Communications.

Our Washington Correspondence.

To the Editor of the Scientific American:

Notwithstanding the delay of business and various embarrassments resulting from the late fire, the receipts of the Patent Office for the month of October from all sources amounted to the large sum of $55,134.03, as against $53,147.82 received during the corresponding month of last year, an increase of $1,986.20. With two exceptions only, the receipts for the past month are larger than those for the same month of any year since the foundation of the Office. The grants of patents during the first ten months of the year do not, however, correspond with this, as the issues of all kinds fall over 1,500 short of those of the corresponding months of last year. The following shows the number granted during the year up to and including the last issue of October: Patents, 10,924; reissues, 481; designs, 604; trade marks, 1,042; labels, 291; total, 13,342, as against a total of 14,886 issued during the same period of last year.

PATENT MATTERS IN CONGRESS.

Some attempts are being made to shorten the life of patents, by the introduction of bills in Congress to accomplish this purpose. One was introduced by Mr. Pridmore, which enacts that "Every patent shall contain a short title or description of the invention or discovery, correctly indicating its nature and design, and a grant to the patentee, his heirs or assigns, for a term of seventeen years, unless the invention be upon an agricultural, horticultural, or mechanical implement or tool, in which case it shall only be for a term of eight years, of the exclusive right to make, use, and vend the invention or discovery throughout the United States, and the Territories thereof, referring to the specifications for the particulars thereof. A copy of the specifications and drawings shall be annexed to the patent, and be a part thereof. And no patent shall be reissued upon any article or improvement thereof to which the limit of eight years applies."

Another bill, introduced by Mr. Oliver, provides that hereafter patents shall be granted for ten years only, but may be extended for a further term of ten years under the provisions of the law regarding extension of patents formerly in force in extension cases. The total duration of any patent hereafter granted, however, must not exceed fifteen years.

THE COURT OF CLAIMS.

Senator Mitchell has introduced a bill extending the jurisdiction of the Court of Claims of the United States, which provides that, if the Secretary of War, Treasury, or Interior Departments, or the Postmaster General, or any other official of the United States, acting under authority from the head of any executive department or bureau, has used, or hereafter uses, in the public service, any invention upon which letters patent of the United States have been issued, by means of which the public service has been or is improved or benefited, the Court of Claims shall be vested with full and exclusive jurisdiction in and over all such cases. It further provides that either the complainant or defendant may appeal to the Supreme Court of the United States within ninety days after judgment or final decree shall have been made by said Court of Claims; such cases so appealed are to be preferred causes in the Supreme Court.

THE FRENCH EXPOSITION.

The House Committee on Foreign Affairs are holding daily sessions on the matter of the bill for providing for American representation at the Paris Exposition. The Secretary of State has sent a communication to the Committee, recommending an appropriation of $225,000, and suggesting also that the bill should contain a provision for transporting intended exhibits from interior cities to the seabord. Representative Hewitt has appeared before the Committee by invitation, and made some additional statements in advocacy of the legislation proposed by his bill on the subject.

Messrs. Salmon and De Stuckle, of New York, who claimed to represent many intended exhibitors, have also appeared and laid before the Committee the plans and regulations of the Exposition, and explained the location and dimensions of the American department. They also suggested that the number of skilled commissioners should be enlarged from fifteen to eighteen, allowing one artizan and one scientific man to each of the nine groups; and that the exhibitors should be given a voice in the selections of American members of the international jury.

PRESERVATION OF FORESTS.

Every now and then Congress takes a step in the direction looking to the preservation of the forests of the country, which are disappearing altogether too fast, but for some reason or other the bill hardly ever gets any further than the committee rooms, or if it should succeed in passing one house, it always fails to reach the other in time for action. Now, however, simultaneous action in both houses is proposed by the Forest Association of Chicago, which body presented memorials to both the House and Senate, setting forth the wisdom in appointing a commission to proceed to Europe to examine into the forests of European countries, with a view to make such adaptations of the Old World practices in regard to the preservation of forests and tree cultivation as may prove advantageous here. Some legislation, it is agreed by every one, is absolutely necessary to prevent the ruthless destruction of trees, and the Committee on Agriculture, to which the subject has been referred, can confer great advantage on the country by acting promptly, by reporting a bill of some kind, intended to further the objects of the association in the manner indicated in the memorials, or by some more direct legislation.

JUDICIAL CONSTRUCTION OF PATENTS.

An opinion of the Supreme Court of the United States has recently been made public, which appears to be important in view of the decisions of some of the circuit court judges, who seem to think that the proper way to construe a patent is by what is shown or hinted at in the specification, rather than what is covered by the claim. The case referred to was an appeal from the decision of Judge McKernan of the Eastern District of Pennsylvania, made in a suit brought by the Keystone Bridge Company *vs.* Phœnix Iron Company, for an alleged infringement of the first claim of Surville & Piper's patent of January 14, 1862, and the third claim of a patent issued to the same parties October 31, 1865. The point in controversy was the construction of the claims, which on their face appeared to cover only chord bars made, by upsetting the ends, when the bodies of said bars were *wide and thin*. The defendants' chord bars were of cylindrical form, so far as related to the bodies, but their ends were substantially like the plaintiffs', and the latter took the ground that they were not limited to the wide and thin construction, but to any form of chord bars in which the ends were upset like theirs. Judge McKernan, however, construed their patent in the exact terms of their claim, and as the defendants' did not make "wide and thin" bars, he held that they did not infringe; but waiving this ground, he further held that the claim of the patent being for "the use" in truss bridges, of chord bars constructed in the manner described, the method of making the same being disclaimed, and it appearing that the defendants had only *made* and *sold* chord bars, that they only did what they had a legal right to do, and did not thereby assume any responsibility for the wrongful acts of others. From this decision the plaintiffs' appealed to the Supreme Court, who affirmed the decree, but with reference mainly to the point as to whether the plaintiffs' should be held to the strict terms of their claims or not. Justice Bradley, who delivered the opinion of the Court affirming the decree, said that "When a claim is so explicit, the court cannot alter or enlarge it. If the patentees have not claimed the whole of their invention, they should have sought to correct their error by a reissue. They cannot expect the court to wade through the history of the art and spell out what they might have claimed, but have not. Since the act of 1836, the patent laws require that an applicant for a patent shall not only, by a specification in writing, fully explain his invention, but that he shall particularly specify and point out the part, improvement, or combination which he claims as his own invention or discovery. This provision was inserted in the law for the purpose of relieving the courts from the duty of ascertaining the exact invention of the patentee. * * * * This duty is now cast upon the Patent Office. There his claim is, or supposed to be, examined, scrutinized, limited, and made to conform to what he is entitled to. If the Office refused to allow him all he asks, he has an appeal. But the courts have no right to enlarge a patent beyond the scope of the claim, as allowed by the Patent Office, or the appellate tribunal, to which contested cases are referred. When the terms of a claim in a patent are clear and distinct (as they always should be) the patentee is always bound by it. He can claim nothing beyond it." The construction thus put upon the patent obviated the necessity of the court expressing an opinion on the other point made by the court below, namely, that the patents only covered the *use* of the chords in question in truss bridges, and not the *making* of such chords, which is all that the defendants are known to have done. The court therefore affirmed the decree of the court below, with costs.

The Supreme Court has also affirmed the decree of the Circuit Court for the District of New Jersey, in the case of Roemer *vs.* Simon *et al.* This was a suit for an alleged infringement of a patent to Roemer for an improvement in travelling bags, consisting in the application of two staples, or clamps, one at or near each end, to the frame of the bag, so that when packed the ends will remain closed. The defense was that the alleged invention was not original with the patentee, having been previously known to the public through a publication in London, from which it was alleged plaintiff had taken it and unjustly patented it in this country. The court below sustained the defense and dismissed the bill. It was contended in the appeal that the evidence should have been held sufficient to sustain the patent; that the patent itself is *prima facie* evidence that the invention was original with the patentee, which, supported as it was by a former adjudication, much stronger evidence than was adduced should have been required to overthrow the presumption in favor of its validity. Justice Clifford delivered the opinion of the court affirming the decree of the Circuit Court, with costs.

CROPS ABROAD.

The Commissioner of Agriculture has returns which indicate that, owing to the poor crops in England, that country will have to buy 104,000,000 bushels of wheat this year. The English crop was unusually poor this year, but on the continent of Europe there has been a fair general crop. In Eastern Europe the supply will not greatly exceed the demand, and it is certain the war will limit the exportation from Russia and Turkey. Egypt and India will have a larger surplus than usual, and will probably increase their shipments to Europe. Our export amounts now to 55,000,000 bushels, but the Commissioner thinks that this year we may be able to supply the entire British deficiency.

ENGLISH MANUFACTURES.

The State Department is constantly receiving reports from our Consuls, respecting the manufactures, commerce, etc., of the people where they are located. The Consul at Leeds, England, reports that our high tariff and home manufacturing have almost closed our markets against woolens and linens, which are their principal wares, the only demand being for a small quantity of the very highest class of woolens to meet the demand of those people who will have foreign goods no matter what price they have to pay for them. The decline of their exports, and the means to be taken to regain their former supremacy in this regard, are now the leading topics among the thinking people. Our Consul thinks that no effectual remedy can be applied, but that British commercial interests must decline, and that American interests will be affected in the inverse ratio. This is mainly owing to the perfection of our machinery, the style and finish of our goods, the results of the inventive genius of our countrymen, together with the acknowledged fact that our artizans will do a much larger amount of work in a given time than the English, which working together have not only shut out British manufacturers from our markets, but have enabled us to become a formidable competitor with England for the trade of other countries. A somewhat similar report comes from our Consulate at Lyons, France, which notes a decrease in the exports to the United States for the year ending September 30, 1877, as compared with the preceding year, of $1,522,835, which is a decrease of 15 per cent. The decrease in silk goods alone was more than 20 per cent of the whole export of these manufacturers. An increase in the export of raw silk to the United States of over half a million dollars (more than the entire export of the previous year) is noted as showing the large increase of our own manufactures. From our Minister to Holland we have a report containing some refreshing items in these days of bank and insurance failures, from which it appears that there has not been a bank failure in that country for forty years; that the paper money of the banks is equal to gold, and that, notwithstanding the rate of insurance does not average more than one half of one per cent, there is no such thing as a failure of a fire insurance company on record. First class railroad travel costs only a cent a mile, and yet the roads pay good dividends, as pilfering officials are scarcely ever heard of; and when they do shock the nation by turning up, they are severely punished and for ever disgraced. Dishonesty of any kind or failure in business means public dishonor, and utterly debars from any future public consideration. Four millions of people live within an area of 20,000 square miles, and all appear to be happy, prosperous, and contented; the secret of which appears to lie in the fact that all live within their income, and that industry and honesty are principles so firmly established that their violation is looked upon as an outrage on the national characteristics. From the Bahamas the consular report seems to show that our high tariff on salt and pineapples has a depressing effect on our trade with that region, as these articles have been hitherto the main export to the United States. The Consul thinks that if our high duties on these productions were abolished, an immense impetus would be given to the trade and industries of these islands, which would result in a large increase in our exports. Although it is not probable that under our present tariff any very great enlargement of the trade will be effected, yet even at present American manufactures are surely and steadily taking the ground of the British, and the islands rely upon us almost entirely for breadstuffs, salt provisions, tobacco, sugar, ropes, paints, oils, liquors, boots and shoes, and, latterly, American cottons are being exported. From our Consul at San Domingo we have a detailed account of the alleged discovery of the bones of Columbus in the Cathedral there, notwithstanding the fact that the bones of the great discoverer were believed to have been transferred to the Cathedral of Havana about 90 years ago, where they were supposed to have reposed ever since. If these are the true bones, the church authorities were guilty of fraud in palming off the bones of somebody else on the Spaniards for those of Columbus, and if not, they are trying to perpetrate one now. From Capetown, South Africa, it is reported that an International Exhibition is to be opened at that place next April, under the patronage of Governor Sir H. Bartle Frere, with an agricultural department organized on a grand scale. Diplomas of honor, with gold, silver, and bronze medals, will be awarded, and every facility will be given for the sale of articles exhibited, as well as for taking orders in the building. The exhibition will be divided into classes, which include foods, drinks, chemicals, perfumery, furniture, fabrics, sewing machines, domestic appliances, watches, jewelry, hardware, edge tools, cutlery, metals, agricultural implements, machinery, etc. Further information may be obtained by communicating with Edmund Johnson, delegate commissioner, at No. 3 Castle St., Holborn. London.

The Lighthouse Board gives notice that an automatic signal buoy has been placed off Cape Hatteras in 12 fathoms of water. Cape Hatteras bearing northwest by north, about 12 miles distant. The buoy is painted black and white in perpendicular stripes, and occupies the position of the buoy which disappeared from its moorings early in October.

Washington, D. C. OCCASIONAL.

TO MAKE hard tallow candles, use a mixture of mutton tallow 10 ozs., camphor ½ oz., beeswax 4 ozs., and alum 2 ozs.

New Inventions.

Setting up Music by Machinery is the subject of Mr. Hannibal Goodwin's (of Newark, N. J.) late invention. The idea is to produce plates by which in connection with any of the well known photolithographic processes music can be rapidly and economically printed. The music is set up on a grooved board and then photographed. The photograph is used for the production of photolithographic plates.

A new adjustable Rowlock has been patented by Mr. William B. Padgett of Batesville, Ark. The general arrangement is such that the oar works in a universal joint. The advantages are that the oar may be moved with less friction, lengthened or shortened as desired, easily attached and detached from the boat, and that it will not when left to itself catch on any obstruction.

An improved device for Measuring Beer and other liquors that foam when drawn has been patented by G. J. Cave and G. E. Nicholson of Elizabeth, N. J. In the bottom of an ordinary measure is a small box, in the top of which is a screw cap perforated with a small hole to allow the liquid to pass to the box. A short elbow is secured to the side of the measures and opens through a hole in the lower part into the box. A glass tube rests in the elbow, upon the upper end of which is placed a ring of rubber which is pressed down upon the glass tube by a plug. This plug has a hole formed through it, to allow the air contained in the tube to escape. The tube is surrounded by a case arranged with cross bars which serve as indices of the liquid within. If the tube is broken it can readily be replaced.

A useful as well as ornamental Cane patented by James Pool of Friendsville, Ill., is a curious combination of instruments. In the handle is a microscope, in the top a compass, in the center a spy glass, and on the outside a thermometer. All of these parts are readily detachable and fit snugly together.

A new Apparatus to Cleanse Feathers by steam has been patented by J. J. Van Alstine of Bristol, Wis. The feathers are placed in a double walled bottom chamber, having a series of perforations and containing perforated steam pipes and is provided with a double walled upper part. A reel agitates the feathers with a series of beater arms, which are held between flanged clamps on a prismatic shaft by means of transverse bolts.

An improved Counterfeit Coin Detector, patented by Mr. W. H. Rice of New York city, furnishes a convenient, compact and reliable device for pocket use, cash tills, etc. It has guide tubes gauged in length and width for coins of different denominations, in connection with a fulcrumed and weighted trip lever gauged to the weight of the genuine coins. A spurious coin if too large cannot enter the guide tubes, and if too light will fail to trip the trip-lever.

A new and useful Washing Machine patented by Louis Rivers of Auburn, Oregon, keeps the clothes supplied with fresh suds while being washed and also allows the dirty water to run off freely when squeezed out. By an ingenious combination of rollers, chains of slats, spring, etc., the machine washes the clothes, at a considerable saving of time and soap.

The forward end of an improved Last invented by J. R. Jacques of Hancock, Mich., is connected with the lower portion by means of dowels. The rear end of the upper portion is connected with a thumbscrew and the two parts are separated by wedges. This gives a simple yet strong construction.

A new Drawing Pen patented by Bethune Perry of Albion, Cal., makes a broken line instead of a dotted one. Upon the lower end of the handle is attached a spindle, upon the inner part of which is placed a sleeve to which a disk is secured. The middle part of the sleeve is fitted with a second disk which is held in place by a nut screwed upon the outer end of the sleeve. The two disks are placed with their concave sides opposite each other and are held apart by a rubber. Their edges have radial notches. By tightening the nut so as to prevent the sleeve revolving a continuous line is made; by loosening the nut, a broken line. A very useful implement for draughtsmen.

In an improved Sewing Machine Shuttle patented by H. J. Nott of St. Mary's, Texas, the shuttle case is fitted with a cap having a hook and catch for securing it to the shuttle, and a projection that holds the bobbin in place. The invention simplifies the operation of shifting bobbins and of threading shuttles.

A simple Button Swivel for connecting a tether with the ring of a head stall has been patented by Norman Brooks of Clifton, Kan. Upon the shank of the hook are two projecting arms forming a pivoted button. In using the device the button is turned lengthwise with the hook and passed through the ring of the headstall and the button turned sidewise.

In many Copying Books, the oil employed in making the leaves transparent soaks into the index and the back of the book, and spoils them. A new device has been patented by W. H. Ellis and W. McDonald of Brooklyn for obviating this. The body of the book consists of thin leaves, alternate ones being oiled to render them partly transparent. A half cover of enameled cloth is attached to the back cover which has elastic loops for envelopes. The index has a half cover of oilproof material to protect it from oil.

An improved Barrel Holder and Skid has been patented by G. W. Brown of Damariscotta, Me., which greatly facilitates the moving of barrels. The skid is made of two sections jointed and hinged so that they can be folded together, and is composed of cross bars and longitudinal bars rigidly connected together, so as to form an inclined plane. The upper section is hinged and pivoted inside of the curved side bars, forming a holding which receives and retains in place the barrel which has been rolled up.

An adjustable Switch for Ice Runs patented by H. F. Dernell of Athens N. Y., facilitates the handling of blocks of ice. At suitable points on both sides of the ice run flanges are omitted and lateral chutes constructed for conducting the ice into different houses, and fitted with flanged sides and grated bottom. The switches form a segment of a circle and are strongly braced.

A novel Top Prop for Carriages has been invented by Mr. Leonard Sawyer of Merrimac, Mass. The arrangement is such that the washers cannot turn on the bolt, and hence the nut and thimble will not be unscrewed by the action of the braces. The invention is an excellent method of securing parts very apt to work loose.

A simple and Automatic Wagon Brake is the invention of Messrs. W. L. Whitman and Ephraim Manes of Ringgold, Ga. The arrangement is such that the forward pressure of the wagon against the horses will apply the brake, while the wagon may be backed without the brake being thrown into action. The brake also acts as a clog to prevent the horses from starting.

Mr. Uel W. Armstrong of Evansville, Ind., has devised an ingenious Mosquito Net Canopy which consists of uprights to be attached to the bed which support a frame made in three pieces. The frame is easily folded into compact form, and the entire device may be quickly put up for use or taken down for storage. It has no detachable parts that are liable to get lost.

Mr. Henry Sutter of Baker City, Oregon, is the inventor of a new Breech-Loading Firearm in which one movement of the operating lever cocks the hammer, opens the breech block, and actuates the extractor, while the return movement of the lever closes the breech, locks the breech block, and pushes back the extractor. The barrels are fixed permanently in the stock.

A novel Vehicle Device for Checking Horses has been patented by Mr. Geo. L. Kenyon of Lonsdale, R. I. When it is desired to fasten the horse the end of the line is attached to a ring on a disk connected with the hub of one of the wheels. Should the horse start, the line is wound on reel arms and the bit pulled upon. Should the horse back, a pawl and ratchet connection prevents injury. This invention is both new and ingenious.

In a new Refrigerator patented by Mr. William P. Bradley of Mobile, Ala., there is a main box and an interior box forming an intermediate cold air space and closed by a water joint. The inner box contains ice chamber and water cooler, and by suitable devices the melted ice way may be drawn off. This refrigerator is claimed to reduce the consumption of ice to a minimum.

Mr. Frederick Dassori of New York city proposes a new Ceiling for Grain Vessels so as to make them safer and to protect the grain from damage or loss. The ceiling is carried up in a curve from water line to deck near the sides of the main hatchway and a lining of cloth or similar material is provided to prevent the grain sifting through and choking the pumps.

An improved Fire Escape that may be placed on the top or roof of a building and operated from below has been invented by Messrs. H. K. and Z. Warner of Lake City, Minn. On pulling a cord a catch is released, a platform drops, and a spool rolls down the chute thus formed and falls to the ground. A cord attached to this spool is now pulled and a rope ladder is thus hauled down. The object of the ladder is to furnish a convenient and readily adjusted means of access to the tops of buildings for the use of firemen.

A combined Sole and Toe protector for boots and shoes devised by Mr. Charles Nobs of Newark, N. J., consists of a sheet metal plate which covers and is screwed to the sole and has at its front end a tip portion. The object is to protect the sole and toe against wear and hard usage.

A new Meat Chopper by Mr. John C. Lloyd of Northumberland, Pa., embodies numerous ingenious improvements. The knives are adjustable so that they can be set forward as they wear, the springs may be adjusted so as to regulate the force of the chopping blow, novel contrivances rotate the meat box, and others turn the meat over to bring it into position to be operated upon by the knives.

Scientific Potato Culture.

A French agricultural journal, the *Basse Cour*, describes the result of some experiments in potato growing recently conducted by scientific men in Germany, in which it is demonstrated that the "eyes" at the top of the potato produce a much more vigorous offspring than those in the lower part, and the consequence is that those agriculturists who cut their potatoes in half before planting them are not well advised in cutting them vertically, but should always divide them horizontally, planting the upper half and using the other as food for cattle. But the best plan of all is to plant the tuber whole, cutting out, nevertheless, all the "eyes" except those in the top part.

Crystallized Boro-Manganese and the Action of Manganese in Blast Furnaces.

We find in *Comptes Rendus* a paper by Troost and Haute feuille upon manganese, from which we abstract a few points, such as may prove interesting to our readers.

Manganese combines with boron more readily than iron does, for in making ferro-boron, or boride of iron, crystallized boron must be employed, while in making the boride of manganese it is only necessary to fuse boracic acid with carburetted manganese, Mn_3C, in order to obtain this substance in small grayish violet crystals. Analysis of these crystals showed them to be a definite compound of 1 equivalent boron and 1 of manganese; hence its formula is Mn Bo. The crystallized boro-manganese, if free from excess of manganese, dissolves in acid with the evolution of hydrogen gas. When heated to redness in hydrochloric acid gas it is but slightly attacked; it decomposes water only at 212° Fah. Alkaline solutions attack it at somewhat lower temperature. In contact with moist mercuric chloride (corrosive sublimate), in a few minutes it yields manganous chloride, boracic acid, and hydrochloric acid. Mercury cyanide also attacks it in the presence of water.

In a previous paper the authors stated (*Comp. Rend.*, LXXXI., 264) that their researches had established the fact that carbon and silicon form with manganese definite chemical compounds, while these same non-metals unite with iron only at higher temperatures and form far less stable compounds. Hence it would be interesting to ascertain whether boron, which is generally placed in the same group with carbon and silicon, acts in the same manner toward iron and manganese. Experiments upon the amount of heat evolved by the decomposition of boro-manganese and ferro-boron with mercuric chloride show that both of these substances are chemical compounds. Hence boron does not make such a distinction between iron and manganese as do carbon and silicon. (Here is an important distinction between boron and silicon, which also differ in quantivalence.) Experiments were made with two kinds of ferro-boron; the one which contained 11 per cent of boron was somewhat malleable, that with 23 per cent of boron was not malleable, but brittle and crystaline.

There are similar distinctions and analogies in the compounds of sulphur and phosphorus combined with both of these metals. We know that small quantities of sulphur or phosphorus combined with iron do not destroy its metallic lustre, but alter its malleability and ductility considerably. The sulphuretted and phosphuretted iron, which cannot be considered as sulphides and phosphides, act quite differently when considered thermetrically. Two kinds of sulphuretted iron, one with 1·8 per cent of sulphur, the other with 5·4 per cent, when treated with moist mercuric chloride, evolved respectively 810 and 840 units of heat per gramme. The metal with 1·8 per cent of sulphur, which is quite considerable from a point of view, evolved the same quantity of heat as pure iron, while the other with 5·4 per cent sulphur evolves more heat than the latter. Iron containing phosphorus acts totally different. Two samples of iron, containing respectively 5 and 10 per cent of phosphorus, when treated with mercuric chloride, evolved 790 and 480 equivalents of heat per gramme. From this it is evident that the combination of iron with phosphorus takes place with a great evolution of heat, and that a permanent chemical compound is formed. The sulphuretted iron is comparable to the silicuretted iron, which is formed without scarcely any evolution of heat. We know, too, that sulphur is far more easily eliminated from iron than phosphorus. The sulphur and phosphorus compounds of manganese, prepared from manganese that contains carbon, are attacked with difficulty by moist mercuric chloride, which is a sign that they are formed with a great evolution of heat, and are therefore more stable compounds than the corresponding iron compounds.

The results of these and previous experiments upon the thermic relations of iron and manganese compounds leads to the conclusion that the manganese used in treating impure iron forms with the foreign substances compounds which are dissolved in and distributed through the mass of metal, and they render purification easier because they impart to the elements which are to be eliminated the oxidizability of the corresponding manganese compounds. At all events, this is frequently the case; but the manganese also plays another and simpler part, namely, it acts at the same time as the reducer of the oxide of iron.* In different metallurgical operations the elimination of the sulphur and and phosphorus, if carried far enough, requires a long protracted oxidation, which produces an iron which contains oxide of iron. By adding ferro-manganese, which is always rich in carbon, the necessary amount of carbon is added to the iron, and at the same time the oxide of iron is reduced with an evolution of heat, both by the carbon and the manganese.* The oxide of manganese produced is distributed through the metal, but does not impart to it the injurious properties that oxide of iron would, for it passes almost completely into the slag and takes the impurities with it. Hence, whether the manganese is already in the metal to be purified, or is added during the refining, its importance always consists, first, in the formation of compounds, the formation of which is accompanied by more evolution of heat than the corresponding iron compounds, and second, in the ease with which these compounds go into the slag, because they oxidize with the evolution of more heat than those which contain an equal quantity of iron, especially when, as is always the case in metallurgy, they are mixed with a large amount of the metal in excess.

* Not only have manganese and carbon the power of reducing the oxide of iron in molten iron, but silicon likewise will perform this function, and but for the danger of introducing an excess of silicon, which would then remain unoxidized to the detriment of the iron, this element could be substituted for manganese in the Bessemer process, by making use of ferro-silicon instead of ferro-manganese. The question of the practical use of silicon in metallurgy cannot be considered settled yet, and offers an interesting field for investigation.