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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE ERIE CANAL QUESTION.

The most important question affecting the commercial welfare of New York city and State that will come before the Legislature is that of the enlargement of the Erie Canal—a waterway whose share in the development of the port of New York it is scarcely possible to overestimate. Not only has it carried a large proportion of the commerce which seeks the leading shipping point of the Atlantic coast, but it has played the equally important part of a regulator of freight charges by the railroads. For this last reason, if for no other, it will be to the interest of the city and State to keep the canal open, especially in view of the fact that the railroads are steadily passing into the hands of a small number of individuals. The fewer the number of owners of our railroads, the more likely they will be to get together in some form of agreement for the abolishing of competition, and in view of this contingency it is well to remember that the canal through this State must ever remain the constant regulator of freight charges.

The present situation renders necessary an immediate decision, either to abandon the canal altogether or to bring it up to a point where it can meet the modern conditions of traffic. The great improvements which have been made in recent years, both in the track and rolling stock of the railways, have resulted not only in a vastly increased capacity, but in a reduced expense of haulage, and have rendered the canal in its present condition so much out of date that it has lost, or is rapidly losing, its influence as a regulator of freight. Moreover, in order to bring the canal up to a standard at which it can compete successfully with the railroads, it will not suffice to enter upon the reconstruction in any half-hearted and parsimonious spirit. The question of the extent of reconstruction necessary was carefully gone into during President Roosevelt's term of office as Governor of this State, and the findings were expressed in a report by the committee of which Gen. Greene was chairman. The scheme proposed received the hearty indorsement of Governor Roosevelt. Briefly stated, the report proposed, at a cost of $60,000,000, to deepen and widen the canal sufficiently to admit barges of 1,000 tons capacity and to provide enlarged locks which would enable these barges to be towed in fleets of four from the Lakes to New York city. This would necessitate a uniform depth of 12 feet throughout, and to every student of the canal question it is evident that this is the smallest practicable depth on which the canal could be brought up to modern requirements. That nothing less than this will meet the case is further evident when we remember that the great canal improvement which was completed three or four years ago on the St. Lawrence River gives the Canadian territory a system of canals which provides a minimum depth of water of 14 feet from the Great Lakes to the Atlantic. A determined effort is being made to divert to the St. Lawrence route much of the wheat which hitherto has come to the port of New York, and the best answer to the Canadian canals would be the carrying through of the proposed $60,000,000 improvement. The prospects of favorable canal legislation are improved by the increasing and more intelligent interest which is manifest in the canal in the rural districts, which hitherto have been either lukewarm or strongly opposed to the whole scheme. With public attention aroused throughout the State, the prospects of successful canal legislation were never brighter. To New York city itself the canal is of most vital importance, for the reason that we are gradually losing our relative standing among the great grain ports of the Atlantic coast, because of the differential charge which the railways make against the port of New York. This is an extra charge on freight which is made on account of the easiness of access for western freight to this city as compared with the difficulties in the way of mountain ranges and heavier grades which are encountered by freight that is taken to other Atlantic ports. Not only have we the easiest approaches by rail, due to the absence of mountain grades; but New York possesses the finest harbor, is the terminal port of the speediest and largest steamers, is the great center of capital, and has all the advantages which accrue to a great metropolitan city. Hence the railroads which terminate at other ports have demanded that there shall be a higher charge on freight to New York to offset these natural advantages. This being so, it is evident that if we are to maintain the equilibrium on our side, we must see to it that these natural advantages, among which the Erie Canal is one of the greatest, be maintained in the very highest state of efficiency. Whatever may be said about the justice or injustice of differential rates, it is certain that the argument for the canal based upon them is unanswerable.

LIQUID FUEL FOR NAVAL PURPOSES

Congress at its last session made an appropriation of $20,000 to enable the Navy to carry out exhaustive trials of liquid fuel to determine its suitability for use on naval vessels. This sum, in addition to several thousand dollars which was also available, enabled the Navy Department to make a most elaborate investigation of the subject. The work was planned and carried out with characteristic thoroughness, and while the tests have not yet been completed, sufficient data have been gathered to enable the Board to make a preliminary report which will be found in the current issue of the Supplement, that cannot fail to be of the greatest value to marine engineers throughout the world.

On reading this document one is forced to the conclusion (and this is the most important fact developed thus far in the inquiry) that there is no immediate prospect of oil fuel being immediately adopted to any extent on battleships and cruisers, although the installation of oil-burning furnaces is regarded as quite practicable on torpedo boats and, indeed, its installation is recommended in the report. The tests were carried out in Washington in a very complete experimental plant in which Beaumont oil, slightly refined and of uniform quality was used. In his review of the report submitted to the Secretary of the Navy, Rear-Admiral Melville observes that any fuel which will get rid of smoke, reduce the fireroom staff, extend the steaming radius, and assist in the realization of maximum speed at short notice, will add to the efficiency of warships. Referring to the experiments made by various naval powers with the use of oil, he points out that failure has resulted from the mistaken attempt to burn oil in the same manner as coal. It is now well understood that the oil must be atomized at the burner, since it is impossible to completely turn it into gas before ignition, and that to secure its full value in the boiler, the length of furnace, volume of the combustion chambers, and calorimetric area are factors which must be carefully considered. The experiments conducted by the Liquid Fuel Board have proved that it is possible to force the combustion of oil, and that in an oil fuel installation, where provision has been made for atomizing the fuel and heating the air and oil, it is possible to greatly exceed the highest evaporation per square foot of heating surface that have been secured with coal. Rear-Admiral Melville expresses his conviction that by further experimental work the engineering features of the problem will undoubtedly be resolved in a degree materially satisfactory to maritime or commercial interests, if not to the naval experts.

With regard to its installation on battleships and large cruisers, where the fuel would have to be stored in the double bottom, it is considered that the proximity of such a large amount of electric wiring as is found on a modern warship, to the oil tanks, which would necessarily throw off a considerable amount of vapor, might cause an explosion and set the fuel on fire, and it is pertinently suggested that the limited experience of the Navy with submarine boats may provide a lesson as to the liability of hydrocarbon gases to explode. In concluding his review of the report, Admiral Melville affirms that he has no hesitation in declaring that, in view of the results already secured with these tests, an installation should be placed at once on at least one-third of the torpedo boats and destroyers, where there would be an opportunity for further systematic study of the subject. With regard to merchant vessels, where the structural disadvantages under which warships labor are not present, it is believed that oil fuel may be used to advantage, and that the information gathered by the Board will materially increase the installation of oil-fuel plants in the merchant marine.

A NEW HYDRIDE OF SILICON.

A new hydride of silicon has been lately discovered by Messrs. Henri Moissan and S. Smiles. This body is a gas at ordinary temperature, but by using liquid air the experimenters were able to liquefy and then solidify it. The process is described in a paper read before the Académie des Sciences. The combinations of hydrogen and silicon are few in number and only two are known, one a gas discovered by Buff and Wöhler in 1857, SiH_4, and a solid body prepared by Ogier as a yellow deposit by the action of the electric stream upon hydrogen silicide. The gaseous hydrogen silicide was obtained by the former experimenters in decomposing water by the electric current, using aluminium electrodes rich in silica, then by Wöhler in reacting upon silicide of magnesium by hydrochloric acid. It is the latter method which has been followed here, applying the method of fractional separation. The silicide of magnesium is prepared by mixing powdered magnesium such as is used in photography with crystallized silica in fine powder, the proportions corresponding to $SiMg_2$, and the mixture is calcined at a red heat in a tube through which is passed a current of pure hydrogen. Thus a friable and bluish mass is obtained, which is an impure silicide of magnesium, but does not seem to be a definite compound. When the bluish mass is acted upon by dilute hydrochloric acid, it gives off a gas containing hydrogen silicide, that is spontaneously inflammable. The gas is prepared by placing 5 grammes of the impure silicide of magnesium in a flask and pouring dilute hydrochloric acid upon it through a tube. The gas given off is washed and dried, then passed in a U-tube which is cooled by liquid oxygen or liquid air. The tube has a bulb below for receiving the condensed liquid. At a temperature of 80 degs., obtained by acetone and solid carbonic acid, only a trace of liquid is condensed, but with liquid air at 180 to 200 degs., the gas is condensed in the solid form and the remainder of the gas which passes through ceases to be inflammable on contact with air. This solid body becomes liquid as the temperature rises, and soon begins to boil, giving off hydrogen silicide gas, which may be collected. At last, when the tube has reached the ordinary temperature there remains a liquid whose properties have been studied. The experimenters obtain thus a liquid hydride of silicon, which when cooled in liquid air, crystallizes upon solidifying, and these crystals melt at 138 degs. The most remarkable property of this new compound is that it takes fire spontaneously in air at the ordinary temperature; it burns with explosion, producing a white and brilliant flame and giving a deposit of amorphous silicon and also silica. Its density is greater than unity, for when placed in water it falls to the bottom of the vessel and dissolves slightly. It takes fire spontaneously in chlorine gas, and at the ordinary temperature the reaction is violent. If a small quantity is vaporized in an atmosphere of hydrogen, the gas becomes spontaneously inflammable in air, while ordinary silicide of hydrogen has not this property. The analysis of this body was difficult on account of its inflammability, but the experimenters collected it in bulbs which were broken in a test-tube full of mercury and the liquid could thus be acted upon by an alkaline solution, when the hydrogen given off was measured and the silica of the alkaline silicate estimated. The reaction is as follows:

$$Si_2H_6 + 4NaOH + 2H_2O = 2(Na_2SiO_3) + 7H_2.$$

The formula Si_2H_6 is given from analogy with ethane, and this is to be verified by obtaining the vapor density of this body.

FRUIT PARASITES AND THEIR DESTRUCTION.

The fruit growers of California willingly acknowledge their great obligation to the entomological department of their university for the success with which the ravages of fruit pests in that State have been diminished if not totally prevented. To the scientific investigations of the faculty of that institution is due the general immunity from severe financial loss which the orchardists of the State enjoy.

No class or variety of fruit, the cultivation of which has been attempted in California, ever reached the period of successful propagation than some new species of destructive insect pest instantly appeared to prevent it. This fact is true in all localities. The orange, for instance, could not have been successfully raised in California, but for the introduction of the Australian lady bug, which feeds upon the orange scale. The plum, peach, apricot, apple, and in fact every other fruit known to the coast, each developed a natural enemy which would have destroyed it but for the successful efforts of the university entomologists in combating it. In some portions of the State, notably in Placer County, a new specimen of moth developed which proved so destructive that a loss of fifty to sixty per cent in the peach crop was suffered. Around Newcastle the direct financial loss in the peach crop alone is estimated at $1,373,000 in the past four years.

The University of California was appealed to, and Warren T. Clarke, assistant entomologist, was sent to investigate. He was successful in his search, and returned with complete data of the habits and life history of the worm and methods of propagation. Prof. Clarke, in order to learn the characteristics of the new species of insect which was doing such immense damage, fastened twigs, in which the eggs were embedded, to his underclothing and thus hatched them out.

From the knowledge thus gained, Prof. Clarke was enabled to devise a means for the extermination of the destructive pest. The loss of fruit was reduced in the current year to a maximum of one and one-half per cent.

RECOVERY OF WASTE IN USING WHITE METALS.

A very valuable paper by Joseph Richards, ex-president of the Franklin Institute, upon utilizing the waste entailed in working silver, tin, zinc, antimony, bismuth, lead, mercury, and their alloys is here reduced to its lowest terms for the benefit of manufacturers employing such metals in their goods. The author says that it is more than forty years since he began his investigations in the direction indicated, and his experience is therefore of practical value.

I found, says the author, that tin and galvanized iron scrap could be utilized by removing the coatings, the average tin amounting to 3 per cent; the resulting iron plate could be re-puddled, and the scheme was so promising that I resolved to erect a plant upon a commercial scale. Six lager beer casks, about 6 feet by 6 feet, were set in the ground in a semicircle and a crane rigged that commanded all of them. In the first tank hydrochloric acid was placed, in the second water, and water with a little lime in the third. In the fourth cask was water again, and in the fifth a solution of copper sulphate. A wooden cage containing about 200 pounds of clippings put in loosely was turned into No. 1 tank, and raised after ten minutes' immersion to observe the result. If the tin had been dissolved the cleaned scrap was put in the tank containing water alone, and agitated thoroughly and then put into lime tank No. 3, which neutralized all the acid remaining in the pores of the iron; afterward washed again in tank No. 4, and finally plunged into the copper sulphate for a moment to prevent the scrap from rusting when exposed to the air, which would almost instantly attack it. The iron scrap was then worked into balls under a press and was worth from $10 to $12 per ton. After the process described had been continued for some time the acid would be neutralized in No. 1 tank and would contain tin chloride in solution. The tin-scrap cleaning was here discontinued for a time, for another stage of the recovery. Galvanized iron scrap was put into the cage and immersed in tank No. 1; when it came in contact with the tin solution the metallic zinc took the place of the tin, forming zinc chloride, all the tin being precipitated as metallic tin, in a finely divided state. From about 10 tons of scrap I got about 600 pounds of tin; the zinc chloride sold for $20 per barrel for disinfecting purposes, and for treating wood to make it fireproof. Although commercially successful, the process had to be discontinued, on account of the objectionable vapors created which annoyed the public.

The galvanizing bath is of various sizes, according to the work to be done, and divided on the surface by a partition into two parts. On one side a flux is placed which will dissolve the oxide of zinc on the surface or prevent its formation.

The flux used is ammonium chloride (salammoniac), and the other side of the bath is kept clean by constantly skimming the oxide of zinc as fast as it forms. Just here is where loss occurs, for considerable shot-zinc is formed and removed with the oxide. Also, the salammoniac side soon becomes covered with a thick black crust, or scum, consisting of the dissolved oxide which has partly decomposed the ammonium chloride and formed a double chloride of zinc and ammonium. Salammoniac must be fed constantly to the top of the pot so as to keep the surface of the molten zinc clean and free from oxide, or else the oxide will adhere to the iron surface and seriously injure the finished product by leaving spots on it not coated with zinc. After a time the crust gets so thick on the top that the plates cannot be pushed through it, and a portion must be removed. This causes waste on one side of salammoniac and on the other of zinc.

Another by-product made is zinc-slab dross, formed by washing away a portion of the iron being galvanized, for molten zinc alloys with iron, and as soon as it becomes hot as the bath, begins to dissolve in the zinc. This addition of iron to the bath forms an alloy of iron-zinc which is heavier than the zinc and falls to the bottom; a bath of the usual size for sheets will collect a ton in one week. It is removed by a perforated spoon to allow the zinc to run out and the dross is pasted into molds and forms the slab-dross of commerce. There are then, in galvanizing, three by-products, salammoniac skimmings, slab-dross, and zinc oxide. The skimmings can be recovered by leaching the skimmings in hot water and steam, which gives all the zinc chloride and ammonium chloride in solution, which last can be evaporated down and recrystallized for use in the bath again. The residue contains zinc oxide, dirt, and shot-zinc; this last on being put into a tumbling barrel ground out all the oxide and cleaned the zinc finely, so that it was worth $30 per ton to makers of zinc paint.

The average yield was: zinc 20 per cent, zinc oxide 35 per cent, ammonium and zinc chloride 30 per cent, iron scale and dirt 15 per cent. I then visited galvanizing works and bought all the waste skimmings, etc., I could get and it realized about $300 a carload. The largest lot I ever treated realized when melted and refined 25,000 pounds of good spelter. The oxide process is now generally used in the trade, having been purchased from my workmen by other parties. Galvanizers now separate their skimmings, and it is worth about $40 per ton, according to quality.

The most valuable by-product in galvanizing is the zinc-dross, and I made numerous costly experiments before I had any success at all. Cyanides answered the purpose of recovery well, but were too costly. I finally patented a process which dispensed with the direct use of cyanide and solved the problem of recovering the zinc from the dross, so that it is almost equal to virgin spelter by analysis.

The sensitiveness, so to call it, of zinc to any addition of aluminium is well shown by the fact that 1-1000th part of the latter is immediately detected, and the quantity, although so small, is taken up at once and distributed. It is of no advantage to exceed the quantity mentioned. If a quantity of pure zinc be poured into a mold it will not run half way down, but if a portion only of aluminium alloy be put into the ladle, the effect is to make it as fluid as water. For practical purposes I use 2 per cent aluminium and 98 per cent of zinc, and over 100,000,000 pounds of zinc dross have been treated by this process. Scrap zinc is melted in pots and treated in the same way as the zinc dross for impurities, and battery zincs which contain mercury are treated in a special way which recovers all the mercury. Britannia metal, pewter and scrap pewter are often plated with silver, which must be stripped off before treating them. This is done by the usual processes well known to the trade, and not calling for special mention. The metal is then made into ingots and sold for typefounding, stereotyping, and Babbitt metal. The composition being changed, according to the metal to be made at any time by adding tin or copper, etc.

BAROMETER READINGS.

BY ROBERT GRIMSHAW.

We often hear: "It is going to rain soon; the barometer stands at 'stormy.'" It is high time that barometer-makers stopped putting their instruments on the same level as the frog-in-a-bottle affairs, by marking them "Clear," "Very dry" and so on. Properly understood and used, the barometer is a reliable instrument, not only for measuring the weight or pressure of the air, but also in connection with the weather-cock and the thermometer, for prophesying weather conditions in the near future.

What a good barometer does tell is the weight of a column of air of definite cross section, reaching upward from the level of the instrument to the surface of the aerial ocean which surrounds our earth. But no matter what the condition of the weather, this weight varies with the depth from the surface of the aforesaid ocean, so that if the column stands at 762 millimeters at the level of the water-ocean which lies at the bottom of the aerial one, the same instrument would stand at a height of 1,178 meters above the sea level at only 663 millimeters. This being the fact, a barometer that at the sea-level stood at "Very dry," would, under the same conditions of temperature of the air and of the instrument itself, indicate "Stormy" when carried to a height of 1,178 meters above the sea.

The "prophecies" of the mercury barometer are different for various temperatures and degrees of moisture of the air in any one country, and for different countries. Further, the "weather indications" of an aneroid and of a mercurial barometer for the same readings are different; because a good aneroid is not influenced by the air-temperature.

Those who use the mercury barometer scientifically and for scientific purposes, use tables giving the following data:

(1) Height of the column of mercury for each distance above sea-level; (2) "corrections" for the height, for different latitudes; (3) logarithmic corrections for temperature and latitude; (4) the height of a column of air corresponding to each difference of one millimeter or of one special fraction of an inch, in the height of the mercury column; (5) "corrections" for the height of the mercury for different barometer temperatures, at different heights above the sea, and which latter corrections must be applied, before the height of the mercury column can be used with the other tables; (6) the average temperature of the air at the sea level for each month for the district where the observation is made.

It may be noted here (a) that the differences of temperature during the day vary with the latitude; (b) the higher the latitude, the greater this variation; (c) the average temperature for the twenty-four consecutive hours in the day is that of 9 A.M., and (d) the average daily temperature between 9 A.M. and 5 P.M. occurs at noon.

SCIENCE NOTES.

For the last three years it has been planned to study the sea and the fisheries of northwest Europe. Two international conferences have been held, and a third convention is now meeting at Copenhagen, where delegates from the governments of the United Kingdom, Germany, Holland, Denmark, Norway, Sweden, Russia and Finland are discussing the problem. It has been decided that simultaneous observations are to be made four times a year. The British government has assigned two ships to the task of making periodical trips in the Faroe-Shetland channel and across the northern end of the North Sea. Trips will also be made in the western part of the British channel. Dutch ships will scour the southern half of the North Sea, while the northern half will be covered by the Germans. Denmark will investigate the region between Faroe and Iceland. Norway will explore the North Atlantic along the extensive western seaboard of Scandinavia. Work has been assigned to Russia along the Murman coast and across Barents Sea to Novaya Zemlya. The Baltic will be studied in detail by Danish, Swedish, Finnish, Russian and German ships. Much scientific, as well as practical, information will be gathered.

Prof. Baccelli's method for the treatment of tetanus has been used during the last few years in a considerable number of cases, especially in Italy. This method consists essentially in administering a series of hypodermic injections of phenol in dilute solution. The phenol is rapidly absorbed, and its action is that of fixing the state of the malady; in the favorable cases no new symptoms appear after the first injections of phenol have been regularly made. As to the symptoms which already exist, these are not at once attenuated, but at the end of several days they diminish gradually. Dr. Croffi has been engaged in formulating the results of the cases treated by the Baccelli method, of which 80 have already been published, and shows that it has given more satisfactory results than the other methods. The figures show a mortality of 12 to 13 per cent, while in the case of anti-tetanic serum as used by Holesti, Haberlinge and others the mortality reaches 30 per cent, which is a considerable difference. Even considering the grave cases, the method is still superior, and shows a mortality of 30 per cent, but this is not excessive, as in the treatment of grave cases of diphtheria by the anti-diphtheritic serum the mortality reaches 37 per cent. The advantages of the Baccelli method are best seen when it is applied from the commencement of the disease, in this case, if the patients arrive at the seventh or eighth day, the issue is almost sure to be favorable. It is a striking fact that while the method is successful in the case of the human system, it seems to have no marked effect upon the animals which have been used in the experiments, but this may be explained by the fact that in the latter case the tetanus shows itself in the acute form which causes a rapid mortality, and here the remedy is of no avail.

An extended series of observations upon the hygiene of acetylene lighting has been recently carried out by M. Masi, a prominent Italian scientist, who made a number of experiments at Rome. The number of appliances for producing acetylene is considerable, but in many cases their imperfections and defective construction have rendered the use of acetylene less extensive than might be, seeing that it has many advantages and is a more healthful method of lighting. According to the experiments of Grehant, Weyl and Frank, the gas has a harmful influence only upon the air when it reaches the proportion of 46 per cent and it is only at 79 per cent that it causes death. When absorbed by the blood in quantities not exceeding 10 per cent it seems to combine easily with the albuminoid elements. The burner, to give a good light, should work under a pressure equal to 3 or 4 inches of water at least, and be mixed, before burning, with oxygen or an inert gas which permits it to come in contact with a great quantity of air. Messrs. Lewes and Hempel have shown that its lighting power is 15 or 20 times that of illuminating gas used in an ordinary burner and from 3 to 5 times when in a Welsbach burner. M. Masi carried out some experiments in a chamber fitted up in the cellars of the Institute of Hygiene at Rome, under the most unfavorable conditions as to ventilation, so as to bring out as much as possible the effect on the respiratory organs. He observed also the intensity and steadiness of the flame, the quality of light produced, the heat and the change brought about in the surrounding air. Repeated experiments on these different points showed that acetylene gave superior results. The gas in burning consumes less oxygen and gives off less carbonic acid gas and water vapor than is the case with other methods of lighting, excluding, of course, the electric light. In a confined locality it produces less heat than either gas, candles or petroleum, and it does not give rise to ammonia, nitrous acid or carbon monoxide. He considers that it does not present any more danger from explosion than gas or petroleum, and that it is cheaper for a given candle power than all other methods of lighting.