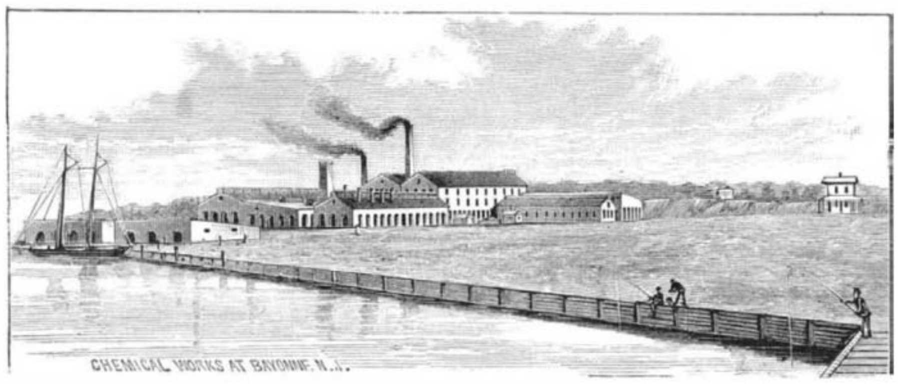
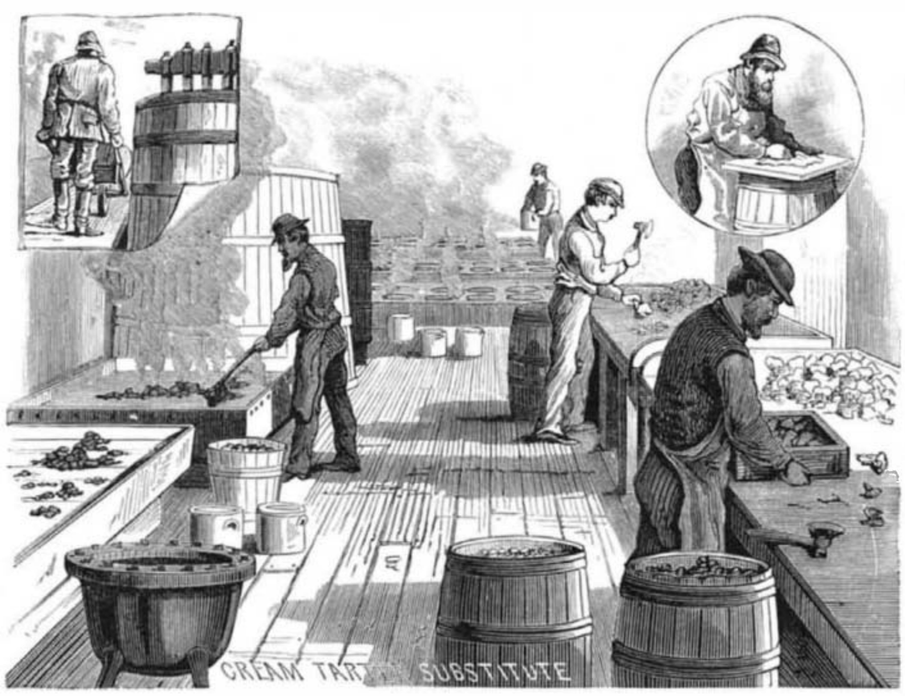
AMERICAN INDUSTRIES.—No. 60.

THE MANUFACTURE OF CHEMICALS.

Great as have been the advances of late years in chemical knowledge, and important as have been the relations of this science to many of the most signal discoveries and inventions of modern times, we fear that some of its most simple principles are even yet as an almost unknown world to many otherwise very intelligent members of the community. As the changes caused by chemical action are not generally accompanied by sensible motions, so that we can see their effects as in ordinary mechanical operations, even the broad truths by which so many of the phenomena of every day life are explained, involving as they do a knowledge of the composition of air and water, the elements of matter, the laws of heat, electricity, etc., appear to many only in a sort of dim and misty horizon, as it were, in which the most incongruous and the simplest of demonstrated facts are thrown together in inextricable confusion. To most people, therefore, even the symbols of chemical nomenclature, designed to simplify and render exact the accounts of such changes, are but a stumbling block, and are usually passed over in reading, as would be a quotation from the Arabic or Chinese. For these reasons, no less than for its great importance as a branch of American industry, the illustrations we herewith give of the manufacture of chemicals, as carried on at the works of Martin Kalbfleisch's Sons, the largest establishment of the kind in the country, cannot fail to command particular attention, the more especially as their productions are used in nearly every manufacturing town in the country, and these or similar articles constitute an indispensable part of the stock of every chemist.



The principal article made at this establishment consists of sulphuric acid, or oil of vitriol, it being usually classed as sulphuric acid when about 58 to 60 degrees strength, while all of the product shipped as oil of vitriol must come up to 66 degrees. But the economical manufacture of this one article, in a large way, almost necessarily involves the production of some of the other acids, and gives such great advantages in the making of several of them that their manufacture may be considered as closely correlative branches of one industry, the processes being to a great extent similar, and the product or refuse of one being a necessary component of the other. The celebrated German chemist, Dr. Rudolf Wagner, describes sulphuric acid as holding the same relations to chemical work in the industrial world as iron holds to the mechanical department thereof. In this establishment we see a good exemplification of the truth of the statement, for sulphuric acid is largely used, directly or indirectly, in all the other productions of the company, which include muriatic and nitric acid, aquafortis, alum, blue vitriol, aqua ammonia, muriate of tin, tin crystals, and sulphate of zinc. The works were originally started in 1829, with one small factory for the production of sulphuric acid, but there are now five factories for this branch of the business, besides those devoted to the other specialties, the buildings and yards covering about twenty acres of land on Newtown Creek, at a point which can be reached by vessels drawing nine feet of water, but yet within the city limits of Brooklyn, N. Y. The firm also have extensive works of a similar character at Bayonne, N. J., and Buffalo, N. Y., with which localities they have thought it best to divide their business on account of its rapid growth of a few years past.

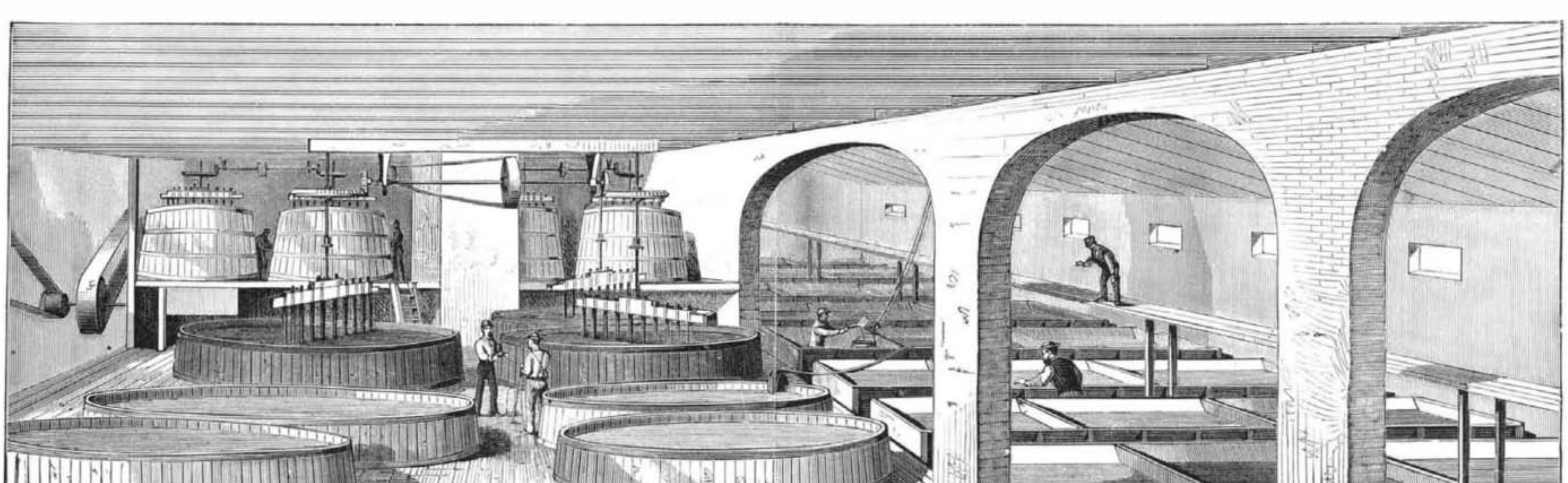


The making of sulphuric acid consists, in brief, in so burning sulphur as to unite its vapor, in the proportion of 1 part to 3, with the oxygen of the air, while 1 part of water in the receiving chambers (this water also contributing its 1 part of oxygen) will be saturated therewith. These proportions must be absolutely obtained, or we do not have sulphuric acid, which is represented by the chemical symbols, H_2SO_4, meaning water (H_2O) 1 part, sulphur 1 part, and oxygen 3 parts. With 1 part less of oxygen we shall have sulphurous acid, represented by SO_2, instead of sulphuric acid. The sulphur burned here comes principally from Sicily, where are the largest deposits in the world, it being an almost constant product of active volcanoes, and in all the factories about twenty tons a day are used. The oven-like furnaces in which it is burned are arranged side by side, with large flues at the back to conduct away the vapor; the door at the front is sufficiently loose to admit enough air to form, in combination with the sulphur vapor, sulphurous acid, and the size of the flue singly, or where two or more are joined together from different ovens, must be of corresponding capacity. The sulphur furnace has an iron bed plate instead of grate bars, and, before the manufacture has been put under way, the furnaces must be heated up by fires thereunder, after which the burning sulphur consumes itself, care being necessary to prevent too great heat, which is prevented by the moderate admission of air under the bed plate. After the furnaces are once in thorough operation they are kept going continuously, day and night, the year through. The charge of sulphur is put in by weight, and consists of from 60 to 75 pounds, according to the size of the furnace, each charge requiring about three hours to burn off.

The flues to conduct the sulphur vapor from these furnaces are great lead pipes, leading to immense leaden chambers above, where the vapor is hydrated and oxidized. The latter part of the work, or imparting to the sulphur vapor the necessary proportion of oxygen, may be practically effected in a great many ways, and there are important variations of detail in the processes followed by different establishments, but, in the manner it is commonly effected, through the agency of sodium nitrate, or Chili saltpeter, chemists are even yet divided in opinion as to the precise nature of the various reactions through which the actual results are always definitely obtained. The niter, which is used in exact proportion to the amount of sulphur burned, may be put in a pot, covered with vitriol, in the furnace where the sulphur is burned; here it will be converted into nitric acid, which, on passing into the leaden chambers, in the presence of sulphurous acid, air, and water, is changed into nitrogen trioxide, and freely gives up most of its oxygen to oxidize the vapors there and convert the sulphurous into sulphuric acid. In such establishments as that of the Messrs. Kalbfleisch, however, where the manufacture of nitric acid separately forms a distinct branch of the business, this plan is not followed, but the specified quantity of nitric acid required is introduced directly into the leaden chambers, instead of being made in the furnaces where the sulphur is burned.

The leaden chambers required for the oxidizing of the sulphur vapor are on an immense scale, as may be readily seen from our engravings. They are in a series, generally of five chambers for each set of furnaces, though less may be made to answer with interior curtains or divisions. The capacity of some of these chambers is enormous, amounting to 100,000 cubic feet, or large enough to completely inclose two or three good sized city houses. Lead is used in their construction because it forms a durable material on which the acid has but slight effect. The sides and top are sustained by a framework of wood, to which the sheet lead is held by leaden straps, and, as no solder can be employed in joining the sheets, the joints are made by melting the edges together.

The vapors from the sulphur furnaces, as they pass upward toward the large leaden chambers, have their draught somewhat accelerated by jets of steam in the same direction, and similar jets also furnish steam inside the chambers ready to combine with the sulphurous acid fumes. Nitric acid may also be placed here, in jars, supplied regularly from the outside, or it may be introduced through a system of siphon tubes, the object being to have such a constant movement of the acid as will present its surface many times to the sulphurous vapors, to which it gives up its oxygen for the formation of sulphuric acid. The usual way, however, is to first bring the sulphur vapor into direct contact with the nitric acid in the second chamber of the series, after it has passed there through a tube low down in the first chamber, and then, it having been largely hydrated by the steam jets to which it has been exposed, it rapidly takes up an excess of nitric acid, and the whole is taken back by a tube from the bottom to the still lower bottom of the first chamber, where it is exposed to the fresh mixture of gases, and gives up a large portion of the nitric acid. From this chamber the acid is conducted into the bottom of the third chamber, where all of the acid produced is collected. This chamber is lower than the others, and in order to complete the mixing of the gases therein several jets of steam enter it from different directions. It is provided with a drip from which the acid trickles, in order that its strength may be



determined, and this acid, called chamber acid before it goes to the concentrating retorts, varies from 45 to 55 degrees. It is adapted to many uses in the works, but is never sold outside except to manufacturers who may call for this particular grade. The product of the other chambers, so far as their gases are condensed, are taken back to the third chamber, and what is passed off, consisting mainly of atmospheric air and nitrous vapors, is taken to the "Gay-Lussac Towers," or coke columns, so called after the name of the chemist who first contrived them. These towers are high, narrow chambers, lined with lead and filled with pieces of coke, through which oil of vitriol is made to trickle, and the waste gases of the chambers passing through the coke give up their nitrous fumes, making nitrous acid to be again used in the chambers, so that very little niter is actually wasted. The nitrous fumes, in fact, again take up oxygen as readily as they gave it out in the chambers, so that with these coke columns, and due care in the working of the furnaces and chambers, the same nitric acid is substantially used over and over again, needing only sufficient replenishing to make up for unavoidable waste, which averages some 5 to 6 per cent. of the weight of sulphur burned.

The proper regulation of the temperature of the leaden chambers is a matter of great importance, and it may be effected by increasing or diminishing the supply of nitric acid or nitrous gas, the greater the quantity used in a given time the higher being the temperature. At a distance of five feet from the floor of the chamber it should be from 40° to 44° C., but near the center of the chamber it will vary from 40° to 60°.

The further concentration of the acid after it has left the chamber is effected by two stages, first in open lead pans, set on iron plates, to receive the heat of the furnace, and then in platinum stills. By the leaden pans the concentration is carried up to 60° Baumé, and a specific gravity of 1·75, but it is impracticable to carry it further by this process, as the necessary heat for evaporation then causes the acid to attack the lead. These platinum stills are beautiful to look at, but so very expensive that many efforts have been made to find a substitute for them. In some establishments glass has been tried for this purpose, but its constant liability to breakage has prevented its general adoption. These stills are arranged in steps one above another, and from them the acid is conducted to cooling chambers, whence it is drawn through leaden pipes to fill the carboys in which it is always shipped. These hold eight to ten gallons, and are packed in hay or straw in stout wooden boxes. The mouth of the carboy is closed with a stopper of clay, bound around with canvas, and the whole smeared outside with tar, this care being necessary to prevent the access of air, from which the acid would take up water. Should this glass carboy be cracked or broken the escaping acid would quickly convert the wood and straw around it into charcoal. These carboys are not very expensive, but they are generally returned to the works when the points to which they are shipped are not too distant.

In the nitric acid manufacture the operation is conducted in a series of ovens, 18 in number, 3 of which only are charged each day. These ovens are nearly circular, 4½ feet in diameter by 8 feet deep; into those to be charged are placed the proper proportions of nitrate of sodium, or Chili saltpeter, and sulphuric acid, usually about equal quantities of each, and then the fires are started, it requiring twelve to eighteen hours to burn off the charge. From the rear of the ovens the vapors given off are conducted by clay-lined pipes into a series of earthenware and glass receivers and flasks, these being connected by earthenware pipes. The vapors condensed in the first two or three vessels usually consist of strong nitric acid, while, to secure the entire condensation of all the fumes, water is introduced into the following ones, and the acid there made is of diminished strength. The acid thus produced, when of the best grade, is a colorless, transparent fluid, having a specific gravity of 1·55, and the boiling point at 80° C. Ordinary aquafortis has a specific gravity of 1·19 to 1·25, but when the specific gravity is as high as 1·35 to 1·45 it is termed double aquafortis. Besides its extensive use in the manufacture of sulphuric acid and many other chemicals, nitric acid is largely employed for etching on bronze, brass, and copper, for separating gold and silver, and for many other uses where a powerful oxidizing and dissolving agent is required.

The commercial article known as muriatic or hydrochloric acid, also called spirits of salt, is a solution of the gas given off during the decomposition of common salt by sulphuric acid. It is so readily soluble that water at 15° C., or about 60° Fah., will absorb over 450 times its volume under the normal atmospheric pressure. The apparatus by which it is prepared and condensed consists of several cast iron cylinders, closed similarly to gas retorts by lids luted with clay. At one end of each cylinder is an earthen pipe to convey the gas to a condensing apparatus, and at the other is a leaden funnel, through which, after the retort is charged with salt, sulphuric acid may be introduced. The construction of the furnace is such as to allow the flames to play around the cylinders, when the gas passes off by the earthen pipe at the rear into a series of receivers. That which is collected in the first receiver is raw acid, but the following ones contain each a small quantity of water for the absorption of the vapor, and this aqueous solution is generally purest, the chief impurities having been left in the first receiver. The raw acid is distilled and its product passed into water for purification, or it is diluted till its specific gravity is but little above that of water and then distilled, it being necessary in both cases to reject the first portion of the distillate, which contains chlorine or sulphuric acid. The saturated solution is drawn off into carboys, with air-tight stoppers, but it is necessary to leave in each carboy a small empty space, to avoid risk of breakage in warm weather from the expansion of the acid.

There are many technical differences in the manner of making alum, according to whether it is produced from alum stone or shale, or earths having various proportions of alum in combination with other salts, but it is only necessary here to refer to the manufacture from alum stone, as now being carried on at the works. Ordinary alum stone is mostly amorphous and of a reddish color, the purer kinds being white and crystalline. In the preparation of alum therefrom the stone is merely burnt, the calcined mass lixiviated with water, and the solution evaporated to crystallization. In burning, great care must be taken to have neither too much nor too little heat, as in the latter case the stone would not be sufficiently disintegrated, and in the former sulphuric acid would be driven off, leaving an insoluble compound, the burning operation being generally judged to be complete when the vapors contain sulphurous and sulphuric oxides. After burning, the stone is gradually mixed into a paste and lixiviated with hot water in large tanks or pans. When the solution has become sufficiently clear it is drawn off, evaporated at a temperature of about 50° C., and allowed to cool and crystallize in vats, upon the sides of which alum deposits; the mother liquors also yield cubic alum on further evaporation. To keep up the required temperature of the vats for the proper evaporation in the different stages, they are all fitted up with steam pipes, by which the heat is carefully regulated. Alum is very extensively used as a with the use of coal tar colors.

Blue vitriol is made by heating metallic copper, or the crude ores, having only about 60 per cent of the metal, with concentrated sulphuric acid. It may also be made by heating sheets of copper in a reverberatory furnace to the boiling point of sulphur, then adding a quantity of that element, and afterward sufficient sulphuric acid to saturate the oxide of copper, when the clear solution is decanted until it crystallizes. Blue vitriol is the base of many of the pigments obtained from copper, is also used in dyeing and printing, in the amalgamation process of extracting silver, etc.

In the manufacture of aqua ammonia a large iron still is employed, in which are placed sal ammoniac or ammonium sulphate, with an equal weight of fresh burnt lime previously mixed with four times its weight of water, the whole being thoroughly stirred together. A delivery tube leads to near the bottom of a vessel two thirds full of water, and heat being applied, gently at first, ammonia gas and aqueous vapor are driven off; the aqueous vapor is condensed in the first vessel, but the ammonia is absorbed by the water in the second vessel. Pure ammonia gas may be reduced to a liquid state, at ordinary temperature, under a pressure of about 17 atmospheres, or by cold alone at a temperature of —40° to —50° C., and it is this property of "storing up cold," as it were, which has made it so serviceable in the manufacture of artificial ice.

The manufacture of muriate of tin and tin crystals, both being tin salts, is conducted by dissolving granulated tin in muriatic acid ; the evaporated solution then leaves colorless, transparent, deliquescent crystals, of course very readily soluble in water. The aqueous solution, forming the muriate of tin, soon deposits a basic salt unless more hydrochloric or tartaric acid be added. Both of these productions are chiefly used in dyeing and calico printing.

The sulphate of zinc, also known as white vitriol or white copperas, is made by dissolving either zinc or its oxide or carbonate, in dilute sulphuric acid, and evaporating the solution, when it separates in small crystals as an opaque white granular mass. The native sulphide or blende is also used, but the sulphate thus obtained is redissolved in water and the solution left in contact with plates of metallic zinc until its impurities, as iron, copper, lead, etc., are precipitated. Aside from its medicinal uses it is largely employed in the preparation of drying oil for painting, in calico printing, and as a mordant in dyeing.

One of the necessities in the manufacture of this large line of chemicals is a continued supply of earthen or clay ware, of many different sizes and shapes, for the breakage of such articles, in so extended a business, would necessarily be great. The firm, therefore, long since commenced to manufacture for themselves all the articles of this class they require, having a pottery suitable for such purposes on the grounds, and workmen especially skilled in filling the requirements of the different factories. The senior Mr. Kalbfleisch, who died seven years since, besides being a man of remarkable executive ability, always exhibited a wonderful degree of push and energy. He personally superintended the starting of this department, and had the kiln built after his own plans, but he was always in such a hurry to get out his ware that he would not wait for the kiln to be heated up as slowly as it should be, and a very large portion of his pots and pipes were snapped in consequence before he would allow an experienced man to take charge of that part of the work. This is a detail which the workman, who still runs this specialty, now relates with no little zest.

The productions of this establishment are shipped to all parts of the country. Lighters convey them up the Sound to the manufacturing establishments of Connecticut, Rhode Island, and Massachusetts, and also up the North River, besides the larger amounts that are forwarded by rail, although their works in Buffalo now supply a considerable proportion of the Western trade. The production of sulphuric acid alone amounts to between 50 and 60 tons daily, and for this, as for all of the other articles they make, each succeeding year shows that the demand is larger than was that of the preceding season.

Their office and store in New York are at No. 55 Fulton, corner of Cliff street.

Adulteration of Artists' Materials.

The system of adulteration which is in such extensive practice at the present time appears not only to affect our food, drugs, and our articles of apparel, but even our artistic productions. The paintings of artists of the highest reputation suffer from this crying evil of our time, and all true artists will feel greatly indebted to Mr. W. Holman Hunt, for his excellent paper on "The Present System of Obtaining Materials in Use by Artist Painters, as Compared with that of the Old Masters," which was read before the Society of Arts, on the 21st of April, and which appears in the society's journal of the 23d of that month. In this paper Mr. Hunt points out the deterioration generally, not only of pigments and coloring matter, but also of varnishes, oils, and even of the canvas itself, the effects of which are prejudicial to the picture either in point of coloring, cracking, or some other change, all of which were guarded against by the old masters.

On the subject of oil alone, which Mr. Hunt refers to as an important one, he says that before the Crimean war the linseed for making oil came principally from the ports of the Black Sea. The practice which then prevailed in the trade was to empty into the hold of the vessel one measure of hemp or other common seed to thirty-nine of linseed. This was called legitimate adulteration.

The war destroyed this trade, and linseed was subsequently brought from India, where the quality was inferior, and where carelessness in planting and reaping the crops caused the seed to be much more extensively mixed; but, in addition to this inferiority, the trade had thought it well to advance its legitimate adulteration to the extent of one measure to every nineteen. Mr. Hunt further stated that it was impossible to find pure linseed oil in all England, and that to procure it the seeds had to be carefully sorted out one by one with the fingers ! This question of the genuine nature of artists' materials is one of really great importance, inasmuch as it affects the character of the work of our greatest painters in this generation in future ages, as well as the reputation of the artists themselves. The care with which the old masters treated their colors did not exceed that which they gave their oils, which may look bright without being perfect.

THE address of the inventor of the bolt for double doors, described in our last issue, is W. P. Brachmann, 147 Walnut street, Newark, N. J., instead of Philadelphia, Pa., as erroneously given in the article referred to.

Substitute for Alum in Bread.

Mr. C. Estcourt, F.I.C., writes as follows to the *Analyst*: During the past month I have had submitted to me for examination, by a large baker here, a sample of the liquid, together with a loaf in which it is said to have been used. The sample is declared by the inventor to be perfection, and certainly practically gives no alumina in bread in which it is used.

I give below the result of quantitative analysis of the liquid:

Sp. gr. at 60° = 1174.

	In 100 parts by measure.
Free phosphoric acid, calculated as $H_2P_7O_8$	14 58
Magnes. pyrophosphate	6·94
Ditto sulphate	6·39
Sodium chloride	traces.

The compound is therefore mainly magnesium phosphate kept in solution by phosphoric acid.

The bread sent was said to have been made from poor English flour, which would not, owing to deficiency in gluten, have made a presentable loaf without alum. It was found to be beautifully white, firm, and yet well aerated. The air spaces of the loaf, shown when it was cut through, were very numerous and of a uniform size. The total amount of alumina found in it equaled rather less than 10 grains of alum per 4 pound loaf, which, as will be remembered, does not much exceed the quantity allowed for by some analysts as being naturally present.

Whether or not such a compound can be safely used in bread is a question of vital importance, both to the general public and the baking trade. If the compound is declared by competent medical authorities to be innocent in its results in the small quantities used, there is no doubt it will be a great boon. Wet harvest times result in large quantities of wheat, which wheat, when ground, cannot by itself be made into presentable food for man without the use of the admittedly injurious drug—alum. Thus this quality of wheat is not available for use by bakers who prize a good name; but if the use of this compound can be proved to be innocuous it would render possible the use of such flour to the mutual advantage of both the public and the agriculturists—the one obtaining cheap bread, and the other being saved from that partial ruin which is so often the result of a bad harvest. I am making experiments as to quantities used, and will give the results in a future paper.

English Views of American Farming.

In the report of Messrs. Read and Pell on American agriculture, they say:

"Few English farmers have any idea of the hard and constant work which falls to the lot of even well-to-do farmers in America. Save in the harvest, certainly no agricultural laborer in England expends anything like the same time and strength in his day's work; therefore it is essential to guard against putting the value of the farmer's own labor at too low a figure, and to make due allowance for the drawback which must occur upon the most skillfully managed and best arranged big farms. The calculations are here made in the endeavor to strike an average of the cost of the production of wheat between the very large and the very small farms of America, and in estimating the cost of the latter to give a fair and reasonable value to the labor of the farmer and his family.

"The readiness with which the tillers of the soil take to machinery in America would surprise some of the farmers in the old country. The skill and ease with which they are worked say something for the manufacturer, but still more for the intelligence of the farmer. In America the presence of labor-saving machinery upon even a small farm is an absolute necessity. There is the further inducement to obtain implements of all kinds by buying them on long loans, and by paying for them by installments, which sometimes tempts a farmer to buy more machinery than he can afford. The machines used upon the farms are well constructed, and exceedingly light and handy. The land is level, the soil light, the climate dry, and the crops by no means bulky. Under these favorable conditions, machines that would soon come to grief in England, work well for many seasons in America. But having got a good machine, and skillfully used it, it appears beyond the power of an American farmer to take the slightest care of it. Not only the common implements of the farm, but such costly and delicate machines as drills, mowers, self-binding reapers, and thrashing machines, stand abroad all the year round. A few poles and a ton or two of that straw which is lying about in masses ready to be burnt, might protect all the spare machinery on a farm. But nothing of the sort is attempted, or at least it is so rarely done as only to prove the exception to a very general rule of wanton negligence. When, therefore, one hears of the perishable nature of the American implements, it would appear that the chief fault rests with the farmer rather than the maker. We should say that good machinery and improved implements are much more common on American than English farms. The tools are certainly lighter, better shaped, and better made. It may be true that a 'good workman never finds fault with his tools,' but it is truer still that a Yankee laborer is too sensible ever to work with a bad one."

Improvement of the Upper Mississippi.

THE Mississippi River Commission have finished the examination of that portion of the river between St. Paul and St. Louis, a distance of 700 miles. Great improvement was found in the channel, especially for low water navigation, the result of the improvement works in process of execution by the corps of engineers. These works consist of low wing dams of brush and stone, projecting from the shore for the purpose of narrowing the water way, supplemented by a brush and stone revetment of the opposite bank and elsewhere if necessary wherever the contraction produces caving.

New Explosive Substances.

In the coal mines at Polnich-Ostran, near the Ferdinand Railroad, in Austria, a number of experiments have recently been made with some new explosive matters in order to ascertain whether they could be used advantageously instead of dynamite. The results show that these new substances answered the purpose even better than dynamite.

Their composition is as follows:

1. *Peralite*, a large grained powder, manufactured by Prochska & Lisch at Buda-Pesth, seems to contain 64 per cent of nitrate of potassium, 30 per cent of charcoal, and 6 per cent of sulphuret of antimony.

2. *Janite*, manufactured by H. Jahn, at Peggau, contains 65 to 75 per cent of nitrate of potassium, 10 per cent of sulphur, 10 to 50 per cent of lignite, 3 to 8 per cent of picrate of soda, and 2 per cent of chlorate of potassium. It is less inflammable and less violent in its action than peralite, blasts greater quantities of coal and in larger pieces.

3. *Carbazotine*, invented by Messrs. Cahuc & Soulage, and manufactured at Dombrau in Moravia, contains about 610 per mille of nitrate of potassium, 8 per mille of sulphate of iron, 247 per mille of soot, lamp black, and organic substances, and 135 per mille of sulphur. It is not in the form of grains, only half as heavy as powder, and is very hygroscopic, but can easily be dried by the heat of a stove. It is slow in its action and not easily inflamed; its use is therefore perfectly safe, if the necessary caution is taken.

The cost of each of these substances is about $13.60 per hundredweight.

4. *Carbon Dynamite, No.* 3. This product is manufactured by Messrs. Mahler & Eschenbacher at Vienna; it is analogous to the cheap dynamites of Noble, and consists of a mixture of nitro-glycerine and a gunpowder of an inferior quality, which here takes the place of the porous silica.

The experiments were made in a stratum of coal having the thickness of about 10 feet. The surfaces of attack were 10 inches square and 10 feet distant from each other. The results are shown by the following table, in which three different sizes of the coal obtained are given, large, medium, and small:

Explosive Substances.	Large.	Medium.	Small.
Carbon dynamite	21·4 p. c.	35·6 p. c.	43 p. c.
Carbazotine	26·3 "	37 7 "	36 "
Peralite	19·9 "	37·7 "	44·4 "
Janite	22·9 "	38·5 "	38·6 "

The price of the different explosive substances, and the market price of the quality of coal obtained by the employment of these substances for blasting, are indicated by the following table:

Explosive Substances.	Price per ton.	
	Of the explosive sub. used per ton.	Of the coal.
Carbazotine	$0·043	$2.66
Janite	0·059	2.64
Carbon dynamite	0·042	2.60
Peralite	0·015	2.56

The amount of the savings per year in using these explosive substances in the coal mines at Polnisch-Ostran was, as the report says, fully $10,000.

New Ammonia Process.

The *Chemical News*, of April 2, mentions a patent taken out by Messrs. Rickman & Thompson for the manufacture of ammonia from the nitrogen of the atmosphere and the hydrogen of water, which, if it realizes the expectations formed concerning it, will exercise an important influence on the future of artificial fertilizers. The operation is carried on in a closed brick furnace, having an ash-pit closed to regulate the current of air. The deoxidizing material used is the dust of steam coal. In the presence of this at a full red heat the vapor of water is decomposed and the hydrogen combines with the nitrogen from the regulated current of air. But ammonia is decomposed at a bright red heat, so, to prevent loss by accidental excess of temperature, 5 to 8 per cent of salt is mixed with the coal. This chloride of sodium being decomposed at a full red heat, in the presence of the nascent ammonia, chloride of ammonia is formed, which is volatilized without decomposition. It is estimated that, with a consumption of 20 to 28 pounds of the mixture of coal dust and salt per hour, from 2 to 3 pounds of ammonium chloride will be obtained.

Balloon Photography.

An interesting paper on balloon photography, giving a detailed account of the results of some experiments made by M. De Fonvielle in the neighborhood of Rouen on the 14th of June last, is contained in a recent number of the *Spectateur Militaire*. Two views of the surrounding country were taken during an aerial excursion, from a height of about 3,300 feet, while the balloon was traveling at the rate of 20 to 25 feet per second. The photographic apparatus was affixed to the rim of the car on the side opposite to the direction in which the balloon was traveling. Miniature views were obtained of territorial sections about twenty-three acres square, upon which roadways, house roofs, garden walls, hedges, are plainly discernible. Had the sky been perfectly clear, M. De Fonvielle entertains no doubt that every human figure within the scope of the lens would have been distinctly visible in the pictures obtained, and he points out the obvious availability of balloon photography for supplying exact information respecting the dispositions of an enemy's camp and the number of his forces in war time, the operator being safely beyond the range of any projectile susceptible of discharge from a rifle or other "arm of precision." The objections to the utilization of balloon photography for military purposes are at present twain—namely, the rapid movement of the balloon, which interferes with the distinctness of the picture, and the impossibility of steering the balloon so as to impart to it exactly the desired direction. The first of these difficulties M. De Fonvielle alleges to have been already obviated by a mechanical process of Paul Desmarets's invention; for the second, no remedy has hitherto been discovered.

About Filing Saws.

The all-absorbing question of the present day among mill men seems to be, how can we run thin saws? Now, the practice of many filers is to use a beveled face, or beveled backed tooth—or both—claiming that it cuts easier and runs straighter than any other. Having learned this when young, they conscientiously think that it is all so, and as it is very difficult for most men to file a square tooth, they stick to the old bevel, and will not try the square. This is their practice, and this class of men number about one-half the filers.

In some sections all filers use this absurd old-fashioned tooth, which practice has already said was wrong. We will look at this phleme tooth in a theoretical way. It is a well known fact that all hand-filed saws get "out of space," that is, alternate spaces between the teeth get wider than the others, consequently, the teeth following these spaces have more work to do than their fellows, and as each draw outward, the teeth having the most to do—and they are all on the same side—will pull the hardest, and the saw be drawn that way just in proportion to the amount of feed carried or the work done, and no amount of hammering, tinkering, or grinding will prevent this continual pull and hard drawing, so long as the phleme tooth is used. Then we will look a little further and see what theory has to say against this beveled tooth. The filer must give his saw all the set necessary to clear itself upon, running on slow feed, and when forced to carry heavy feed, the teeth will be drawn outward all that they will spring, increasing the width of the cut from one-sixteenth to one-eighth of an inch, although the saw may go perfectly straight. This condition of things will make the lumber thicker at one end than the other, and as the saws are generally started in on slow feed, which is steadily increased, until the other end is reached, there is a taper on both sides of the board. Then again, when these teeth run into a hard knot, they are suddenly drawn in opposite directions, making the saw cut wider and consequently very much harder. This sudden wrench has been the cause of breaking more saws than any other one thing.

There are reasons enough why a man who files a phleme tooth cannot run thin saws, because they are more sensitive than thick ones, and show the defective fitting more readily, and no filer ever fitted thin—if hammered right—with a perfectly square tooth, top and bottom, who could not run them and do good work. At least of the hundreds of mills I have visited in the last three years, I have failed to find one. If millowners would require their filers to swage the teeth full and heavy, giving them one-fourth of an inch side joint, with a comparatively steady motion, a 10 gauge saw can be run just as easy as a 6 gauge saw. No man should ever use a taper saw, for if it be tapered on one side and straight on the other when standing, it will be tapered alike when running, as the centrifugal force will straighten it up and put twice the strain on one side that there is on the other, making it more liable to break. These theories can be proven by any mill man, without cost, in his own mill, and will enable him to show himself practical as well.—*W. L. Covel, in N. W. Lumberman.*

Arizona Cement.

Tucson, Arizona, is underlaid by a deposit of cement, which promises to be of great value to the Pacific coast. The *Citizen* says that hundreds of tons of it were recently excavated by the railroad company in leveling the ground for their roundhouse at that place. It is easily converted into quicklime by burning, after which, if mixed with from two to four parts sand, it produces a hydraulic building mortar, or artificial stone, said to be equal to that made with the best English Portland cement. By similar treatment with three parts of fine sand through one-eighth mesh sieve it produces a concrete, which, when moulded and pressed, gives a hydraulic stone-brick of superior quality, suitable for all common building purposes. There are hundreds of thousands of barrels of Portland cement used on the Pacific coast which may be entirely supplanted by an Arizona production.

This deposit seems to correspond closely with that forming the hydraulic mineral belt of Texas, as described in the SCIENTIFIC AMERICAN a few weeks ago.

Removal of Hair from the Face.

We frequently have inquiries, chiefly from ladies, who find their beauty marred, as they think, by growth of hair on the lips or other portions of the face, for a recipe or method by which they can get rid of their trouble. Caustic alkalies have been recommended; but they injure the skin and the hair soon grows again; the razor no lady likes to use. The only permanent remedy appears to be the absolute destruction of the follicle by electricity, the hairs being killed one by one. The operation is tedious, and is thus performed by Dr. John Butler, of this city:

The patient being seated in a chair in a semi-reclining position, the head well supported, and the face opposite a strong light, the operator selects the hair for the first attack, takes hold of it in a pair of forceps, making it tense by gentle traction.

A moistened sponge electrode from the positive pole of the battery having previously been placed on the back of the neck, or fixed at some other convenient adjacent spot, a three cornered needle with sharp cutting edges set in a suitable handle and attached to the negative pole of the battery, is made to enter the hair follicle, alongside the hair, care being taken to make the needle penetrate to the entire depth of the follicle. The action of the current soon causes a few bubbles of the viscid froth alluded to, to be observed. As soon as this evidence of electrolytic decomposition manifests itself, the needle should be rotated a few times, so as to cause the sharp corners of the needle to scrape away the *débris*, and allow electrical contact with a fresh surface. The operation is continued until the hair becomes quite loose, and comes away with the very slightest traction, the whole operation lasting a very much shorter time than it takes to describe it. The operator then proceeds with the next hair in like manner, and so on with the whole series, as many as there are to be removed, or as long as the patient can bear it. It is by no means a painful procedure (except in trichiasis), but is usually complained of as a disagreeable sensation. There is a great difference in patients, however, in this regard; some will tolerate a seance of half an hour or even more; indeed, I had one patient who stood it, or rather sat it out, unflinchingly and uncomplainingly, for over an hour, and would willingly have allowed the seance to be continued much longer, but that the operator's eyes became so tired that it was impossible to proceed. I should not omit to mention that I use a modification of a jeweler's magnifying glass, which I had made for me by Meyrowitz Brothers, the well-known opticians. It consists of a lens with a four inch focus set in a cork cap, for the sake of lightness, and made of such a shape as to fit the eye, and is readily held there as a single eyeglass is made to do.

Even with the lens the operation is fatiguing to the eyes; but without it it is almost impossible to continue the seance uninterruptedly for over ten or twelve minutes, and then it must necessarily be done in an unsatisfactory manner, as it is impossible to see how the details are being carried out. With the lens, a skillful operator ought to be able to destroy about three or four hairs to the minute, and continue the seance half an hour. It will be noticed that I have laid great stress upon the non-removal of the hair previous to the destruction of the papilla; this is one of the principal points in the operation, for as long as the hair remains in, we have a positive guide as to the direction of the follicle, and when it becomes loosened, from the action of the current, it may be taken as almost proof that the papilla has been entirely electrolyzed. I use the word "almost" advisedly, as about ten to twenty per cent of the hairs acted upon return, and have to be electrolyzed the second time.

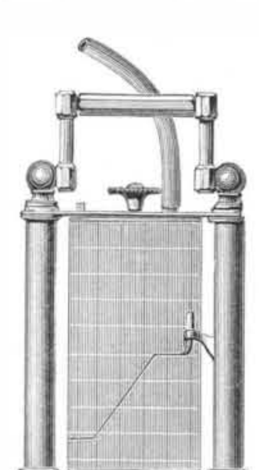
The points of the operation for which I claim originality are: the shape of the needle, and the rotatory movement therefor; the construction of the lens, and the mode of holding it as adapted to its special use; the advisability of leaving the hair in situ, until the chemical action of the current effects its loosening.

The Cultivation of Vaccine Virus.

Dr. Martin, of Boston, was the first American physician who, in view of the danger attending the use of vaccine virus taken from the human body, experimented successfully upon a return to Dr. Jenner's original method of using the bovine virus. Dr. Foster, of New York, and in 1867 Dr. Robbins, of Brooklyn, followed Dr. Martin's example, and Dr. Robbins, with his associate, Dr. Lewis, is now engaged in the production on a large scale, of virus derived from Beaugency stock, upon which they have "ingrafted" the celebrated Vincennes stock, to procure which Dr. Robbins made a special visit to France. It is worthy of note, however, that the original stock is just as potent as ever, though its power varies according to the constitution of the animal from which it has been obtained. The *modus operandi* is to select the best calves—heifers being preferred—at an age varying from a few days to a year or even more, but the younger the better, the animals being the more easily handled. If the subject is a small one it is thrown upon its side upon a table, and its fore feet and head being secured, its hind legs are stretched apart and spots upon the belly six or eight inches wide are shaved, and if necessary the epidermis or skin is thinned down. After this vaccination as in the ordinary manner is proceeded with, the animal being retained in the one position for six or seven days, when the matter is ready for removal either into tubes or quills, and must be as clear as water or else rejected. Calves of the Jersey breed are preferred. Drs. Robbins and Lewis have sent the vaccine to France, to Egypt, to China, Japan, and to all parts of North and South America. The greatest care is taken to provide that the calf which is to be vaccinated shall be in the best possible health. It is said that after a day or two the calves do not appear at all inconvenienced by their confinement, but munch their food with zest and in fact get fat. During the summer animals which are "under process" are kept in the country, it being found that they thrive better than in town.—*New York World.*

THE STEP OF MAN.

At a recent sitting of the French Academy of Sciences, Monsieur Marey read a very interesting paper, giving the result of his experiments with a machine for measuring the length and rapidity of man's strides in walking. The machine, called the odograph, consists of a cylindrical body containing clockwork which causes the cylinder to revolve at the uniform rate of 2·36 inches an hour. A pen is so arranged as to trace a line on paper rolled around the cylinder, and the track made by this pen shows the rapidity of the footsteps of the person to whom it is attached. An air valve is placed in the sole of the shoe, and it communicates with the instrument by means of a rubber tube leading up the trowsers' leg. Each time that the foot strikes the ground a slight puff of air is sent through the tube, causing the pen (which would otherwise mark only a horizontal line) to rise a distance equal to 0·004 of an inch. Thus a line is traced on the paper from left to right, rising at a greater or less angle with the horizontal according as the rapidity of the step is increased or diminished. If a man stepped exactly 3 feet at each step it is evident that in going 3,000 feet the pen would rise just 0·4 of an inch, but it was found in practice that the distance the pen was raised varied between 0·51 and 0·67 of an inch, showing that the average step varied in length from 2½ to 2 feet.



Mons. Marey found that a number of circumstances modified the length of the step. His experiments were made with soldiers from the young recruits to the bronzed veteran, and as they knew nothing of the objects of the experiments, their walk may regarded as absolutely natural.

From the large number of trials made certain facts were positively determined as follows: The step is longer going uphill than in going down; longer for a man carrying a load than for one unloaded; longer with low heels than with high heels; and longer for a man wearing thick soles and those which project slightly beyond the toe than for one wearing short and flexible soles. It was found that while the heel might be lowered indefinitely without detriment to the gait, the sole could not be made perfectly rigid nor prolonged too far without interfering with the speed and ease of the wearer. Experience alone was able to determine the exact length and thickness necessary to produce the best results.

The rapidity of the step and its regularity could be determined to a nicety. If the rapidity of the step did not change, the line drawn on the paper would keep a regular fixed angle with the horizontal; but if the step quickened, an increased angle would result, making the line curve upward; and if it slackened, the curve would have its concavity downward, these results being, of course, irrespective of the length of the step. Sometimes, as in going uphill, the length of the step increased while its rapidity slackened; but on a level it was found that hastening the step caused an insensible increase in its length also.

Mons. Marey proposes to study all the circumstances which affect man's walk, in order to determine those which produce the best results. The nature of the soil walked on, the temperature of the air, the state of abstinence or digestion, fatigue or repose of the walker, will all be taken into consideration. The effect obtained by marching troops to the drum-beat and bugle will be compared with that produced by their free march, and finally the effects of gymnastic training will be carefully observed.

An English Engineer on American Locomotives.

Mr. R. M. Brereton, C.E., writing on this subject, says: "I argue that the greater duty done by the American motor is due to the better design and the better system of working the locomotives. The American builder excels in the system of framing and counterbalancing, and in the designs of crank axles, etc., so that the engine may run remarkably easy and without jar round sharp curves, and work not only the light roads, but also diminish the wear and tear on the solid roads, and at the same time increase the effective tractive force. The English engine is a very heavy affair, and in running it not only wears and tears itself very rapidly, but also the roadway, and it greatly, by its unsteadiness and jar, fatigues the drivers and firemen. I have ridden hundreds of miles on engines in India, in England, in France, and in the United States, and I have always found the American engine most easy and comfortable, but I never did the English or the Continental engines. It is almost impossible to give these engines their full hauling power, simply because the greater portion of the weight cannot be thrown on the driving wheels."

Unsinkable Ships.

A party of gentlemen interested in steam navigation lately met at North Woolwich to inspect a steam launch built on Mr. James Long's unsinkable system. The principle consists in attaching to the sides of the hull of a vessel a series of flat air-tight metallic cylinders or drums, the inner heads of which are built into and form part of the framing and inner skin of the vessel. These drums project on either side of the ship and are cased in, the under sides of the casings normally resting upon the surface of the water and becoming slightly immersed under a load. The result is a light draught with great freeboard, and it is claimed that a greater stability under canvas and a higher rate of speed under steam or sail are thereby attained, besides the advantages of greater cargo capacity, economy in construction, and, above all, unsinkableness, however damaged by collision or otherwise. The launch in question, which is only experimental, is steel built, 37 feet in length, 6 feet in depth, and 5 feet 8 inches beam internally. She has seven cylinders fitted on each side, each cylinder being 3 feet 6 inches in diameter and 1 foot 8 inches deep, and which give her a width on deck of 9 feet over all. She draws 2 feet of water without her load, and has a freeboard of 4 feet. A short run was made with the vessel, a fair rate of speed being attained, while its unsinkable character and other points were demonstrated by Mr. Long by means of a model vessel.

600,000 Barrels of Petroleum Wasted.

Since midsummer there has run to waste in the Bradford oil region something like 600,000 barrels of petroleum. A recent dispatch from that region says that there are in round numbers nearly 8,000 producing oil wells in the Bradford district. Their daily yield is 70,000 barrels. The lower or old oil fields are producing 12,000 barrels a day. The daily demand for petroleum is 55,000 barrels. This is the amount now run by the pipe lines. The accumulation of oil for which there is no present demand long ago exhausted the storage capacity. For three months 6,000 barrels of oil have been running to waste every day. There are 2,000,000 barrels of petroleum in wooden tanks at the wells. It is estimated that there are at least 8,000,000 barrels of accumulated stocks in the storage tanks of the pipe lines. The oil that is running to waste is run upon the ground and into the creeks. Enterprising individuals build dams along these streams and collect the floating "grease." Hundreds of barrels are pumped off and stored in improvised tanks to await a market. Individual producers are building private tanks to store the overproduction. There are now 400,000 barrels of this tankage in this region. The number of wells steadily increase every month, in spite of the situation.

The Bradford wells are all flowing wells. This fact is what caused the abandoning of so many of the wells in the lower field, they being all pumpers. Until recently the "sucker rod" and pumping engine were almost unknown in the Bradford field. Now they are in demand. Many of the old wells have fallen off greatly in their yield. The supply companies cannot furnish enough sucker rods and engines to meet the call for them. Second-hand ones from the lower field find a ready market at good prices. This resort to the pump is creating no little uneasiness in the field. It indicates that the gas is failing. A flowing well on being pumped increases its yield largely; but the continuance of a full yield becomes uncertain. The positively defined area of the Bradford oil-producing field includes over 65,000 acres. There is a well to every 5 acres of land that has been developed, which leaves about 30,000 acres yet to drill. Wells on this territory will not be put down with such reckless haste as has characterized past operations, because it is controlled by large companies of capitalists.

Prizes for Designs for Furniture.

The Council of the Society of Arts, London, are trustees of the sum of £400, presented to them by the Owen Jones Memorial Committee, being the balance of the subscriptions to that fund, upon trust to expend the interest thereof in prizes to "students of the schools of art, who in annual competition produce the best designs for household furniture, carpets, wall papers and hangings, damask, chintzes, etc., regulated by the principles laid down by Owen Jones;" the prizes to "consist of a bound copy of Owen Jones' 'Principles of Design,' a bronze medal, and such sums of money as the fund admits of."

The prizes will be awarded on the results of the annual competition of the Science and Art Department. Competing designs must be marked "In Competition for the Owen Jones prizes."

The next award will be made in 1881, when six prizes are offered for competition, each prize to consist of a bound copy of Owen Jones' "Principles of Design," and the society's bronze medal

American Carriage Production.

At the recent meeting of the Carriage Builders' National Association in Chicago, the president called attention to the fact that more pleasure carriages are manufactured in the United States than in Great Britain, France, Italy, and Germany together. Not one of the countries of Europe produces annually so many pleasure carriages as are made in "one little city" in this country. Since carriages are kept only by the smaller portion of our well-to-do citizens, the vast number in use speaks volumes with regard to the general wealth and prosperity of the American people.