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Contents.

(Illustrated articles are marked with an asterisk.)

TABLE OF CONTENTS OF

SCIENTIFIC AMERICAN SUPPLEMENT

No. 619.

For the Week Ending November 12, 1887.

Price 10 cents. For sale by all newsdealers.

THE RICH COAL FIELDS OF COLORADO.

Prof. Newberry, of Columbia College, at a meeting of the New York Academy of Sciences, October 31, gave an enthusiastic description of some exceedingly rich coal fields in western Colorado. He exhibited specimens of coal that he had taken from various veins there but a few weeks ago, equal to any mined anywhere in the world, some of it showing only three per cent of ash and one-half of one per cent of sulphur. Some of the coals were anthracite and others bituminous, with an abundance of excellent coking coals, portions of some veins just as found comparing favorably with the best Connellsville coke.

One of the veins he described as 18 feet thick of solid coal, with numerous other veins of 14, 10, 8, and 6 feet thickness. Three railways are now approaching this wonderfully rich coal field, and, notwithstanding the great difficulties attending freight transportation in so mountainous a region, its almost exhaustless stores of the best of fuel will soon be furnished in abundance for that large section of almost treeless country just east of the foothills of the Rocky Mountains, from Dakota to Texas.

BOOKS FOR THE INSANE IN ASYLUMS.

From Georgia a very touching appeal has reached us. The State Lunatic Asylum at Milledgeville has within its walls between twelve and fifteen hundred patients. Many of them are not only well able to read in spite of their mental infirmity, but really need and crave some such literary exercise. A hall within the institution is fitted up for a library, but there are no books. To supply this pressing need, contributions of any kind, old books, magazines, periodicals, and the like, are solicited. We trust that many will respond to the demand, directing their contributions to the superintendent, Dr. T. O. Powell.

We notice the above mentioned appeal not only for its own sake, but because it seems to us the index of what is probably one of the great needs of our country. All through it are large insane asylums, but in how many of them is there any certainty that a sufficient library is provided for the inmates? No class would seem so open to benefit from literature as the insane. The majority are monomaniacs, or at least possess a part of their understanding. They emphatically require to be taken out of themselves. The error many sane people make is to depend too much on reading and too little on thought. The reverse may be made an aphorism for the insane, as they certainly brood or think too much.

It would appear that an opening for a most beneficent charity might be found in this direction. The asylums of the country should be investigated, and the extent of their libraries determined, and efforts made to supply their deficiencies. Every house has in it some unused books that idly fill the shelves, and which having been read once are never again opened. These could find no more useful destination than the one suggested. Many periodicals accumulate, to be ultimately destroyed. All such we are sure would be gladly received by the superintendents of the insane asylums.

So much is now done by organized charity that the suggestion of a new field for work will undoubtedly find many willing to assist in it. The question of the character of the books might safely be left to those in charge of each asylum. Even if the indiscriminate use of books were permitted, then for one patient who would be excited or injured by some work fostering or increasing his delusion, probably hundreds would be benefited. If ill effects were feared, the books could be examined and weeded out before being sent.

It is clear that a need exists, and that it is one which can be easily supplied. We hope soon to receive evidence that work is doing in this field.

THE AMERICAN INSTITUTE EXHIBITION.

The American Institute exhibition in this city is now at its best. In general it is fully up to the standard of former years, and in some respects it is far in advance. The electrical display is especially noteworthy. A large number of dynamos and electric motors are shown in operation. The halls are illuminated by electric light exclusively. The arc lights, 100 in number, within and without the building, are operated by four Ball unipolar dynamos, driven by a smooth running high speed engine made by the Ball Engine Co., of Erie, Pa.

Two No. 16 400 ampere Edison dynamos are exhibited, one being used for incandescent lights, and the other for supplying current to motors. One of the Edison machines is driven by the well known Armington & Sims high speed engine, the power being communicated from the engine to the dynamo by a leather link belt. This belt hugs the pulleys closely, and envelops much more of their peripheries than does the ordinary belt. The other Edison dynamo is driven by a Straight Line engine, which seems to do its work quietly and with great ease.

The Mather Electric Co., of Hartford, Conn., exhibit a 500 light dynamo, driven by a Trenton high speed engine, made by the Phœnix Iron Co., of Trenton, N. J. This dynamo supplies a current to 500 incandescent lamps. Another 250 light machine of the same make takes its power from the line shaft of the exhibition building, and supplies a current for running various electric motors. A 50 light dynamo of the same make furnishes a current for the "C. & C." motors.

The Oerlikon Machine Works, of Switzerland, exhibit a compact, efficient dynamo, running incandescent and arc lamps in the same circuit. It has a capacity of 120 incandescent lamps and 12 arc lamps.

The Mutual Electric Manufacturing Co., of Brooklyn, exhibit the Knowles system of electric lighting, in which the dynamo supplies a current to arc and incandescent lamps, and also to motors upon the same circuit. The feature of the dynamo which renders this possible consists of a very sensitive regulator, which is capable of quickly shifting the current according to the electric load. This dynamo is driven by a Hill clutch and pulley on a line shaft.

A feature of electric lighting which has often been discussed, but never practically realized until now, is that of economically producing steady incandescent electric lights through the agency of the dynamo by power derived from a gas engine. Otis Brothers & Co., of New York, exhibit a 4 h. p. Baldwin gas engine, which drives a United States dynamo, and furnishes a current to thirty-two 16 candle power incandescent lamps. The engine, consuming 30 ft. of gas per h. p. per hour, makes the expenditure of gas for the production of 16 candle power 3¾ ft., whereas a 15 candle gas light requires 5 ft. of gas per hour. The lights are readily maintained at a high incandescence, and are absolutely steady. To show the possibilities of electric illumination by means of a gas engine, the dynamo driven by the Baldwin engine is connected with a Julien storage battery when not furnishing a current directly to the lamps. The storage battery requires about five hours for charging, and will maintain 52 lamps for about three hours, thus making it possible to furnish 84 lights with a single 4 h. p. engine.

The gas engine exhibit of the present year excels that of any previous year, both as regards the number shown and the variety and quality of the engines. Messrs. A. C. Manning & Co., agents for the Otto engine in this city, exhibit a 10 h. p. engine running idle, a 7 h. p. engine running arc lights, two 4 h. p., one 2 h. p., and one 1 h. p. engine. The 7 h. p. engine drives a Waterhouse dynamo, which supplies a current to 8 arc lamps. The Clerk gas engine is in place, but not in operation. The Charter gas engine is also in place, and is occasionally in operation.

The Economic Gas Engine Company have an exhibit of six small engines, ranging between 1 man power and 1 h. p. These little engines are extensively used in and about New York for pumping water for household purposes and for running light machinery. They are exceedingly simple and well adapted for any use requiring not more than 1 h. p.

Undoubtedly the greatest novelty exhibited this year is that of the electric welding of metals. This new art of electric welding is one discovered by Prof. Elihu Thomson, of Lynn, Mass. The invention is under the control of the Thomson Electric Welding Company, of Lynn, Mass. The welding is accomplished by sending a very heavy current of electricity through the bars of metal to be joined by welding, the resistance offered by the comparatively imperfect contact between the abutting surfaces serving to create a temperature sufficiently high for the purpose. As the contact surfaces soften under the great heat, they are forced together, and the heat extends to the contiguous surfaces until the adjoining ends are in perfect contact and the union of the metal is complete.

In the exhibit the current is furnished by a Thomson-Houston alternating current dynamo of high voltage, and this current is reduced to low voltage and large quantity by a transformer consisting of a primary and secondary coil and a magnetic core. The primary wire in this case, unlike an ordinary induction coil, is small and long, while the secondary conductor is very large and short. The terminals of the secondary conductor are connected with the clamp by which the material to be operated upon is held in position for welding. There seems to be no limit to the possibilities of this process. All of the metals, so far as known, may be successfully welded by the electric current. No exception is made of aluminum or cast iron. Wrought iron, steel, brass, and copper are readily united, the joint being generally stronger than the other portions of the metal. Unlike metals are also successfully welded—iron and steel, brass and iron, and brass and German silver are examples.

Among electric motors in operation will be found the Daft motor, driving a street car, another applied directly to a Sturtevant blower, another operating an elevator. The Sprague Electric Company show a motor running a band saw, another running a printing press, another driving a large blower. This company also exhibit a railroad car having the electric motor attached. The "C. & C." Electric Motor Co. exhibit a large number of their motors of different sizes, doing various kinds of work—running sewing machines, blowing organs, operating ventilating and cooling fans, etc.

The historical exhibit of the New York Electrical Society includes Franklin's original frictional electric machine, one of Morse's early telegraph instruments, Moses G. Farmer's original self-exciting dynamo, first exhibited by the inventor in 1872, a Saxton's magneto-electric machine, which was exhibited at the British Association in 1833, and a great variety of telephones and other electrical devices too numerous to mention.

James W. Queen & Co., of Philadelphia, have a very creditable exhibit of fine electrical instruments, many of them of quite recent invention. Among them we find Hartmann & Braun's Siemens' universal galvanometer, Weideman's reflecting galvanometer having a Siemens bell magnet, Kohlrausch's Wheatstone bridge made by Hartmann & Braun, also a rheostat graduated to the new ohm, a variety of Deprez-Carpentier's ammeters and voltmeters, a Sir William Thomson's reflecting galvanometer made by Elliott Brothers, London, a variety of Ayrton & Perry's measuring instruments, a Charles Siemens' half meter bridge, and many other modern electrical instruments.

The Writing Telegraph Co. exhibit one of their instruments, which attracts a great deal of attention, the pen of the receiving machine which writes without any apparent controlling power being the center of attraction.

In no branch of the electrical department is the progress of electrical science better shown than in the various exhibits of electrical conductors. Among these we mention the exhibits of the Scoville Manufacturing Co., the Washburn & Moen Manufacturing Co., and Holmes, Booth & Hayden Co., which include every variety of plain and insulated wires. Also the exhibits of the Okonite Co., the Bishop Gutta Percha Co., and Day, comprising cables for aerial, marine, underground, telephone, telegraph, and electric light lines.

Luminous Organs of an Insect.

Dr. Dubois has investigated the light-emitting organs of the *cucuyo*, or *Pyrophorus noctilucus*. They are three in number—two prothoracic and one ventral. The prothoracic plates give a good illumination in front, laterally, and above, and serve when the insect walks in the dark; when it flies or swims, its fine abdominal lantern is unmasked, throwing downward an intense light with much greater range. The insect seems to be guided by its own light. If the prothoracic apparatus is quenched on one side with a little black wax, the cucuyo walks in a curve, turning toward the side of the light. If both sides are quenched, it walks hesitatingly and irregularly, feeling the ground with its antennæ, and soon stops. The light gives a pretty long spectrum, from the red to the first blue rays, is more green than the light of *Lampyris noctiluca*, and is capable of photography, but does not develop chlorophyl. No distinct electric action could be traced to the organs. The luminosity does not depend upon oxygen, for it is the same in pure oxygen, in air, in pressures under one atmosphere, and in compound oxygen. The organs are still brilliant when separated from the body, but the power of emission appears to depend upon a supply of water, and it is recoverable, after thorough drying, upon putting the organs again in water. Dr. Dubois found that the photogenic substance is an albuminoid, soluble in water and coagulable with heat, it entering into contact with another substance of the diastase group. Part of the energy liberated appears as light.

Atmospheric Electricity.

Prof. L. Weber, of Breslau, read a paper before the British Association, on "Observations of Atmospheric Electricity." Prof. Weber said that the increase of potential seemed to be a linear function of the height; but the presence of dust in the air disturbed this relation. The earth represents a surface of equipotential, and the other surfaces of equipotential are parallel, but come closer together above the mountain tops.

Prof. Schuster said that, granting that the earth has a given potential at any moment, the convection currents in the air would tend to reduce this, or to equalize the potential within the earth itself.

Prof. Everett remarked that wherever electricity is carried down by raindrops, an inequality of potential will be caused; and evaporation would also cause inequalities.

Prof. Rowland said that observations had been made during the last four years at his laboratory by the U. S. signal service. He did not see how the raindrops could disturb the distribution of potential much. If the earth is electrified, most of the electricity would be on the outside of the atmosphere. He therefore looks for some other theory, and has given one in the *Phil. Mag.*, viz., that the earth would naturally be uniformly electrified if it were not for currents of air in the upper atmosphere, which will carry the electricity of the atmosphere toward the poles, making auroras there. At the equator, therefore, a space must be left which has to be filled up with electricity, and this takes place by thunder storms. Accordingly, there is a circulation of electricity. In this connection it is to be remembered that thunder storms are most common about the equator.

Writing and Drawing on Glass.

Fine ground glass is nearly as easy to work upon with pen and pencil as note paper. Such glass as is used for the focusing screens of cameras is suitable for this purpose. The roughness of the surface prevents to some extent the spreading of the ink, and by the latter being absorbed, as it were, into the minute depressions, we obtain blacker lines than we should get on smooth glass. Water colors can be easily applied with a brush. It is best to mix them with a weak solution of sugar or gum, and to prepare the glass for the colors by a preliminary rub with a cloth made damp with the same fluid. After the writing is completed, the appearance of plain, unground glass may be produced by varnishing it. Negative varnish, containing shellac, will do very well, or Canada balsam, thinned with benzole, may be used. The latter will take some hours to dry, during which it should be carefully protected from dust.

Matt varnish may be used to impart an artificial grained surface to smooth glass. It is easily made by dissolving ninety grains of gum sandarac and twenty grains of gum mastic in two ounces of ether, to which is added benzole, the amount of which may vary from half an ounce to one and a half ounces, according to the fineness of the matt required. This fluid is applied by pouring it on the cold plate. As soon as the varnish has set, the glass may be heated to insure a firm and even grain. Upon this surface, writing with a pen or pencil can be easily executed when dry. A sirup or gum arabic solution may be applied with a brush to restore the appearance of unground glass. As sandarac, the chief constituent of matt varnish, is soluble in methylated spirits, we cannot use collodion or shellac varnish to impart transparency. So we are obliged to adopt a water solution, such as sirup, as a protection for lead pencil work, while in the case of ink Canada balsam may be used.

Resin is one of the substances that enable us to work with a plumbago point upon a smooth surface. A thin film of the gum is easily produced from a solution of it in turpentine or benzole, in the same way as gum dammar is used, and resin being of a brittle nature, a little caoutchouc added to this solution will be an improvement. Resin is remarkable in its way, for it dissolves in methylated spirits as well as in turpentine. The former solvent (or spirits of wine) is the best for our purpose, as it contains no grease; and as Canada balsam, thinned with benzole, is also mixable with spirits of wine, a very small quantity of it may be added to the resin solution, to impart the requisite toughness and adhering power. A plain glass coated with this medium can be worked upon with pen and pencil, but it is not equal to gum dammar as a help to retouching, as the resin, though it is brittle when cold, is apt to become tacky when heated, which might occur in printing off a negative in the sun. Another fault is that the resin film dissolves when the negative varnish is applied, so that work done by the lead pencil is exceedingly apt to become displaced. The only chance of a disturbance not taking place is when the resin film is very thin, and the pencil point is hard and sharp, so that the impression is driven into the gelatine basis.

Sugar, although not generally known as a medium for writing on glass, is perhaps the very best. I have used it for some months, and prefer it to any other substance, gum dammar included. It is suitable both for the lead pencil and for the pen. If a sketch in lead pencil upon clear glass is wanted as a lantern slide, I would use a film of sugar, as I could produce thereon lines almost opaque in their blackness, and shading of any depth, combined with a singular freedom from grit. With a gum dammar film the lead is apt to break off in tiny pieces, and a shade, or half tone, cannot be easily produced free from black specks. If an ink sketch or writing is required, with lines clear and distinct, then I would again use a sugar film, as I could produce thereon with ease the finest lines that a pen could trace. The ink, prepared itself with sugar, takes perfectly to the sugar surface, and shows no tendency to spread over the glass. There is no trouble in getting the ink to flow from the pen. Sugar in solution is very tenacious of its continuity, and does not easily divide into drops, which cause blots in writing. Sirup has the same characteristics as thin treacle—we cannot divide treacle into small drops. If we pour it slowly from a bottle we obtain an attenuated thread of the substance. So sirup in a pen forms a narrow thread at the nib point, and being previously darkened with lampblack or other pigment, enables the finest black lines to be produced if required.

Saccharine matter exists in various well-known forms —there are white, brown, lump, crystallized, and moist sugars, and there is treacle. Treacle is a very good thing no doubt, but it is useless for our purpose, as it resembles calcium chloride in its power of absorbing moisture. It can be hardened by heat, but if exposed to the atmosphere it soon regains its pristine softness. Brown or moist sugar partakes of the nature of treacle to some extent. It can be dried by heat, but it absorbs a little moisture afterward. White sugar, on the contrary, has little tendency to become softened by damp, and for an ink sketch on glass, a sirup made by dissolving white sugar in cold water is the best medium. Such a film, when perfectly dry, presents too hard and polished a surface for the lead pencil. By breathing on it the sugar becomes softer, and it then takes the lead perfectly. There is, however, some danger of overdoing the softening process, the result of which is that the lead point sinks into the film and causes a furrow instead of a clear line on the surface. So for the lead pencil I prefer to use white and brown sugar in equal parts, dissolved in cold water. This sirup may be spread on the glass either by pouring or with a brush, and the film may be quickly dried by heating the glass plate. But there is a better way of applying an even film of sugar to glass. Thin sirup has the curious property of being mixable with methylated spirits without causing the precipitation that occurs when gelatine or gum arabic is so treated. Thus we can add sirup to alcohol and coat a hot glass plate exactly as if we were using negative varnish. The film will be dry in a minute or so, and if the glass is perfectly clean the sugar will be equal in thickness throughout. It is best to mix the thin sirup with alcohol in equal proportions and to use it at once. If left at rest for some days a portion of the sugar is deposited in crystals on the sides of the containing bottle, and the mixture does not then produce so even a film as at first. The glass should be made quite hot before pouring on the fluid, to secure the best result.

Sugar dissolved in water does not act exactly as a salt would do. The latter usually dissolves to a certain extent in cold water, and to a greater extent in boiling water. When the water cools, a portion of the salt is precipitated. White sugar, so far, does the same. If a solution of salt in cold water is allowed to evaporate slowly, the salt is gradually thrown down in crystals, but sugar so treated does not crystallize. It becomes of a thick, pasty consistence and dries eventually as transparent as glass and with the same polished surface. So we can use sirup as a varnish, but salt we cannot.

A great advantage of the sirup foundation in writing on glass is that a shellac or mastic varnish can be applied as a protection against damp without the slightest fear of disturbing the design. We have seen that a resin film dissolves if varnished. A gum dammar film resists a spirit varnish better, but a pen and ink sketch thereon becomes wofully faint and attenuated. I presume that the sugary ink becomes softened under the hot varnish and shrinks up, so that the lines become finer. A similar sketch on a sugar basis is unaffected during the varnishing process.—*Albert Wm. Scott, in The British Journal of Photography.*

Ring Spinning.

Predictions made by one of our contributors many years ago, that the ring frame would eventually supersede the mule for spinning cotton yarns, were received by manufacturers as well as by the operators of mules with an incredulous smile. But the revolution in spinning has outrun the sanguine anticipations of the writer to whom we allude, and within the last ten years the introduction of ring frames has gone on with remarkable rapidity. Most of the new mills that have been built within that time have adopted the ring frame for the spinning of warp yarns, and a number of the older mills have thrown out their warp mules and largely increased their spinning capacity by the substitution of the more modern machine. More recently the mule has been completely abandoned in the spinning department of latest constructed mills, in which both warp and weft yarns are successfully spun on ring frames. The new Flint mill led off in this city in the adoption of this system, but not before its practical utility had been demonstrated at Newburyport, Amesbury, and Lowell. The Seaconnet and Osborn No. 2 have followed suit, and the projected new Sagamore, if built, will spin frame yarns only. The ring frame has been much improved in recent years, and its general introduction has resulted from the invention of ingenious devices by several skillful mechanics, that permitted of the adoption of a light running spindle at a high rate of rotation, and to the persistent and enthusiastic efforts of Mr. George Draper, whose personal interest as well as his clear conception of the superiority of the ring frame led him to urge its adoption by cotton manufacturers. The practical advantages of the ring frame have fully met the expectations of those who have adopted it. Double the number of mule spindles can be operated on the same floor space by the use of frames. The yarn can be spun at less cost, is stronger and more even, and consequently makes a better quality of cloth. These advantages are sufficient to insure the final substitution of ring frames for mules.—*Fall River Daily News.*

Intrinsic Light.

M. D. Monnier defines the intrinsic light of a lamp as the ratio of the photometric power to the illuminating surface. The following figures are given as the intrinsic light of certain lamps:

Argand burner	0·3	candle per sq. cm.
Siemens regenerative burners	0·6	" " " "
Incandescent lamp	30·0	" " " "
Arc lamp	480·0	" " " "