later, same year, 10,000 houses destroyed; 1751, 4,000 houses; 1756, 15,000 houses and 100 persons; years 1761, 1765, and 1767, other great fires; 1769, 1771, and 1778, great fires; 1782, fire burned three days, 10,000,000 houses and one hundred lives lost; February, same year, 600 houses; June, 7,000; 1784, 10,000 houses; 1791, between March and July, 32,000 houses burned, same number in 1795; 1799, in suburb of Para, 13,000 dwellings and many magnificent buildings destroyed; 1861, August 16, 12,000 houses and 3,000 shops in finest quarter were destroyed; 1818, August 13, fire destroyed several thousand houses; 1823, 6,000 houses; 1848, 500 houses, 2,000 shops, loss estimated $15,000,000; 1865, great fire destroyed 2,800 houses and public buildings, 22,000 persons left homeless; 1870, June 5, the suburb of Para, occupied by the foreign population and native Christians, swept by a fire which destroyed over 7,000 buildings, many of them among the best in the city, including the residence of the foreign legations; loss estimated at nearly $25,000,000. Scutari, Greece, 1797, 3,000 houses burned. Smyrna, Greece, 1763, 2,600 houses consumed, loss $1,000,000; 1772, 6,000 houses; 1796, 4,000 shops; 1841, 12,000 houses. Yeddo, Japan, 1872, 6 square miles burned over, 20,000 persons homeless; 1873, 10,000 houses destroyed.

At Boston, Mass., 1679, all the warehouses, 80 dwellings, and vessels in the dockyards, were consumed, loss $1,000,000; 1760, fire caused loss of $500,000; 1787, 100 buildings destroyed; 1794, 96 buildings burned; 1872, great fire November 9 and 10, the richest part of city destroyed, an area of 65 acres burned over, 776 granite and brick buildings consumed, loss $75,000,000. Charleston, S. C., 1778, fire caused the loss of $500,000; 1796, 300 houses burned; 1838, one half of city burned, loss $3,000,000. Savannah, Ga., 463 buildings, loss $4,000,000. New York, 1835, 530 buildings in business center of city destroyed, 52 acres burned over, loss $15,000,000; 1845, 300 business blocks, 35 persons killed, loss $7,500,000. Pittsburg, 1845, 300 buildings destroyed, loss $10,000,000. Albany, 1848, 600 houses burned, loss $3,000,000. St. Louis, May 17, 1849, 15 blocks, 23 steamboats, loss $3,000,000; May 4, 1851, three quarters of the city burned, 2,500 buildings, loss $11,000,000; same year, 600 houses, loss $3,000,000. Philadelphia, 1850, July 9, 400 buildings burned, 30 lives lost, loss $7,000,000; 1865, 50 buildings burned, 20 persons killed, loss $500,000. Washington, 1851, part of Capitol and whole of Congressional library burned. San Francisco, May 4 and 5, 1851, 2,500 buildings and a number of persons burned, more than three fourths of city destroyed, loss $10,000,000; June, same year, 500 buildings, loss estimated at $3,000,000. Chicago, 1857, 14 lives, $500,000; 1859, September 15, $500,000; 1866, August 10 and September 18, $500,000 each; 1871, the greatest fire of modern times, October 8 to 10, 2,124 acres, or 3½ square miles, burned over in the very heart of the city, 250 lives lost, 98,500 persons made homeless, and 17,430 buildings, one third in number and one half in value of buildings in city consumed, loss estimated at $190,000,000. Troy, N. Y., 1862, nearly destroyed by fire. Portland, Me., 1866, great fire July 4, one half of the city burned, 50 buildings blown up to stop the progress of the fire, loss $11,000,000. Quebec, 1815-16, $1,000,000; 1845, May 28, 1,650 houses burned, one third population made homeless, loss $3,000,000; another fire June 28, 1,300 dwellings, 6,000 persons made homeless, loss $1,000,000; 1866, 2,500 houses and 17 churches in French quarter burned. St. John, N. B., 1837, January 13, 115 houses and nearly all the business part of the city burned, loss $5,000,000; 1877, June 21, 200 acres burned over, 1,650 dwellings, 18 lives lost, total pecuniary loss $12,500,000. St. Johns, Newfoundland, 1846, loss $5,000,000. Montreal, 1850, June 7, 200 houses in finest part of city burned; 1852, July 9, 1,200 houses burned, 10,000 persons destitute, loss $5,000,000. Santiago, South America, fire in the Jesuit church, 2,000 persons perished.

Improved Electric Candle.

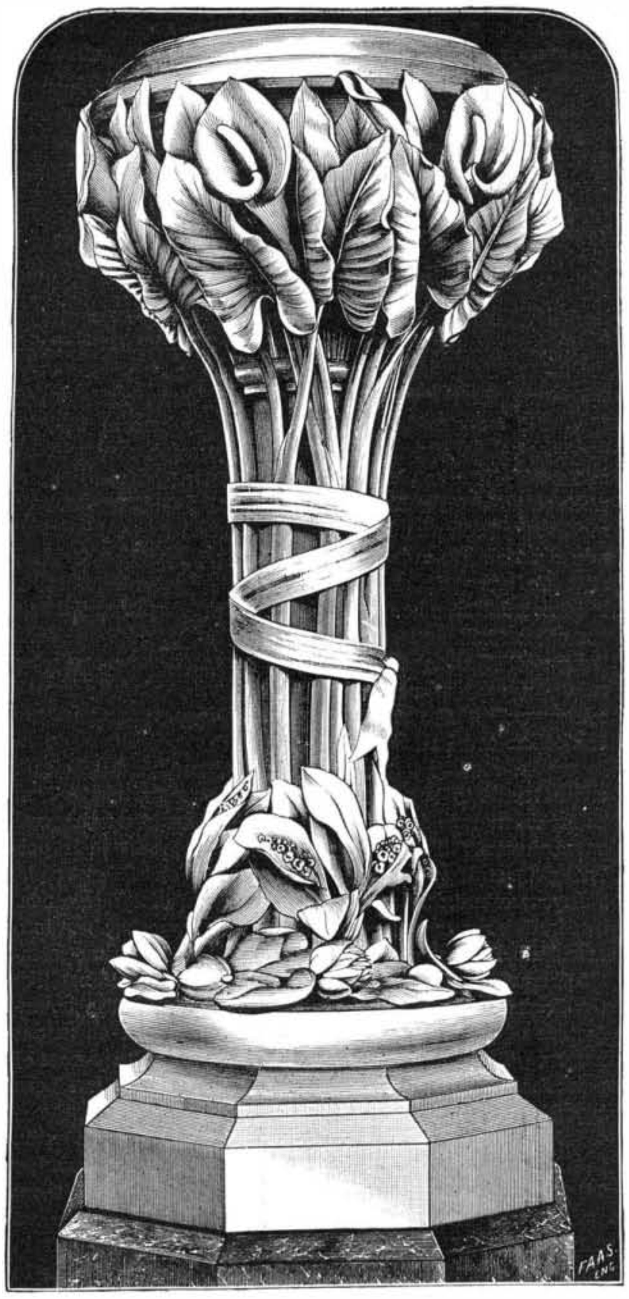
An improved form of electric candle has been produced by Mr. S. Cohné, of London, for which the following advantages are claimed: Up to the present time all electric candles in use have been made from pure carbon or carbon mixed with other substances, such, for example, as kaolin or plaster of Paris, all which have the great disadvantage of burning too quickly away, and producing in a greater or less degree a flickering light. Such candles, therefore, require controlling mechanism to regulate their distance from each other. Mr. Cohné's invention consists in making or forming a candle of ultramarine, or the substances which when united together form or produce ultramarine. The ultramarine may be green, blue, or of any other color in which it is produced. It may be either used in its pure state or mixed with carbon, kaolin, plaster of Paris, molasses, or with any metal reduced to powder so as to be in a finely divided state. The metal preferred is copper, and it is ultramarine, carbon, powdered copper, and molasses that the patentee employs. To about four parts of carbon he adds one part of ultramarine and one part of the finely divided metal, and as much molasses as will, when mixed with the other materials, be sufficient to form the whole into a paste which can be moulded or otherwise formed into the shape desired.

The candle thus formed is dried and heated for a sufficient time by fire, by whose action all the moisture is evaporated, the sulphur is burned away, and the molasses, as well as all other organic matter, becomes carbonized. The patentee does not confine himself to the exact proportions above named, and it will be understood that the mixture alluded to is only one of those in which the candle may be made. When these candles are put into use, the resistance and the current in the arc are to a very great extent less varying, and controlling mechanism to regulate the distance is nearly unnecessary, because the candle is consumed very slowly in comparison to those heretofore in use.

BAPTISMAL FONT.

The marble baptismal font shown in the engraving is from the establishment of Messrs. Struthers & Sons, Philadelphia. In simplicity and grace, in purity of sentiment and harmonious blending of ornament, it is comparable with anything we have seen.

From a plain octagonal base rises a slender, round shaft,



MARBLE BAPTISMAL FONT.

on which rests a circular basin, with receding mouldings lessening toward the rim. Around the foot of the shaft are strewn numbers of pond lilies, their round, flat leaves disposed on a horizontal plane, while here and there among the group are sprays of delicate lilies of the valley, the blossoms half hidden in their sheltering sheath-like leaf. Rising above these, almost to the rim of the basin, is a sheaf of beautiful white water lilies, their long, smooth stems bound to the shaft of the column by a ribbon band, their broad leaves and graceful flowers encircling and completely hiding the lower portion of the basin.

The Influence of Temper on Health.

Our English contemporary, *Capital and Labor*, which is generally correct in its assertions, thinks that, while excessive labor, exposure to wet and cold, deprivation of sufficient quantities of necessary and wholesome food, habitual bad lodging, sloth, and intemperance, are all deadly enemies to human life, none of them are so bad as violent and ungoverned passions. Men and women have survived all the former, says the writer, and at last reached an extreme old age; but it may be safely doubted whether a single instance can be found of a man of violent and irascible temper, habitually subject to storms of ungovernable passion, who has arrived at a very advanced period of life. It is, therefore, a matter of the highest importance to every one desirous of preserving "a sound mind in a sound body," to have a special care, amid all the vicissitudes and trials of life, to maintain a quiet possession of his own spirit.

Powerful Guns.

Exceptionally satisfactory results have been obtained at the proof butts in the government marshes, adjoining the Royal Arsenal, Woolwich, with one of the 80 ton guns constructed for H. M. S. Inflexible. The gun has just been increased from 15½ inches to 16 inches, and has had its chamber enlarged for the effectual and deliberate consumption of the comparatively slow gunpowder, which experience has proved to be of the greatest service in enormous charges, at the same time that the powder was carefully compounded, and particular attention paid to the air spacing of the cartridge. At the first round, which was simply a warmer, with 428 lb. of powder, the velocity of the projectile was 1,603 feet per second, the projectiles weighing rather above 1,709 lb. The full charge of 445 lb. of powder was then fired, and the electric recording instrument marked a velocity at muzzle of 1,657 feet per second, or a fraction of 9 feet in excess of the German gun's velocity under almost precisely similar conditions. The officials engaged in the trial, to satisfy any doubt which might exist as to the accuracy of the test, again had the gun loaded exactly as before, and again the speed of the great bolt was given in the instrument room as 1,657 feet per second, which would enable the projectile to pierce and destroy an enemy's vessel coated with 32 inches of iron plating. It will be remembered that at Meppen, firing a projectile of 1,712 lb. with a powder charge of 451 lb., Krupp registered a muzzle velocity of 1,648 feet per second, which is calculated to be equivalent to an energy of 32,242 foot tons or the penetration of 32 inches of iron armor. The three other 80-ton guns of the Inflexible have to be tried under similar conditions as the one lately tested.

There seems to be no intention of submitting a tube of Sir Joseph Whitworth's so-called compressed steel to the New Gun Committee for consideration and report. Fresh from his recent victory in the United States gun competition, Sir William Palliser proposes to bore out the steel tube of a large Woolwich gun to relieve the strain on the casing, and then to insert a very long loose coiled wrought iron barrel on his well known plan. Notwithstanding the fact that no burst has taken place out of two thousand such guns which are in constant use in the British Empire and the United States, and that the Director of Ordnance of the United States Navy has proved that his guns can be fired with large charges without affecting their casings, it has been decided, as one of our daily contemporaries is informed, that nothing from Sir William Palliser shall be permitted to appear before the new Gun Committee for their consideration and report.

The Italian Government have just ordered eight more 100-ton guns to be made by Sir William Armstrong & Co. They are to be breech-loaders, and as there will be no departure from the coil system in the construction of these weapons, the question will be brought to a practical issue whether large breech-loading guns can be made on the coil system to compete with the steel breech-loaders of Herr Krupp. Eight 100-ton guns represent a tremendous armament. Each shot will start from the powder chamber with a pressure of about 5,000 tons at its rear, and the energy stored up in the projectile as it leaves the muzzle will be equal to the raising of 44,000 tons a foot high. The penetrating force will be equal to 3 feet of armor at close quarters, with proportionate reductions according to distance. There will be eight 100-ton muzzle-loaders for the armament of the Duilio and Dandolo, those vessels carrying four each, and there will be eight breech-loaders for the Italia and Lepanto. The muzzle-loaders already supplied are characterized, like the Krupp guns, by great length of bore, and, of course, this feature will be maintained, if not further developed, in the breech-loaders. While the Woolwich 80-ton gun has a bore only 18 calibers long, that of the Armstrong 100-ton gun is between 20 and 21 calibers in length; but even the 80-ton gun is proportionately longer than the Woolwich 38-ton gun, the latter having a bore of only 16 calibers.

The four 100-ton muzzle-loading guns, made by Sir William Armstrong for the Italian Government, but purchased by the British Government out of the vote of six millions, are destined to be employed for the coast fortifications, the localities specified being Malta and Gibraltar.—*The Engineer.*

The Dominion Exhibition.

The Dominion Exhibition at Ottawa was closed September 27, and though a success as an exhibition, it was financially a failure. The total gate receipts were only a little over $9,000—less than half as much as was taken in at the Toronto fair last year.

ERRATUM.—In the description of the performance of Mr. Edison's electric generator last week, the figures showing the number of lights and the power required to produce them were omitted from a portion of the edition. The clause referring to these points should read: It requires but five horse power to drive the machine, and the current generated is sufficient to produce forty lights of sixteen candle power each. Mr. Edison has since informed us that the generator may be forced to do much more.

Scientific Discoveries the Basis of Invention.

Had not the steam engine been developed, it is likely that railways, steamships, and all the numerous uses to which that instrument is now applied, would have been comparatively unknown. The discoveries of nitric acid, hydrochloric acid, oil of vitriol, and washing soda, by the alchemists, led to the erection of the numerous great manufactories of those substances which now exist in all civilized countries.

The discovery of zinc has led to an improvement in telegraphy. The discovery of nickel has led to the great modern use of German silver in the construction of electro-plated and other articles. The discovery of chlorine formed the basis of nearly all our modern processes of bleaching cottons and other fabrics. The discovery of oxygen has enabled us to understand and improve in a great number of ways the numerous manufacturing, agricultural, and other processes in which that substance operates.

There is probably not an art, process, or manufacture, which is not largely due to scientific discovery; and if we trace them back to their source, we nearly always find them to have originated in scientific research. The great pecuniary benefits arising from the application of science are generally reaped in the first instance by all great manufacturers, agriculturists, merchants, and capitalists. Countless fortunes have been made by means of processes and manufactures based upon scientific discovery. In a general way, however, the greatest pecuniary benefits arising from science, sooner or later go to enrich the possessors of land.

THE BASIS OF INVENTION.

Discovery is usually the basis of invention. Science has shown that it is by means of inventions based upon new discoveries that the greatest utilities are obtained, rather than by the exercise of invention upon knowledge acquired long ago. A man cannot invent an improvement unless he possesses scientific knowledge. The discovery of a single substance, such as oil of vitriol, a washing soda, has led to the formation of many valuable inventions, patented or otherwise. Nearly every manufacturer in this country is deriving, from scientific discoveries, advantages for which there have been made little or no payment to the discoverer.

For instance, the makers of coal tar and the dyers of wool and silk are using the discovery of nitro-benzine; manufacturers of picine acid and "French purple" have enjoyed the fruits of the labors of a well-known Englishman; the various telegraph companies, copper smelters, and makers of copper wire are using the discovery of the influence of impurities on the electric conducting power of copper. The makers of electro plate and of German silver are deriving great profits from the labors of Faraday; makers of Bessemer steel enjoy advantages derived from the spectrum discoveries of Kirchhoff; iron and copper smelters, metallurgists, dyers, calico printers, bleachers, brewers, makers of vinegar, white lead, varnishes, colors, soaps, phosphorus, oil of vitriol, and many others, are deriving benefit from the discoveries of Priestley Added to all this, there are the pecuniary advantages of the use of even only a few of these scientific discoveries where gains are enormous.

ADVANTAGES OF SCIENTIFIC RESEARCH.

There is not a person in the United States who has not derived some advantage, in one way or another, from scientific research. For instance, the advantages of gaslight, rapid postal service and transmission of goods, railway traveling, cotton goods, photography, improved medicine and surgery, preserved meats, condensed milk, etc., etc., have been reaped more or less by every one, even the pauper coming within the pale of the advantages.

Science has also by its developing process given employment to the whole army of workmen in numerous arts, manufacturers, and occupations. In the United States scientific research gives employment, in manufactures alone, to almost 3,000,000 persons, whose wages it is estimated aggregate $775,000,000 annually, and the products of whose work is valued at $4,500,000,000 annually.

Hence the importance of scientific research. As has already been intimated, discoveries produced inventions, inventions give rise to processes and manufactures, the employment of workmen and others, and the erection of workshops and dwellings, towns and cities, and increase in the value of land—and all those great additions to the value of land are largely due to the unpaid labors of scientific discoverers; and it may be said that this nation, as well as England, has largely gained its wealth by, and is still living in a great degree on, the product of those labors.

In other words, a very great amount of the wealth of this nation has been obtained by the application of scientific knowledge to the substances and forces by which we are surrounded.

INVENTION MARKS NATIONAL PROGRESS.

Inventions differ from discoveries, just as a newly found truth in science differs from a newly discovered process. A discovery is not in the form of a salable commodity; an invention is a combination and application to some useful or desired purpose of scientific truths which have been previously discovered. A new discovery soon finds itself incorporated in a text-book, and the inventor is left to apply it to some useful purpose, "without money and without price."

Apropos, the patent law, originated in the statute of James I. (1635), called the statute of monopolies, because it abolished patents for monopolies and only allowed patents for new inventions, holds out in advance a prospect of reward in order to induce inventions. The first Congress passed a patent law in 1790. An invention nowadays is equivalent to a patent, and the granting of patents has not only affected industry, but encouraged art. In fact, our manufactured product is now double our agricultural product; figures from the census show this, and in showing this the West now manufactures more than New England, and this is the result of the last twenty-five years.

The manufactured product of the six grain growing States of the West is greater than the agricultural product. This growth in the whole country coincides in time and extent with the growth of patents; and the change of relation between the East and the West has followed the change of relation in the number of patents taken out by the different sections.

CURIOSITIES OF INVENTIONS.

As has already been noticed, there is a vast difference between scientific discovery and the practical application of such discovery. Scientific discoverers may be considered the most practical men in existence, but it was three hundred years before the form of pin introduced for the benefit of the infant portion of the community was invented, after the ordinary pins were introduced.

No one would imagine that this infantile pin—a wire pointed at one end, and cunningly twisted, so that one end serves as a shield for the point of the pin—involved invention, and yet, although the need always existed, it was not until some happy thought brought it to the mind of some lucky inventor that it was brought into the world. Again, there were once eighteen operations to be performed in the manufacture of pins; twelve pounds of pins were made in a day, but invention has produced a machine that turns out 160 pins a minute, and puts them on papers without the aid of human fingers. Again, go through the streets of a city like Boston, and it will be seen that clocks are cheap by the bushel. Those clocks will keep good time, are tasteful in appearance, and serve all the purposes of the domestic clock. Price $1.25.

America, by the way, is seizing the watch manufacture of the world. Switzerland went home from here in 1877 in dismay at the prospect that this industry of hers would be swept from her hands. The chronometer, the result of a prize offered by the British government of $100,000 for any means by which the longitude of a vessel could be determined within ten miles, is an invention. Harrison worked at it for forty years, and in 1767 he won the prize of $100,000. It is recorded that he made one so perfect that it varied but one second and a quarter in ten years.

An unlimited number of inventions cannot be made by means of a limited amount of scientific knowledge; and in consequence of the lack of new knowledge, manufacturers and others continue to suffer losses which might be avoided. Improvements are wanted in processes, employers of steam engines want to obtain more power from the coals, iron puddlers want to economize heat; manufacturers in general want to utilize their waste products, and prevent their polluting the streams and atmosphere; and so on without end.

Inventors are continually trying to supply these demands. For instance, a machine for completely converting heat into mechanical force cannot be invented until more scientific knowledge is discovered. Yet generic inventions, like the Crompton loom and the machinery used in the manufacture of plain cotton sheetings, have produced enormous results. There has been no radical change in the process of manufacture of these goods since 1835; the gain has been by adding a little improvement here and there.

In one of those mills, 90 hands, working 60 hours a week, in 1878, turned out as much cloth as 231 hands, working 76½ hours per week, in 1838; and in another concern there were turned out 23,300 yards per year per operative, against 9,574 yards in 1835; while each Crompton loom in a certain mill turned out 12,191 yards last year against 7,766 yards in 1835, and the cost of labor has been reduced almost one half.

We might pursue this project in this line of thought almost indefinitely, but we think we have obtained enough of scientific discovery applied in a practical manner to demonstrate the national importance of the former and the utility of invention as applied in these latter days. As we intimated in the beginning of this article, some of the greatest practical realities of this age had their origin in search after pure truth instead of after utilities.—*Commercial Bulletin.*

Fast Speeds.

The St. Louis *Republican* of recent date says: "Mr. F. W. Hill, of this city, long a railroad man and late of the Hannibal & St. Joe road, contributes the most interesting figures yet applying to the mile-a-minute controversy. From the facts given it is shown that the speed of a mile a minute has frequently been exceeded by trains on American roads. In the year 1872, Mr. Hill states, Thomas McDonald, engineer of engine No. 36, a five-foot wheel freight engine on the Missouri, Kansas and Texas Railroad, ran from Parsons, Kan., to Sedalia, Mo., a distance of 156 miles, making more than a mile a minute over a greater part of the way. The occasion of this run was to get Phil Sheridan to Sedalia in time to catch the regular train on the Missouri Pacific Railroad in order that he might reach Chicago in time to keep an engagement. Col. R. S. Stevens, General Manager of the Missouri, Kansas and Texas Railway, was on the train with Sheridan. The most remarkable thing about this run was that the engineer did not know ten minutes before he started that a fast run was expected—in fact, he came in with a freight train late the night previous and expected to go out on freight the next day. At four o'clock A. M. he was called out of bed and not given time to oil his engine properly, as the train was waiting. All railroad men will understand what it means to take an engine off freight and make such a run. The same gentleman also furnishes the following account of fast time made in different years:

"In the year 185-, Albany to New York, Hudson River Railroad, 144 miles, 2 hours and 49 minutes.

"In 1855, New York Central Railroad, locomotive Hamilton Davis, with six cars, 14 miles in 11 minutes.

"In 1850, Paddington to Slough, England, 18 miles in 15 minutes.

"In 1863, Boston to New York, express train *via* Providence and New London, 230 miles in 5 hours and 27 minutes running time.

"In 1868, Indianapolis to Pittsburg, 381 miles in eight hours running time, 47⅝ miles per hour.

"In 1868, Janesville, Wis., to Chicago, 91 miles in 90 minutes. This was done by an engine built at the shops of the Chicago and Northwestern Railroad Company by George W. Cushing. I believe the engine pulled two cars, and side-tracked once to let a train pass they met."

Recent Progress in Soudan.

The financial failure of the late Khedive of Egypt has compelled the abandonment of his splendid projects for the opening up of Central Africa. The provinces of Bahr-el-Gazal and Darfur have already been given up, and the great work so far carried out by Gordon Pacha has been stopped. The importance of this work may be indicated by the following achievements: Since 1874 a tract of country larger than the Southern States of America has been mapped with tolerable accuracy. Over 3,000 miles of telegraph lines have been constructed and are now working efficiently. The slave trade has been suppressed, which alone has involved campaigns of months' duration and revolts of entire provinces. The postal service has been introduced, and a letter put in the New York post office with a five-cent stamp and addressed to the remotest station on the Bahr-el-Gazal or Darfur will reach its destination as surely as if addressed to Washington. The navigable rivers have been kept free from the "sud" or masses of vegetable matter which clog up all free passage, and which formerly stopped up the Nile nearly as far north as Berber. The natives have been taught the use of money, so that provisions and goods can be purchased where but a short time before raids had to be made to procure food. A system of military stations has been established, and by the aid of imported Indian elephants the native African elephants have, in several instances, been trained to serve as beasts of burden, thus greatly diminishing the cost of transportation. Telephones have also been introduced at all available points in the Soudan, and are of the most inconceivable service in quickly dispatching business.

Small Cotton Factories for the South.

The *Star*, of Wilmington, N. C., believes that on every creek of good size from Maryland to the Gulf it is perfectly practicable to set up a small cotton factory. In every county in North Carolina, especially in the cotton section, there ought to be ten or a dozen such factories at work. "They pay elsewhere—in South Carolina and Georgia, for instance. Why will they not pay in North Carolina? There is a factory in South Carolina that is a marvel in two respects—it costs but little, and it makes such a large percentage of profits. Let our people make an effort. Let every neighborhood or township organize for a small cotton factory. There is no doubt that they will pay if judiciously managed. As we have said, they have paid elsewhere, and they can be made to pay in our own State. It would be well if a practical man of business were sent into South Carolina to examine the little mill and get all the facts. We have the cotton, the water power, the labor, and even the capital, for it will require so little to start and keep running one of the mills referred to. The prosperity of a State depends no little upon the diversity of crops and the multiplicity of industries. New England has grown immensely rich by its manufactures. Let North Carolina awake to its true interests and try small cotton factories."

England's Domain again Invaded.

Another of our American products, it is said, is materially affecting a great industry of England. Celluloid, in its use as a substitute for ivory, has already exercised a world-wide effect upon the ivory industry, the falling off in the demand having been felt in the remotest regions of Africa.

This composition of tissue paper, camphor, and certain chemicals, is already used for billiard balls; combs, backs of brushes, hand mirrors, and other toilet articles; whip, cane, and umbrella handles; every kind of harness trimmings; foot rules; chessmen; handles of knives and forks; pencil cases; jewelry of all kinds; pocketbooks; mouth pieces for pipes; cigar holders; musical instruments, doll heads; porcelain imitations; hat bands; neckties; optical goods; shoe tips and insoles; thimbles; emery wheels; shirt cuffs, collars, and a great variety of other articles which England manufactures out of its ivory importations from her possessions in India and Africa.

Business and Personal.

The Charge for Insertion under this head is One Dollar a line for each insertion; about eight words to a line. Advertisements must be received at publication office as early as Thursday morning to appear in next issue.

☞ *The publishers of this paper guarantee to advertisers a circulation of not less than 50,000 copies every weekly issue.*

Notes & Queries

HINTS TO CORRESPONDENTS.

No attention will be paid to communications unless accompanied with the full name and address of the writer.

Names and addresses of correspondents will not be given to inquirers.

We renew our request that correspondents, in referring to former answers or articles, will be kind enough to name the date of the paper and the page, or the number of the question.

Correspondents whose inquiries do not appear after a reasonable time should repeat them.

Persons desiring special information which is purely of a personal character, and not of general interest, should remit from $1 to $5, according to the subject, as we cannot be expected to spend time and labor to obtain such information without remuneration.

Any numbers of the SCIENTIFIC AMERICAN SUPPLEMENT referred to in these columns may be had at this office. Price 10 cents each.

(1) J. R. M. asks for the best way to fill barometer tubes so as to exclude the air. The tubes are straight, about 34 inches long. I have never filled any, and am afraid I will fail without some instruction. A. Invert the tube, pour a little pure mercury into it. Boil the mercury to expel the air and moisture. Add more mercury, boil again, and so on until the tube is filled. As the vapor of mercury is very poisonous, you should not inhale it.

(2) J. J. D. asks (1) how screw heads are nicked. A. By means of a circular saw or cutter. A number of screws are held by a rotating holder, which carries their heads over the edge of the saw. 2. How can I make in malleable iron a groove 1-32 inch wide and 1/8 inch deep? A. By employing a circular saw. See article on rotary cutters, p. 340, vol. 40, of SCIENTIFIC AMERICAN.

(3) C. F. B. asks: 1. Can I make a telephone from the shop to the office, distance 800 feet, without a battery? A. Yes. 2. What would be best for a diaphragm? A. Use ferrotype plates or mica. 3. Would a fine copper wire be best for a conductor; if so, how should it be supported, and what gauge should it be? A. No. 24 copper wire will answer. Support it on elastic rubber bands or strings. 4. How large should the diaphragm be? A. 2 inches in diameter.

(4) W. A. asks whether mercury in a glass tube will rise more degrees at a certain heat when weighted than it will if not weighted. A. As mercury is practically incompressible, there can be little or no difference.

(5) W. H. B. asks (1) how to stain the white part of a black walnut board so as to have it the same color as the rest. A. Apply a thin asphaltum stain, (asphaltum dissolved in turpentine). 2. How to make shellac varnish? A. See p. 252, current volume. 3. Is it proper to apply it with a brush; if so, how can I make it so as to have a smooth surface? A. Apply it with a camel's hair brush. 4. To ebonize walnut wood? A. See vol. 40, p. 91 (18).

(6) W. S. H. asks: What is the Herreshoff coil boiler? A. For illustrated description of this boiler see p. 210, vol. 40, SCIENTIFIC AMERICAN.

(7) W. T. writes: We have a skylight in our store (dry goods) which is surrounded by high brick walls, and black goods shown under this skylight take on an unnatural color from the glare of the sun shining upon the red brick walls. Can you tell us of anything that we can do to remedy this and obtain a soft white light? The skylight is made of hammered glass. A. Your remedy will be to whitewash the brick walls.

(8) T. E. G. asks: 1. How many feet of copper wire of No. 16, 18, and 20 American gauge are equal to a resistance of one ohm? A. No. 16, 310 feet; No. 18, 200 feet; No. 20, 110 feet approximately. The resistance will vary with different specimens. 2. What is the average resistance of the gravity battery? A. 2 to 4 ohms. 3. What should be the resistance of electro-magnet so as to use the battery to the full? A. The resistance of the battery and electro-magnet should be the same.

(9) W. B. asks: What finally becomes of heat? Is it changed into some form of force, or is it scattered and wasted and resolved into nothing? The sun has been for countless ages pouring his store of heat upon the earth. If it receives nothing back, where is the accumulation? The coal beds account for part of it, but not for what has been received since their formation. As the earth and the materials of which it is composed are limited, it seems that the capacity for the storage of force must also be limited. Again, when those forces are liberated, the same amount of heat is evolved that was originally stored there. If there is no loss, the heat must accumulate somewhere. Then, a very small portion of the sun's heat falls upon any planet. What becomes of the rest? A. It is assumed that heat is simply the rapid vibration of an imponderable elastic ether which pervades all matter and infinite space. This hypothesis as to the nature of heat is now generally admitted. If it be correct, it is evident heat is not matter, but a state of matter, and can not therefore be stored.

(10) W. R. writes: To an acoustic telephone line, 1,500 feet long, No. 22 copper wire, with 10 cotton cord insulations, I propose to add at each end an ordinary electric call bell (size 2½ inch box pattern), and to use the above wire for the line. The ground connections will be a gas pipe at one end and an iron water pipe at the other. 1. Can I make the battery at one end answer for both? A. Yes, by using closed circuit bells. 2. How many cells of Calland battery are necessary? A. Probably six or seven will answer. 3. Of the wires from the battery, which is connected to the main line? A. Either. 4. How are the wires arranged to bell battery and ground connection respectively? A. From ground to one pole of the battery, from the other pole to the line, from the line to the ground. Place in your line the closed circuit bells and keys according to your convenience.

(11) A. S. P. asks how papier mache is made for fine, small work. A. Boil clippings of white or brown paper in water, beat them into a paste, add glue or gum, size and press into oiled moulds.

(12) O. A. asks: 1. Can I with a plane slide valve to steam engine cut off at 1-3 or ¼ the stroke with as good results and economy as I can with a cylinder valve; if not, why is it? A. Probably one style of common valve is as good as another, but it is impossible to cut off with such valves shorter than about 2-3 advantageously on account of the compression of the steam within the cylinder. 2. What are the objections (if any) to a slotted cross head. It is full as cheap to make, and the motion of piston and crank pin are alike, when with the ordinary connecting rod the motions are not the same. A. "Slotted" cross heads are frequently used in small engines and steam pumps, but the friction is too great and wear too rapid for larger engines.

(13) J. R. writes: I want to buy a work on engines, one containing steamship and stationary engines, also works on mechanical drawing. Which are the best in use on the subjects named? A. Probably "Roper on Land and Marine Engines" and "MacCord on Mechanical Drawing" will suit.

(14) W. R. writes: A is building a small turning lathe of cast iron 5 feet long; spindle is of cast steel, with a hole clear through, and is to run in a case-hardened iron box in the front, and behind is a plug fitted in, also of case-hardened iron, which is V-shaped on its extremity, and is to run in a center of hard cast steel; the spindle, where it runs in the box in front, also being hard and of conical shape. B claims the box should be of hardened steel instead of iron. Who is right, A or B? A. We do not think there can be any material difference, as a properly case-hardened iron surface is steel.

(15) N. P. R. asks: 1. Which is considered to be the best and most practical signal for railroad switches, those showing bars at different angles, or color signals? Which is most in use in this and in the old country? A. Semaphore signals are largely in use, and we believe increasingly so, for daylight signals, though colored signals are used on many of our principal railroads. We think for daylight signals the semaphore is generally preferred.

(16) B. E. & S. M. write: Having had a dispute with B about the travel of a valve, I contend that the true meaning of travel is the distance the valve moves in traveling from its middle position to the extremity of its stroke and back again to its middle position; but B says I am mistaken. Who is right? A. The travel of a valve is its whole movement between its two extreme positions, or, in case of a direct connection, twice the throw of the eccentric.

(17) L. G. writes: A planer in our factory has been giving us considerable trouble for a long time. The boxes heat, compelling us to re-Babbitt every week and sometimes oftener. I noticed an article in the SCIENTIFIC AMERICAN several months ago concerning the use of plumbago in such cases. I cannot find the paper now. Can you name a remedy, or rather a preventive, to the heating? A. You can try fine plumbago and oil, or fine soapstone and oil; but the probability is that your shafts and boxes are out of line, or the cylinder may be out of balance.

(18) H. C. H. asks: If two balls of the same size, and one twice as heavy as the other, be dropped from a great height, which will reach the ground first? Of course there will not be much difference, but will there be any? A. If falling in the atmosphere, the heavier ball would reach the ground first; if falling in a vacuum, there would be no difference.

(19) G. B. asks: What is the best composition for expansion metal? A. Brass is generally used for expansion tubes and bars.

(20) H. S. writes: You say in your answer to J. G. B., in SCIENTIFIC AMERICAN, September 27, 1879, that 150 revolutions = 300 feet per minute, and 150 revolutions = 500 feet per minute. This I do not understand—that is, whence you obtain the 300 feet and 500 feet in finding the horse power of an engine. It occurs on page 204 (29). A. 150 revolutions is 300 strokes of the piston, as it requires two strokes to one revolution. In the first case the stroke is 1 foot, hence the speed is 2x150=300 feet; and in the second case the stroke is 1 2-3 feet, two strokes = 3 1-3 feet; 3 1-3x150=500 feet.

(21) G. H. S. writes: In your issue of the 27th inst., I noticed an error in the figures given in answer to "Novice" (26). Diameter of wheel should be 19·77 inches; diameter or pinion should be 5·60 inches, without any regard to pitch or number of teeth.

(22) W. S. W. writes: 1. I have a condenser working with a pair of Corliss engines, 20 inch by 23 inch cylinders, adapted to use with either or both. It acts on the principle of an injector, and a column of water, with a head of 9 feet, flows through a nozzle (which has an adjustable nozzle that regulates the quantity of water passing in), and the steam from either or both engines meets this water at the combining nozzles and is condensed. After having condensed the steam, the column of water flows through an expanding tube and is discharged into a canal. The natural head gives this column a velocity of about 24 feet per second, and when there is a 27 inch vacuum, the velocity is increased to over 400 feet per second. Now with both engines on, we have run with a steady vacuum of 26 inches to 28 inches, but when running only the 20 inch engine, the vacuum would dance up and down from 27 inches to 15 inches, and the only way we could get it steady was to admit a small quantity of air into the exhaust pipe, when it would hold at 22 inches. Can you explain why this should act so, as we have always aimed to exclude every particle of air to hold a vacuum? A. It is difficult to say, without actual examination, precisely what is the cause of the peculiar action of your condenser; it may be due to an air leak, but we are inclined to think that it is the irregular action that we have heard attributed to this class of condensers. 2. The level of water behind our dam extends back some ten miles. Now, theoretically, would we gain more power in our water wheels, by keeping the water 3 inches below the level of the dam, so as to make the water flow more rapidly towards it; or by keeping it right up to the top of the dam and having the 3 inches more head? A. Keep your 3 inches additional head. 3. How is it that authorities like Cooper, Haswell, Buel, etc., state that rubber belts will drive 25 per cent and 30 per cent more than leather ones? I had a 12 inch leather belt, driving from a 30 inch to a 20 inch pulley, 10 feet apart, and keeping 16 roving frames up. On some days it would slip badly, so I put on a 12 inch, 4 ply, rubber belt, thinking there would be a gain of 25 per cent, and the result was it would not drive eight frames. I had to take it off and put on the old 12 inch leather one, with a six inch rider on the outside, and I have heard no complaints. A. We do not remember any experiments to test the relative adhesion of leather and rubber belts under the conditions of actual use. It is probable that in a damp atmosphere rubber would be superior.

(23) F. M. asks for a receipt to make a black ink for the copying press described in the SCIENTIFIC AMERICAN. A. Dissolve soluble nigrosine in about 5 parts of boiling water and strain through a fine cloth. When cool it is ready for use.

(24) W. R. H. writes: We want to use kerosene in a liniment, but the offensive odor is very objectionable. Can you tell me how to destroy it without taking from its virtue as a medicine? A. It cannot be completely deodorized without altering its character. The odor may be cloaked by the addition of various essential oils without materially affecting its properties.

(25) A. E. F. writes: I wish to make good red sealing wax in quantities of about 5 lb. I have hunted through several books of receipts and can find no receipt for my purpose. Will you kindly furnish formula? A. Yellow resin, 1 lb.; shellac, 5½ oz.; Venice turpentine, 5½ oz.; vermilion, 1 oz. Melt the shellac in a copper pan over a fire, add the resin, pour the turpentine slowly in, and soon afterwards add the vermilion, stirring continually.

(26) F. E. H. asks: What will make the darkest brown lacquer to put on copper bronze? A. 2½ oz. shellac, 2 quarts wine spirit, 2 oz. gum sandarac, ½ oz. gum elimi. Mix and keep warm until solution is effected, then strain and color with dragon's blood and aniline brown to suit.

(27) R. F. B. asks: 1. Can commercial zinc be made sufficiently pure for battery use by remelting? What is the dross left in the crucible? A. Your question was answered on p. 187 (4), current volume. Zinc cannot be purified by fusion, as you suggest. The dross is zinc oxide, formed by the action of atmospheric oxygen on the molten metal. 2. Can electroplating be done as economically with the gravity battery as with the Smee? How do they compare as to first cost? A. Yes, on a small scale; they are cheaper. The gravity form is the cheapest. 3. Please explain how stencil dies and solid burning brands are made. A. Stencil dies are made by driving red hot steel into suitable matrices, afterward filing them into shape. Burning brands are moulded in sand from a pattern and cast.

(28) J. H. K. writes: I wish to know how to make Pharaoh's serpents' eggs, as I have need of some in experiments I am about to make. A. To solution of ammonium sulphocyanide add mercuric nitrate solution; mercuric sulphocyanide is precipitated as a white powder. This washed, made while moist into little cones, and thoroughly dried, are the so-called serpents' eggs. They are very poisonous.

MINERALS, ETC.—Specimens have been received from the following correspondents, and examined, with the results stated:

S. G.—The sample contains lime phosphate, clay, quartz sand, iron oxide, lime carbonate and sulphate, of some value for fertilizing purposes. A full analysis would be advisable.—H. J. D.—A, B, D, and E are banded agates, of very little value in the rough state. C is a variety of jade and jasper. F is jasper, of little economic value.—A. E. F.—It is a lignite of good quality.

COMMUNICATIONS RECEIVED.

On Sea Sickness. By C. K. M.

On Wear of Shafts. By J. B.

On Explosion of the Alaska. By J. H. R.