity.

On another hand, we may consider the atmosphere as formed of two strata, the lower of which contains clouds and dust and the upper of which is more transparent. These two strata, as regards their refrangibility and absorption, behave differently in the presence of the rays that traverse them. From this Prof. Rovelli concludes that the crepuscular green is the precursor of rain; and, on the contrary, that a rosy twilight announces fine weather, according to the saying: "Rosso di sera; buon tempo spera." Let us compare with this adage the one current in Provence: "Roudgé dé matin, ploou sü lou vesin," *i. e.*, "red in the morning, rain is approaching."

Chemical Misnomers.

An editorial in the *Popular Science News* recites some of the curiosities of names of chemical compounds, which, when their inappropriateness is considered, appear extremely ludicrous. Thus: Oil of vitriol is no oil, neither are oil of turpentine and kerosene. Copperas is an iron compound, and contains no copper. Salts of lemon is the extremely poisonous oxalic acid. Carbolic acid is not an acid, but a phenol. Cobalt contains none of that metal, but arsenic. Soda water has no trace of soda, nor does sulphuric ether contain any sulphur. Sugar of lead has no sugar, cream of tartar has nothing of cream, nor milk of lime any milk. Oxygen means the acid maker, but hydrogen is the essential element of all acids, and many acids contain no oxygen. German silver contains no silver, and black lead no lead. Mosaic gold is simply a sulphide of tin. This list might readily be extended, both in chemistry and other natural sciences, and it is only fair to state that these terms all come from the older writers, and tend to give way to a more scientific nomenclature.

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The Best Material for Propellers.

At a recent meeting of the Institution of Naval Architects, Mr. W. C. Wallace read a paper on the above subject, in which he gave the following conclusions:

Taking the life of cast iron blades at about six years and steel at four years, a steamer of 5,000 tons having four propeller blades of the joint weight of 12 tons, if of cast iron, an expenditure at the rate of 192*l*. per four years for cast iron and 396*l*. for steel would be required. On the whole, the author leans toward cast iron. Turning to a comparison of steel and bronze, there are three matters claiming attention: 1. The larger coal bill with steel blades. 2. The necessity of renewal of steel on account of pitting and corrosion. And 3. The possibility of having to renew bronze blades on account of failure from no immediate ostensible cause. It has been said that for the same speed 4 per cent difference of power in favor of manganese bronze may be expected. Allowing the same difference to apply to the comparison of steel and the other alloys, in a 5,000 ton ship, with a coal consumption of 50 tons a day, this 4 per cent difference of power means 2 tons of coal a day of a mean value of, say, 2*l*. This in four years amounts to 1,200*l*., which should be added to the 396*l*., which is, as stated, the price of steel blades. Therefore, 1,596*l*. is the disbursement in connection with steel blades every four years. The price of gun metal blades for the same steamer would be obtained by multiplying 144 by 12, the weight of cast iron blades. This comes to 1,728*l*. each time the gun metal blades are renewed. If renewal took place at intervals of $4\frac{1}{3}$ years, the disbursement for gun metal blades would be identical with the disbursement for steel over the same period. This is neglecting the charge for docking and the cost of zinc.

Making similar calculations for the other alloys, and tabulating the results, it appears that economy in the use of the alloys would be the same as that of steel if on an average one blade had to be renewed every

13	months for	gun metal.
11	" "	manganese bronze.
14	" "	phosphor bronze.
10	" "	delta metal.
12½	" "	aluminum brass.

It will be seen that the two things which tell against steel are the necessity for the renewal of blades every four years and the extra coal. In strength, mild steel is superior to all other materials, and the author was informed by the Cowles Electric Smelting Company that its strength and soundness can be greatly improved by the addition of mitis or ferro-aluminum. It was also stated that something had been done in improving the strength of wrought iron by the addition of mitis, making it fusible and readily cast.

The discussion on this paper was opened by Admiral Colomb, who stated that he had seen propeller blades scored and pitted on the back surface. These marks generally took a direction radial to the boss.

Mr. Hall, of Messrs. Jessop & Co., of Sheffield, said that the chief objection to steel blades was the corrosion referred to. As a steel maker, he was sorry to be obliged to confess that in this respect steel was worse than cast iron. He wished to refer to what might be a possible cause of this pitting. Some time ago he took out of working four boilers made from hard steel plates which had been in work twenty-four years. Iron rivets had been used, and the plates near the rivet holes were gone. He had thought that the iron rivets abstracted the carbon from the steel, and possibly the same action might take place between the steel propeller blades and the iron stern frames of the ship. For this reason he had suggested cast steel stern frames. But he thought that there might be a further cause for the pitting of propeller blades. The corrosion was mostly found on the idle side of the blade, and it might be that air was drawn down through the water to fill the vacuum formed by the water not being able to follow up the blade sufficiently quickly, and corrosion was thus set up. If this were the case, it would be no good making these blades of softer metal. The author had given 31 to 32 tons steel, but the speaker would go to very far higher tensile strength, and this could be got with about 10 per cent elongation and a good bend. It would not necessarily be carbon that would be used to get the tensile strength, for there were other alloys that could be used with greater advantage for the purpose. The author had said very little about steel alloys, but Mr. Hall was of opinion that an alloy of steel would not corrode when used for propeller blades.

Mr. F. C. Marshall said that if any one could discover a method of producing non-corrodible steel blades he would make a large fortune. The problem had been engaging many minds for a long time past, but the difficulty had not been overcome yet. It was pretty generally accepted that air gets down to the back of the propeller and causes the pitting. As to what Mr. Hall had said, there was no doubt that deterioration more readily takes place in soft than in hard steel. Ship builders have used the soft Lowmoor iron for rivets, and found it gave rise to the trouble from pitting far more than did the commoner and harder brands. He thought it strange that the paper had not made more reference to mitis metal, and thought it would be extensively used in future, for it was wonderful what could be done with it. He would be glad for some information as to the strength of this metal. He was well acquainted with its remarkable ductility.

Mr. G. W. Manuel, superintendent engineer to the Peninsular and Oriental Steam Navigation Company, said that he would give some details from actual practice. In 1880 they had much trouble from ships breaking off the cast iron blades of propellers in going through the Suez Canal, and from the loss through failures in manufacture, and also from corrosion, by means of which the blades became blunted. In order to get out of these difficulties they had recourse to steel, using a very ductile metal supplied by Vickers. Blades made from this would bend when struck, and this settled the breakage problem. But they found the corrosion was greater with steel than iron. In order to meet this difficulty, soft brass plates were put on the surface of the part corroded, being attached by screws. Latterly the plates were let in flush, great care being taken in fitting them. This plan was so far successful that the plates would sometimes last six years, sometimes only three years. The average efficiency was four years. They next made a sheathing of brass to lap over the blade, and thus form a cutting edge. Propellers fitted in this way were still running. On the whole, though, it was concluded that steel was not the right material, and about this time manganese bronze came into the market. They hesitated in adopting this alloy, because they had heard of a good many breakages of blades made from manganese bronze. On inquiry he found that the failures had been in blades not made by the Manganese Bronze and Brass Company, Mr. Parsons, the manager, informing him that none of their metal had given way. It was, therefore, determined to give the metal a trial. The following are some of the results obtained with one of the company's vessels, the Ballarat, on an Australian voyage from England and home again:

	Speed.	Coal per day.	Indicated horsepower	Slip of Screw.
		Tons.		Per cent.
Steel blades	12·11	63·8	2,828	13·1
Bronze	12·35	55·0	2,577	9·7

The diameter, pitch, and surface of the propeller were the same in both cases. The figures are a mean for the whole voyage, and show an increase of 0·24 knot per hour, and a saving of 8·8 tons per day in favor of the bronze blades, or a total saving on the voyage of 715 tons. The displacements and weather were alike on each occasion. The company then determined to fit manganese bronze blades to one of two ships then building, the Victoria and Britannia. The following is a comparison of the trial trip results:

Ship.	Material of propeller.	Steam.	Revolutions.	Indicated horse power.	Speed.	Displacement.	Slip.
							p. c.
Victoria....	Manganese bronze	146	63	6,084	16·52	8,124	8
Britannia....	Steel..............	146	64	6,203	16·47	8,040	10

The propellers of both vessels were alike as regards diameter, pitch, and surface. The results of the various trials were to impress the speaker with the fact that manganese bronze propellers were more effective than those of steel. He thought one great advantage with manganese bronze was the thinner edge that could be got. He did not place so much value upon thinness in the central part, as when their cast iron blades broke they thickened them two inches, and got the same speed with the same power.

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Natural History Notes.

Reproduction of Parts of Plants.—Prof. F. W. C. Areschony explains, in the *Botanisches Centralblatt*, the tendency of some parts of plants to produce leaf buds and stems, and of others to produce roots, or, of the same parts, sometimes to produce leaf buds, at other times roots, by the hypothesis that leaf buds are produced by those parts where there is a larger accumulation of nutrient material, roots by those parts where the supply is smaller, stems requiring a larger amount of nutriment than roots in consequence of their larger size and greater complexity of structure. This is illustrated by the well known fact that in trees the strongest branches always spring, not from the lower, but from the upper part of the previous year's shoot, where there is a larger supply of nutriment. Again, leaves in which the supply of food material is limited can, as a rule, produce adventitious roots only; but occasionally leaf buds on their basal portion.

Effect of Violet Rays on the Development of Flowers.—Prof. Sachs, the celebrated German botanist, has discovered that the ultra-violet and invisible rays of the solar spectrum especially promote the development of flowers, the growth of which is exceedingly feeble when the rays are suppressed, although that of the other parts of the plant is very luxuriant.

Sieve Tubes.—In a paper on the obliteration of sieve tubes in the *Laminariæ*, published in the *Annals of Botany*, Mr. F. W. Oliver gives it as his opinion that the callus or thickening of the sieve plates in plants is formed, as suggested by Wilhelm and Janczewski, by an alteration of the cell wall, and not from the contents of the cell. Although in the foreign genera *Macrocystis* and *Nereocystis* true sieve tubes very like those of *Cucurbita* are met with, yet in the majority of the *Laminariæ* sieve tubes are represented only by narrow tubes known as trumpet-shaped hyphæ, in which the callus extends up the sides of the cell wall and is not restricted to a thin plate-like form. Mr. Oliver has been fortunate enough to meet with an instance in which the mode of formation of the callus is shown in different stages of development, the walls of the tubes presenting callous degeneration at intervals. The callus of *Laminaria* was found to agree with that of flowering plants in its micro-chemical reactions, and may be regarded as chemically the same substance.

Milk and Butter Trees.—The rich and little known vegetation of Upper Senegal and Upper Niger includes curious forest specimens whose fruit or sap furnish men with food products analogous to milk and butter. In the first place, we may mention a sort of oak called the *karité*. This tree bears fruit somewhat like that of the horse chestnut tree, and having a white and compact flesh. These nuts, dried in a furnace and then decorticated, are crushed and powdered, and the resulting pasty flour is put into cold water. This forms a white substance of buttery aspect, which rises to the surface of the liquid, and which, beaten and pressed, constitutes a sort of butter which the natives use as a food. Commander Gallieni, who has studied this substance and its production *in situ*, considers it very nourishing, and thinks that it might also be used for making soaps and candles analogous to those manufactured from paraffine.

In Venezuela, the *karité* has a vegetable competitor in a tree of another species, the *tubayba*. In this case, it is the abundant lacteous sap of the tree that is utilized. This is collected by the natives by simply making an incision in the bark. According to explorers, the milk of this tree is fatty, has an agreeable odor, and is nutritive. Perhaps the most remarkable of these milk trees is found in the forests of British Guyana. The pith and bark of this tree contain so large a quantity of sap that the least incision made in the surface causes the valuable liquid to flow. The natives hold it in high esteem as a food. This product, called *hya-hya*, not only resembles milk in appearance, but also in unctuousness and taste.

The Smallest Plant in the World.—The smallest flowering plant in existence is *Wolffia microscopica*, a native of India. It belongs to the natural order Lemnaceæ, or the duckweed family. It is almost microscopic in size, destitute of proper stem, leaves and roots, but having these organs merged in one, forming a frond. There is, however, a prolongation of the lower surface into a kind of rhizoid, the purpose of which seems to be to enable the plant to float upright in the water. The fronds multiply asexually by sending out other fronds from a basilar slit, or concavity, and with such rapidity does this take place that a few days often suffices to produce from a few individuals enough similar ones to cover many square rods of pond surface with the minute green granules.

But small as these plants are, and simple in their structure, they yet produce flowers. Two flowers are produced on a plant, each of them very simple, one consisting of a single stamen, and the other of a single pistil, both of which burst through the upper surface of the frond. There are two species of this genus growing in the Eastern United States, one of them, *Wolffia Columbiana*, about 1-25 of an inch in diameter, and the other, *W. Brasiliensis*, somewhat smaller in size. The American species has been collected near Philadelphia.

Subterranean Fishes.—In the Algerian Sahara there are numerous subterranean lakes in which a number of small fish and mollusks live and multiply. Moreover, the artesian wells of the Sahara often throw out fish that are sometimes two inches in length. The governor of the oases of Thebes and Garbes, in Egypt, in 1849, asserted that he took from an artesian well 440 feet deep, near his residence, fish in sufficient quantity to supply his table.

Fauna of the Tomb.—Concerning this subject, Mr. P. Megin said at the meeting of November 14 of the French Academy of Sciences: "It is generally believed that the buried cadaver is devoured by worms as in the free air, and that such worms grow spontaneously. We know, however, that these so-called worms are the larvæ of insects which arise from eggs deposited upon the cadavers. They consist of diptera, coleoptera, lepidoptera, and arachnidæ, and we find that the time chosen by these organisms for the depositing of their eggs varies in accordance with the degree of decomposition undergone by the cadaver. The time varies from a few minutes to two or even three years after death; but the period of appearance is so regular and constant for each species that we may, by an examination of the debris which they leave, decide upon the age of the cadavers, that is to say, ascertain with accuracy the time of death.

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