Correspondence.

Molecular Motion.

To the Editor of the Scientific American:

In an article copied into the SCIENTIFIC AMERICAN SUPPLEMENT of September 3, on "A Theory of Illumination," the writer says that "scientists are somewhat off the track as regards certain minor points, such as the illumination of opaque bodies." In explaining his theory of illumination he remarks:

"Go to your room at night, when all is dark, and you see nothing whatever, for the composing atoms of each object in that room are in comparative rest. But now light the gas. Immediately vibration is set agoing by the combustion, and, passing on, it agitates the atoms of every object present.

"You now look at matter made visible, not by reflected rays, as commonly supposed, but by light waves of their own creation, caused by the imparted energy. A luminous body is the source of etheric light waves, while an opaque substance is made visible by the presence of a luminous one.

"The rays of the sun reach the side of the moon visible to us, creating among the atoms of that body a violent agitation. When they strike, their office is fulfilled; their motion has been checked, and they cease to be. But now the commotion of the moon's particles imparts its energy to the surrounding ether and thence to us, giving us the delightful evenings of full moon."

I cannot agree with the writer of the above, that matter is not made visible by reflected waves of the ether, but by light waves of its own creation, caused by imparted energy from some luminous body. If our moon were a perfect sphere and absolutely smooth, we could see it only as a point of light, in the angle equal to the angle of incidence. A perfectly smooth moon, however, would be impossible, even if composed of glass, because all matter consists of atoms and molecules, and the ultimate particles have certain dimensions.

Foliage on the banks of placid water appears to be inverted in the depths below when seen from the opposite side. As the light which impinges upon the trees is scattered in all directions, we receive those rays which bound to us from the surface of the water, and get the picture in the direction of the reflected rays. What is sometimes erroneously called the shadow of ships and foliage in marine pictures is not caused by what is supposed to be the partial absence of light, but by its reflection.

St. Helena is one of the numerous islands of the St. Lawrence River. It is here where I have been very much interested the present season in watching the play of light upon the water. I have noticed the broad band of reflected light of the moon when it appeared to dance upon the ripples in the warm summer breeze, and I have seen the narrow line of reflected light from the planet Mars. In the direction of the setting sun, when the clouds have a red and golden tint, these colors are reflected upon the water. At night the river course can be discerned by the light from the sky.

Sound is reflected as well as light. While light waves are somewhat similar to the waves of water, sound waves are produced by a to-and-fro movement of the air in concentric layers from the source of disturbance. The echo, or reflection of sound, is beautifully illustrated on the Canadian side of the river, near the "Lost Channel." As the steamer passes along the perpendicular rocks of the Laurentian range, the "toots," as they strike the shore, bound back to the boat, and we get a distinct repetition of the original sound.

Molecular motion is inherent in all matter. No atom is at rest. As the undulations of the ether from the sun strike upon the surface of the earth they shake its atoms and molecules, and this motion is what gives it warmth. A portion of the waves are quenched in doing work, while the remainder are reflected. In this mode of absorption and reflection we have all the beautiful colors in nature. I cannot undestand that light of its own creation can come from any other source than intensely heated bodies. The sympathetic agitation of the molecules of opaque bodies is not competent to produce this phenomenon. H. C. STILLMAN.

Island St. Helena, St. Lawrence Park, N. Y., September 13, 1892.

The Mount Washington Search Light.

The top of a mountain 6,300 feet above sea level seems at first sight a curious location at which to install an electric search light, and it will be admitted that few men would ever have conceived the idea of making the experiment. To Mr. L. H. Rogers must be attributed the honor of first suggesting that a search light would be an attraction on the top of Mount Washington, and that it could be operated successfully. Mount Washington, as is well known, is the highest mountain in the States east of the Rockies and north of the Carolinas, and belongs to the White Mountain range in New Hampshire. Large numbers of people visit these mountains every summer, and beautiful little towns and large hotels nestle in the surrounding valleys, most of them being situated where a good view of the king of the mountains may be had. Access to the mountains is extremely easy, the Concord and Montreal Railroad from Boston being the most popular route, as the line runs through country abounding in fine scenery, and takes the traveler to the very base of the mountain where the Mount Washington Railroad begins. Besides affording a vast amount of interest and amusement to the mountain summer visitor, the search light, poised at this extreme elevation, is of scientific interest.

A tower has been erected on the very highest point of the mountain, 27 feet square at the base, 50 feet high, and tapers to 14 feet square at the top. It is built of eight 9 inch spruce timbers reaching from the foundation to the top, each of the floors being supported on similar timbers, and the whole tied together by iron straps and bolted, and the framework chained down to the rocks on the mountain top. The whole building was then covered by heavy planking and clapboarded on the outside; but, even with this protection, so severe are the wind and rain storms, the moisture penetrates the building and makes the condition of operating a dynamo extremely severe, the armature after a great storm being frequently saturated with moisture. The first floor of the tower contains engine, boiler, dynamo and switchboard, the whole steam plant having been furnished by J. A. Grant & Co., of Boston. It consists at present of a 30 horse power vertical tubular boiler manufactured by the Erie City Iron Works, of Erie, Pa., which works at a pressure of 80 pounds. The engine will eventually be a 25 horse power McIntosh & Seymour high pressure engine, as it is expected that current will be furnished for lighting the Summit Hotel, but at present a 15 horse power Armington & Sims engine is used. Rain-water is used for the boiler, and it is fed through a National heater by means of a small Worthington pump, which lifts the water from a tank 10 feet below. In dry weather the water is brought up in tanks by one of the Mount Washington railroad locomotives, filled from the watering tanks on the side of the mountain. The dynamo is of the Thomson-Houston spherical armature type, compounded and capable of giving 75 volts and 110 amperes. In spite of the severe conditions owing to the extreme dampness, it has given every satisfaction, and has run without a hitch from the first. The switchboard is of the skeleton type, made of wood, and contains ammeter, voltmeter, a double pole single throw 120 ampere switch for the main search light circuit and two 10 ampere switches for the 18 incandescent lights distributed on the different floors of the tower. These lamps are on two circuits, one for the upper floors and one for the engine room. Fuse blocks and lightning arresters are also mounted on the switchboard, so as to prevent any chance of accident. In the engine room and protruding through the floor may be seen the top of the highest point of the mountain. In the center of the room a red incandescent lamp burning in a vase filled with water serves to mark the position of the copper bolt inserted in the rock, which formed one of the station marks set by the Geodetic and Coast Survey during their operations now completed. The second and third floors of the tower are used as storerooms, the fourth as the lower observation room, and the fifth as the general observation and controlling room. In this room is the controlling stand, on which is mounted a standard Weston voltmeter and ammeter, resistance coils and various switches for operating the light and the motor in the base of the search light by which the projector can be turned round in any direction, and the elevation altered at will. On the roof of the tower, open to the atmosphere, is situated the search light, which was manufactured by the General Electric Company. The light is inclosed in a projector of 30 inches diameter, the largest ever made in America, and is of 100,000 candle power nom., the actual candle power of the lamp without the reflector being 20,000. Hardtmuth carbons, made specially for this work in Vienna, Austria, are used in the lamp, measuring 1¼ inches diameter for the positive and 1 inch for the negative, the positive carbon being cored. The reflector consists of a Mangin lens with 14$\frac{1}{16}$ inch focal point, made in Paris by a secret process, by which the quicksilver on the back of the reflector can withstand the extreme heat of the arc. The lamp when operating requires 45 volts and about 90 amperes, the voltage of the dynamo being reduced by resistances on the floor below.

Viewed from any of the well known summer resorts in the vicinity the effect is very fine, and it is astonishing to note the interest shown in the light by the visitors to these hotels, who gather in knots on the verandas and discuss the all-absorbing topic of "search lights" and endeavor to read the messages signaled to them, by means of a code which has been distributed in thousands all over that section of the country. At Maplewood, for instance, where the writer recently stood on one beautiful clear night 20 miles from the top of the mountain by air line, the light was "turned on" the hotel for about 20 minutes, and signals were read with the greatest ease and precision. At that distance the light is almost too bright to be looked at comfortably, and the effect of the illumination on the hotel is quite marked. The time on a watch is easily told and type as large as the heading of this article read with ease. On white surfaces such as the front of the hotel a curious shimmering effect is produced, and small dark patches seem to float constantly over the surface, produced perhaps by the magnified effect of minute particles of vapor in the atmosphere, or by some other phenomenon not yet accounted for. The signaling is accomplished by a metal damper in the inside of the projector which can be lowered between the arc and the lens by a lever extending to the outside, and by means of which flashes of short or long duration can be effected. At Maplewood, on the night when the writer was present, several signals were given and readily interpreted. Before spelling out the words, ten short flashes were given to attract attention, and then came a series of long and short flashes, spelling out the words of the famous message which will go down to all posterity as being the first telegraphic message ever sent by the Morse telegraph: "What hath God wrought!" After each word, the beam of light is moved up and down, and at the conclusion of the sentence a circular sweep of the beam shows that the message is concluded. A few minutes later the words: "Maplewood Hotel, good night," came flashing through the air, and one felt as if on personal terms of friendship with the friendly beam shedding its pure light over the intervening miles of rocky glen and wooded hillside. At Fabyan's, eight miles from the top of the mountain, ordinary type can easily be read, and at Mr. Milliken's Glen House, which is only five miles away by air line, the light makes the grounds as light as day. Standing alongside of the projector on the top of the tower at night, the sight is also a very grand one, and a beautiful view of the beam of light can be had.

When the projector is turned in the direction of any of the portions of the mountain from one-half to one mile away, the effect is very pretty, as it makes a round circle of light, and shows up any particular object even more distinctly than by daylight. It is a great source of pleasure to the visitors and they never seem to tire of watching the different effects produced. That it is a great attraction in the mountains is amply proved by the fact that in small places where the lights of the village cannot be seen by the naked eye from the mountain top, large bonfires are nightly kindled in the hopes that the ray of light will be turned in their direction. Many letters and telegrams are also received daily with "special requests for the search light," and letters from many eminent men within a radius of 100 miles have been received stating that the light had been seen and asking for further experiments in their particular directions.

As to the distance from which the light has been seen, it is a little difficult to get accurate figures. At Portland, which is 85 miles away, the beam of light has been distinctly seen, and actual telegraphic conversation held with the operator on the mountain, the search light flashing out a message, and the telegraphic operator at Portland repeating it by ordinary telegraph back to the mountain. Many towns 100 miles away have reported seeing it, and one report states that it was seen on one occasion at Pigeon Cove, Cape Ann, on the coast of Massachusetts, a distance of 116 miles. Recently the New England district of the Weather Bureau has instructed Mr. Rogers to make experiments on weather signaling, and for the past three weeks weather signals have been shown at eight o'clock every evening to the surrounding districts, a combination of long and short flashes signifying fine or rainy weather, according to the reports from the bureau. These signals have been seen and read at Exeter, N. H., a town about 100 miles from Mount Washington, and are giving general satisfaction to the surrounding countryside.—*A. C. Shaw, in the Electrical Engineer.*

Only Man Ever Killed by a Meteor.

To the writer's certain knowledge there is but one case on record where a human being has been killed by an aerolite or fall of meteoric stone. The fatality mentioned occurred in Whetstone Township, Crawford County, O., in 1875, and is recorded in the Bucyrus *Journal* as follows:

"As David Misenthaler, the famous stockman of Whetstone Township, was driving his cows to the barn about daylight this morning he was struck by an aerolite and instantly killed. . . . It appears as if the stone had come down from a direction a little west of south, striking the man just under or on the right shoulder, passing obliquely through him from the right shoulder to just above the left hip, burying the greater portion of his body under itself in the soft earth. The stone is about the size of a wooden water bucket, and appears to be composed of pyrites of iron."—*Philadelphia Press.*

[The item quoted by our contemporary the *Press* was a canard. It was published at the time stated in the Bucyrus *Journal*, and was manufactured by one of the reporters of that paper. No such occurrence took place.—ED. S. A.]

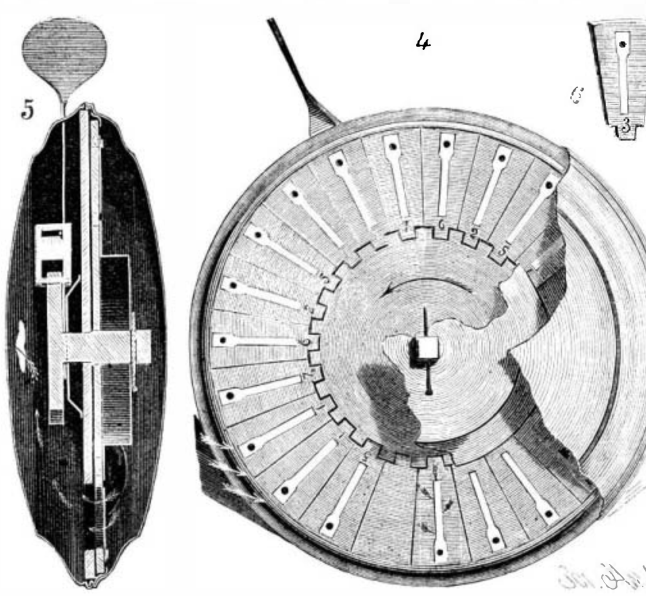
The Chicago New Drainage Canal.

August saw the actual beginning of one of the largest engineering schemes in the country. For many years Chicago has had spasmodic attacks of realizing that her sewerage system was inadequate to her needs. After each fresh attack improvements have been planned and executed, which, however, were only of a temporary nature, owing to the ever-increasing size of the city. At present, with every severe storm the sewers are flushed out into the river, and with any heavy fall of rain a few miles back in the country the low river valleys are flooded and the waters come rushing down into the South Branch of the river, driving all its dangerous pollution into Lake Michigan. Pumping works have from time to time been established to induce the beautiful Chicago River to change its nature, and, unlike most rivers, be able to flow two ways. These pumps are no longer powerful enough, and for the last five years there has existed a drainage commission whose history is more stormy than that of the Guelphs and Ghibellines, but which has now either killed off its most belligerent members, has lost its fighting blood, or at least appears to be devoting itself in a somewhat more energetic manner to drainage and less to lively discussions of a somewhat political character. The present scheme is to create a channel from Lake Michigan, at Chicago, for a distance of forty miles to Joliet. The route of this channel will lie chiefly through the valley of the Des Plaines. Starting from one of the southwest "tributaries" of the Chicago River, it will, in its westward course, utilize the Illinois and Michigan canal, create new cuts, and finally settle itself into the bed of the Des Plaines, widened and deepened to suit its needs. In time the current will reach the Illinois River, and by this waterway will eventually gain and mingle with the floods of the Mississippi. The one saving feature of the scheme for the counties adjacent to Cook County, and in fact for part of that same county itself, lies in the fact that the land surrounding the lake is considerably higher than that several miles back in the country, and consequently sufficient fall can be secured in the channel to obtain for it a large volume of water from Lake Michigan. That the towns along the route of this channel, into which Chicago intends to pour all of her liquid and semi-liquid filth, should have for an hour entertained the idea of permitting such an enterprise seems incomprehensible. Such, however, in the main is the idea of the present great drainage undertaking of Chicago. There is talk of eventually constructing the channel so as to make it navigable for large vessels, thus making Chicago, as well as the smaller towns along its course, in a degree, seaports, giving them direct connection with the Atlantic.

The law requires that the channel must be two hundred feet wide at the surface, one hundred and eighty feet wide at the bottom, with a depth of water of eighteen feet. The flow of water must be at the minimum rate of three miles an hour. These conditions are required, not because of any question of navigation, but that the sewerage may be sufficiently diluted to render it harmless and inoffensive. Experience and experiments in various countries have shown that twenty thousand cubic feet of water a minute is the least amount that, by diluting, can render harmless the sewage from a city of one hundred thousand population. The plans will contemplate the possibility of the growth of the city during the next thirty years up to the number of three millions in population; and, consequently, the channel will provide for a possible flow of six hundred thousand feet, or three times the original estimate. Not all the water sufficient to dilute the sewage can be carried through the South Branch, and another channel from the lake will have to be created, to enter the main channel at a point farther west. As consent to carry the drainage canal through the west-lying towns has been obtained from the inhabitants, conditional upon the amount of pure water brought into the channel, and this permission would be canceled if any lack of the fresh water supply arises, it appears probable that the requirements will be fulfilled. Though this sketch of the plan contains the chief elements embodied in the scheme, there are many minor details yet to be arranged. The ceremony of breaking ground for the main channel has already taken place, accompanied by the usual amount of flourish. When this great undertaking is finally completed, Chicago will have a system of drainage to be proud of, with a lake unpolluted by the drainage of a great city. The result will be most important, not only to the sanitary condition of the city, but will be the means of adding not a little to its beauty, so far as its water surroundings are concerned.—*Amer. Architect.*

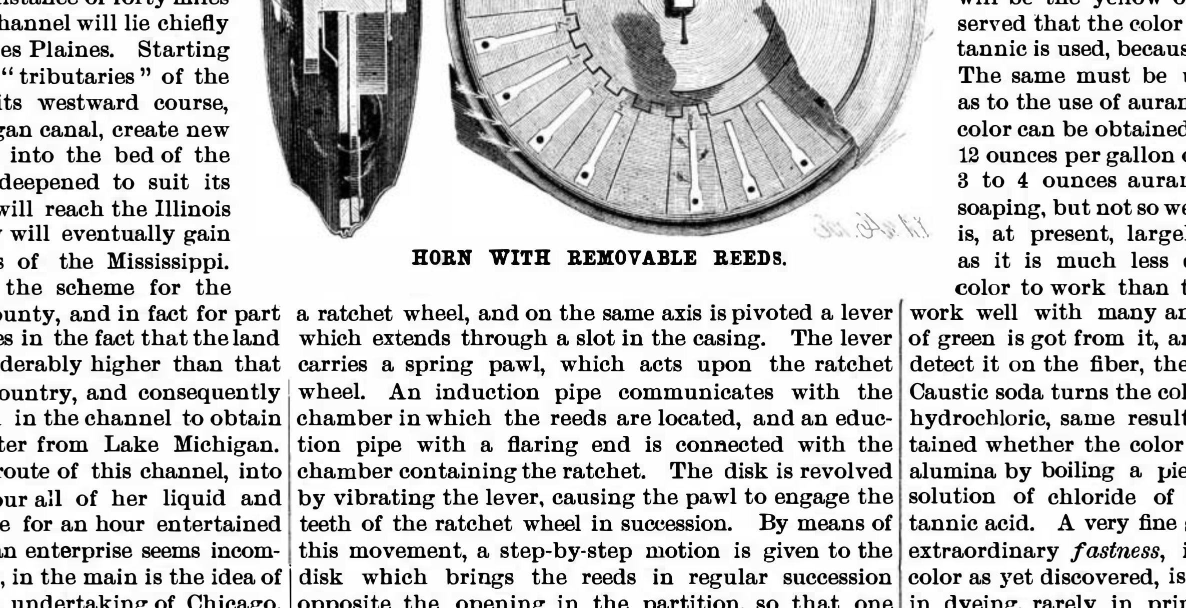
AN INTERESTING TOY.

We give engravings of a toy bugle provided with an air chamber divided into two compartments, in one of which is placed a disk having a series of radial slots covered by reeds. In the partition is an aperture through which air passing through the reeds can find its way into the rear chamber. In this chamber, on the prolongation of the axis of the reed disk, is placed a ratchet wheel, and on the same axis is pivoted a lever which extends through a slot in the casing. The lever carries a spring pawl, which acts upon the ratchet wheel. An induction pipe communicates with the chamber in which the reeds are located, and an eduction pipe with a flaring end is connected with the chamber containing the ratchet. The disk is revolved by vibrating the lever, causing the pawl to engage the teeth of the ratchet wheel in succession. By means of this movement, a step-by-step motion is given to the disk which brings the reeds in regular succession opposite the opening in the partition, so that one after another of the notes of the music represented by the different reeds are produced and the tune is played. At the end of the tune there is a blank space, which prevents any sound being made, and this notifies the player to stop, unless he wishes to repeat the tune.



HORN WITH REMOVABLE REEDS.

In Figs. 4 and 5 is shown a disk carrying removable reeds, which admit of changing the tune by simply drawing out one set of reeds and inserting another set. The construction of the reeds is shown in Fig. 6, while the arrangement of the lever, ratchet wheel, disk and apertures in the central partition is clearly shown in Fig. 4. A person who is not a musician may play upon this instrument as well as the best player.



DETAILS OF THE MUSICAL HORN.

Cotton Manufacture.

Arsenic in Prints.—A large proportion of prints contains small quantities of arsenic—so small, in fact, that there is not the slightest cause for alarm. Many of the anilines, such as ceruleine blue, aniline greens, etc., and many of the vegetable colors, are fixed on calico by printing the color with a salt of alumina and a solution of white arsenic in glycerine, or in a borax solution. The reaction that takes place on steaming the goods is a double compound of arsenic, alumina, and coloring matter or, briefly, double arseniate of alumina and dye. This compound constitutes the insoluble *lake* which colors the fibers of the cloth with a more or less *insoluble* and fast color. This at once removes any danger in the wearing of the material. As a matter of fact, arsenic colors contain a considerable excess of alumina, and this is a *preventive* against the possible presence of uncombined arsenic. In extract alizarine colors, the soluble arseniate of alumina is sometimes added to brighten the colors, but, on steaming, the insoluble compound is obtained. When used properly, there is no harm in the use of this drug, and the cry which, no doubt, has been the cause of a decline in some classes of prints has originated from experiments on a small scale and conducted on false premises.

Colors.—Auramine is a coloring matter which gives a very pure shade of yellow, whether dyed on yarn or printed on calico; for yarn, chrome yellow is, however, cheaper and more readily produced. Auramine has all the advantages of aniline yellows without their deficiencies, as it is moderately fast to soap and light. If dyed by means of alumina, a good green shade is obtained, but it is loose; when fixed with sumac and tin, or tannic acid and tartar fustic, a most beautiful shade of pure maize yellow is obtained. The more tannic acid employed—up to the limit of 12 ounces good tannic acid to 3 ounces auramine—the faster will be the yellow obtained, but it must be observed that the color is not so bright as when less tannic is used, because the brown dulls the yellow. The same must be understood with equal force as to the use of auramine in printing, where a fine color can be obtained by fixing the auramine with 12 ounces per gallon of pure tannic acid and from 3 to 4 ounces auramine; this will stand strong soaping, but not so well as *berry yellow.* Auramine is, at present, largely adopted in many styles, as it is much less difficult and a more regular color to work than the berry yellow, and it will work well with many aniline colors. A yellow shade of green is got from it, and aniline crystal green. To detect it on the fiber, the following tests are reliable: Caustic soda turns the color white very rapidly; dilute hydrochloric, same result. It can be readily ascertained whether the color is fixed with tannic acid or alumina by boiling a piece of the cloth in a dilute solution of chloride of iron. Blackness will show tannic acid. A very fine shade of yellow, possessed of extraordinary *fastness*, in fact, the fastest artificial color as yet discovered, is chrysamine, used very much in dyeing, rarely in printing. It is not materially affected by acids, soap, or alkalies, and even caustic soda, light, air, rubbing, or chemic have little effect, except that alkalies turn it to an orange shade, while acids will restore it to a pure yellow, with a slight tendency toward light green. The present prevailing features in some print dress goods of pale yellows and buffs, as well as in cotton hosiery and laces, are produced by chrysamine, or mixtures of it, with benzopurpurine and other *azo* colors. In dyeing, the shade is obtained at one bath and without a mordant operation, etc., necessary in other dyes, and which are so injurious to the fiber of fine cotton lace goods. The reason the use of this dye is so much restricted is that a deep shade of yellow cannot be obtained so far. It is, however, found useful for buffs, and every delicate shade of pale yellow, salmon, etc.; it is not readily soluble in cold water, but dissolves freely in hot, and is still more soluble when in boiling water with a small atom of caustic soda. There is little doubt that this is the yellow of the future, when science unfolds nature's mystery.

Metallic Tungsten.

Dr. Martin Krieg, of Magdeburg, prepares pure metallic tungsten in the following manner: The finely ground tungsten mineral is made into a porous mass with fine carbon and tar or pitch. This mass is placed in the voltaic arc of the Jablochkoff system and chlorine introduced through the hollow candles. The candles can be made to furnish the chlorine by adding chloride of lime and silica to the material from which they are made. In either case chloride of tungsten is produced together with chloride of other metals.

If these chlorides be boiled in concentrated hydrochloric acid, oxide of tungsten is thrown down; the other chlorides are dissolved. The oxide is separated by decantation and washed. This oxide, mixed with carbon, can be easily reduced in the voltaic arc in an atmosphere of neutral gas.