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OUR OBLIGATIONS TO THE ARABIAN ALCHEMISTS.

It is well known that our modern chemistry, that wonderful science which, in this nineteenth century, is revolutionizing the industry of the world, is of recent growth. One century ago, it deserved hardly the name of a science; and only since the discoveries of Priestly and Lavoisier can it lay claim to be a systematic whole. And it has since grown in a twofold aspect: first, as a most practically useful pursuit; and, secondly, as one of the branches which ought to enter, more or less, into the curriculum of the studies of every man and even woman who lays claim to a civilized education, as it has a peculiar influence in the development of the human mind.

Still, notwithstanding the youth of this science as a systematic whole, it stands on a basis built ten centuries ago; in fact, our modern chemists may be considered to stand on the shoulders of the ancient alchemists, who, notwithstanding that they were always searching for unattainable results, have succeeded in discovering thousands of facts which have laid the foundation for that wonderful knowledge which gives us an insight into the secret recesses of the composition of matter. It is, therefore, highly interesting to trace the slow progress of that alchemistic science, chiefly nursed by the cupidity of men who wanted nothing but the increase of their personal possessions, and who, in place of that, increased the knowledge and well-being of the human race.

The *Divine Art*, as the ancient alchemists called their pursuit, appears to have been practiced first in Egypt, that cradle of knowledge; for historians tell us that the Emperor Dioeletian, after the conquest of the rebellious Egyptians in the year 296, ordered that all the writings on the alchemy of gold should be burnt, in order that the people should not, by making gold, grow so rich as to commence a second rebellion. It was thus already known, at that time, that the success of revolutions and rebellions depends on the possession of money.

In the large European libraries, manuscripts on alchemy are preserved, many of them dating from Alexandria in the fifth century, and written by Greeks living in Egypt and practising alchemy there. It appears, further, that when the Arabs invaded the north of Africa and the south of Europe, they learnt this art from the conquered nations; and the results of their labors and their wonderful advance are recorded in the archives of the Spanish Moors. So we find that Djafar, better known under the name of Geber, who lived in the end of the eighth and the beginning of the ninth century, in Seville, Spain, and who was wise enough not to believe that any one had succeeded in making gold, discovered that a metal when calcined, which we now call oxidized, becomes heavier. It took 1,000 years to bring such facts to bear on the destruction of Stahl's theory of the Phlogiston, which taught that during this calcination, or burning of metals, something was driven out which had negative weight. Geber also was the first to make nitric acid by mixing blue vitriol, alum, and saltpeter, and distilling the mixture; he changed it into *aqua regia* by adding sal ammoniac; then he dissolved gold in the same, and obtained thus the solution of gold, so long searched for by other alchemists and supposed to be the elixir of life which would cure all diseases and even prevent death. The experiments undoubtedly made in this direction, however, failed, of course, and the results therefore have neither been recorded nor handed down. We know now that gold is one of the most dangerous elements to introduce into the human system, because its insolubility makes its removal afterward very difficult Geber gives very clear instructions in many chemical operations, as sublimation, distillation, filtration, water and sand baths, cupels of bone earth to absorb the metals which become calcined (oxidized), etc.; and there is no wonder that, in the middle ages, he was called the master of all masters in alchemy.

Sulphuric acid was first made in the end of the ninth century by Rhazes, head physician to the great Bagdad hospital. He made it in the same way as at present practiced to make the Nordhausen vitriol, by distilling copperas. He also made absolute alcohol by distilling spirits of wine over quicklime, while phosphorus was made by Achill Bechil, who sublimated a mixture of urine, clay, lime and charcoal; he called it an artificial carbuncle, and said it shone in the dark like the moon. This was a lost discovery, when, in 1669, Brand in Hamburg made phosphorus in a similar manner. Geber had a clear conception of the evolution and combination of gases, which he called ghosts or spirits (whence our word "gas"). This is proved by his account which, translated, runs thus: "When spirits fix themselves in solid bodies, they lose their form and are in their nature no longer what they were before. When you compel them to be disengaged again, this is what happens: Either the spirit alone escapes in the air, and the solid body remains fixed in the alembic, or the spirit and the solid body escape (volatilize) at the same time."

As a few other eminent Arabian alchemists, must be mentioned El-Raii, Ebid-Durr, and Togbagré, who wrote an alchemical poem, and Djildegi, one of whose chemical works is called "The Lantern," a very significant title for such a subject. But the most astonishing fact of all is the definition which some of these authors give of the chemical science they practiced, and which is worthy of the nineteenth century. It is: "The science of combustion, the science of weight, the science of the balance."

PUDDLING IRON BY MACHINERY.---AN IMPORTANT IMPROVEMENT.

Many attempts have been made to supersede, by mechanism, the laborious and expensive hand processes, employed in making wrought iron, known as puddling. But until within the past four years, all efforts have failed. To Mr. Samuel Danks, of Cincinnati, Ohio, belongs the credit of having successfully solved the problem. He has invented improvements, now in successful operation, which promise to revolutionize the art, and which are recognized as indispensable to the trade by the leading iron puddlers of this country and England. Last year, Mr. Danks appeared before the Iron and Steel Institute in England, and read a very instructive paper, in which he described the practical workings of his inventions, as shown at Cincinnati, in such forcible terms, exhibiting, at the same time, such thorough knowledge of the whole subject, that the attention of the members was immediately called to its importance. They voted to appoint a committee to visit the United States, examine the practical operation of Mr. Danks' alleged improvements, and report in full to the Institute. The committee consisted of some of its most scientific as well as most practical members, and they came over here determined to make the most crucial tests possible. Every facility was granted them, and they went home fully satisfied that all that Mr. Danks had claimed had been realized in their presence, and even more, and they have so reported to the Institute. The invention is now being rapidly introduced in England, where hand puddling is declared to be doomed, and rotary puddling announced among the iron men as an accomplished fact. The saving effected by the use of the Danks machinery is placed at $5 per tun of iron.

In puddling iron by the Danks process, a revolving furnace is employed in which the pig iron is melted down. This furnace is provided with a fire grate, and a blowing fan to urge the fire and supply the necessary gas. The revolving furnace rests on rollers, and its exterior has cog teeth by which motion is imparted. Mr. Danks gives the following particulars:

A suitable engine is attached to each machine, so that the furnace can be made to revolve at any speed that may be required according to the different stages of the operation. The most important feature in connection with the invention is the lining of the vessel. The foundation consists of what is termed the "initial" lining, which is composed of a mixture of pulverized iron ore and pure lime, worked with water into the consistency of a thick paste. The method of putting on this "initial" lining is fully described, and, when completed, the author says that upon it is placed the fettling proper. A quantity of pulverized iron ore—about one fifth of the total amount required to fettle the apparatus—is thrown in, the furnace is heated and made to revolve slowly until the iron is found to be completely melted, and the apparatus is then stopped. That part of the molten iron, which has not been consumed by glazing of the "initial" lining surface, runs to the lowest level of the furnace, and there forms a pool, into which there are put a number of small and large lumps of iron ore of such dimensions as will be required to allow the said lumps to project over the surface of the liquid ore by from two to six inches. This part of the fettling is allowed to set, when a fresh quantity of pulverized ore is thrown in. The furnace is again made to rotate slightly until the newly added ore is liquefied, when the apparatus is again stopped, and the pool is filled with lumps as before. The operation is continued in this way until the whole of the vessel is properly fettled. From 2 to 2½ tuns of iron ore are required to fettle a 700 pound furnace.

The iron is charged into the furnace either in a solid or molten condition. When charged in the shape of pig iron, the melting down occupies from thirty to thirty-five minutes, during which a partial rotation is given to the furnace, from time to time, in order to expose equally all sides of the charge to the flame. When the whole of this is thoroughly melted, the furnace is made to rotate once or twice per minute only during the first five or ten minutes, in order to obtain the most perfect action of the cinder upon the molten iron. A stream of water is injected through the stopper hole along and just above the line of contact between the floating cinder and the inner surface of the vessel on the descending side. A certain portion of uncontaminated cinder is thereby solidified on the metal surface, and is carried down into or below the bath of molten iron in a continuous stream, which, in rising up through the iron, combines with the impurities of the latter in a far more effectual and complete manner than any mode of puddling hitherto known can effect. On the expiration of the said five or ten minutes, the iron begins to thicken and the motion is stopped. The heat is then raised so that the cinder shall be perfectly liquefied, and the vessel is brought into such a position that the tap hole shall be just over the level of the iron, which by this time has become partly pasty. The puddler gently pushes back the iron and the cinder is made to run off. The heat is again raised, and the furnace is put in motion at a velocity of from six to eight revolutions per minute, by which means the charge is dashed about violently in the furnace. A high temperature being kept up, and the charge being continually turned over, the particles begin to adhere, when the velocity of the apparatus is lowered to from two to three revolutions per minute, upon which the ball then very speedily forms. The puddler then solidifies the front end of the ball by a few blows from a tool applied through the stopper hole. The props of the movable piece are then removed, and the flue hanging from the overhead rail is moved away. A large fork, suspended from a crane is put into the vessel along one side, and the ball, which by a turn of the vessel is rolled on to the fork, is then taken out by means of the crane. The ball is then worked in a squeezer. The flue is replaced after the requisite quantities of cinder and metal have been again charged, and the process is continued. From eight to ten charges are made before any refettling is required, and these heats are worked in a day of ten hours.

Mr. Danks claimed for the revolving furnace the following advantages: A great saving in the cost of labor and also in the consumption of coal, varying according to the size of the furnace; a superior and more regular quality of puddled iron from a given quantity of pig; a yield of puddled iron much in excess of the charge of pig metal, instead of the usual loss, the extra yield being obtained by the reduction of the rich fettling used in the machine; eight to ten heats, whether of from five to ten cwts., are made in a day of ten hours when suitable metal is used; the refining process is very complete, the whole of the phosphorus and silica, and the sulphur to a large extent, being removed by the chemical action of the lining mixture; the very heavy and exhaustive labor of puddling is performed by steam power, thereby enabling one skilled man to attend to the working of a large quantity of iron; the bringing to nature and balling of the iron is completed by the rotary action, without the use of rabbling, except when the heat has to be divided into smaller balls; and the capacity may be suited for heats of any weight from five cwt. upwards. The cost of the furnace, weight of product considered, is about the same as that of the usual hand puddling furnaces.

RESULT OF ILLUSTRATING A NEW INVENTION.

We have received a letter from Captain W. F. Goodwin, whose invention for the propulsion of canal boats was illustrated in these columns a few weeks ago, in which he alludes to the success he has attained in the introduction of his screw gear mower and reaper, which was illustrated in the SCIENTIFIC AMERICAN, November 25, 1871. After alluding in a complimentary manner to the great number of patents he has obtained through this office, he states that he has made some money out of his patents, but the amount would have been much larger had he earlier appreciated the advantages to be derived by placing his inventions before the public through the medium of the press. Immediately after the publication of the engraving and description of the mower and reaper in this paper, he states that he had so many letters of enquiry, from manufacturers and agriculturists for rights to build and for the purchase of machines, from every State in the Union and from Canada, that he was for a time exceedingly embarrassed, not having the facilities for supplying the machines. "And much to my surprise and satisfaction," he says, "I found I had established, before I hardly knew it, a large business abroad; orders were received for machines from Europe, and applications for agencies as far north as Russia poured in upon me by every mail." The result has been the establishment of agencies in London, Edinburgh, Vienna, and St. Petersburgh, and arrangements are about being consummated in Prussia. Captain Goodwin accords his success in the introduction of his harvester to the publication of it in the SCIENTIFIC AMERICAN, and closes his letter by stating that he hopes the same good result will follow the publication of his system of propelling canal boats that resulted from the publication of his mower.

ON ATMOSPHERIC AND PNEUMATIC PROPULSION.

The workings of the weather bureau have confirmed what was anticipated, namely, that the changes in barometric pressure are the causes of the winds, which, in their turn, become the causes of the different conditions of weather. If we trace the changes in the barometric pressure further back, we come finally to the solar heat which expands the air in some localities, and causes it to become specifically lighter than the colder air, and to the solar and lunar attractions which cause continual atmospheric tidal waves to run around our globe. In this way, our atmosphere is kept in a permanently agitated condition; and the cosmical power expended in keeping up this agitation is something startling when we attempt to reduce it to our common measure of force, the foot pound. We have only to consider what an infinitely small portion of this force is utilized by sailing vessels, and what an enormous power is required to move about the sailing fleets of the world. Little Holland gives in its windmills an example of how this power may be further utilized; there are in that country (where the construction of windmills has been improved since more than 1,000 years, thanks to the study of the most profound mechanical thinkers) more than 12,000 windmills for the pumping of water alone, not like the mere toys we see in this country, but colossal structures of masonry 100 and more feet high, attended to by a regular crew, as is customary on shipboard, each mill lifting from ten millions to fifty millions gallons of water per day; there is an equal number of mills for sawing lumber, and at least an equal number for grinding corn. The total labor, performed by the utilization of the wind alone in that country of four million very industrious inhabitants, is estimated to equal that of four million horses.

In order to fix in the memory the relation between the velocity of the wind and the pressure exerted on a surface, it is best to remember that the velocity of a violent hurricane, of 100 miles per hour, exerts a pressure equivalent to 50 pounds on a vertical surface of one foot square, and that as the velocities decrease the pressures decrease as the squares of the velocities; so with half the velocity of the wind, or a storm of 50 miles per hour, the pressure is one fourth of 50 pounds or 12·5 pounds per foot; at one third the velocity, or a brisk wind of 33 miles per hour, the pressure is one ninth, or 7 pounds per square foot; at one quarter the velocity, 25 feet per hour, the pressure is one sixteenth of 50, or 3 pounds upon each square foot, etc. These rules hold for one square foot while the wind is in motion and can glide off all around the surface; when several square feet are united in one whole, so that the wind cannot glide off around each square foot, as in the case of the sails of a vessel, the pressures become considerably greater, and more still when the surface on which the pressure acts is enclosed in a tube or tunnel so that the wind or air is entirely prevented from gliding off or passing beyond the surface acted upon. The latter is practically the case with the system of pneumatic propulsion; and in order to see at once the great advantage of this mode of applying power, we have only to consider the effect of a difference of atmospheric pressure on both sides of the surface, acting as a piston in the tunnel of a pneumatic railroad, and separately attached to the car, or the effect on a well fitting car itself. Suppose the blowing machinery is able to raise the barometric column on one side of the car only one inch: this will be nearly one thirtieth of the whole mercurial column; and thus one thirtieth of the atmospheric pressure of 15 pounds, or half a pound per square inch, which is 72 pounds per square foot, will be exercised. If now the diameter of the tunnel is $8\frac{1}{2}$ feet, the surface of the section will be nearly 55 square feet, and the total pressure, 55×72 or 3,960 pounds, almost two tuns. This means that such a car will be propelled with an initial velocity equal to the effect of two tuns suspended on a rope and the rope passed over a pulley to change the vertical traction into a horizontal one. As, now, on a level railroad, the friction resisting the propulsion is about one per cent of the total weight, the power thus obtained will be able to start any load less than 200 tuns weight, and this load will move with increasing velocity, only limited by the capacity of the air blasts to supply more air as fast as the motion of the car diminishes the pressure.

Another consideration, greatly in favor of the system of pneumatic propulsion, is that a column of air enclosed in a tube or tunnel is in fact equivalent to an infinitely flexible and elastic rod, which may push a load forward through any number of curves and inclines; but what is most curious, it may be also used as a rope for pulling trains towards the source of power, by simply inverting the current and thus producing suction; or, in more correct scientific language, by diminishing the normal atmospheric pressure, it will propel the load by a simple excess of the ordinary pressure over the partial vacuum produced in front of the car. But the most beautiful consideration of all this, is that this wonderful, infinitely flexible and elastic pushing rod and pulling rope costs nothing, never wears out, can never have a break or loss of connection; while, at the same time, we obtain the secondary but immensely important advantage of a most thorough ventilation in every part of the road, which is a necessity in localities so entirely excluded, from the atmospheric vicissitudes of hot and cold, rain and snow, as will be the case in the comfortable tunnel which, we flatter ourselves, will soon practically demonstrate its advantages to the population of our metropolis.

PROPOSED BOOK ON PATENTS.

There is a very general but erroneous opinion among a large class of people that patents are humbugs, and that more money is lost than made by them. Now the fact is that the greater part of the wealth acquired by manufacturers in every branch of industry has been acquired through some advantage, gained by inventive skill and secured by patent. There is hardly a successful manufacturing business in the country but owes its success in some way to patents. We do not say that all inventions are improvements, or that all patents are good; but we do say that nearly all valuable inventions are, or have been, patented.

We received a call a few days ago from a gentleman who is collecting facts and statistics for a book of successful inventions. We commend the idea as well calculated to remove the prejudice against patents, and as a matter of interest to all who are connected therewith. Instances enough have come under our own observation, of men who have made ample fortunes from patents, to fill a large volume had we written them down. But among the cares of business, many details have escaped our memory, while others are so dim that we cannot state them with the precision necessary for such a work. Nevertheless, we shall afford the author such facilities as are in our power, and in his behalf we cordially invite the co-operation of our readers. If they will send us statements of such instances as they may be acquainted with:

First. Where inventors have sold their patents in whole or in part for large sums.

Second. Where they have received or are receiving large sums as royalties.

Third. Where a large and successful business has been built up by manufacturing patented articles.

Fourth. Where articles are made cheaper by means of patented machinery.

Fifth. Where joint stock companies have been founded in part or wholly upon patents, and the stock has greatly advanced in value.

Names and figures and reliable information are wanted as far as possible. The book is designed to prove the actual benefit which has been derived from patents in the various branches of industry. If each one will contribute the facts within his knowledge, a work may be soon published which will be of inestimable value to inventors. Parties possessing such information will oblige by sending the facts to this office.

SUPPLEMENT TO THIS WEEK'S EDITION.

The attention of our readers is called to a supplement to this week's issue of the SCIENTIFIC AMERICAN, containing a full and exhaustive history of the discovery of petroleum, with complete descriptions of all the processes used in its refinement and manufacture. The works selected for illustrating this article are those of Charles Pratt's extensive manufactory. His establishment and appliances afford the best opportunities for describing the most recent and improved methods of treatment.

Subscribers are requested to see that their news' agents deliver a supplement with each copy of our issue of May 18.

Balancing Slide Valves.

A correspondent, L. A. T., in commenting on the remark of a western engineer, published on page 121 of the current volume, states that "if a slide valve were relieved of all the pressure above and the cylinder filled with steam, the valve would of course be lifted from the seat.

When the engine is in motion and the steam chest filled with steam, the pressure on the slide valve is equal to that in any part of the chest; but then the valve gets considerable relief, although it is constantly increasing and decreasing as the valve slides to and fro upon its seat. For instance, when the valve opens a port, it instantly fills with steam, and at the time the valve cuts off that port, the pressure is equal above and below that edge of the valve; but as the piston travels back in the cylinder, the pressure in the port decreases until the valve exhausts that port; and then, from the time of the exhaust until the opposite port is opened, the cylinder is empty; and at this time the valve needs the most relief and gets none.

Now, if we relieve the valve of all its pressure, we commit an error. Why? Because it relieves itself, and the longer the steam follows the piston, the more we relieve the valve. For instance, we relieve it more when it is working at full stroke than when at half stroke, because we let a greater amount of steam into the cylinder at full stroke than we do at half stroke; and consequently we get a greater amount of pressure therefrom to relieve the valve just when it cuts off and before it exhausts.

To balance a slide valve successfully, we must take into consideration the relief as much as we do the pressure."

A MAN'S actions are effaced and vanish with him. But his intellect is immortal and bequeathed, unimpaired, to posterity. Words are the only things that last for ever.

American Ideas in China.

The Chinese government, influenced by the counsels of Yung Wing, an intelligent and enterprising native who enjoyed the advantages of a thorough college education in this country, has now determined to send over to us quite a number of young men for educational and professional training.

The plan, as it is now being carried out, is understood to be as follows:

1. The Chinese government to select thirty boys each year for five consecutive years, 150 in all, without distinction of rank and by competitive examination. They are not to exceed fourteen years of age when they enter the preparatory school at Shanghai or other schools that may hereafter be organized. Their education in Chinese is to be made as thorough as possible before they are sent to the United States.

2. The entire expense for their support and education in the preparatory schools and also while in the United States will be borne by the Chinese government.

3. An educated native of rank to be appointed as instructor to each yearly instalment, who is to accompany them to the United States and remain with them. He is charged with the instruction of the youths in the Chinese language and literature while in the United States, and is required to devote a portion of each week to that object.

4. The students are required to prosecute their studies for twelve years, and during that time each is expected to acquire one of the professions. They will not be allowed to remain in the United States beyond that period, nor to enter upon any private occupation.

5. Each student is regarded from the first as in the service of the Chinese government. A definite rank is assigned to him on the completion of his education, and he goes immediately into service on his return. In case the parents of any student are in narrow circumstances, a certain indemnity is to be paid them by the government.

6. The students will not be permitted to divest themselves of their Chinese nationality or become naturalized citizens of the United States.

From New York to New Orleans in Pneumatic Tubes.

A bill is now pending in Congress to incorporate the "National Pneumatic Tube Company," capital one hundred millions of dollars, with authority to lay pneumatic tubes between New York and New Orleans. The freight is to be carried in hollow balls, which are to be blown through the tubes, and this the projector thinks can be done at a high velocity and cheap cost. This plan of using "hollow spheres" in pneumatic tubes is very old. It was patented in England, by James in 1842, and again patented in this country, by Brisbane in 1869.

The idea of competing with long lines of ordinary railways by means of pneumatic tubes is chimerical. Pneumatics is well adapted for short routes in cities, where the traffic is large and the use of locomotives objectionable. But for extended lines through the country, the cost of construction, maintenance, and operation would be greatly in excess of an ordinary railway of same capacity and speed.

Measuring the Velocity of Railway Trains.

Several devices have been invented for registering the velocity of trains, but none of sufficient simplicity to come into general use have yet been suggested. Messrs Samman and von Weber's construction, a German invention, consists of a disk driven by clockwork and a recording pencil. While the train is halting, this describes a circle, but during the journey, a crooked line is produced by the vibration. In M. Cremer's apparatus, a strip of paper moves by clockwork. This paper is graduated and marked in minutes. A needle with an up and down movement, which is in connection with an axle, pricks the paper. The distance of the holes serves as a guide in ascertaining the speed. On French lines, an apparatus is met with in principle not unlike the centrifugal governor, the coupling box of which is in connection with and moves a pencil. In Schiff's apparatus, which is not unlike that of Cremer, the needle is moved by a battery, which renders its working more complicated and uncertain.

THE polarizing instrument, known as the Nicol prism, is composed of a prism of Iceland spar, divided at an angle into two halves, the angular surfaces polished and again united with Canada balsam. Professor H. F. Talbot finds that glass may be substituted for one of the halves of spar, and a good prism will be thus produced.

NOT long ago, the whole stock of the paraffin wax in the world did not exceed four ounces, which was carefully preserved in the laboratory of Professor Liebig as a chemical curiosity. There is now produced in Scotland alone a quantity of not less than 5,800 tuns annually.

HERE is the business done by the Western Union Telegraph Company in one hour, by means of one wire, between New York and Boston, employing the Stearns instruments for sending messages both ways at the same time. From New York to Boston, 72 messages; from Boston to New York, 62 messages. Total, 134. This remarkable improvement in telegraph instruments doubles the capacity of every existing wire without increasing the cost of maintenance.

Edwin F. Johnson, one of the most eminent of American engineers, died on the 12th inst., and was buried at his home in Middleton, Conn. He was Engineer in Chief of the Northern Pacific Railroad until a little more than a year ago, and since has been Consulting Engineer of that company.