Chemical Analysis in Manufactures.

The successful pursuit of any business depends mainly on the intelligence of the men engaged in it. It is not enough in these times for a man to have qualified himself by a general commercial education as ordinarily understood. He must have had some knowledge of science, and have been trained to see the necessity of relating his plans and methods of working to principles of technology. No manufacturing business can be thought of without also thinking of the services of the physicist and chemist.

The baker who makes our bread needs to know the percentage strength of his yeast as a ferment, or of the baking powder he uses to raise the bread. If he use baking powder, he may depend on working experience to aid him in maintaining the quality of his work. Such experience unassisted by frequent tests is a very fallacious guide. There are in the market several very good powders, but each one has a varying constitution, sometimes giving more, sometimes less, than the standard results. If fifty cents per pound be regarded as a good value for serviceable powder of 125 cubic inches of gas per ounce of powder, then it follows that rival powders yielding but 100 or 75 cubic inches are not worth more than half the money. Exact analysis in this case can alone determine values.

The sugar refiner is dependent on the chemist for the successful conduct of his business. He must know in buying a cargo of raw sugar about how much sugar, in terms of the polarimeter, he will get from a ton of raw material. The beet root sugar manufacturer needs still more than the worker in sugar cane to know the percentage sugar value of his beets, and not merely so, but to know the quantity of impurities—such as potash and soda salts—which retard crystallization in the pans.

The cotton manufacturer and the cloth weavers need to be informed of the quality of their bleaching materials. How much of chlorine gas can be evoked from a sample of bleaching powder. The value of the article depends on the amount of chlorine gas that can be turned out of it. The dyer also needs analytical processes to aid him in his selection of dyeing materials; differences in the percentage strength of any one of his ingredients would spoil the work he undertakes. The harmony of color, the beautiful shading of his work, depend entirely on his obedience to principles of chemistry. The manufacturer of chemicals tests every description of materials he manipulates. The iron and copper pyrites, which yield him sulphur for his sulphuric acid, are bought at per cent of sulphur they yield. The common salt used to make the hydrochloric acid must pass through the same ordeal before it can take its place in the list of manufactured goods.

The manufacturer of fertilizers must be most scrupulously careful in his examination of raw materials. His phosphate must yield tribasic-phosphoric acid; his sulphuric acid must be fully up to the strength called for by the terms of his contract, and the sulphate of ammonia which he buys from the gas house must be pure. The blood he obtains from the slaughter houses must give him the 13 or 15 per cent of ammonia which the article ordinarily contains. Any variation in the strength of dried blood will lessen or increase its value to the amount of $2.50 to $3.00 per cent according to the market values.

The value of lime to the builder for the manufacture of mortar depends on the percentage of real lime, or oxide of calcium, it contains. The quantity of this determines the amount of water it will take up and the efficiency of the set mortar when it is converted into calcium carbonate in the walls of a building. Fresh or caustic lime makes good mortar, but partially slaked lime is unfit for use as a cement.

The gas engineers depend on the analysis of coal to inform them what quantity of illuminating gas they can get from a given cargo of coal, and the percentage of residuals—as coke, tar, and ammoniacal liquor—they will furnish.

Smelters of iron and copper ores rely on chemical analysis for economical working, and in many businesses the purity of the metals determines their fitness for their respective functions in the arts. Pure metals are an absolute necessity to the electrician in construction of machines for telephonic, telegraphic, and lighting purposes.

The handmaidenly help of chemistry has frequently decided the question of profit or loss for many a manufacturer. The more efficient this great science can be made in its operations the more prosperous will the manufacturing interests of the country become. The more we can learn to appreciate this force the easier will be our work, and the burdens we carry will lighten.—*The Canadian Manufacturer.*

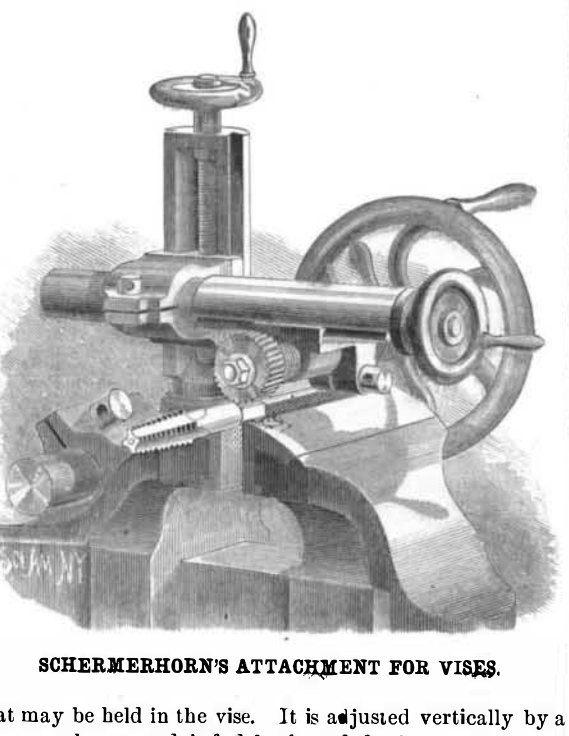
A Station Indicator for Cars.

An automatic station indicator, invented by Mr. H. E. Bissell, of Hartford, Conn., is now being tried on the elevated railroads in New York. One of these indicators is in operation on the cars in use on the branch road running to the 34th Street ferry, and has so far worked very well. At either end of the car, just above the door, is a neat box on which is painted the words, "Next Station." Below this appears the name of the station at which the next stop is to be made by the train. For example, take a train on the Third Avenue line: A passenger entering the up-train at 9th Street will see at each end of the car "Next Station—9th St." But as soon as the train left that station he would hear a bell ring at either end of the car and would see the annunciator change to read, "Next Station—14th St." The same changes would be made at 18th, 23d, and 28th, and so on up. At 34th Street station the annunciator would read: "Change cars for 34th Street ferry," and at 42d Street, "Change cars for Grand Central Depot." All these changes are made automatically and at the same time in every car on the train. The machinery is very simple, and the ringing of the bells and changing of the indicator are accomplished by the moving of a small lever in the locomotive cab, which is connected with the air brake valves. The connections between the cars and the locomotive are simple rubber tubes similar to air brake hose, but smaller in size.

A NEW ATTACHMENT FOR VISES.

The machinist, model maker, or amateur who is not so fortunate as to possess a milling machine is often obliged to spend hours with the file, etc., over a job which can be easily, quickly, and accurately done with a rotary cutter. Milling cutters are sometimes used on an arbor running in a lathe, but from the lack of means of adjustment their use in this way is quite limited.

This attachment will not only reduce very much the labor performed at the vise bench, but will save its cost in a short time in files. A file once dulled is useless, but the milling cutter can be sharpened again and again. The reproduction of a number of small articles of the same form is easily accomplished by the use of suitably shaped cutters. This attachment can be bolted to any vise by the aid of clamps, or it may be carried in a special place cast for it on the rear jaw of the vise, as shown in the engraving. It can be readily turned back out of the way when not in use by simply loosening a screw, and without detaching it from the vise. In the case of a piece of work too large to be held in the vise, the machine can be clamped directly to the work itself. The standard and arms are of round section, and can be fixed in position to operate at any angle and on any piece of work



SCHERMERHORN'S ATTACHMENT FOR VISES.

that may be held in the vise. It is adjusted vertically by a screw as shown, and is fed back and forth over the work while the cutter is revolved by the hand at the wheel shown on the right.

Horizontal adjustment is accomplished by a threaded sleeve working in a split bearing which can be clamped to hold the cutter in any position without interfering with its free revolution.

By substituting a drill chuck for the cutter it becomes a most efficient drilling machine, doing work that it is impossible to accomplish in a lathe or ordinary drilling machine. For cutting off bars, rods, etc., the milling wheel is replaced by a circular saw. This invention has been patented by E. E. Schermerhorn, of 125 West 53d Street, New York.

Fire-Proof Theaters.

In two recently constructed theaters abroad—one at Edinburgh and the other in London—special effort has been made to render them practically fire-proof. With this view, one of the most important provisions is that of building the proscenium wall, separating the stage from the auditorium, from the basement to the roof, and providing its large opening with an iron curtain. In the case of the new Prince's Theater, London, this fire-proof curtain weighs 7½ tons, is 30 feet 6 inches wide by 28 feet 6 inches high, and is constructed of two screens of wrought iron plate ⅛ inch thick, forming a double division, with an air space of 6 inches between.

This curtain is raised by means of a hydraulic ram, for which only 84 gallons of water is required, furnished by the city mains. It may be raised or lowered in 40 seconds, by simply touching a lever in the prompter's box. The only two other openings in the proscenium wall at this theater having iron doors, a fire on the stage might thus be readily separated completely from the audience portion of the house.

Messrs. Clark, Bunnett & Co., of London, and of No. 162 West Twenty-seventh Street, New York, constructed and put up the fire-proof curtains in both the above theaters.

Death of Professor Guyot.

Arnold Henry Guyot, Ph.D., LL.D., Professor of Geology and Physical Geography at Princeton for nearly thirty years, died there on February 8, in his 77th year. He was of Swiss birth, and an intimate friend of Prof. Agassiz, with whom and Forbes and Desor he made a specialty of the study of glaciers. He had been Professor of History and Physical Geography in the Neuchatel Academy from 1839 to 1848, coming to America in the latter year, where he delivered occasional lectures at Cambridge on the relation between physical geography and history, that attracted wide attention. He also lectured in the Massachusetts normal schools, and was employed by the Smithsonian Institution to organize a system of meteorological observation. At Princeton, where he was for so many years, he was regarded by the other professors as remarkable, not only for his wisdom and scientific attainments, but also for his great gentleness and humility. He was the founder of the Museum there, which is regarded as one of the best of the kind in this country; and many of the specimens were collected and arranged by his own hands.

Professor Guyot prepared a series of primary, intermediate, and physical geographies between 1866 and 1873, which had an extensive use in the public schools of the country. At the Vienna International Exhibition, in 1872, he received a medal for his geographical works. Before the Evangelical Alliance in New York, in 1873, he read a paper on "Cosmogony and the Bible." Almost his latest work was the preparation of a biographical memoir of Professor Louis Agassiz, for publication by the National Academy of Sciences, of which he was an eminent member. Half of this was read in October, 1877, at the semi-annual meeting of the Academy in New York. He co-operated with President Barnard, of Columbia, in editing Johnson's "Cyclopedia." The last work of this voluminous writer, "Creation," showing the harmony of Mosaic cosmogony with the facts of science, is now in the hands of a publisher. He had been hourly expecting the arrival of the first copies, and a message came a short time after his death, stating that the delay was occasioned by the fact that he had been addressed at Princeton, N. Y., instead of Princeton, N. J.

This work had engaged the Professor's attention during the past fifteen years, and he had fondly looked forward to its completion as being the crowning work of his life. It seems a pity that he should thus have been deprived of what would have afforded him the highest pleasure he would have asked in his closing hours.

Value of Small Things.

Some years ago a firm in England patented a candle. Now, a candle seems to be a pretty small thing to patent, but it made a fortune for its owners, and when one reflects on the large number of candles annually consumed they will better realize that a very small royalty on every pound of them will aggregate a large revenue. Similar instances might be given from cases at home, where inventors have originated some simple article in daily use, patented it, and then have received large rewards. "Despise not the day of small things," says the proverb, and we may say in addition, deride no idea as useless that intends to advance the arts and sciences in ever so small a degree, merely because it seems simple.

A very great misconception prevails in the minds of many persons in respect to patents. They are regarded as stepping stones to fame! This is usually a delusion. An invention is first and principally an investment—just as an artist's picture. The glory and renown attaching to either picture or invention is the after part—the dessert to the solid feast of dollars and cents. The natural result of the mistake alluded to is to lead persons to underrate the value of their ideas. It is not at all uncommon to hear individuals exclaim: "What, get a patent on that thing!" in alluding to some little affair that can be carried in the pocket. That very despised "little thing" is just as likely to be the means of putting dollars into the pocket of its patentee as the little candle patent was the foundation of one of the largest candle manufactories in England.

How long would it take to fill the Sahara?

In view of the recent project to fill up the Desert of Sahara by connecting it with the Mediterranean Sea, a correspondent, E. L. B., writes to us inclosing a few figures, the results of some calculations.

According to the latter it would require 4,000 years for the waters from the Mediterranean to fill the valley of the Jordan, which is 1,000 feet below the former, the water to flow through a passage 100 ft. wide by 25 ft. deep with a velocity of 4 miles an hour. With a channel 100 times this capacity it is possible, he says, to limit the period of filling to 40 years. At the same rate it would take 40,000 years to fill up the Caspian Sea to the sea level, and thousands of years to fill up the Sahara.

To Cure Bacon without Smoking.

Curing bacon by hanging it up, after proper salting, in a tobacco barn, is recommended by a Kentucky correspondent as making a sweet and perfect cure, with no necessity for smoking, and leaving no taste of tobacco in the meat. It is probable that the aroma given off by the tobacco has a mild antiseptic effect, such as that which belongs to creosote, carbolic acid, and other substances which occur in wood smoke.

A New Potato.

At a recent meeting of the Linnæan Society, at London, a paper was read by Mr. J. G. Baker, on the species of *Solanum* which bear the tuberous roots called potatoes. Out of the 700 species of *Solanum* known to botanists, there are only about six which produce tubers, and only one of these, the common potato, *Solanum tuberosum*, has as yet been cultivated. Mr. Baker said that the native home of the potato is those parts of Chili where the air is exceedingly dry, and that it grows at a considerable altitude. There is, however, another species, which grows in the moister portions of the same country, where the climate is even damper than in Great Britain, and this species would, therefore, be far more suitable for cultivation. As long ago as 1826 some specimens of this potato were sent to England, and were cultivated by Mr. J. Sabine ("Hort. Trans.," v., p. 256, etc.), but were supposed to be identical with the common potato, and did not attract any further attention. When growing in the wild state the roots are small and of a bitterish taste, some with red and others with yellowish skins. Under cultivation, however, the plants were found to grow most luxuriantly, sending out stems in all directions, so that two plants yielded in one year over 600 tubers, and the principal stems were more than 7 feet long, while the tubers showed a remarkable increase in size and had lost entirely their bitter flavor. The ordinary potato is grown as if its sole object in life were to produce tubers, and, moreover, it is grown under artificial conditions of climate and soil. Under these circumstances, the plant naturally loses its vitality, as indicated by the fact that after a time it ceases to produce flower and seed, and it then readily becomes a prey to the potato disease. The same rule applies to other plants, where one function is stimulated at the expense of another. The best method therefore of preventing the potato disease is to grow that potato which is most suitable to the climate, and to restore the vitality as soon as the plants cease to flower and fruit by cutting off the stems which produce tubers and saving only the roots, which obtain nourishment for the plant. Another species, *Solanum Commersoni*, a native of the eastern portion of South America, being found at Montevideo, Buenos Ayres, etc., is now being cultivated experimentally in France, and is likewise suitable for damp soil. A third species, *S. Jamesii*, is being experimented with in the United States, but of these the *S. Maglia* seems the most likely to promise good results.

The Western Floods Unavoidable.

A Kentucky civil engineer writes to suggest that we open the columns of the SCIENTIFIC AMERICAN to a discussion of the best engineering methods for the prevention of the disastrous overflows in the Ohio and Mississippi valleys. This is so large a question that, except as to making suggestions covering small sections, we doubt whether any competent engineering authority would seriously undertake to present a solution. Our correspondent favors the idea of constructing a system of "catch basins," or enormous reservoirs, along the headwaters of the Ohio, to hold back the surplus of the spring floods, and then distribute the excessive waters as might be to the best advantage during the year. But how enormous would have to be the capacity of any such storage system in order to be efficient.

If we had a reservoir of something like the capacity of Lake Erie in the mountains of Western Pennsylvania, to be the first receiver of the spring rains and melting snows, it would possibly be effective in preventing the floods, but hardly less than this would suffice.

All the principal tributaries of the Ohio flow from regions where there are only few and small lakes. The Alleghany, the Monongahela, the Cumberland, and the Tennessee drain a vast territory of high land, whose waters rapidly find the low level of the Ohio valley, only to flow very leisurely from there all the long way thence to the Gulf. For particular localities the protection of levees or embankments may be sufficient to keep out the floods, but to hold back this mighty tide of water is evidently impracticable, and those who cannot locally protect themselves have only to retreat in the best way possible from conflict with a power surpassing human energy.

Some Experiments upon the Otto Gas Engine.

Messrs. Brooks and Steward, of the Stevens Institute of Technology, have lately made a series of tests on the Otto gas engine, published in *Van Nostrand's Eng. Mag.*, and the conclusions at which they arrive are valuable, not only on account of the accuracy of the experiments, but also on account of the disinterestedness with which they were made.

As regards the efficiency of the engine (a 10 H. P. Otto), the indicated work represented 18 per cent of the total heat of combustion of the gas, while the actual useful work was 14½ per cent. The dispositon of the heat in detail was as follows:

Indicated work (useful work and friction)	.17	per cent.
Hot expelled gases	15½	"
Water jacket	.52	"
Radiation	.15½	"

It will be seen, therefore, that 52 per cent of the heat generated by the combustion of the gas is wasted and carried off by the water jacket, which thus points out the direction in which improvements can be made that will greatly increase the economic value of the engine.

It also shows that as a *heat engine* the gas engine is superior to the steam engine, since the best of the latter utilize only 10 per cent of the total heat of combustion of the coal, and this only in very large engines, smaller ones showing a corresponding decrease.

The ratio of air to gas was found to be 7 to 1 when the engine was working most economically, thus proving the inaccuracy of the ratio generally given with this engine, viz., 10 to 1; this result was obtained by actually measuring the air as well as the gas which entered the cylinder.

In comparing the commercial efficiencies of an 8 H. P. gas and steam engine, the latter is shown to be more economical, but the cost of gas is taken at $2.50 per thousand feet, and, as the authors remark, the production of a cheap gas especially adapted for heating will bring the cost down to if not below that of steam. But even at the present time, where power is used intermittently, the gas engine may still approach and often exceed the commercial economy of the steam engine.

American Scientists on the Red Sunsets.

At a meeting of the New York Academy of Sciences on the evening of Feb. 11, Prof. John K. Rees, of Columbia College, read a paper entitled "Theories in regard to the causes of the recent red skies." Professor Rees pointed out several of the recorded phenomena before proceeding to discuss the theories as to their cause. There were three theories, he remarked, which were worthy of consideration: That ascribing the glow to the presence of aqueous vapor, that attributing it to cosmic dust, and that finally which traced it to volcanic dust. He considered these briefly in that order, dismissing the aqueous vapor theory as accounting only for the different colored suns. The spectroscopic investigation, which gave weak rain lines and a well defined dry air band, also prevented the acceptance of this theory. The cosmic dust theory was next reviewed, but also met with little favor, as the analysis of the particles which had been collected from snow and rain water proved them to resemble volcanic rather than meteoric matter.

Professor Rees was inclined to believe that the theory which attributed the usual sunsets to the presence of volcanic dust thrown out during the Java earthquake presented less difficulties than either of the others. He stated that this was probably the greatest volcanic eruption on record. Thousands of tons of volcanic dust must have been thrown into the air. In rebuttal of the objection that the speedy settling of such dust would prevent the persistence of the phenomena, he brought forward Professor Crook's theory that the minute particles were negatively electrified, and were therefore not only repelled by the earth but also repelled each other, and thus might be kept in the air for an indefinite length of time. Finally, Professor Rees referred to one or two other theories, electrical and scriptural, which had been promulgated, and also to that which held that the earth is surrounded by a meteoric ring above the equator. This last he considered untenable, as the glows were as perceptible south of the equator as north of it.

Professor Trowbridge than made a few remarks, in the course of which he cordially indorsed Professor Rees' views, and suggested that the upward currents of the air might have much to do with keeping the particles suspended in the atmosphere, and thus account for the persistence of the phenomena. Professor Newberry added the results of his observations, which were strongly confirmatory of the volcanic dust theory.

To Equip a Wheat Farm in Dakota.

"The amount of machinery necessary to plant and harvest the crops of the Northwest," according to the St. Paul *Pioneer Press*, "is enormous. The principal crop of the Northwest is wheat, and as nearly all the labor required to seed and harvest it is performed within a few months, usually from the first of May to the first of October—rarely six months—everything must be done with a rush. Farmers who raise nothing but wheat cannot afford to employ help all the year around, and this fact renders it very difficult to obtain the necessary assistance when it is needed during the busy season. Wages are high on account of this fact, and the wheat raiser finds himself compelled to depend upon mechanical help instead of muscle. It is questionable whether it is more profitable. To properly equip a farm of even 160 acres with all machinery necessary to plow the ground, seed it, harvest and thrash the grain, requires a large outlay of money. The total outlay for wagons, plows, harrows, seeders, and harvesters necessary to work a farm of this size is about $700. This is an outlay that must be made before the farmer can realize from his first crop. It is not to be supposed that cash is required to buy all this machinery. The farmer can buy his entire outfit on credit. Mortgages are often taken, but not as a rule. The agents of reapers and harvesters require no security beyond a simple note of hand. Early in the spring a perfect array of "machine men," as the agents are called, invade the Northwest to take orders. A farmer can buy a harvester or whatever he needs and have it delivered in his field, set up all ready to start, even to being supplied with twine for the binder, by simply giving his note of hand, without security, and drawing 7 per cent interest. These notes run from two to three years, and are often renewed if the interest is properly paid. Some idea of the amount of machinery sold in the Northwest every year may be gained from the statement that during 1883 nearly 1,700 car loads were received at Minneapolis alone, the total number received at St. Paul and Minneapolis reaching nearly 3,600."

Telephone Fortunes.

We can all remember the time when Bell telephone stock went begging, and when some of the largest holders of to-day were almost reduced to the same occupation. If we begin with Professor Bell, we find him down now for a snug fortune of $5,000,000. Mr. Blake bids poverty defiance from behind an intrenchment of $4,000,000. Mr. W. H. Forbes is credited with about as much as both of these gentlemen have put together, and Mr. G. G. Hubbard enjoys as the reward of his early foresight and courage upward of $3,000,000. Mr. Theodore N. Vail, who was at one time an operator, but was from the first marked out for positions of commanding influence, devotes the little time he spares from the general management of the American Bell Telephone Company to the care of a private fortune estimated at not less than $4,000,000. It is also said that among the telephone millionaires must be placed Alexander Cochran and C. P. Bowditch with about $3,000,000 each, and Thomas Sanders with not less than $2,500,000.

These gentlemen have all done very well on the new Tom Tiddler's ground. But there are many others who have found an El Dorado in telephone stock or telephone territory. Take the famous Lowell Syndicate, and not one of its members can complain of any fickleness on the part of Dame Fortune. Mr. Loren N. Downs is said to have three-quarters of a million, and we are inclined to think that that is not the full extent of his capital. Mr. W. A. Ingham and Mr. J. C. Glidden are rated at a cool million each, while Messrs. A. A. Coburn and W. H. Bent would not sell out under half a million each. Mr. O. E. Madden, the assistant general manager of the parent company, is reputed to be worth from $300,000 to $500,000. Among those who have also pulled large plums out of the pie, are named the late Governor Jewell, of Connecticut; W. W. Crapo, C. J. Clifford, and W. Ivers, all of New Bedford; G. W. Piper and A. P. Sawyer, of Newburyport; C. Sanders, of Salem; A. D. Swan and Mr. Knox, of Lawrence; C. F. Cutler and J. C. Clark, of South Framingham; Herrick P. Frost and M. F. Tyler, of New Haven, Conn.; George Howard and Henry Cranston, of Providence, R. I.; G. L. Phillips, of Dayton, O.; H. L. Stork, of New York; A. B. Uline, of Albany; and C. Williams, Jr., of Somerville. This list could be greatly lengthened by additions from all parts of the country, but it includes most of the names of those who were early identified with the introduction of the telephone into public use. It is not to be forgotten that many large manufacturing concerns have done an immense and profitable business in connection with the telephone, and that the Western Union Telegraph Company draws annually now about $400,000 as royalty from the American Bell Company, and is so greedy as to want more.

The various little sums we have mentioned foot up to nearly forty million dollars. If they were only ten millions, they would still be a magnificent yield from the patent in so short a space of time as eight years. We are not surprised that the patent is supposed to be worth, capitalized, about twenty-five million dollars; that the money now invested in operating the telephone is over one hundred million dollars, or that the rapid acquisition of such immense wealth has stimulated invention and aroused cupidity. When the full history of the early days of the telephone in America is written, it will be among the most thrilling of the romances of scientific invention and its commercial development. Ben Butler might, perhaps, after his dark hints, employ his present leisure in writing that history.—*Electrical World.*

A Whistle Heard Thirteen Miles.

The Chesapeake and Ohio Railroad have decided to put upon their passenger engines steamboat whistles. At present six engines are thus supplied, and soon all of the passenger engines will have them. They will be very convenient, both to the public and the employes of the road, as indicating on the approach of a train whether it is passenger or freight.

The Staunton *Vindicator*, in commenting on this innovation in railroading, says that the whistle can be heard at a great distance. A brakeman on one of the night trains coming to Staunton from the West the other night, says when he got home his wife told him she had heard the whistle at a distance in the still night air, had gotten up, made a fire, and cooked his supper by the time her husband reached home. It turned out that the whistle she had heard had been blown at North Mountain, about thirteen miles distant.

Condensation of Carbonic Acid Gas upon the Surface of Glass.

Prof. Robert Bunsen has recently published the results of his investigations upon the film of carbonic acid that adheres to the surface of smooth, clean glass. He found that the quantity gradually increased from year to year, and more rapidly in cold weather than in warm, but change of barometric pressure makes no difference. In three years over 5 c. c. of carbonic acid gas had attached itself to the square meter (1,600 inches) of surface, and had been compressed to 0·05 c. c., which represents the very considerable pressure of 135 atmospheres. Bunsen thinks that there can be no doubt that it exists on the surface in a liquid form.—*Wiedermann's Annalen.*