PROPULSION OF BALLOONS BY ELECTRICITY.

(*Continued from first page.*)

the electrical energy supplied to the machine by the formula—

$$W = \frac{E\ I}{9{\cdot}81}$$

(W representing the work in kilogrammeters; E, the difference of potential at the terminals of the machine in volts; I, the intensity of the current in amperes) and in the determination of the mechanical work produced by the motor by making it absorb this work by the dynamometrical balance of M. Raffard. The electrical energy was measured by the aid of an ampere meter and a volt meter of M. Marcel Deprez.

Comparative measurements made by means of the volt and ampere meters of Messrs. Ayrton and Perry, constructed and graduated in England, gave results which agree perfectly with those given by the apparatus of M. Deprez, constructed in France by the Maison Breguet.

The experiments showed that, when the machine works with a current of 45 amperes and 40 volts at the terminals, *thirty per cent* of the total energy supplied was absorbed for the maintenance of the magnetic field in the inductors. By exciting the inductors separately it was found that 32 amperes sufficed to saturate them. There was therefore a real *waste* of energy for the production of the magnetic field, which was diminished by omitting one layer of wire on the inductors. This modification allowed of working under the same conditions of work and velocity with fewer elements, and consequently with a better return.

The Source of Electricity.—M. Tissandier thought, in his first experiments, of using electrical accumulators, but this source presents, at least for this particular application, the inconvenience of not discharging itself rapidly enough—that is to say, of only furnishing a weak delivery. It is necessary, in fact, that in a period varying between two and three hours, the source of electricity should furnish all of which it is capable, and from this point of view accumulators are found inferior to bichromate batteries. After a minute investigation, and a long series of experiments upon the nature of the liquid, the form and nature of the cells, the size and thickness of the plates of zinc and carbon, their number, etc., M. Tissandier devised a type of bichromate batteries with concentrated liquid, which, with a weight of seven kilograms per element, can furnish a current of 50 amperes for two hours, the electromotive force being about two volts, and the internal resistance not exceeding 0·01 of an ohm. The elements established in the aerostatic laboratory of M. Tissandier at Point du Jour are 24 in number, and arranged in four series of six elements each (Fig. 3). We are indebted to *La Nature* for our engravings. The liquid required to fill each series is placed in a copper tank coated with lead communicating, by means of a ramified tube, with the ebonite boxes which serve for receptacles. By raising one of the tanks by the aid of small pulleys, we can fill the corresponding series, and put it in action immediately; on lowering it the liquid runs off, and the series is emptied.

A commutator varies the number of series which actuate the motor, and a volt and ampere meter show at every moment the electrical energy supplied. The machine is suspended to a longitudinal beam by cords; the screw is fixed upon the lower axis; the static effort exerted by the rotation of the screw is measured by the aid of a spring balance attached at one end to a fixed point, and at the other, by a thin metallic wire and a swivel, to the extremity of the revolving arbor of the screw. Precautions are taken that the center of gravity of the machine may remain always in the vertical plane passing through the points of suspension, in order that the horizontal component due to the inclination which it might take without these precautions may not influence the indications of the balance. In Fig. 1, S is a tank containing solution of bichromate of potash; P, batteries; C, commutator; A, ampere meter; V, volt meter; M, dynamo: H H', screw; E, swivel; D, balance.

The screw constructed from the plans of M. Tatin is 2·85 meters (9½ feet) in diameter, and has a pitch equal to its external diameter; it is formed of two blades made of silk varnished with gum lac, stretched upon a frame furnished with two spokes of pine, with laths of the same wood, and an axle box fixed upon these laths. With 12 elements in series the screw turns at the rate of 80 revolutions per minute and exerts upon the balance a pull of five kilograms; with 18 elements the speed is 120 revolutions and the pull seven kilograms; with 24 elements in series the speed of rotation reaches 150 revolutions and the pull nine kilograms.

It results from the experiments that the motor, without exceeding, with the generator, a total weight of three men, is capable of furnishing regularly during a period of three consecutive hours the work of 12 to 15 men, that is to say, 75 to 100 kilogrammeters. This motor only requires, for raising it in the air with two or three travelers, a balloon of the small capacity of about 900 cubic meters. An elongated balloon of about nine meters diameter in the center, and 27 meters length, constructed of silk, inflated with pure hydrogen, is amply sufficient. Under the action of the propeller such a balloon would have in calm air a velocity of about four meters per second, or 15 kilometers per hour in round numbers. Very often the speed of the wind in calm weather is below this figure; in this particular condition of the atmosphere, this balloon could deviate sensibly from the line of the wind, go backward or forward, and perhaps return to the place of its departure.

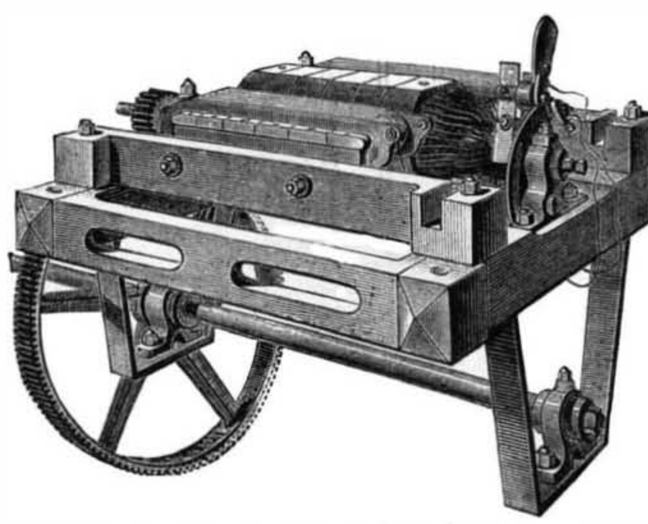
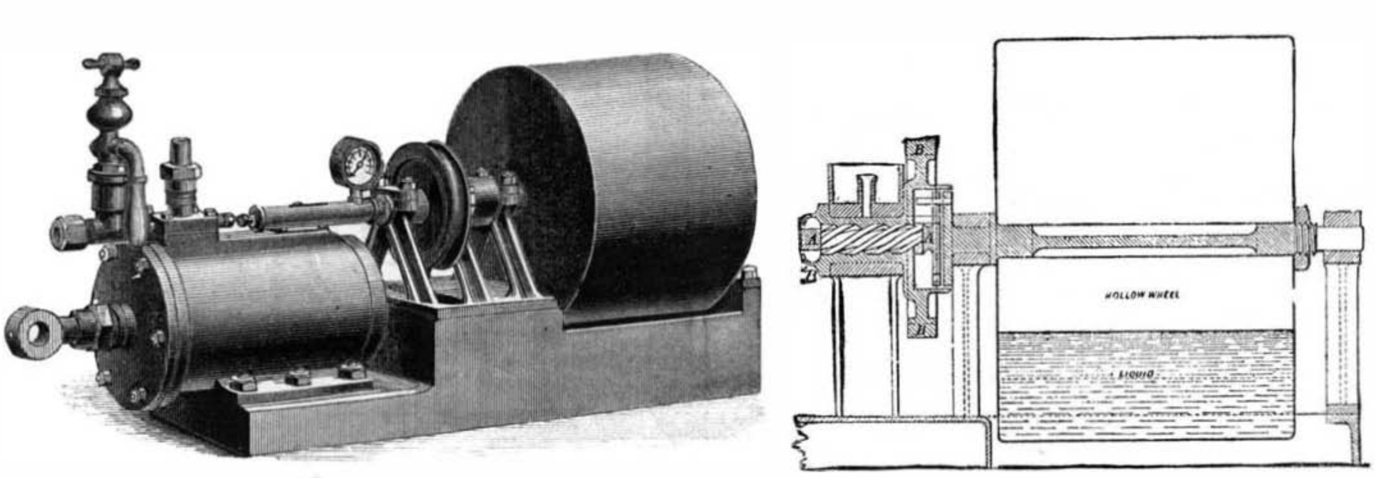


Fig. 2.—SIEMENS DYNAMO-ELECTRIC MACHINE.

M. Tissandier, satisfied with the results furnished by the batteries and motor, which present all the desired lightness (of course the system disposed under the balloon would be arranged quite differently to the battery in the experiments which we have just described), is busy with the construction of a pure hydrogen gas apparatus capable of furnishing 1,000 cubic meters in a few hours; he will then construct an elongated balloon to receive the screw and its electromotor.

THE ISOMETRIC GOVERNOR.

We annex engravings of a governor devised by Mr. Girdwood, and to which the name of isochronometer has been given. Its action, like that of some previous governors, is based upon the use of an appliance that offers a resistance to rotation that is a function of the speed, and increases with the velocity. This appliance consists in this case of a hollow drum or cylinder partly filled with fluid and rotating on a horizontal axis. When the cylinder is put in motion, the liquid is carried up one side to a height that is determined by the speed, and, if the motion be uniform, it will remain at that point, and will offer a resistance to the rotation which increases in proportion to the lateral displacement of its center of gravity. Should the speed increase, the liquid will be raised still higher, its center of gravity will be carried further to one side, and it will offer an increased resistance.



THE ISOMETRIC GOVERNOR.

These varying resistances are balanced by a spring which responds to them by contracting and expanding, and in so doing gives the motion for operating the governing mechanism. As will be seen from the illustrations, which we find in *Engineering*, the cylinder spindle ends in a crank disk provided with a driving pin, which engages with a similar disk at the end of a screwed or rifle spindle, A. This spindle fits in a corresponding nut formed in the boss of a driving pulley or wheel, B, and abuts at its other end against a spring arranged in a case, and provided with an index and scale. When the wheel, B, is turned, its first tendency is to force the screw, A, endwise to the left, compressing the spring, but the moment that the latter opposes a sensible resistance to its motion, the screw begins to rotate with the wheel and to carry the hollow cylinder round with it. As the speed increases, the resistance of the wheel likewise increases, and the spring is more strongly compressed, there being a certain definite pressure upon it for every velocity. A rod connected to the spring is attached to the slide valve of a small steam cylinder, the piston of which works the throttle valve of the engine that is to be regulated. The valve is designed so that an extremely small motion opens the cylinder either to the steam or the exhaust, and thus comparatively minute changes of engine speed are sufficient to cut off the steam.

The Inventor.

Now we do not for a moment expect to revolutionize the world, or to be successful in eliminating selfishness from the catalogue of shortcomings which afflict the human race, says the *Manufacturers' Gazette*, but we do desire to put in a plea for the inventor, the man of genius, the man to whom we are so largely indebted for the great progress made in nearly every department of human affairs, and to urge a more liberal and generous recognition of his merits. It is no new or uncommon thing for some men to ride to fortune on the brains and genius of others, and, where the arrangement is mutual, we do not object; but when, in good faith, the man who has given ceaseless study and thought to perfect and make practical an idea which will simplify some process, increase the quantity and improve the quality of some article of manufacture, unites his fortunes with the man or men of means in order to bring such improvement before the public, and is mercilessly "swallowed up," "bought off" with a pittance, or "cleaned out" by false representations, it is time at least to enter a protest and to ask men to apply the golden rule in these cases.

We are not quite sure but that most of the blame belongs to the inventor himself, for if a man possesses the genius and brains to do something that no other man has done, solving problems which start the world ahead a point, and thus becomes a benefactor, he has no excuse for being swindled with his eyes open, save the excuse of poverty, and even then, if his invention bears unmistakable evidence of merit, poverty need not be a stumbling block, for good goods always sell at a fair market price, and there are always purchasers. There are tempting allurements certainly, and it is not infrequently the case that to a poor inventor a dollar (and much more so a hundred or a thousand) looks as "big as a cart wheel," and throws him unsuspectingly off his guard, and before he knows it he is "gone." Don't be too quick or anxious to give up a good thing for a song, and thus have cause to repent at leisure. We earnestly hope, adds the *Gazette*, for a reform in this matter, that this class of benefactors may have their just deserts.

Lime Juice in the Treatment of Diphtheria.

M. Czartoryski, M.D., of Stockton, California, writes as follows to the London *Lancet:*

During a prolonged residence in the interior of China, I became acquainted with the fact that the Chinese place great reliance during epidemics of diphtheria on the internal use of the fresh juice of limes, and of the fruit itself, which they consume in enormous quantities, in every conceivable form—as lemonade, with native spirits, cut in slices, etc.—during attacks of this dreadful disease, with apparently most successful results, it hardly ever failing to effect a cure. The Chinese consider it a specific, and will, in case of need, do anything to obtain a supply.

Since I have come back to California, as also in Louisiana, I have used limes and their juices in my practice as a physician with most successful results in cases of diphtheria, even in the most desperate cases. As soon as I take charge of a case of diphtheria, I order limes to be administered as freely as possible, in any manner the patient can be prevailed upon to take them, especially in the form of hot lemonade, sweetened with white sugar or honey, or cut in slices with powdered white sugar. Besides lime juice (which I suppose acts by imparting an excess of oxygen to the circulation, and thereby prevents formation of vibriones, etc., and so has almost a specific effect on disease), I prescribe whatever drug may be indicated to relieve symptoms as they develop, and impart strength by appropriate stimulants and nourishment.

RECENT tests of yarn made from different hemps gives the following relative strengths: Manila, 245; Italian, 221; New Zealand, 143; Russian, 128. Manila is evidently the yarn to be hanged with.

Solid and Liquid Illuminating Agents.

Mr. Leopold Field, F.C.S., lately lectured before the Society of Arts, Adelphi, on "Solid and Liquid Illuminating Agents." There was a large display of exhibits and illustrative diagrams. The lecturer began by saying that the electric and gas lights, brilliant though they were, left something to be desired. The one was unsteady, the other injurious to pictures and books. The candle and oil lamp to a great measure supplied the deficiencies of the larger lights, and these would form the subject of the lectures. Mr. Field then proceeded to give a slight outline, illustrated by elaborate tabular views, of the scheme of the hydrocarbons, and their derivative alcohols and acids—marsh gas represented the paraffines; ethylene the oleofines; and acetilene might be called the taproot of the whole, as it might be formed by the direct union of carbon and hydrogen, and again reunite directly with hydrogen to form olefiant gas, from which again the paraffines and alcohols could be got by simple action. All the above were shown and descanted upon. The fatty acids were the most important series at present, as nearly every animal and vegetable combustible contained one or more of them, free or combined as an ethereal salt or glyceride. The lecturer then proceeded to give a rapid sketch of the history of lighting. The fire had always been associated with divinity, and the custom of celebrating great festivals with lights was handed down from the remotest ages, as in the old Roman Lupercalia, changed by Pope Gelasius into Candlemas. The earliest light was probably the torch, which led to the candle. Various torches were exhibited, one nearly eighty years old, disinterred from the cellars at Lambeth. These would, by degrees, grow smaller, and at last assume a suitable size for domestic purposes, in which state they were used by many nations, who surrounded a simple strip of tow, cotton, rush, or wood with bitumen, ozokerite, pela, wax, or tallow, as the case might be; some even drew a wick through the body of the gannet. But, though from a passage in "Apuleius" it is evident that candles both in wax and tallow formed part of the domestic light of the Romans, these were confined entirely to the lower classes. Strips of pine formed the street lights, and lamps illuminated the house. These gave scope for every variety of ornamental design, and were sometimes marvelously beautiful, as in the great golden lamp of the Erecthium, which burnt for a whole year, and that of Cortona, which had sixteen nozzles most exquisitely carved. Mr. Field quoted several authorities to show that candles were regarded as out of date and vulgar by the Romans, and gave it as his opinion that wherever candlesticks and candles are mentioned in Holy Writ and elsewhere oil lamps are to be understood. The substance burnt and the wick varied. The former was generally olive oil, the latter a kind of cotton, though in many countries doubtless other vegetable and animal oils, and in some, as Egypt, naphtha and bitumen fed the flames. There was, however, no appliance, even among the wealthy and refined Romans, for checking the smoke, not even a chimney; nor was the wick supplied constantly, having to trust entirely to its capillary attraction. In fact, with the exception of a few slow improvements in candle making—such as that of mould candles by the Sieur de Brog, drawn tapers by Pierre Blaisenier, and a few modifications in the process of dipping, the art of lighting might be said to have stood still till the inventions of Argand in lamps and Chevreul in candles gave it an impulse which had steadily increased.

Inventions to Prevent Fires.

Until some new and cheaper material than timber for building purposes is discovered, or until all the trees in the land are cut down, it seems probable that inflammable materials will continue to be used for building purposes. The demand for improved means for the prevention of fires becomes every day more urgent, and there should be increased study on the part of inventors to find out and make known new and better ways to prevent the ravages of flames. Among recent inventions in this direction we give the following from *Engineering:*

The latest fireproof paint is the invention of Mr. C. J. Mountford, of Birmingham. This consists of asbestos ground and reground in water, aluminate of potash or soda, and silicite of potash and soda. When it is to be exposed to the weather, it is combined with oil, driers, and gummy matters, and in some cases with zinc oxide or barytes. The buildings of the Fisheries Exhibition in the Horticultural Gardens are to be painted with this material. On two sides of the ground are valuable collections of works of art and scientific objects, while on the third side is the Albert Hall. Over the way, too, is the South Kensington Museum, containing the vastest assemblage of objects of decorative art ever amassed, and it requires little acquaintance with government officials to know that their consent could never have been obtained to the erection of light timber buildings covering 230,000 square feet if they had not been convinced that there was a method by which they could be rendered fireproof.

A public trial was lately made in the gardens before fifty gentlemen to demonstrate the security of the buildings. Two wooden huts, one of plain timber and one painted with three coats of asbestos paint, were filled with shavings and simultaneously ignited. The first caught fire at once, driving the spectators backward by its heat and the extent of its flame, while in the second the shavings, after a hearty blaze that scorched and blistered the paint, fell into a heap of red embers. Half a bucketful of petroleum flung into the hut filled the inside with a fierce flame that belched forth in a solid body and curved on to the roof, and for a few minutes it was the opinion of the on-lookers that the confidence of the inventor had overleapt itself. But gradually the petroleum vapor became exhausted and little flame remained beyond that of the gas driven out of the cracks of the wood by the intense heat. The structure was intact, and it needed no special skill to see that a slight building filled with combustible material would, if painted with asbestos paint, be able to retain the fire within itself for sufficient time to allow of the arrival of the firemen. But the reputation of the paint does not rest upon an isolated experiment; not only in London, but also in Birmingham, Manchester, and Liverpool has it been severely tested, and every time successfully. Asbestos has now established its character as a fire-resisting material, and we think that a grave responsibility will attach to all that have the management of buildings in which special risks are run, such as theaters, music halls, carpenters', and packing-case makers' shops, and the like, if they fail to avail themselves of it in some form or other.

But although it may be possible to localize a fire for a time, our experience of the way in which the flame will destroy a building almost entirely of iron and stone forbids the anticipation that the use of fireproof materials will be of sufficient avail by themselves. Once a structure is fairly alight, stone and cement crack and fly, and iron girders twist, and it is not paint alone that will preserve them. The respite that it gives must be turned to good use in extinguishing the flames. Unfortunately, this interval is often lost for want of apparatus, particularly in the country, where it is a long way to the fire engine station. To supply the necessary means for quickly quenching a fire, Mr. Foster, of Bolton, has brought out a portable fire engine, which emits a stream of carbonic acid and water. By this arrangement he is able to keep his apparatus within small limits, as the pressure of the carbonic acid is available for propelling the jet, and, as is well known, it is extremely efficacious in stopping combustion. The same idea has long been before the public in the form of the extincteur, which is universally known and appreciated. Mr. Foster's engine differs from this in being a pump that can be kept going during the whole progress of the fire, and can be supplied with fresh chemicals from time to time as they become exhausted. In addition to his pumps he has a portable chemicalizing chamber, through which water from a high pressure main can be passed and be impregnated with carbonic acid.

A public trial of Mr. Foster's apparatus was recently made on a piece of waste land near the City of London Schools. A wooden house had been built, the upper story of which represented a bedroom. This was saturated with tar and petroleum, and when filled with flame was extinguished by a jet from a one-eighth inch nozzle in one minute. The lower story represented a warehouse filled with boxes saturated with petroleum, and when fairly alight was extinguished in little more than a minute. Other experiments followed, all of which were successful in demonstrating that a small quantity of water impregnated with carbonic acid will put out a fierce fire, especially in confined situations and in cases where the combustion has not penetrated below the surface of the burning surface.

The Polyphemus.

This novel production of the British navy is, according to the London *Engineer*, a failure so far as anything effective as a war vessel is concerned. But the experience gained by her construction may be worth her cost. Our contemporary says:

She carries no guns, save a couple for saluting and signaling purposes, and relies altogether for her power of offense and defense on her speed, her ram, and her torpedoes. She is fitted with special appliances for discharging torpedoes under water from her bows and her sides; and up to the present moment nothing but disappointment has attended every effort made to use these last. The torpedoes fired from the bow ports have at all events been got away from the ship; but as much cannot be said of those discharged from her broadside. They are expelled from tubes 9 feet below the water line. A fish torpedo is about 18 feet long. The Polyphemus has attained a speed of seventeen knots an hour, and the moment the torpedo shows its nose outside of the hull it is deflected by the apparent current running alongside the ship, and is thereupon jammed in the tube. If it can be got clear of this, it is only with its screw blades broken and its stern or tail twisted that the luckless torpedo gets off; and it is not curious that the short course which it then describes is erratic in the extreme. To prevent this action, a steel plate 16 inches wide and 25 feet long has been pushed out from the ship's side, and under the lee of this the torpedo is discharged; but hitherto the resistance of the water has proved too much, and the steel bar, standing like an ore blade in the water, has been bent, and the torpedo has stuck half in and half out of the ship. The Polyphemus is coming round from Portsmouth to Chatham to have new boilers put in, and renewed attempts will then be made to fit her with some apparatus which will allow of the discharge of broadside torpedoes when she is running at full speed; but we confess we see little reason for expecting that success will be attained. Even though the torpedo is discharged, the course which it will take must be, to say the least, doubtful. Up to the present the targets aimed at, even at distances of 200 and 300 yards only, the ship steaming at 8 knots or less, appeared to be specially avoided by the torpedoes, which sometimes turned round on the ship, and now and then hastily sought a bed in the mud.

The velocity actually attained by the ship was 17½ knots, but this was only maintained for very short periods by bottling up steam; and her best regular performance may be taken as 15 knots, which was obtained when the boilers were in good humor, and did not prime very heavily. The ship is 240 feet long, 40 feet beam, and 18 feet 9 inches deep. Her displacement is about 2,620 tons, and it is calculated that with 5,000 horse power she can be propelled at 17 knots. She has twin screws, and two pairs of compound horizontal direct acting engines, with cylinders 38 inches and 64 inches diameter, and 39 inches stroke. Her boilers are, as we have said, of the locomotive type, ten in number, arranged athwartships on each side of a longitudinal bulkhead, in two groups of three boilers and two boilers. The uptakes all lead into one fixed chimney. We do not know what power has been developed by her engines, nor is it likely any one will until questions are asked in the House of Commons by and by; but it is easy to see that to augment her speed from 15 knots to 18 knots, which speed it is hoped she will reach, the power of the engines must be nearly doubled. Let us suppose, for example, that she steams at 15 knots with 3,375 horse power, which, probably, is not far from the truth. Then to go at 18 knots, she will require at least 5,832 horse power, and probably considerably over 6,000. Such an increase will entail a very great augmentation in the weight of the generators, and how this is to be provided for no one seems disposed to explain. A locomotive boiler with water, capable of working up to 500 horse power, need not weigh more than 10 tons at the outside. About half this will suffice in torpedo boat boilers, but an ordinary tubular boiler and water to develop as much will weigh at least 20 tons. If we suppose that the locomotive boilers worked up to only half their anticipated power, they were still doing as much as an equal weight of ordinary boilers; and to obtain the full power required the weight of the new boilers must be nearly, if not quite, doubled. This appears to us to be a very serious consideration in the case of a comparatively little ship like the Polyphemus, in which there is already hardly room to turn round.

Preparation of Carbonic Oxide.

In a recent number of the Berlin *Berichte*, E. Noack describes a convenient method for the preparation of pure carbon monoxide (CO) in a continuous current for laboratory use. Two methods have hitherto been employed for the manufacture of this gas on a small scale. One consisted in the decomposition of oxalic acid by means of strong sulphuric acid, but the resulting gas was a mixture of equal volumes of carbon monoxide and dioxide, and a large amount of alkali was required for the absorption and removal of the latter gas. The other and better method, that of Townes, consists in decomposing crystallized ferrocyanide of potassium (yellow prussiate of potash) with an excess of strong sulphuric acid. The mixture foams, the evolution of gas is rapid but not continuous, and more or less prussic acid is formed.

Noack's consists in the reduction of carbon dioxide (CO_2) by means of zinc dust. A piece of hard glass tubing, such as is used for combustions in organic elementary analysis, is filled with zinc powder, which is held in place by a tuft of asbestos at each end. A narrow channel is left free above the zinc, as in combustions, and the tube placed in a combustion furnace, which is slightly inclined, or one end of the tube may be bent downward, so that any water formed may run off. A current of carbon dioxide generated from marble and hydrochloric acid is passed through a solution of sodium carbonate to retain any of the hydrochloric acid that might be carried along, then conducted through the hot tube filled with zinc, and afterward passed through a wash bottle containing caustic soda or potash to absorb any undecomposed carbon dioxide.

With the use of 200 grammes of zinc dust Noack says that he obtained in a short time over 20 liters of carbonic oxide gas. The best results were obtained when the heat employed was just enough to make the clay channel under the combustion tube red hot, and the current of carbon dioxide was rapid enough to form 400 bubbles per minute from the end of a 4 mm. tube.

In a quantitative experiment made by passing a measured quantity of the gas over the zinc and measuring the resulting gas, he obtained 11 liters of carbon monoxide from 13 liters of carbon dioxide used. An analysis of the gases obtained when the carbon dioxide was not absorbed, gave only 0·73 per cent of the latter with a slow current, and 3·21 per cent with a rapid current.

A Caution to Plumbers.

A decision was rendered in an English court recently, which is, to say the least, highly suggestive. A plumber sued a civil engineer for the cost of erecting a lavatory, something near $150. The defendant made a counter claim of $600, on the ground that the plumber's work was improperly done, thereby allowing sewer gas to enter the house, causing the illness of six members of the defendant's household and the death of his son.

The plaintiffs claim was denied by the court, and judgment was given for the defendant.

This decision might or might not have any direct effect upon the action of an American court in a case of that nature; yet the awarding of consequential damages for bad work by an English court furnishes a warning which careless or tricky plumbers may do well to bear in mind.