

SPIRITUALISTIC TIES.*

BY W. B. CAULE.

The following article is not written with the intention or desire to antagonize any believer in spiritualism, but merely to explain how anti-spiritualists, as well as several professional "mediums," secured their release after being fastened in their cabinet. During the years the writer has been before the public as a magician and cabinet performer he has met a number of cabinet test "mediums," and can safely say that all of these people who have come under his observation have been impostors. This may be due, however, to the bad fortune of the writer.

The writer has been tied with ropes, fastened with handcuffs, brass collars, and chains, many times in many different cities, and by people who were just as alert as any investigator of spiritualistic phenomena, yet, unlike many "mediums" he has met with, was never exposed.

The methods used are many, some simple, others complicated, but all mystifying. To the average auditor the most wonderful point is, how does the performer release himself after being so securely bound? For the benefit of the curious the writer will explain a few of the methods by which he has secured his release after being fastened by a committee from the audience. All anti-spiritualists, as well as several "mediums" personally known to the writer, make use of these same methods of release, or others founded on the same principle.

Among the many successful rope tests, the following is about the best. A piece of soft cotton rope about six feet long, and of the size known as sash cord, is securely tied around the performer's left wrist, dividing the rope so that the ends will be of an equal length. When the committee is satisfied that they have made the knots secure, the performer places his hands behind him, with the right wrist resting over the knots on the left wrist, and the ends of the rope are securely tied together, bringing the knots down tight on the right wrist. This appears fair enough, but it is not as fair as it appears, because, while the knots are secure enough, there is sufficient slack between the wrists to enable the performer, by giving his right wrist a half turn, to withdraw this hand from the rope encircling it.

The reader may say, "That is all well enough, but how and by what means does he secure this slack?"

In placing his hands behind him after the rope is tied about the left wrist, he gives the rope a twist, crossing one end over the other, pressing the twist down on the knot and covering the twist and knot with the right wrist, which is then tied. When ready to release himself, the performer gives his right hand and wrist a half turn, releasing the twist lying on the knot, which thus becomes a part of the loop tied around the right wrist, and enlarging it sufficiently to enable the performer to pull the right hand free from the rope, when he can perform any trick he chooses with the free hand. Our first and second engravings show the formation of the twist, thus making the above explanation clear. By replacing the hand in the loop and giving the hand a half turn the knots can be shown as secure as when first tied.

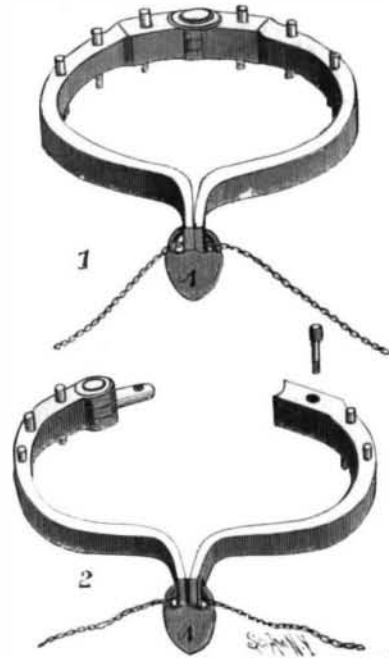
The handcuff test is a great favorite of the "medium." In this test the performer uses any pair of handcuffs furnished by the audience, and by them put on him. Yet, in a very few moments after he takes his place in the cabinet, his coat is thrown out, but on examination the handcuffs are found to be on his wrists just as they were placed by the audience. As a final test, the performer comes out of the cabinet holding the handcuffs in his hand, removed from the wrist but locked.

The explanation of this trick is very simple, but, like many simple tricks, very mysterious. There are only a few styles of handcuffs made in this country, and all that a "medium" has to do is to secure the proper key for each style, which keys are concealed about the person, and by the aid of fingers and teeth the proper key can be fitted to the handcuffs. In some types of handcuffs it is impossible to get the fingers to the keyhole. If such a pair is placed on the performer and he cannot use his teeth to hold the key, he slips the key in a crack in the chair or cabinet, which crack he makes sure is there before undertaking the test, thus holding the key and unlocking the handcuffs.

As the space allotted for this article is limited, the writer will explain but one other piece of apparatus

used to secure the "medium," which is known as the spirit collar.

The collar is made of brass, and fits closely about the performer's neck. Through the openings in the ends of the collar is passed a chain, after the collar is on the performer's neck, and this chain is passed around a post, carried back and through the padlock which is used to lock the collar. By this arrangement the performer is fastened securely to a post—at least it appears so to the audience. This collar is shown in our engraving. As seen by the cut, the collar is decorated with a



THE SPIRIT COLLAR.

number of small bolts, which impart to it an additional appearance of strength.

These bolts are all false, with one exception. This genuine bolt can be removed by the performer when the collar is on his neck, thus allowing the collar to come apart at the hinge, as shown in the cut, thus releasing the performer, allowing him full liberty to perform any trick he wishes, and permitting him to again apparently fasten himself securely. This loose bolt fits so securely that there is no danger of any of the committee removing it with their fingers. The performer uses a small wrench to remove the bolt.

Great Inventions of Thirty Years.

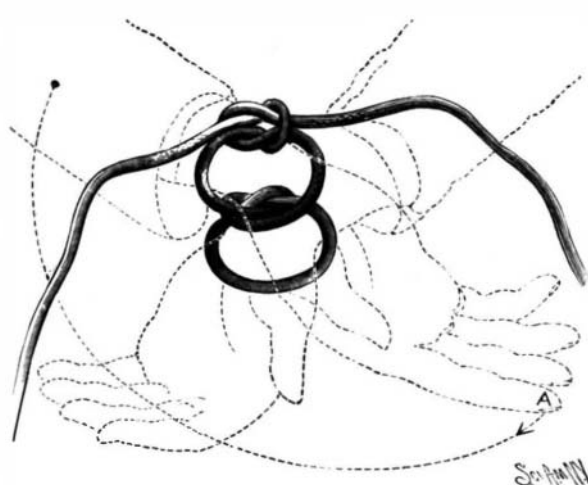
Inventions of the first order have been very numerous during the past thirty years. The decade 1866-76 marks the beginning of the most remarkable period of activity and development in the history of the world. The American Woodworker numerates the following as the most important of these. The perfection of the dynamo and its twin brother, the electric motor, by Wilde, Siemens, Wheatstone, Varley, Farmer, Gramme, Brush, Weston, Edison Thomson, and others brought the great development of the electric light and electric railways. Then appeared the Bessemer process of making steel, dynamite, the St. Louis bridge, Westinghouse air brake, and the middlings purifying and roller processes in milling. That great chemist, Louis

near neighbors, but it remained for the Bell telephone to establish the close kinship of one great talkative family, in constant intercourse, the tiny wire, sentient and responsive to the familiar voice, transmitting the message with tone and accent unchanged by the thousands of miles of distance between. Then come in order the hydraulic dredges; and Mississippi jetties of Eads; the Jablochhoff electric candles; photography by electric light; the cigarette machine; the Otto gas engine; the great improvement and development of the typewriter; the casting of chilled car wheels; the Birkenhead and Rabbeth spinning spindles, and enameled sheet iron ware for the kitchen. Next the phonograph of Edison appears. In this decade we find the first electric railway operated in Berlin; the development of the storage battery; welding metals by electricity; passenger elevators; the construction of the Brooklyn bridge; the synthetic production of many useful medicines, dyes and antiseptics from coal tar products, and the Cowles process for manufacturing aluminum.

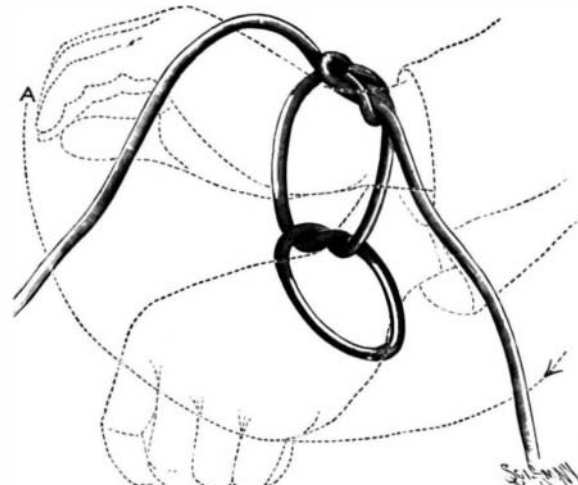
In the last decade, 1886-96, inventions in such great numbers and yet of such importance have appeared that selections seem impossible without doing injustice to the others. The graphophone; the Pullman and Wagner railway cars and vestibuled trains; the Harvey process of annealing armor plates; artificial silk from pyroxyline; automobile or horseless carriages; the Zalinski dynamite gun; the Mergenthaler linotype machine, moulding and setting its own type, a whole line at a time, and doing the work of four compositors; the Welsbach gas burner; the Krag-Jorgensen rifle; Prof. Langley's aerodrome; the manufacture of acetylene gas from calcium carbide; the discovery of argon; the application of the cathode rays in photography by Roentgen; Edison's fluoroscope for seeing with the cathode rays; Tesla's discoveries in electricity and the kinetoscope, are some of the modern inventions which still interest and engage the attention of the world, while the great development in photography and of the web perfecting printing press, the typewriter, the modern bicycle and cash register is so great as to defy measurement.

Ancient Extravagance.

The great display of jewels by women of fashion on both sides of the ocean has been severely criticised, even by those who could well afford to wear them if they desired to. But if the precedent of history furnishes any justification for this fashion, the jewel wearers of the present day are thoroughly justified. According to Pliny, Lollia Paulina, the wife of Caligula, wore on her head, arms, neck, hands and waist, pearls and emeralds to the value of one million six hundred and eighty thousand dollars. Faustina had a ring worth two hundred thousand dollars. Domitia had one worth three hundred thousand dollars, and Kæsonia had a bracelet worth four hundred thousand dollars. Seneca bewails that one pearl in each ear no longer suffices to adorn a woman; they must have three, the weight of which ought to be insupportable to them. There were women in ancient Rome whose sole occupation was the healing of the ears of the belles who had torn or otherwise injured the lobes with the weight of their pendants. Poppæa's earrings were worth seven hundred and fifty thousand dollars, and Cæsar's wife, Calpurnia, had a pair valued at twice that sum. Marie de Médicis had a dress made for the ceremony of the baptism of her children which was trimmed with thirty-two thousand pearls and three thousand diamonds, and at the last moment she found it was so heavy she could not wear it and had to get another. But men led in the splendor of the middle ages, and Philip the Good, of Burgundy, often wore jewels valued at two hundred thousand dollars. When he walked along the streets the people climbed over each other to look at him. The Duke of Buckingham wore a suit at the Court of St. James which cost four hundred thousand dollars. The dress of the nobles during the middle ages was literally covered with gold and precious stones.—San Francisco Chronicle.



A ROPE TEST.



EXPLANATION OF THE ROPE TEST.

Pasteur, added his work to this period; the Gatling gun appeared; great developments were made in ice machines and cold storage equipments; machines for making barbed wire fences; compressed air rock drill and the Mont Cenis tunnel; pressed glassware; Stearns' duplex telegraph and Edison's quadruplex; the cable car system of Hallidie and the Janney car coupler; the self-binding reaper and harvester, the tempering of steel wire and springs by electricity; the Low process for making water gas; cash carriers for stores, and machines for making tin cans.

With the next decade, 1876-96, there arose a star of the first magnitude in the constellation of inventions. The railway and telegraph had already made all people

AFTER the great fire of 1872, says an exchange, the cost of bricks laid in the wall was ordinarily reckoned in Boston at \$36 a thousand. Now, better bricks, quite as well laid, with better lime and cement, cost there, in the wall, \$15 a thousand. Fireproofing processes have been greatly improved and cheapened, so that an ordinary mercantile building can be erected, with floors, roof and partitions all of iron and concrete, or terra cotta, for 10 to 15 per cent more than it would cost with cheap wooden floors.

* Copyrighted, 1897, by Munn & Company.—From "Magic Stage Illusions and Scientific Diversions, Including Trick Photography." Ready about September 1. An illustrated circular sent free on application.

The Colors of Birds.

A remarkable law of nature has only recently been discovered and formulated by the artist, Mr. Abbott H. Thayer, says the Home Journal. For more than a generation of men, naturalists have been studying the part which color plays in protecting animals from their enemies. Protective coloration is the technical name which is given to such cases of protection, and much keenness of observation and of reasoning has been shown by students of the great problems of evolution. Yet no naturalist has ever perceived the secret of protective coloration, which, as the name suggests, lies in the painter's province, and might never have been discovered by naturalists.

"The law of gradation in the coloring of animals," says Mr. Thayer, "is responsible for most of the phenomena of protective coloration except those properly called 'mimicry.' Mimicry makes an animal appear to be some other thing, whereas this newly discovered law makes him cease to appear to exist at all. For example, the screech owl, when startled, makes himself tall and slim, and, with eyes shut to a narrow line, simulates a dead stub of the tree on which he sits. Certain herons stretch their necks straight upward, and, with head and green beak pointed at the zenith, pass themselves off for blades of sedge grass. Many butterflies have stone or bark colored under sides to their wings, which make them look like a bit of bark or lichen when they sit still on a stone or tree trunk, with wings shut over their backs. The newly discovered law may be stated thus: Animals are painted by nature darkest on those parts which tend to be most lighted by the sky's light, and vice versa."

The ruffed grouse is a bird which shows the gradation in its simplest form, the color making a complete gradation from brown above to silvery white beneath. The top light makes him so like his surroundings that he is nearly, if not quite, obliterated. The cause of this obliteration has been assigned to the fact that his color is like that of the surroundings. Mr. Thayer ingeniously proves not only that, were he colored like his surroundings, he would be completely visible, but proves at the same time what the true cause of his concealment is. He carefully and accurately painted

a dead grouse on the lower part of the body with brown to match his back, and painted the sides in gradation till the bird was uniformly colored all over, except that the upper surfaces were left as nature painted them. He then set the bird up in a lifelike position on the ground. The effect was magical. What was before almost invisible at a short distance became clearly visible, proving that it is only this gradation of color which deserves the name of protective coloration, and that it is the compound gradation made by the daylight's co-operation which conceals the animal.

Mr. Thayer made some wooden eggs of about the size of a woodcock's body, and mounted them on wire legs about six inches above the ground. Most of them were colored in imitation of the color gradation of a grouse or a hare, being earth color above to pure white beneath. To two of the wooden eggs he gave a coat of earth color all over, and then set the whole, like a flock of shore birds, on the bare ground in a city lot. He then invited a naturalist to look for them, beginning at a distance of forty or fifty yards. The naturalist saw immediately the two monochrome ones; but, although he was told exactly where to look, he failed to find any of the others till he was within six or seven yards of them, and even then he saw them only by knowing exactly where to look.

The reader can easily get an illustration of this law with no more trouble than merely using his eyes. Look at a horizontal branch or a twig of a tree in the woods, which is either on the level of the eye or below it. You will see that, although it has exactly the color of its surroundings, it is not at all concealed. This is because it is of uniform color above and below, and wears that uniform attitude of a solid—a gradation of shade from its light side above to its dark side beneath. This is the case of the painted grouse—mentioned above—right over again.

On November 9, 1896, Mr. Thayer gave an open-air talk, demonstrating his theory of protective color, to naturalists gathered from all over the country. He placed three objects, of about the size and shape of sweet potatoes, horizontally on wires a few inches above the ground. They were covered with a sticky material, and then dry earth from the road where

they stood was sprinkled over them to give them the same color as their background. The two end ones were then painted white on the under sides, and the white color was shaded up and gradually mixed with the brown of the sides. When viewed from a little distance, these two end ones, which were white below, disappeared from sight, while the middle one stood out in strong relief, and appeared much darker than it really was. Mr. Thayer explained that terrestrial birds and mammals, which are protectively colored, have the under parts white, or very light in color, and that the color of the under parts usually shades gradually into that of the upper parts. This is essential in order to counteract the effect of the shadow side, which otherwise, as shown by the middle potato, makes the object abnormally conspicuous, and causes it to appear much darker than it really is. In the case of Mr. Thayer's experiment some of the witnesses could hardly believe that the striking difference in the visibility of the three potatoes was entirely due to the coloring of the under sides, and Mr. Thayer was asked to color the middle one like the two others, in order that the effect might be observed. Mr. Thayer complied with the request, painting the under side of the middle potato white, shading the white up into the sides, as in the case of the others. The effect was almost magical. The middle potato at once disappeared from view. A similar experiment was tried on the lawn. Two potatoes were painted green, to resemble the green of the grass above which they were suspended. One was painted white on the under side, and at once became invisible when viewed from a little distance, while the other showed plainly and seemed very dark, the shadow, superadded to the green of the under side, making it remarkably conspicuous. The experiments were an overwhelming success.

This device of nature is operative throughout the animal kingdom, the marine world offering scarcely any exceptions from its universality. When we realize that to this color gradation the animal kingdom, with few exceptions, owes its present status—that it everywhere finds this fact a balance wheel to check the rate of destruction of one species by another—the universality of the principle makes its discovery a great one.

RECENTLY PATENTED INVENTIONS.**Mechanical.**

CUTTER HEAD AND KNIFE.—James B. Vuncanon, Asheborough, N. C. To improve the efficiency and durability of rotary cutter heads for surface planing and moulding machines, and for the improved adjustment of the knives, the cutter head stock is four-sided, according to this invention, the knives having transverse slots, and the clamping plates having rabbets of the same depth as the thickness of the knives, there being two transverse rows of aligned screw-threaded holes in the under side of the rabbeted portions. Screws passing through and countersunk in the slots of the knives are adapted to enter any of the holes, the knives being thus adapted for individual adjustment and also for adjustment together with the screws. Fitting strips extend between the backs of the knives and the shoulders of the rabbets, and have lateral bends that fit together, preventing longitudinal displacement.

VALVE REGISTERING DEVICE.—Charles L. Quimby, Philadelphia, Pa. For registering and indicating the opening as well as closure of gate or other valves, this invention provides a simple and practical device adapted to be connected with the movable gate or equivalent part of a valve, to indicate the position and register on dials the movements of the valve, so that any change may be seen at a glance by an inspector. Gearing within the valve casing and actuated by the valve stem is supported upon spindles which are also graduated dials, an apertured face plate above the dials exposing but one graduation on each dial, while an index finger, by its movement toward either of the words "open" or "shut," indicates the position of the valve.

PAPER MAKING MACHINE.—George L. Bidwell, Warren Paper Mills, N. J., and Samuel C. Reynolds, Comstock's Bridge, Conn. For cylinder machines this invention provides improvements whereby the pulp is perfectly couched and waste and loss of pulp are entirely prevented, the decks also being adjustable for any desired width of paper while the machine is in motion. The cylinder mould shaft is journaled in the vat in bearings which form outlets for water from the cylinder, and the mould is engaged on part of its periphery by two decks made as endless rubber bands, the face next the cylinder being of soft or spongy rubber and its reverse of harder and smoother rubber, the decks not passing between the cylinder mould and the couch roll, so that the latter is free to perfectly couch the pulp on the cylinder mould.

Railway Appliances.

CAR AND BRAKE PIPE COUPLING.—John W. Bryan, Quincy, N. C. A car coupling which is designed also to establish communication between the brake pipes of the adjoining cars when they are coupled is afforded by this invention, the drawheads having mortises into each end of which a tube extends and there being connections between the tubes and the fluid pipes. The drawbar fits into the mortises of the drawheads and is formed of a block tapering from the middle toward each end, with a longitudinal channel joining at its ends the tube ends of the drawheads, there being also notches along its upper side, and pin bars arranged to be held in the thickened portions of the drawheads and engaged by the notches.

Electrical.

TROLLEY HANGER.—Theodore Fletcher, St. Louis, Mo. According to this improvement

the hanger is made of two ears secured to the trolley wire a short distance from each other, the ears being connected by a short section of wire which passes over a pulley whose shank is embedded in an insulated block to which the suspension wires are attached. The construction permits a slight longitudinal movement of the trolley wire, and the support is somewhat flexible, doing away with any tendency of the wire to bend or buckle.

Bicycles, Etc.

BICYCLE HOLDER.—John F. Bengert, Brooklyn, N. Y. To support bicycles in an erect position when not in use, according to this improvement, a clamp having a tubular transverse bearing is secured to the frame, sleeves having lugs turning in the bearing and the lugs being connected and arranged to turn together, there being rods slidable in the sleeves, and means for securing the rods adjustably in the sleeves, whereby the rods may be made to fold along the frame of the bicycle or swung out to engage the ground and afford fixed supports for it. The device is adapted to be conveniently attached to and detached from bicycles of all kinds, and when in place does not interfere in any way with the operation of the machine.

Miscellaneous.

RANGE FINDER.—George M. Searle and George N. Saegmuller, Washington, D. C. Two patents have been granted these inventors for a range finder for determining the distance of remote objects, such as an enemy's vessel at sea, one which will, by a simple adjustment, indicate at once, without calculation, the distance of a remote object on the scale of the instrument. It comprises a graduated base line bar having a fixed right angular reflecting surface and also a movable one with a pointer traveling on the graduated scale of the base line, the two reflecting surfaces being in different planes to throw their images on different portions of the object glass of a telescope constructed to bring the two images into coincidence. The readings on the scale are marked, according to one of the patents, by the adjustment of one of the prisms, the position and form of the refracting plate remaining constant, while, according to the other patent, the two prisms are fixed and the readings are taken by the radial adjustment of the refracting or coincidence plate by means of a pointer on a cotangent scale.

KINETOGRAPHIC CAMERA.—Leo Grubman, New York City. A photographic apparatus has been devised by this inventor to take in succession upon a ribbon film a series of pictures of a scene or moving object, each picture being separated from the next by a very short period of time, and the apparatus being also adapted for use as a lantern to project the pictures on a screen. The apparatus is inclosed in a lightproof box, and the mechanism is so proportioned that the ribbon is advanced by steps for spaces exactly equal to those occupied by each picture, the feed device preventing any possibility of scratching or injuring the surface of the film.

HAND-PROPELLED VEHICLE.—Ferdinand Damour, Bolckow, Mo. This invention is for a vehicle to be propelled by hand and guided by the feet, the car moved by the operator being also designed to draw after it another car of novel construction. The propelling car has front steering wheels journaled in brackets in which are also journaled vertical shafts carrying gear wheels, both of which mesh with a gear on a shaft carrying a piston which meshes in rack bars on

opposite sides of the car and adapted to be moved by the feet for steering the car, while crank handles, to be operated by hand, are connected by sprocket wheel and chain to rotate the short axes on which the drive wheels are mounted.

HORSE DETACHER.—Joute L. Bouma, Wanari, South Dakota. For detaching runaway horses from their vehicles and steering the vehicles while they move on from the momentum previously gathered, a shaft carrying a drum is, according to this improvement, journaled just behind the dashboard, and a cord passed around the drum is connected with spring-pressed pins which hold the whiffletrees, the pins being withdrawn by rotating the shaft by turning a hand wheel and the team thus released. A sprocket and chain gearing connection is also made with the front axle, whereby, on turning a handle bar, the vehicle may be steered.

BAG HOLDER.—John Littlejohn, Aurora, Ill. A combined bag and pail holder is provided by this invention for retaining in convenient readiness for use what are styled "oyster pails," and the paper bags commonly used for wrapping purposes. It comprises a frame, preferably of wire, having side sections to which the pail receivers are secured, while a bag clamp is held to and adjustable along one of the side sections or upon the front, as many of these clamps as desired being employed for holding different sizes of bags.

SINK DRAINING BOARD, ETC.—John Foran, Flemington, N. J. This is a device adapted to be readily and conveniently applied to any form of sink. A combined adjusting and supporting rod or arm is used in connection with a novel form of bracket, whereby the draining board may be dropped to a vertical position below the top of the sink or carried to and supported in a horizontal or inclined position, with any desired inclination in the direction of the sink.

DESIGN FOR A SINK.—Robert M. Johnson, Hainesport, N. J. This sink has in one of its bottom corners a corner pocket, with semicircular or segmental front, the bottom of the pocket, on the inside, being a little distance above the sink bottom.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co. for 10 cents each. Please send name of the patentee, title of invention, and date of this paper.

NEW BOOKS, ETC.

THE MAMMOTH CAVE OF KENTUCKY. By H. C. Hovey and Richard E. Call. Louisville, Ky.: John P. Morton & Company. Pp. 108. Price, paper, 50 c.; cloth, \$1.

This is an attractively got up illustrated manual, with maps and many fine half tones, designed to afford the reader as complete an idea as possible, through words and pictures, of the beauty, grandeur, and sublimity of this most wonderful of caves. Readers of the SCIENTIFIC AMERICAN will doubtless remember some of the highly interesting and delightful descriptions of the Mammoth Cave which Mr. Hovey has heretofore written for our columns, and will therefore be prepared to welcome in this manual a complete and exhaustive treatment of the subject. Those who visit the cave can but poorly afford to do without having the book as their guide, and for those who cannot make the visit the manual affords much the best account yet published.

BLOCK SIGNAL OPERATION. A practical manual. By William L. Derr. New York: D. Van Nostrand Company. 1897. Pp. 270. Price \$1.50.

This is a practical work by the superintendent of the Delaware division of the Erie Railroad. Its aim is to present the latest practice in block signal operation that obtains in this country and in Europe. It appears to be a thoroughly practical work and cannot but prove of interest and value to all those who are interested in the safe running of railway trains. The complicated system of interlocking at junctions is illustrated in very clear diagrams.

SIXTH ANNUAL REPORT OF THE BUREAU OF LABOR, STATISTICS AND MINES. To the Governor and Fiftieth General Assembly of the State of Tennessee. 1896. A. H. Wood, Commissioner and Labor Inspector of Mines. Nashville: Franc. M. Paul, Printer to the State. 1897. Pp. 310.

BULLETIN OF THE GEOLOGICAL INSTITUTION OF THE UNIVERSITY OF UPSALA. Edited by H. Sjogren. Vol. II. (1894-1895.) Upsala. 1896. Pp. 372.

A. D. LECTRA'S SHORT CUT CALCULATOR. Containing the most practical methods of business calculation. Pp. 108. Price \$1.

The author is a professional accountant and calculator, and is therefore in a position to give practical advice regarding the relation of mathematics to business transactions. A large number of excellent short cuts are given, with illustrative examples. The author claims nothing new in the principles involved, only in the method of presentation.

CANOE CRUISING AND CAMPING. By Perry D. Frazer. Illustrated. New York: Forest and Stream Publishing Company. Pp. vii, 87. Price \$1.

This is a handsome little book, beautifully illustrated with well taken and well printed half tones. The author is evidently well versed in the subject, and all those who are in any way interested in the delightful sport of canoeing will find many kinks which will tend to secure their comfort.

THE DRAMATIC MAGAZINE. Chicago: Dramatic Magazine Press. Price \$2.50 a year.

This is a new monthly publication devoted to theatrical and operatic subjects, copiously illustrated with half tone engravings of the most celebrated actors and actresses of the present day, and many full page scenes from plays which are being acted in this country and in Europe.

ELEMENTS OF ELECTRO-CHEMISTRY TREATED EXPERIMENTALLY. By Dr. Robert Lüpke. With 54 figures in text. London: H. Grevel & Company. Philadelphia: J. B. Lippincott Company. 1897. Pp. xv, 223. Price \$2.50.

The present time is most opportune for bringing together the recent results of electro-chemistry in condensed form. The present work gives an excellent short survey to those who are not in a position to make an exhaustive study of the voluminous literature of the sub-