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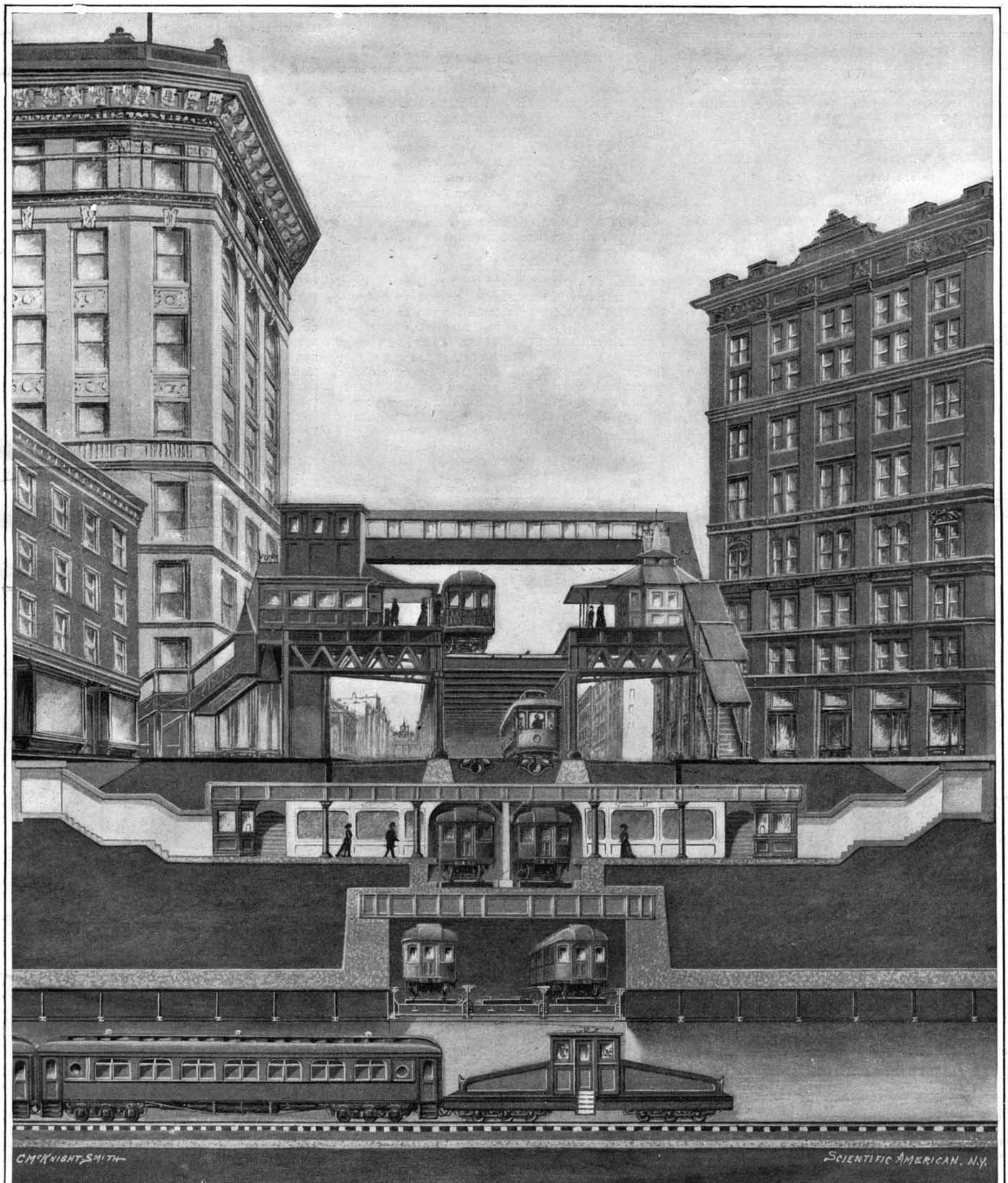

Sectional View Looking North at the Junction of Sixth Avenue and 32d Street, Showing Five Superimposed Railway Systems—The Pennsylvania, Rapid Transit Subway, Hudson Companies, Street Surface, and Elevated Railways.

HOW NEW YORK CITY IS SOLVING ITS TRANSPORTATION PROBLEM.—[See page 486.]

SCIENTIFIC AMERICAN

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NEW YORK, SATURDAY, DECEMBER 29, 1906.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

PRESENT CONDITION OF THE NEW YORK TUNNELS.

So extensive are the ramifications of subway construction beneath Manhattan Island and the adjoining rivers, that it becomes increasingly difficult to keep in close touch with the progress of the work on the individual enterprises. The approaching close of the year renders timely a survey of the progress of this work, and an approximate estimate of the time of its completion. Commencing then, with the most important of the schemes, that of the Pennsylvania Railroad Company, the present conditions are that the two tunnels under the Hudson River have been completed as far as the driving of the tubes is concerned, and there remains now the work of carrying the supporting piles down to bed rock and the lining of the tubes with two feet of concrete. It is expected that these two tunnels will be in condition for the passage of trains by the autumn of 1908. The four tubes which the company is building below the East River are known as tubes A, B, C, and D. The most difficult portion of the driving, in which there has been a great amount of delay due to the obstruction of wharves and docks, has been accomplished. Tube A has been constructed for 180 feet, tube B for 1,100 feet, tube C for 700 feet, and tube D for 1,000 feet. The tunnels are being driven from both sides of the East River, and it is expected that all four of them will be put through before the close of 1907, and that they will be concreted up and in condition for use during the following year. The work on the crosstown tunnels connecting the river sections is proceeding without any serious difficulty, and they are expected to be completed by the end of next year.

The Hudson Companies have been making remarkable progress with their four tunnels. The two tunnels from Jersey City to Morton Street were completed several months ago, and the Cortlandt Street tunnels have been advanced about 3,200 feet beyond the Jersey shore. The Morton Street tunnel has been driven up to Sixth Avenue, and north along the avenue to a point between Ninth and Tenth Streets. This tunnel will be extended to Thirty-second Street, where it will end in a commodious terminal station. It is anticipated that this section, with the branch below Ninth Street to Astor Place, will be ready for service toward the close of the year 1907, and that the Cortlandt Street tunnel will be completed about twelve months later.

The Steinway tunnel, which is being built from the Grand Central Station, Manhattan, to Long Island City, is also making remarkable progress. About four weeks ago the headings which were being driven from Manhattan and from a shaft sunk in Man-o'-War's Reef in the middle of the river met, and at the present writing considerably more than one-half of this tunnel has been completed. Unless some unforeseen obstacle arises, this tunnel should be driven through early in February of next year, and should be ready for use by the late summer or early autumn.

The first of the East River tunnels to be completed will be that of the Rapid Transit system, extending from the Battery to Brooklyn. The bore was broken through on the northerly tunnel two weeks ago, and connection will be established next month between the two headings of the south tunnel. There will then remain only the work of completing the concreting and track-laying, to put this tunnel in condition for service, and it is probable that in April or May of next year trains will be running from Manhattan to the Flatbush Avenue station in Brooklyn. When we bear in mind the inherent difficulties of this tunnel work, due either to the depth at which it has been carried on below the water, or the treacherous nature of the material which has been encountered, it will be agreed that the contractors and the companies are to be congratulated upon the great progress which has been made, and upon the promise of such early completion.

THE PRESIDENT'S MESSAGE ON THE PANAMA CANAL.

The President's message on the Panama Canal, the full text of which, with illustrations, is published in the current issue of the Supplement, is one of the most satisfactory documents of the kind that have issued from the present occupant of the White House. President Roosevelt wisely refrains from any critical discussion of the strictly technical features of the problem, and confines himself to a lucid description of what he saw, and the impressions which he received, during his three days' visit to the Isthmus. The value of this diary, for such it is, lies in the fact that the people of the United States, to whom through Congress it is now given, have an abiding faith in the clear-sightedness, the impartiality, and absolute integrity of purpose, with which President Roosevelt approaches every subject that becomes, like this, the subject of his immediate personal investigation.

The visit was particularly well-timed. "I chose the month of November for my visit," says the President, "partly because it is the rainiest month in the year, the month in which the work goes forward at the greatest disadvantage, and one of the months which the medical department of the French canal company found most unhealthy." Furthermore, the visit followed close upon the publication of a series of articles and pamphlets which tended to discredit the work which was being done by the Isthmian Canal Commission, and give the impression that in sanitation, construction, and administration, this gigantic enterprise was rapidly approaching a *debacle* as disastrous as that which marked the close of the operations of the first French company.

Although the Scientific American was prepared to find that, in the preliminary work at Panama, there had been a certain amount of that confusion and misdirected effort which seem to be inseparable from the inception of all great enterprises involving the collection, redistribution, and setting in motion of vast bodies of men and supplies, we have always felt satisfied that the great ability and unquestionable integrity of the professional men who had been selected to control this work, were a guarantee that the preliminary work was being well done and the foundations being laid for a successful execution of the task. Therefore, it is particularly gratifying to us, as it will be to all Americans whose patriotism is of a broad stamp, to find that, as the result of his personal inspection of the work, the President is satisfied that the country is getting its full worth for the large sums of money which are being expended. "The wisdom of the canal management," he says, "has been shown in nothing more clearly than in the way in which the foundations of the work have been laid. To have yielded to the natural impatience of ill-informed outsiders, and to have begun all kinds of experiments in work, prior to the thorough sanitation of the Isthmus, and to a fairly satisfactory working out of the problem of getting and keeping a sufficient labor supply, would have been disastrous. . . . The only delay has been the necessary delay until the 29th day of June, when Congress definitely and wisely settled that we should have an 85-foot level canal. Immediately after that the work began in hard earnest, and it has been continued with increasing vigor ever since. When the contracts are let, the conditions will be such as to insure a constantly increasing amount of performance."

A well-deserved tribute is paid to the manner in which Dr. W. C. Gorgas has worked out the problem of sanitation, upon which the success of the whole work absolutely depended. "After two years of our occupation the conditions, as regards sickness and the death rate, compare favorably with reasonably healthy localities in the United States." Drainage, the removal of the dense tropical vegetation, careful sanitation, and the judicious use of quinine, have combined to abolish the mosquito and protect the canal force from the ravages of malaria and yellow fever. "Among the 6,000 white Americans, including some 1,200 women and children, not a single death has occurred in the past three months, whereas in an average city of the United States the number of deaths for a similar number of people in that time would have been about thirty from disease." Further on, the President says that Corozal, formerly one of the most unsanitary places on the Isthmus, where there is a big hotel filled with employees, for the last six months has a record of less than one per cent a week admitted to the hospital. "Yet this healthy and attractive spot was stigmatized as a 'hog wallow' by one of the least scrupulous and most foolish of the professional scandalmongers who, from time to time, have written about the Commission's work."

The work of improving the terminal cities proceeds apace. In the city of Panama 90 per cent of the streets that are to be rebuilt are already paved with an excellent brick pavement laid in heavy concrete. Colon, at the other end of the canal zone, is being graded, and a new reservoir capable of holding 500 million gallons of water is about completed, together with the distribution mains for supplying the city. The President rode through the streets of Colon after two days of heavy downpour of rain, and found that the streets "taken as a whole were undoubtedly very bad; as bad as Pennsylvania Avenue in Washington before Grant's administration; but," he says, "all the men to whom I spoke were a unit in saying that the conditions of the Colon streets were 100 per cent better than they were a year ago."

The police force consists of over 200 men, one-fifth of whom are white. "With one exception all the white men I questioned had served in the American army, . . . and belonged to the best type of American soldier." In view of the fact that many of the white and colored employees have brought their families with them, schools have been established. "The schoolrooms were good, and the teachers had taken a pride in their work and in their pupils." Saloons were altogether too numerous, but "the new high-license law which goes into effect January 1 next will probably close four-fifths of them."

The President found that the great task of securing and caring for the laborers and other employees has been well done. At present there are 6,000 white and 19,000 colored employees engaged on the work. Nearly 5,000 of the white employees are Americans, and "they represent, on the average, a high class." They are employed chiefly on the steam shovels, as engineers and conductors of the work trains, and as machinists and carpenters in the shops. The President inspected the living quarters personally, talked with the men themselves and with their wives and families, and found that "the houses themselves were excellent, and the conditions satisfactory." Of the day laborers, the Spaniards appear to be doing the best work. A steady effort is being made to secure Italians, but "for the present we shall have to rely, in the main, for the ordinary unskilled work, upon colored laborers from the West Indies and upon Chinese labor." Summing up, the President says: "From my own experience I am able to say that more care has been exercised in housing, feeding, and generally paying heed to the needs of the skilled mechanics and ordinary laborers in the work of this canal, than is the case in the construction of new railroads, or in any other similar private or public work in the United States proper."

Speaking of the question of the Gatun dam, the President found that "the ablest men on the Isthmus believe that this problem is certain of solution along the lines proposed, and that the dam will show less seepage than the average natural mountain range." There has been a rapid increase in the amount of material taken out of the Culebra cut, and even during the last three months of the rainy season there has been steady progress, as is shown by the fact that in August 242,000 cubic yards were excavated, in September 291,000 cubic yards, and in October 325,000 cubic yards. At the close of the rainy season the increase in the rate of excavation will be even more rapid.

The plan for letting the whole work by contract, "in its essential features was drafted, after careful and thorough study and consideration by the Chief Engineer, Mr. Stevens, who while in the employment of Mr. Hill, the president of the Great Northern Railroad, had personal experience of this very type of contract." Under this contract a premium will be put upon the speedy and economical construction of the canal, and a penalty imposed upon delay and waste. If no satisfactory bids can be secured, the government will do the work itself.

In conclusion, it is gratifying to learn that this great national undertaking is free alike from graft and politics. Of this vital question, the President says: "After the most painstaking inquiry, I have been unable to find a single reputable person who has so much as heard of any serious accusation affecting the honesty of the Commission or of any responsible officer under it. . . . The Commission breathes honesty as it breathes efficiency and energy. Above all, the work has been kept absolutely clear of politics."

It has been found that there are certain favored localities in Florida where the sandy soil has been naturally enriched in a singular way, and become especially adapted to the growing of orange trees. One of these localities is at Orange Bend in Lake County. Under the sandy vegetable loam there is a soft tenacious clay of fine texture, which was probably transported from the hills of Alabama and Tennessee, and deposited in a depression of a shallow sea which once covered the Florida peninsula; and underlying this clay at a depth of seldom more than three feet is a deposit of marl of a kind that is of very rare occurrence, there being very few such deposits in the State. It is *nummulite* marl, so named because the shells that it contains resemble coins. Their average size is about that of the old silver half-dime. The special value of this marl as a fertilizer is due to the presence of this coin-like shell, and especially to the animal substance that held the whorls of the shell together. This substance was almost pure phosphate material, and it gave to the soil in large quantities one of the most important constituents of orange-tree food. The tap roots of the orange trees easily penetrate to this marl bed, and thereby enable the trees to nourish themselves.

CATECHISM OF A SCIENTIST.

Sir Oliver J. Lodge, LL.D., F.R.S., principal of the University of Birmingham, has issued the text of a catechism, which is designed for the use of teachers interested in the education of the young. The object sought after is the harmonizing of religion and the theories of evolution. The text of the catechism has been cabled to the New York Sun. In the preface Sir Oliver says:

"From the viewpoint of a teacher and a trainer of teachers the following clauses have been drafted by me as affording a partially scientific basis for future religious education:

"Question—What are you?

"Answer—A being, alive, conscious upon this earth, my ancestors having ascended by gradual processes from the lower forms of animal life and with struggle and suffering become man.

"Question—What then is meant by the fall of man?

"Answer—At a certain stage of development man became conscious of the difference between right and wrong so that thereafter when his actions fell below a normal standard of conduct he felt ashamed and sinful. Nevertheless the possibility of the fall marks a rise in the scale of existence, as creatures below this level are irresponsible, feel no shame, suffer no remorse and are said to have no conscience.

"Question—What is the distinctive character of manhood?

"Answer—That he has responsibility for his acts, having acquired the power of choosing between good and evil with freedom to obey one motive rather than another.

"Question—What is the duty of man?

"Answer—To assist his fellows, to develop his own higher self, to strive toward good in every way open to his powers, and generally to seek to know the laws of nature and obey the will of God, in whose service alone can be found that harmonious exercise of the faculties which is synonymous with perfect freedom.

"Question—What is meant by good and evil?

"Answer—Good is that which promotes development and is in harmony with the will of God. It is akin to health, beauty, and happiness. Evil is that which retards and frustrates development and injures some part of the universe and is akin to disease, ugliness and misery.

"Question—How does a man know good from evil?

"Answer—His own nature, when uncorrupted, is sufficiently in tune with the universe to enable him to be well aware of what is pleasing and displeasing to the guiding spirit of which he himself should be a real, effective portion.

"Question—How comes it that evil exists?

"Answer—Acts and thoughts are evil when they are below the normal standard attained by humanity. The possibility of evil is a necessary consequence of the rise in the scale of moral existence, just as an organism whose normal temperature is far above absolute zero is necessarily liable to a damaging, deadly cold, but the cold is not in itself a positive or created thing.

"Question—What is sin?

"Answer—Sin is the deliberate, willful act of a free agent who sees better but chooses worse and thereby acts injuriously to himself and others. The root of sin is selfishness, whereby needless trouble and pain are inflicted on others. It is akin to moral suicide.

"Question—Are there beings lower in the scale of existence than man?

"Answer—Multitudes. In every part of the earth where life is possible we find it developed. Life exists in every variety of animal, in the earth, the air and the sea, and in every species of plants.

"Question—Are there beings higher in the scale of existence than man?

"Answer—Man is the highest of the dwellers of the planet Earth, but the earth is only one of many planets warmed by the sun. The sun is only one of a myriad of similar suns which are so distant that we hardly see them, and group indiscriminately as stars. We may be sure that in some of the innumerable worlds circulating about distant suns there must be beings far higher in the scale of existence than ourselves. Indeed we have no knowledge which enables us to assert the absence of intelligence anywhere.

"Question—What caused and what maintains existence?

"Answer—Of our own knowledge we are unable to realize the meaning of its origination and maintenance. All we can accomplish in the physical world is to move things about by means of our bodily organisms and then leave them to act on each other. But we conceive that there must be some intelligence supreme over the whole process of evolution or else things could not be as organized and as beautiful as they are.

"Question—Is man helped in the struggle upward?

"Answer—Man did not bring himself into existence nor can he unaided maintain his existence or achieve anything whatever. There is certainly a power in the universe vastly beyond our comprehension. We trust and believe it to be a good, loving power, able and willing to help us and all creatures, to guide us wisely without detriment to our incipient freedom. This loving kindness surrounds us every moment. In it we live and have our real being. It is the mainspring of love, joy, and beauty. We call it the grace of God. It sustains and enriches all worlds. It may take a multiplicity of forms, but its essence and higher meaning is especially revealed to the dwellers on the earth in the form of the divinely human, perfect life of Jesus Christ, through whose spirit and living influence man may hope to rise to heights at present inaccessible.

"Question—How may we become informed of things too high for our own knowledge?

"Answer—We should strive to learn from the great teachers, prophets, poets, and saints of the human race whose writings have been opened to us by education. Especially should we learn how to interpret and understand the Bible, which the nation holds in such high honor.

"Question—What then do you reverently believe can be deduced from a study of the records and traditions of the past in the light of the present?

"Answer—I believe in one infinite, eternal Being, a guiding, loving Father, in whom all things consist. I believe the divine nature is especially revealed to man in Jesus Christ, who lived, taught, and suffered in Palestine 1,900 years ago and has since been worshiped by the Christian Church as the immortal Son of God and Saviour of the world. I believe the Holy Spirit is ever ready to help us along the way to goodness and truth, that prayer is the means of the communion of man and God and it is our privilege by faithful service to enter life eternal, the communion of saints and the peace of God.

"Question—What do you mean by life eternal?

"Answer—Whereas our terrestrial existence is temporary, real existence continues without ceasing in either higher or lower form according to our use of the opportunities and means of grace and that the fullness of life which is ultimately attainable represents a state of perfection at present inconceivable to us.

"Question—What is the significance of the communion of saints?

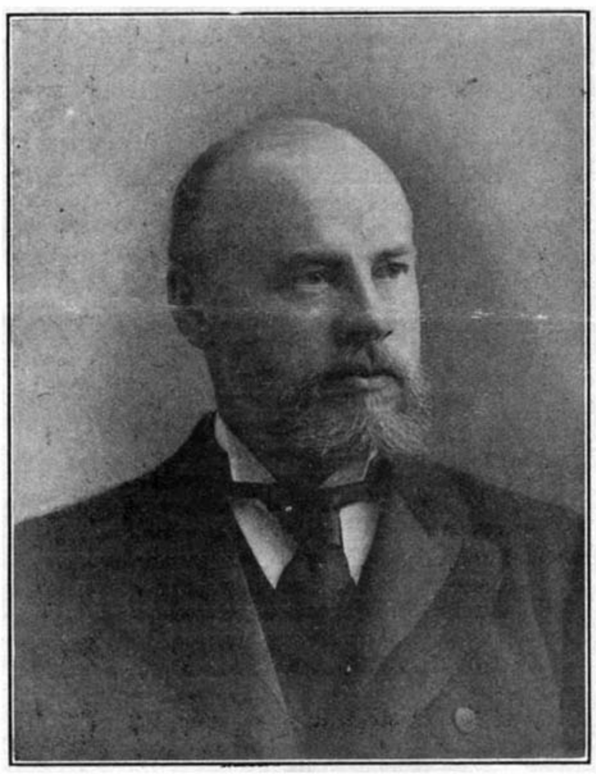
"Answer—Higher and holier beings must possess in fuller fruition those privileges of communion which are already foreshadowed by our own faculties, language, sympathy and mutual aid, and just as we find our power of friendly help not altogether limited to our own order of being so I conceive the existence of a mighty fellowship of love service.

"Question—What do you understand by prayer?

"Answer—That when our spirits are attuned to the spirit of righteousness our hopes and aspirations exert an influence far beyond their conscious range and in the true sense bring us into communion with our Heavenly Father. This power of filial petition is called prayer. We are encouraged to ask for anything we need. As children we ask our parents in a spirit of trust and submission and we may strengthen our faith in the efficacy of prayer by pleading the example and merits of the Lord Jesus and rehearse the prayer taught by Christ—'Our Father, who art in Heaven.'

"Question—What is meant by the kingdom of Heaven?

"Answer—The kingdom of Heaven is the most essential feature of Christianity. It signifies the harmonious condition or state in which the divine will is perfectly obeyed. It represents the highest state of existence, individual and social, which we can conceive. Our whole efforts should directly and indirectly make ready its way in our hearts and our lives and in the lives of others. It is the ideal state of society toward which reformers are striving. It is the ideal of conscious existence toward said aim."



DR. WILLIAM HENRY WELCH.

WILLIAM HENRY WELCH.

BY MARCUS BENJAMIN, PH.D.

First in 1887, then in 1900, and now for a third time in its history, the American Association for the Advancement of Science will meet in the great metropolis of New York. Langley, distinguished for his researches in astrophysics, presided over the meeting in 1887; Woodward, famous among physicists, was the presiding officer in 1900; and at the present meeting one who has gained eminence in pathology, and indeed the foremost among his contemporaries, will direct the deliberations of the scientists who have gathered this week in Columbia University.

William Henry Welch, son of William Wickham Welch and Emeline Collin Welch, was born in Norfolk, Conn., on April 8, 1850. He prepared for Yale, where he graduated in 1870. Among his classmates was Edward S. Dana, like him a leader in science. His college class numbered 113, and of these ten elected to study medicine, among whom was Welch. And so he came to Columbia and matriculated in her medical department, more generally known as the College of Physicians and Surgeons, receiving his degree in 1875. Three years were then devoted to study abroad, and he listened to the masters in his specialty at the universities of Strasburg, Leipsic, Breslau, and Berlin.

In 1878 he returned to New York city, and accepted an appointment as demonstrator of anatomy in Bellevue Hospital Medical College, becoming soon after also professor of pathological anatomy in this institution, which chair he continued to fill until 1884, when he was elected to the professorship of pathology in Johns Hopkins University, which he still retains. Five years later, when the Johns Hopkins Hospital was opened, he naturally became its pathologist, a place in which he has added fame to the institution as well as gaining reputation for himself. Increasing responsibilities have come to him as the years have advanced, and recently he has been made dean of the medical schools.

It is not necessary to summarize his researches in a brief outline sketch of his career, but they were embodied in numerous valuable papers, especially in pathological and histological subjects, contributed to medical journals both at home and abroad. Of his more extended writings, mention may be made of the sections on pathology and pathological anatomy in the fifth and later editions of Flint's "Theory and Practice of Medicine," of the chapters on organic diseases of the stomach in Pepper's "System of Medicine," and of the chapter on general considerations concerning the biology in bacteria, infection, and immunity in the same author's "Text Book of the Theory and Practice of Medicine." He has also contributed to Dennis's "System of Surgery," Allbut's "System of Medicine," and to "A Textbook of Medicine by American Teachers." The Cartwright lectures were delivered by him, and these he published in 1888 under the title of "General Pathology of Fever." His valuable contributions to his chosen specialty have not failed to receive recognition. In 1894 the University of Pennsylvania gave him the honorary degree of M.D. Western Reserve in 1894, Yale in 1896, Harvard in 1900, Toronto in 1903, and Columbia in 1904 welcomed him into the ranks of their alumni by conferring upon him the degree of Doctor of Laws. His other honors include membership in the Philadelphia College of Physicians, the Pathological Societies of Philadelphia and of London, the American Academy of Arts and Sciences, and the National Academy of Sciences, in which body he has served with repeated elections as a member of council.

His recognized ability as an administrator has likewise received conspicuous recognition, and notable among the honorary appointments that he has been called upon to accept is that of trustee of the Carnegie Institution in Washington, to which he was elected in 1905 and re-elected in 1906. During 1891-2 he was president of the medical and chirurgical faculty of the State of Maryland. He has been president of the State Board of Health of Maryland, and in 1897 presided over the Congress of American Physicians and Surgeons.

Dr. Welch became a member of the American Association at the Boston meeting in 1898, and was made a fellow two years later. He manifested his interest in the organization by aiding in the formation in 1902 of a section on Physiology and Experimental Medicine, of which he was chairman in 1902, and again in 1903.

The long-established practice of alternating the selection of a president from the representatives of the natural and physical sciences has slowly yielded in recent years to the better policy of recognizing the most eminent man of science in the United States as the most desirable person to fill the presidency of the American Association for the Advancement of Science, and this opinion found its expression at the last meeting in the choice of William Henry Welch, America's most famous pathologist.

THE "UNILENS." A NOVEL FORM OF TELESCOPE.

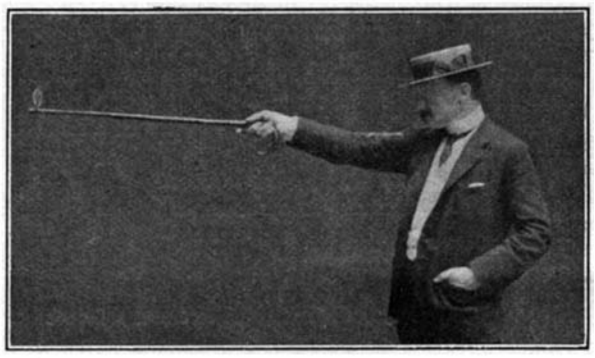
BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

A novel form of telescope or field glass, to which the name "unilens" has been applied, has recently been devised by Major Baden-Powell, F.R.A.S., of London, the feature of which is that it can be carried in the waistcoat pocket. As may be gathered from its title, the instrument comprises a single lens of convex form, 2½ inches in diameter and mounted in a simple metal rim. The mount is provided with a small clip and screw, by means of which the lens can be readily attached to a walking stick or umbrella, being carried, as the illustration shows, at the outer end. With this simple device it is possible to obtain an enlarged view of distant objects, the maximum magnification being about four diameters. In view of the simple nature of the device and its handy form, it constitutes a convenient and efficient means for all ordinary purposes where a slight magnification is desired, being capable of fulfilling the same functions as the general type of opera and field glasses; but owing to its flat form and small dimensions, it can be carried in the pocket without inconvenience.

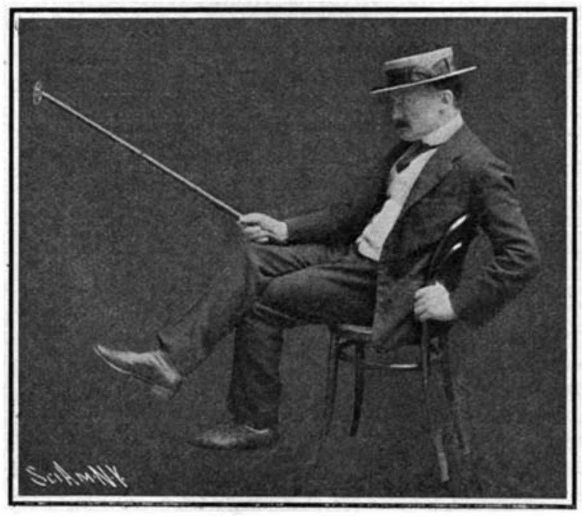
When mounted on a walking stick and held at the full extended length of the arm, its greatest efficiency is obtained, since the farther it is held from the eye, the greater is the magnification. At the full extended length, which is equivalent to a distance of about six feet between the eye and the lens, the object has its maximum magnification, though at this point a slight blurring is discernible. The most convenient and easy position to assume when studying subjects through the device is a sitting posture with the hand holding the stick resting on the knee, at which point the glass, about four feet distant from the eye, enables the user to view objects clearly and sharply. The lens, however, is always in focus, and consequently is a handy form of hand-glass, especially when held at arm's length. It then forms a great aid to the natural sight, more particularly in the examination of hanging pictures, the architectural features of a building, and so forth, and it will even fulfill the purposes of an opera glass at the theater.

From an astronomical point of view the "unilens" has no great claim, though in this work it has its possibilities. For instance, in looking at the Pleiades through the "unilens," eight stars can be discerned quite easily, whereas with the naked eye only six can generally be distinguished. In following the movements of birds and animals in their natural habitat from a distance of a few yards, the glass is of great utility to the naturalist.

Although the "unilens" is not applicable to all sights, yet, according to one very widely known firm of London opticians it may be safely said that three persons out of four can use it quite well. To be sure, those afflicted with myopia or short sight cannot see very clearly through the single lens, but when it is employed in conjunction with a concave eyeglass, not only can they see clearly through the "unilens," but such sights are found to be improved under ordinary circumstances by the habitual use of the eyeglass.



Greatest Magnification at the Maximum Distance from the Eye.



A Convenient Method of Viewing Objects at a Distance.

THE "UNILENS."

THE NEW LUSOL LAMP.

BY JACQUES BOYER.

The introduction of the lusol lamp marks an era in the history of illumination for, according to the calculations of its inventor, the new illuminant furnishes for a cost of one cent an amount of light which would cost 4 or 5 cents if furnished by kerosene, 8 or 10 cents if produced by electricity, and 15 or 20 cents if obtained from animal or vegetable oils.

There is no mystery about the composition of the substance, which is known by the trade name of lusol. It is simply impure benzene obtained by distilling coal tar. It is not a definite chemical compound but a mixture of hydrocarbons containing a very high percentage of carbon. The various forms of apparatus which have been devised by M. Louis Denayrouze for the utilization of lusol in domestic and other illumination are not simple lamps but rather complicated devices for the safe production and combustion of lusol vapor.

If we dissect a lusol lamp of the small, or household, type we find that the openings of the lusol reservoir are hermetically closed by conical screw plugs, in order to prevent escape of the thin and very inflammable fluid if the lamp is overturned, or by capillary action or "sweating," in the normal position. On removing the burner we see a central tube extending nearly to the bottom of the reservoir and surrounding a metal core, the space between which and the tube is very tightly filled by a tubular cotton wick. The tube, however, is closed at the top so that the wick does not protrude from the reservoir or come into direct contact with the flame. The sole function of the wick is to raise the liquid lusol, by capillary action, to a small vaporizing chamber just above the top of the wick. From this chamber the vapor escapes through an orifice so small that it cannot be seen in the illustration. This hole, fine as a hair, is the only means of communication between the interior of the reservoir and the exterior. And as the liquid cannot reach this hole without traversing the tightly compressed wick there is no danger of leakage in this way. On the other hand, this orifice regulates the flow of the vapor to which it gives a velocity sufficient to cause it to carry with it the proportion of air required to produce a very hot flame. Finally, this little injector is surmounted by a chamber covered with wire gauze in order to perfect the mixture of air and vapor and to prevent the flame from striking back to the reservoir.

But in order to produce rapid vaporization heat must be applied, and for this purpose M. Denayrouze has adopted an original device which he had already employed in one of his earlier inventions. As the photograph shows, the inverted U-shaped support of the Auer mantle is not a thin wire, as in most incandescent lamps, but is massive and is soldered to the base of the distillation chamber. When the lamp is burning this support is very hot, and it consequently heats and vaporizes the lusol with which the top of the wick is saturated and which is continuously replaced by fresh liquid raised from the reservoir by capillary action.

But, in order to light the lamp, this support of the mantle must first be heated by an extraneous source. Different methods are employed in lusol lamps of the various types. In lighting a parlor, office, or hall lamp the upper part of the burner is first raised with the left hand. This action exposes two clusters of points on which two alcohol pastilles, consisting of paraffined cotton soaked in alcohol, are next placed. The gallery is then replaced and the pastilles are lighted with a match.

Street lamps of the type now in experimental use in the Square du Ranelagh, in Paris, have little reservoirs which can be filled with alcohol by means of a vessel mounted on a pole. In every case, however, a little time elapses before the mantle glows with maximum brightness.

In the very large street lamps, which rival the electric arc in intensity, the upward flow of liquid to replace the loss by vaporization cannot be produced by capillarity alone. It is consequently maintained by a low air pressure, involving the employment of only a very small volume of air. The apparatus which produces the air pressure consists of two small vessels connected by a long India-rubber tube. At the beginning of the operation one of these vessels is empty—or rather, filled with air—while the other, placed about 5 feet higher, is filled with glycerine. The glycerine flows slowly down the tube, compressing the air and forcing it into the lusol reservoir, and thus causing the lusol to rise in the wick. The operation is repeated once a day, by simply raising the filled vessel and lowering the other. A three-way cock may be arranged to apply and remove the pressure so that the lamp may be operated with or without pressure as desired. In one form of lamp the lusol and glycerine reservoirs are ingeniously combined, so that there is only one descending tube which, together with the air chamber, is concealed in the chandelier.

In point of economy the lusol lamp appears to surpass all other known lighting apparatus. A Denayrouze lamp having the power of 10 Carcel burners costs 0.3 of a cent per hour, while the same illumination produced by stearine candles costs 36 cents per hour.

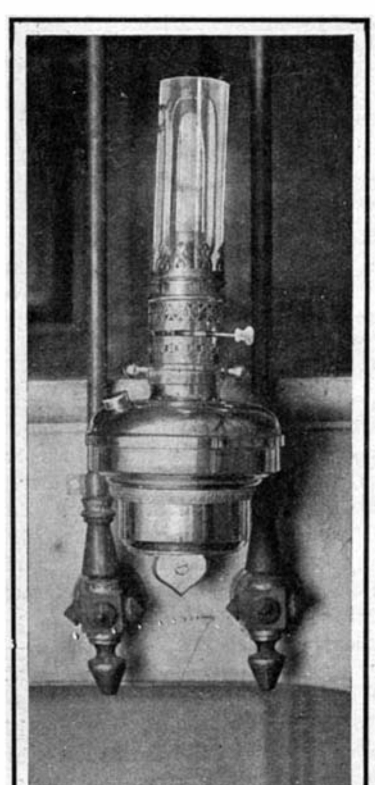
The use of lusol, however, is attended with certain inconveniences, the most serious of which is the necessity of filling the lamps and the time consumed in lighting them. On the other hand, it does not appear to be particularly dangerous. M. Lucion, the Belgian engineer who furnished the information on which this article is based, truly observes that: "Electricity is dangerous, causing death and fires due to short circuits. Gas is a frequent cause of asphyxiation, voluntary and involuntary. Acetylene is explosive, and a surgeon of my acquaintance was recently summoned in one day to attend five women fatally burned in five separate accidents with kerosene. The essential thing is to know how to use all these dangerous things."

Lusol, while it is in the lamp, is perfectly harmless. It cannot escape in the liquid form and the flame cannot strike back to a space filled with vapor, as it can in a kerosene lamp. Furthermore, the lusol reservoir remains cold even after the lamp has been burning for hours, owing to the following arrangement: The central tube is double, the space between the tubes communicating with the external air, and the inner tube, in contact with the wick, being made of an alloy which is a comparatively poor conductor of heat. This air-cooling device has another object, in addition to safety, for if the tube should become hot the lusol would be vaporized so rapidly that its loss could not be supplied by capillary action.

The lamp is extinguished instantly by moving a little lever which closes the small orifice for the vapor. The lamp should be filled very carefully, at a distance from all lights and fires and never while the lamp is burning.

A favorable forecast for the future of the lusol lamp may be drawn from the past record of its inventor. Denayrouze and Jablochkof were the first champions of the electric light in Paris. Later M. Denayrouze became the most ardent advocate of incandescent lighting by means of alcohol and he

LIGHTING A SMALL LUSOL LAMP WITH ALCOHOL PASTILLES.



LUSOL LAMP DESIGNED FOR A STAIRCASE.

will, doubtless, soon apply to his new invention improvements of detail that will insure its success and extensive employment. The peculiar merit of the lusol lamp is the elimination of all mechanism. As we have seen, capillarity and the heat of combustion suffice to raise the liquid, vaporize it, and mix the vapor with the quantity of air that is required to accelerate its combustion and cause the mantle to glow with dazzling brilliancy. Finally, the lusol light needs no costly and inconvenient system of factories, tanks, and pipes, or wires.

How Rats Disseminate Plague.

That the rodent is an active agent in the propagation of plague has been a steadfastly maintained theory among scientists for many years past, but exactly how an epidemic is disseminated among the rats and also communicated therefrom to human beings it has been left to the special plague commission appointed by the Indian government to determine. This scientific commission is still engaged in its undertaking, but the discoveries that have already been made are of such paramount importance, that a short and interim report upon the subject has been published. In the course of this proceeding the commissioners definitely state that the disease is conveyed from one rat to another and also to human beings by the parasite commonly known as the "rat flea." This hypothesis has been confirmed as the result of several experiments. When plague-infested and healthy rats were incarcerated separately in wire cages, thereby preventing them coming into contact with one another, the healthy rodents became infected, and it was also ascertained that guinea pigs could also become contaminated in the same manner. But on the other hand, if the plague-stricken rats, immune, however, from the flea, were confined and permitted to come into free physical contact with healthy animals, no such signs of infection were observed. Directly the fleas were introduced, the animals in a short time were all similarly affected, the progress of the epidemic varying in direct proportion to the number of fleas present. These tests conclusively proved that the parasite was the active agent in propagating the disease, since every precaution was adopted to prevent the possibility of infection being spread atmospherically. Moreover, similar tests were repeated in plague-infected houses. For instance, guinea pigs were permitted to run freely in a house, which though it had been disinfected still harbored parasites, with the result that the animals were found to be soon attacked by the fleas and contracted plague, and the parasites caught on their bodies were found to be capable of spreading the epidemic. When, however, under the same conditions, the guinea pigs were immured in cages of wire gauze, thereby preventing the infesting of fleas, no ill results attended the animals. There is one important theory advanced in the preface to this report—that the plague itself may in reality be a disease of fleas.

Light Paint for Machinery.

There is a very marked tendency at the present time on the part of manufacturers of machinery to make a departure from the use of black or dark paint in finishing their product. It has been the custom for a long time to cover the heavier parts of machinery of all kinds with paint or enamel of somber hue and the only variation which seemed permissible was an occasional striping of gilt or some bright color. During recent years a revolution has been going on in the matter of the construction and design of workshops and with it has come the demand for machinery painted some bright color. Not infrequently there is a demand for white, while light gray, buff, and cream color are favorites. The recommendation for this change is that the machine shop presents a much more attractive appearance and that the light surfaces of the machinery are responsible for the reflection of a great deal of light while the black absorbs the rays. The power plants of some of the new office buildings, hotels, and theaters are now regarded as show features of the establishment and one up-town hotel in New York has special accommoations for visitors. The engine room is in a very accessible place and it is fitted with a gallery for the convenience of spectators. Hardly a night passes but that a theater party with men and women in evening dress is to be seen viewing the installation with interest. This plant is finished in white with stripings of gold. The New York, New Haven and Hartford Railroad Company, in ordering machinery for the new power plant at Readville, Mass., reserved the right to name the color of the paint to be applied to the machinery.

A SIMPLE EXPERIMENTAL DYNAMO.

BY PAUL H. WOODRUFF.

A generator giving from 30 to 40 watts of electrical energy is a very convenient piece of apparatus for experimental purposes, as it requires little power to drive it yet may be made to take the place of several cells of battery. Of course, with a given number of watts we have our choice of voltage; thus, allowing 40 watts as the output of our generator, it is practicable to wind the machine so as to give 1 volt and 40 amperes, or 40 volts and 1 ampere, or anything between these figures, always remembering that whatever voltage we get, we must divide 40 by that number to find the amperes. The machine we are about to consider is so arranged as to deliver current at either of two voltages, according to adjustment; that is, if we wind for 8 volts 5 amperes, we can also obtain 16 volts 2½ amperes if we wish, by merely changing two connections. It will also deliver either direct or alternating current at both voltages. At any store handling electrical goods, a telephone magneto generator, either new or second-hand, may be bought for a small sum. The kind known as "bridging generator" should be selected; but before buying, the magnets should be tested as to strength, especially in a second-hand machine, as they will lose some of their magnetism if roughly handled. Another test is the shock. In most of these machines the current is collected by a spring resting on a pin in the end of the armature shaft. By placing a finger and thumb, one on this spring, the other on the metal body of the machine, considerable current should be felt when the handle is turned at a very moderate speed.

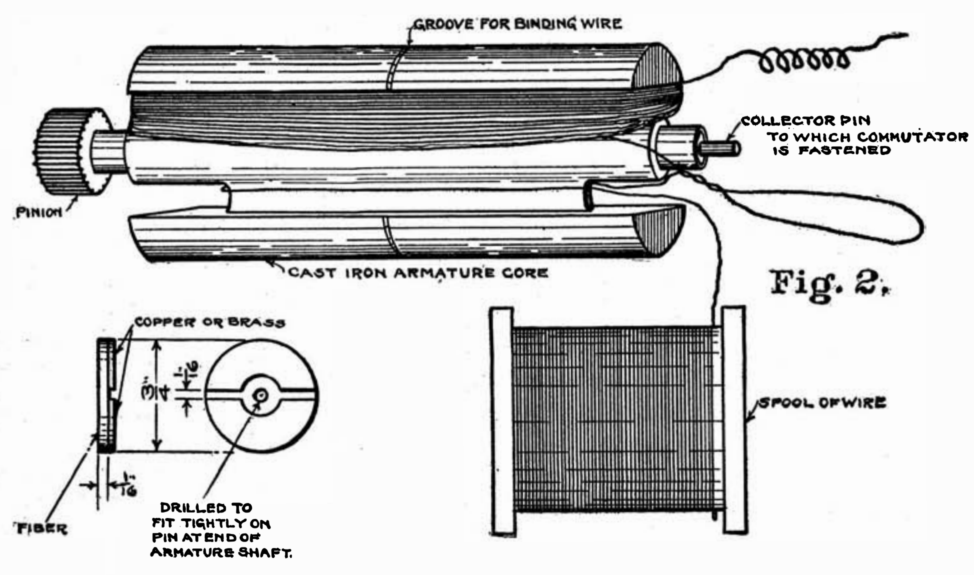


Fig. 1.

Constructional Details of the Dynamo.

Having made our purchase, we proceed to dismantle it. Take out the screws in the brass end plates or bearings, and remove the armature. The contact spring previously spoken of would best be removed now, as we shall not need it. The armature in most of these machines is 1½ inches in diameter, of the H or shuttle form, and wound with No. 31 wire. This should all be unwound with care, as it may come in handy for making other apparatus.

Now, while the armature is bare, we will make a commutator. This consists of a ¾-inch disk of red fiber, 1-16 inch thick, with a center hole that is a drive fit on the pin in the rear end of the armature shaft. On one side of this disk are fastened the two halves of a ¾-inch copper or brass washer, which has been sawed or filed into two equal parts. These may be drilled and tapped for small machine screws put through the fiber, or they may be cemented to the disk, exactly as Fig. 1 shows them. But before fixing the commutator on the shaft, we would better rewind the armature. As we have decided on the 8 and 16-volt arrangement, we will use No. 23 wire. Before starting, be sure that the iron is well insulated; it is usually covered with paper or cloth shellacked on. Leave two or three inches free at the end of the wire, and see that the covering on the wire is not torn or loose. Wind the channel at one side of the shaft full first, and in going over to start the other side leave a loop of several inches of wire, as in Fig. 2; then fill the other side. Always wind tightly and get as much on as possible. There is almost always a groove cut around the armature used for binding the bundle of wire. Wrap a turn of wire tightly in this groove, and solder it, or at least, twist it as tight as possible, or when the machine is running at a high speed, centrifugal force will throw the wires out against the pole pieces, spoiling the winding.

When the loop left in the center of the coil is cut, there are practically two separate coils on the armature. If the starting end of the whole winding is connected to the shaft or body of the armature, and the finishing end to the pin by soldering, while the remaining ends are connected together, the higher voltage will result. For the low voltage the coils are separated, and both starting ends connected to the shaft, with both finishing ends to the pin. The machine may now be put together again, that is, the armature and bearings assembled with the pole pieces, and the shaft given a whirl to see that it runs all right. Now, drive the communtator onto the pin at the end of the shaft. The metal pieces are insulated from each other by a 1-16-inch or less air gap; but one must be connected to the shaft, the other to the pin in the end. Probably this can best be done with a bit of No. 23 copper wire and a speck of solder. Be very careful to remove every trace of soldering fluid after the operation. The slot in the commutator should be parallel with the iron of the armature, as shown in Fig. 3. A little cement will make it solid in this position, but should not be used until the machine is tested, as described later.

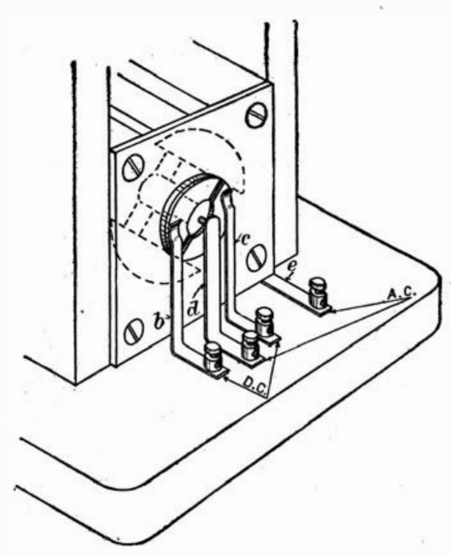


Fig. 3.—The Commutator.

It is now time to make a base of some kind for the machine. This is, of course, a matter for individual choice, but do not make it too light; about one inch thick, of hard wood, and say 3 inches larger each way than the extreme dimensions of the machine, ought to be satisfactory. Drill and counterbore from the bottom of the base for screws to hold the machine; you will find tapped holes already in the bottom of the pole pieces; screw the machine down solid, and we are ready for the final operation—the fitting of the collector springs, or brushes. Spring brass 3-16 inch wide and 1-32 inch thick is about right. Four pieces, made according to Fig. 3, are fastened to the base by binding posts in the locations shown; *b* and *c* rest against the commutator, not too heavily (these serve to collect direct current); *d* against the flattened end of the pin in the center, and *e*, which is simply a straight strip clamped under the machine, and making good connection with it, collect alternating current. These brushes should not press hard enough to interfere with the smooth and easy running of the armature.

In testing, have an assistant turn the handle while you connect the direct-current posts to some piece of apparatus—a small lamp, for instance. The commutator slot is now at right angles with the armature winding; but it may be found that a slight variation one way or the other from this position will increase the output. When the correct point has been found, the commutator may be connected to the shaft. In

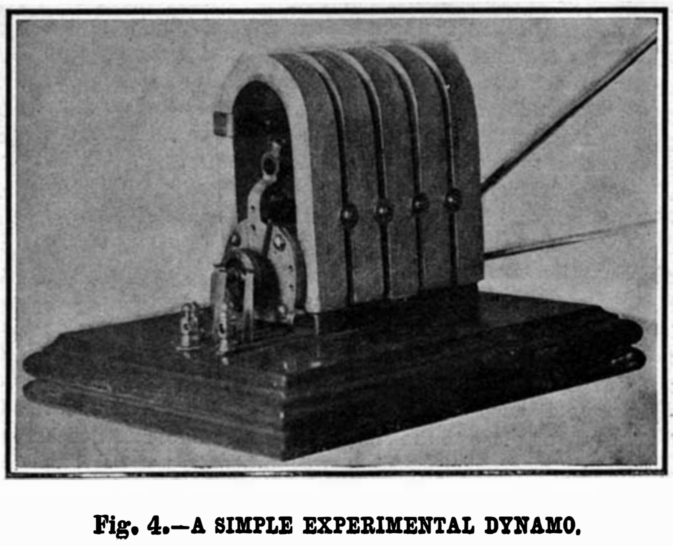


Fig. 4.—A SIMPLE EXPERIMENTAL DYNAMO.

a sense the machine is complete, and may be driven quite satisfactorily with the small crank and gear supplied with it. But in the author's opinion, it is far preferable to discard the large gear altogether. Get a grooved wooden pulley (a V-groove is the best) 1½ inches in diameter, with a center hole a shade smaller than the pinion or small gear on the armature shaft, and drive the pulley right onto the pinion. Driven with a ⅛-inch round leather belt from a hand wheel or sewing machine flywheel, a speed of 2,400 revolutions per minute can easily be attained, at which speed the machine will be found very efficient and useful.

The following table gives windings for various approximate voltages at 2,400 revolutions, although nothing very definite can be given, as much depends upon the make and condition of the machine. The voltage varies directly as the speed.

Wire No.	Volts.	Amperes.	Volts.	Amperes.
31	100	0.4	50	0.8
28	50	0.8	25	1.6
25	25	1.6	125	3.2
24	20	2.0	10	4.0
23	16	2.5	8	5.0
22	12	3.25	6	6.5
20	8	5.0	4	10.0
19	6	6.5	3	13.0
17	4	10.0	2	20.0
14	2	20.0	1	40.0

THE SOLUTION OF NEW YORK'S TRANSPORTATION PROBLEM.

Less than a decade ago the Scientific American was urging upon the authorities of New York city the immediate construction of the first Rapid Transit Subway, pointing out that the objections to underground travel were mainly founded on prejudice. We pointed to the fact that the increase in the traffic on the surface and elevated railroads, which even then was beginning to be very marked, was but the beginning of a tide which would rise with increasing rapidity, and unless speedy measures were taken to meet the contingency, would, before many years had passed, entirely swamp the existing means of transportation. After many disappointments and protracted delays the Subway was authorized and built. Its completely successful operation, and the fact that its trains were speedily filled to their maximum capacity, proved the truth of our contention that it was only by going underneath the surface, that New York could hope to grapple sucessfully with the tremendous problem of providing adequate rapid transit. It has frequently been remarked, perhaps not altogether without some truth, that while New York city is apt to be somewhat late in adopting new improvements, when she once has done so, she develops them with a zeal and on a scale of magnitude, for which no parallel can be found. Certainly this has been the case in the matter of providing means for underground travel. The first rapid transit subway with its four-track road, its eight-car express trains, and its high running speed both in local and express service, ranks easily as the finest complete system of city underground railways to be found anywhere in the world; and to the 21 miles which are now in operation in this city, there will be added within four or five years' time an additional mileage of rapid transit tunnels, which will bring the total to over 100 miles.

The enterprise of the city itself is being ably seconded by the efforts of the great railway corporations. The New York Central Company is about to place its freight tracks which parallel the western water front of Manhattan, entirely below ground, and the company is also proposing to build a connecting tunnel from this new subway to connect with its existing main lines, running to the Grand Central terminal. The Pennsylvania Railroad Company has already completed its two tubes below the Hudson River, and is rapidly excavating its way across Manhattan Island, at a depth of 50 to 60 feet below street level, to a junction with the four tunnel tubes which are being driven below the East River to connect with the Long Island Railroad system.

Another enterprise whose magnitude is little understood is that of the Hudson Companies, whose project includes the construction of no less than four tunnels below the Hudson River, two crossing at Morton Street and two at Cortlandt Street, and a connecting tunnel running parallel with the Jersey shore and underneath all the big terminal stations of the roads which run into Jersey City. Moreover, the two tunnels which cross at Morton Street are being rapidly extended below Manhattan Island, one branch running from Sixth Avenue below Ninth Street to Astor Place, and the other extending below Sixth Avenue to Thirty-third Street, where there will be a terminal station. In addition to the four East River tunnels of the Pennsylvania Railroad Company, the Belmont interests are building what is known as the old Steinway tunnel, which passes below the East River and extends under Forty-second Street to the Grand Central Station. Finally, there is the Rapid Transit tunnel from the Battery to Joralemon Street, Brooklyn, which will connect the subway lines of Manhattan and Brooklyn.

The whole of the extensive and exceedingly costly work which we have outlined above is being built entirely below the street and river surface; and to this must be added the vast network of street railways which was formerly operated by the Manhattan Street Railway Company, and the equally extensive lines of the old Manhattan Elevated Railway Company, all of which—elevated, surface, and subway—are now amalgamated and operated by a single corporation known as the Interborough Company.

It will readily be understood that the planning and construction of so many underground railways, crossing and recrossing the island and each other, has necessitated careful consideration of the depths at which they must be built in order to avoid interference. As a matter of fact, when the work which is at present under way or proposed has been completed, there will be presented, in at least one part of Manhattan Island, the curious condition of five separate railway systems running, one above the other, at five different levels. The particular spot referred to is the intersection of Sixth Avenue and Thirty-second Street, where, in addition to the three superimposed underground roads, there will be two distinct railway systems above ground; first the trolley street railway, and above that the elevated railway. The arrangement of the tracks and stations, and their relation to the adjoining buildings, is shown in the sectional view on the front page of this issue.

We doubt if it would be possible to find in any city in the world a center of transportation which will compare in importance with that which is herewith represented. Far down below the street surface, at a depth of 55 feet, will be the tunnels which lead from the new terminal station of the Pennsylvania Railroad, across Manhattan Island and below the East River to Long Island. These tracks will be used both for the local service and for such of the main line express trains as will be run through to the extensive yards of the company on Long Island. The local trains will be operated on the multiple-unit system, with motor cars and trailers alternating, while the express trains will be hauled by powerful electric locomotives of the general type shown in our engraving. Immediately above the roof of this tunnel, and separated therefrom by the depth of its steel floor, will ultimately be built a three-track subway, the two outer tracks to be used for local trains and the center track for express service. Above this, again, will be the two tracks of the Sixth Avenue branch of the Hudson Companies' system, and at this point will be located their terminal station. At the street surface are the two tracks of the street railway; and above them are shown the elevated railway and its Thirty-third Street station. Above the elevated tracks is yet another means of travel in the shape of the footway bridge, connecting the two platforms. Finally, as if to render this epitome of modern transportation complete, we have, on the left hand, or westerly side of the station, one of the modern, electrically-driven escalators. In this connection it is interesting to note that not only the escalator, but the five railway systems, are operated electrically.

Fully to appreciate the significance of this junction, we must remember that from this point it is possible to take a car which, directly or by its connections, will not only take one to any point in Greater New York, or Jersey City and its suburbs, but to any city of the whole United States, and that this, moreover, can be accomplished very largely without having to make any change in the open.

The Discovery of Nubian Manuscripts.

While examining some sheets of parchment bought at Cairo for Coptic manuscripts, Carl Schmidt made a discovery of much importance to philology and history. The repetition of the word "Uru," which among modern Nubians means king, convinced the German savant, who is an authority on Coptic and the early Christian archæology of Upper Egypt, that the text was Nubian, a language which, although still spoken, is no longer written. The manuscripts date from the eighth century A. D., and are translations of Christian works in which frequent references to St. Paul are made. One manuscript is a collection of extracts from the New Testament, and the other a hymn of the cross. The Greek original of the hymn is not known. When the documents are deciphered philological science will be enriched by the knowledge of the language spoken by the people of Nubia before the invasion of Semitic tribes, and the mysterious inscriptions on many of the Egyptian monuments may be read.

The Horseless Age says the United Kingdom remains the best customer for American motor cars, its purchases growing practically in the same proportion as the total exports. The most remarkable development has taken place in the Mexican, West Indian, and South American markets, and it will probably not be long before American manufacturers will control these markets, as they now control that of Canada.

Engineering Notes.

The commission of engineering experts which was appointed by the municipality of Turin to investigate the project for a new international railroad passing through Mont Blanc, and thus providing communication between the Rhone and Dora Baltea valleys, has now issued its report. The commission selects Aosta, at an elevation of 1,600 feet above sea level, as the starting point of the railroad, which, after climbing 1,700 feet, should pass through a tunnel under Mont Blanc at a height of 3,100 feet and emerge upon the village of Les Houches in the Chamounix Valley and Pre St. Didier. By this route the distance between Turin and Chamounix would be reduced to 116 miles, and from the former city to Geneva 166 miles. It is suggested that as the railroad and tunnel would extend through three different countries, the cost of construction should be borne by the respective governments, while furthermore the municipalities of Turin, Geneva, and Chamounix, which have the most to gain from the enterprise, should also participate in the outlay.

Owing to the great crush that always prevails at certain of the great railroad stations in London in the early morning to procure workmen's tickets, automatic machines for the issuing of the same have been installed, thereby avoiding the long queues at the booking offices, and expediting the delivery of the tickets. In Great Britain this class of ticket, which enables the workmen to travel at purely nominal fares over considerable distances—in one case 28 miles can be traveled for four cents—is issued up to about 7:30 every morning, and accordingly there is a vast section of the public which avails itself of these facilities. The automatic machines have proved highly efficient, and expedite the delivery of the tickets to a considerable degree, since no time is lost in tending change, the passengers being required to insert the correct amount into the machine. At Farringdon Street the machine installed issued 2,500 two-cent tickets per day, and proved so reliable in operation, no serious delays occurring through the mechanism breaking down, that the system has since been considerably extended, and now machines for the issuing of three and four-cent tickets are being widely adopted. A further boon possible with these automatic machines is the issuing after 4 o'clock in the afternoon of tickets dated for the following day, thereby relieving the pressure upon the device in the morning, when a considerable rush sets in during the later hours in which the machine is in operation.

The Applied Science Reference Room of the Pratt Institute Free Library (Ryerson Street near DeKalb Avenue, Brooklyn) exists for the purpose of aiding those engaged in any trade or industry. Hundreds of questions arise every day, in the factories and shops of a city, which could be answered from some printed page. It is the intention of the Applied Science Reference Room to supply as many of these printed pages as possible. Sometimes they are in books, very often in periodicals or transactions, and again may be found only in a trade catalogue. In the room set aside for this work in the Free Library of Pratt Institute are taken nearly a hundred trade and scientific papers, giving the latest news of the industrial world. There are besides over fifty of the labor union papers, of which a file is preserved. The most important of the periodicals are bound, and these bound files contain much material that can be found nowhere else. The publications of the United States Patent Office are kept here also, and are used daily. The collection of books here includes up-to-date publications in various industries, such as electrical engineering in all its branches, plumbing, manufacture of textiles, industrial chemistry, gas engines, the making of cement, and so forth. The books in this room are not allowed to go out, so that anyone coming is sure to find the book he wishes to refer to, if it is a part of this collection. The library has, however, a good collection of books in these subjects for circulation, often duplicates of the books in the Applied Science Reference Room. The room is in charge of Mr. Edwin M. Jenks, whose work is to help those who are looking up any question that lies within the province of this room. A large collection of trade catalogues furnishes the very latest information in many lines, and is being enlarged constantly. The library will get any trade catalogue in print, at the request of any user of the library. One new feature of the room is a collection of mounted cuts of machines and mechanical devices. These may be used in the room or taken away to work with, if desired. A man looking up a new form of chuck, for example, will find a score of cuts showing different chucks, and among these may well find some that will be of service to him. Men studying in the evening schools, those preparing for civil service or other examinations, lawyers, and men of various interests will find this department of use. It is open every day except Sunday, from 12:30 P. M. to 9:30 P. M., and can be used between 9 A. M. and 12:30 through the library office. Come in when you have a question, or want to see a trade paper.

Correspondence.

Why Not "Air-plane"?

To the Editor of the SCIENTIFIC AMERICAN:

Air-plane is a much better word than aeroplane.

It is as good etymologically, and much better when it is spoken. ARTHUR C. KIMBER.

New York City, December 13, 1906.

Liquid Specula for Astronomical Purposes.

To the Editor of the SCIENTIFIC AMERICAN:

Your discussion with Sir H. Maxim concerning the "Magic Sphere" and man's "gravitational sense" suggests a subject of extraordinary interest to me. It is now nearly twenty years since I conceived the idea of employing the same two forces (gravity and centrifugal) to produce a telescopic mirror. The reflecting surface was to be mercury, to which a parabolic figure was to be imparted by causing it to rotate. I made numerous experiments with revolving liquid specula, which were not discouraging considering the crudeness of the methods employed.

I endeavored to determine the nature of the curve which the surface of a rotary fluid must assume to reach a state of equilibrium, and searched numberless scientific and mathematical works for a clew to this problem. But so far as I could discover, all authorities were silent upon this point. Pondering the matter for years, I was at length able to decide with some degree of certainty that the curve was really parabolic; but a casual word let fall by you in your reply to Sir H. Maxim was the first and only confirmation of my conclusion which I have yet seen.

In the year 1897 I published in the Leader (Melbourne) a short story entitled "Lindsay's Vision," in which the suggestion was advanced as the nucleus of a scientific romance.

A telescope constructed on the above principle would possess qualities which might be of prodigious advantage, though plainly subject to certain inherent defects; chief among the latter is the necessarily fixed position of the mirror. But assuming it to be possible by mechanical means to put the reflecting fluid into a smooth and uniform state of rotation, we should obtain a parabolic mirror of incomparable precision, with practically no limit as to size. With respect to smoothness or polish, I think the surface of a fluid *at rest* is as perfect as can be conceived, approximating indeed to the minuteness of its molecular structure. Also, the difficulty of mounting and danger of flexure would be completely disposed of, while that of transportation would cease to be an obstacle.

A telescope on this principle could be placed at any part of the world which is now accessible to man, but a situation at the summit of some tropical mountain would be preferable, since the moon and planets would in turn drift across the field of view.

Assuming my speculations to be thus far sound and practicable, there is yet the obvious objection that perfect optical performance must depend upon the position of the object viewed being coincident with the axis of curvature of the mirror—a condition necessarily both rare and transient.

But the problem thus presented would, in my opinion, be far less formidable than that encountered by the early makers of refracting telescopes, and which was met by the invention of the compound object-glass.

A. W. NIGHTINGALE.

Hobart, Tasmania, October 8, 1906.

A Solution of the Lock Problem Upon the Panama Canal.

Hon. Theodore Roosevelt,

President of the United States,

Washington, D. C.

Dear Sir: I beg herewith to offer through the columns of the SCIENTIFIC AMERICAN a plan for the construction of locks upon the Panama Canal which I believe will offer greater safety and less complication than any of the plans made public, with which I am familiar.

The contingency to be guarded against, as I apprehend it, is the possible destruction of a lock by a steamship out of hand, with a subsequent release of the waters of the lake in such volume as to endanger the entire structure below.

So far as I am aware of them, the proposed safeguards may be divided into two classes, the first of which is represented by a false gate, or buffer, which is to be thrown across each lock at fifty feet from its end, for the purpose of arresting the momentum of a ship out of hand; and the second, by normally-submerged devices consisting of horizontally-sunk or vertically-disposed cylinders, or other devices, which in the event that the lock gate is carried away, and the waters of the lake set free, are thereupon to be thrown across the basin at the mouth of the principal lock.

The first plan, of arranging a buffer ahead of each lock-gate, assumes that a movable barrier can be provided which shall be amply strong to absorb the momentum, before it can reach the lock-gate but fifty feet beyond, of, say, a heavy battleship which may be sent ahead through the mistaken reading of a signal, at quarter or half speed.

I beg to submit that reliance upon the strongest structure of this kind that can be provided is not well founded in experience or human nature; for if it be made stiff enough to resist the ram of a 20,000-ton battleship moving at a slow speed, there is no assurance that such a ship out of hand may not develop much higher speed, or that the device may not in time have to be called upon to insure the arrest of a very much heavier vessel.

The second plan, in any of the forms which have been made public, seems to be more unworthy of confidence than the first, for it assumes, first, that the submerged devices used shall always be clear of silt, or gravel, or growths, and that they shall be free to move always with mechanism in instantly workable order; second, that once a gate has given way and the lake has started out there will be sufficient presence of mind on the part of those in charge to set the devices to work promptly enough to avoid the instant damage below which must follow the first onrush of the waters of the lake; and third, that the waters of the lake, once under way, can suddenly be arrested without their sweeping away the strongest surrounding works.

It is likewise respectfully submitted that none of these assumptions is well founded in experience, and that to intrust the safety of such a tremendous project, and the lives which necessarily must always be at stake, to such flimsy devices and to the courage, quickness, and wisdom of the employees in charge upon the occasion of a serious mishap, is neither wise nor necessary in the present state of engineering science.

As a substitute for the safeguards discussed, I propose these simple expedients, which are free of untried elements and offer a measure of safety unobtainable by any of the plans made public:

(*A*.) Surrounding the head of each high-level lock should be a receiving basin sufficient in area to hold, if it be found desirable, a plurality of vessels. Between this basin and the lake proper there should be a gate, which, in the event of the outflow of the waters of the receiving basin, will serve to hold back the waters of the lake. Between this, the lake-gate, and the head lock-gate there should be a system of interlocking devices acting so that neither gate may be opened until after the other has been closed. Thus, whatever damage may result to the lock system itself from a boat out of hand, the lake itself cannot flow out.

(*B*.) Each lock, of the series of three, should be two locks long; that is to say, double the necessary length of a single lock. Midway between the ends of each such lock there should be a lock-gate, of the usual construction, which I term a center gate. Thus, each double-length lock will be composed of two sections, both of which are simultaneously emptied or filled. Between the head-gate of a lock and its center gate there should also be interlocking connections so arranged that the center gate cannot be opened until after the head-gate has been closed, and *vice versa*.

In this system of lock a vessel from the lake will first be admitted to the receiving basin (probably with several others). The lake-gate of the receiving basin will then be closed and the head lock-gate of the high-level lock will thereafter be opened, when a vessel will be passed into its first section, after which its head-gate will be closed and its waters drawn off. The level of the first lock having fallen to that of the second lock both the center and foot gates of the first lock may be opened and the vessel permitted to pass into the first section of the second lock, whereupon the same order of operations may be gone through with respect to the second lock, and so with respect to the third.

If desired, and with as great safety, each lock may be used simultaneously to lower two full-sized vessels, each occupying one of its sections. Under these conditions the first vessel would enter the first section of the high-level lock, after which the head-gate of the latter would be closed. The vessel would then be passed into the second section of the high-level lock and the center gate thereof be closed behind it, whereupon the head-gate could again be opened and the second vessel passed into its first section, after which, the head-gate being again closed, both vessels could simultaneously be lowered to the second level.

Under this plan the various maximum damages which could result from the collision of a vessel with a gate or gates may be summarized as follows, it being borne in mind that the lake-gate is mechanically held closed while the head lock-gate is open, and *vice versa*: First, should a vessel entering a lock carry away its center lock-gate there would be no disturbance of the waters of the lake itself, and no resulting flood; therefore, the canal's damage would be confined to the gate itself and its surrounding works. Second, should the head lock-gate while closed be carried away by a vessel approaching it and the vessel arrested before reaching the center lock-gate, the latter being closed, the resulting damage would be confined to the head lock-gate and no flood would occur. Third, if both the head and center lock-gates were carried away, and the vessel arrested before reaching the foot lock-gate, the damage would be confined to the gates destroyed and no flood would occur. Fourth, taking what would substantially be the maximum possible mishap, should a vessel have sufficient headway to carry the head lock-gate, and thereafter, traversing the entire single lock-length of the first section without arrest, carry the center gate, and then should it still be able to traverse the full single lock-length of the second section, and carry away the foot-gate, then the maximum damage would occur which it would be possible to do the canal by such an accident—an outrush of the waters of the high-level lock, which would be followed by the waters of the receiving basin; but with the passage of these waters further damage would cease and the waters of the lake itself would remain undisturbed.

When examined in the light of such an accident, the double-length lock with center gate offers more than twice the resistance to a flood from above that would be offered by the single-length lock, because it would offer the resistance of two gates, center and foot, and of two sections of water at rest instead of but one.

If in connection with this system of locks, and of lock operation, the banks at either side were arranged laterally to fall away from the locks, leaving the lock masonry above the level of the surrounding earth to right and left, then the flood of water resulting from the bursting of a lock above and falling upon the surface of the lock beneath would largely pass off to right and left with less resulting damage to the lock itself.

If an additional safeguard were ever found to be necessary, two lake-gates set in tandem, a maximum ship's length apart, their mechanisms joined by interlocking devices, would place the works of the canal beyond the possibility of destruction by an outrush of the lake itself through the canal way.

Upon an analysis of this plan many advantages here unrelated will appear; and a careful consideration of the subject has led me to believe that a high-level canal built in conformity with it may be operated, so far as major accidents are concerned, as safely as one built at sea level.

The above, which I am taking the liberty of publishing, is respectfully submitted. H. A. WISE WOOD.

December 8, 1906.

The Current Supplement.

The current SUPPLEMENT, No. 1617, opens with the President's message to Congress on the conditions which he found at Panama. A very complete series of illustrations is given. Mr. J. M. Basford has an article on the motive power officer of a great railroad. During the last few years the steam turbine has formed the subject of many papers read before various leading institutions, and its different applications have often been referred to. Few of these papers possess more interest than that of the Hon. C. A. Parsons and R. J. Walker on the development of the marine steam turbine, published in the current SUPPLEMENT. Prof. C. E. Munroe writes on the development in the explosives art in the United States during the last five years. Mr. W. R. Stewart contributes a very entertaining statistical article on the twentieth century pen. "The Preservation of Foods" is the title of an instructive *résumé* of modern processes. Teeming with much curious information is Mr. G. Bolin's essay on perturbations in locomotion, in which he describes how the normal movements of animals are affected by making lesions of the nerve centers and by unequally illuminating the two eyes. Written in a somewhat similar vein is Dr. Henry Fotherby's contribution on light and visual sense.

Micro-Chemical Detection of Copper.

Meerburg and Filipps (Pharm. Zeit.) say that copper can easily be detected under the microscope by means of cesium chloride, which gives with copper a double salt in the form of handsome red crystalline needles or prisms. These crystals are observable when only extremely small proportions of copper are present. If much cesium chloride be added, yellow crystals form, which become red on the addition of a little cuprous chloride. Cobalt somewhat affects the distinctness of the reaction; lead and bismuth are indifferent.

A German patent has been granted for a new process in spinning artificial threads made from cupric oxide and cellulose, and knitting the fabric for the mantles in the ordinary way. These mantles are subsequently impregnated with the thorium salts, and after drying are placed in a bath of ammonia, or hydrogen peroxide. This last bath is the essential point of the invention, as it converts the previously soluble salts into insoluble compounds, i. e., hydroxides. Since hydrogen peroxide only transforms the salts of thorium into an insoluble state, it is necessary to make use of a cerium bath, after the hydrogen peroxide treatment, in order to give the mantles the necessary one per cent of ceria.

THE APPARATUS OF THE UNITED STATES LIFE-SAVING SERVICE.

BY WALDON FAWCETT.

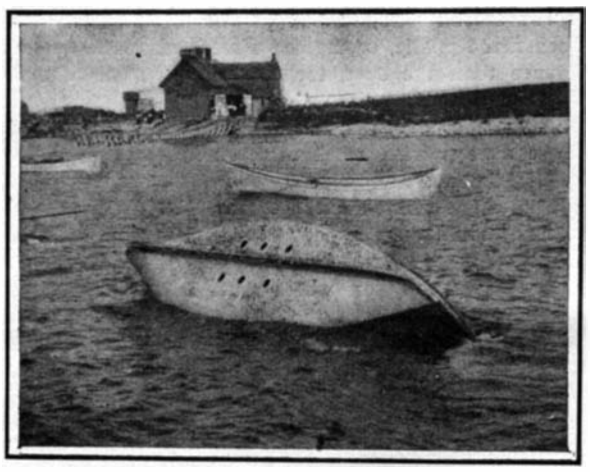
The series of especially disastrous wrecks, which has occurred during the past year or two on the Atlantic and Pacific coasts and on the Great Lakes, has caused an unusual activity in the invention of life-saving devices. The United States governmental board of experts detailed to examine and test all new inventions offered for the use of the United States Life-Saving Service has been sorely taxed by the effort to give serious consideration to the many novelties which have been presented.

This official sifting process has, however, resulted in few additions to the standard equipment of the nation's life-saving stations. Our life savers to-day rely solely in their rescue work on three utilities—the lifeboat (interchangeable with which is the surfboat), the lifecar, and the breeches buoy. As accessories to the use of the two last mentioned pieces of apparatus, is the wreck gun which is used to hurl lines to ships stranded in exposed positions.

Many of the rescues effected by the United States Life-Saving crews are accomplished by means of lifeboats or surfboats. During the year 1905, for instance, there were landed by the surfboats and lifeboats upward of one thousand persons, whereas only about half a hundred persons were rescued by the breeches buoy or lifecar during the twelve months in question.

The lifeboats and surfboats are each propelled by a crew of six or eight rowers—all trained oarsmen of the Life-Saving Service. These staunch craft, weighing perhaps seven hundred or eight hundred pounds each, and by reason of their self-righting and self-bailing qualities rendered virtually unsinkable, are obviously the ideal vehicles for taking considerable numbers of persons from imperiled vessels in a limited space of time. The first duty of a patrolman who in his vigils on the beach discovers a vessel ashore is to ascertain whether the conditions are favorable for the use of a boat in the rescue work. In such event either the large lifeboat is launched from its ways in the station and proceeds to the wreck by water, or else the lighter surfboat is hauled overland to a point opposite the wreck and there launched.

To the crew and passengers of a shipwrecked vessel the space of one to four hours that usually intervenes between the burning of the red light which signals the patrolman's discovery of the wreck and the arrival of the life-saving crew often seems an interminable wait, but such a lapse of time is almost inevitable save on stretches of coast where the stations are located exceptionally close together. This will be appreciated when it is taken into consideration that the beach patrolman must in many instances walk three or four miles, perhaps in the face of a storm, to report the discovery of a wreck, and then the crew of life savers must drag the beach apparatus and perhaps the surfboat an equal distance through the sand or over rough roads. If circumstances permit the use of either the lifeboat or surfboat, the keeper of the life-saving station assumes command and steers the boat—the latter requiring the highest refinement of skill when women and children are to be taken off in a tempestuous sea, since under such circumstances the rescuing craft must approach close to the shipwrecked party, yet without allowing the small bark to be overturned or dashed to pieces by a collision with the stranded hull. Helpless persons and passengers are usually passed into a rescuing boat first, and as a rule several trips are necessary before all members of a ship's company are safely conveyed to shore. In the comparatively few cases when a ship is wrecked amid comparatively dangerous rocks, or when so high a sea is running that neither lifeboat nor surfboat could make any progress even were it able to withstand the destructive force of the waves, recourse is had to the breeches buoy or the lifecar. Under such circumstances the first consideration is to get a line to the stranded vessel. To this end a leaden missile with a line attached is fired across the imperiled vessel by means of the wreck gun, a powerful little portable mortar which will hurl a line over a wreck three or four hundred yards distant even in the teeth of a gale. If the wreck be exceptionally far from the beach, it may be necessary first to establish communication with the wrecked crew by firing a long-distance rocket attached to which is a cord.



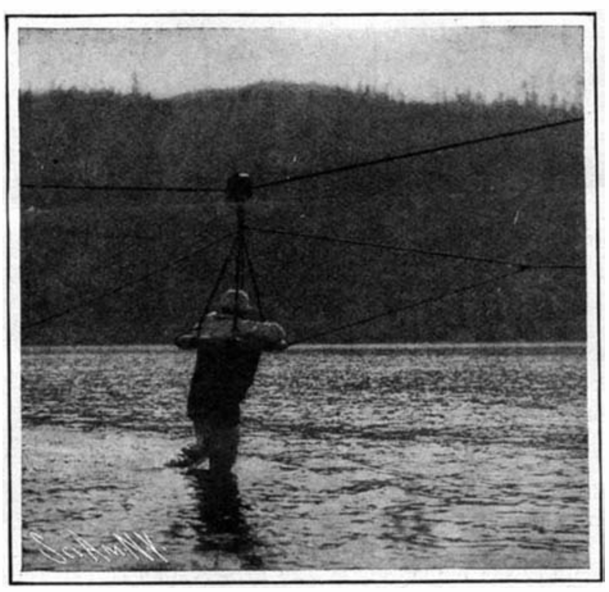
The Surfboat Turning Over.

In any event, once the shipwrecked mariners have a line of any kind placed in their hands, they can speedily haul out lines of fair size, and eventually the three-inch hawser which is to serve as an aerial cableway and a highway to safety. Attached to every hawser thus sent out to an imperiled vessel is a board which bears, in English on one side and in French on the other, instructions how to fasten the hawser to a mast or other secure support, together with directions for signaling to the life savers on shore that the hawser has been made fast according to instructions.

As soon as the rescuers on shore are informed that the other terminal of this life line is fastened, the hawser is hauled taut and the shore end elevated by means of a tripod, in order to lift the rope well clear of the water. There is then sent off to the ship a breeches buoy, suspended from a traveler block or a lifecar from rings running on the hawser. Only one, or at most two persons, can be carried ashore at each trip of the breeches buoy, but from four to six persons can be accommodated in the lifecar. The efficiency of this latter apparatus was well attested in a memorable wreck on the New Jersey coast, when a single car was the means of saving more than two hundred lives.

After all persons have been landed from a wreck, the life savers draw out to the abandoned ship along the cableway an ingenious mechanical device known as a hawser cutter, which upon arrival at the terminus of the line automatically cuts the rope, allowing the crew to draw the hawser to shore and thus preserve intact a valuable part of their apparatus. In connection with this phase of life-saving operations, great care is necessary in coiling the initial line to be hurled to the imperiled vessel, in order that the slender rope may run free when the shot to which it is attached is fired from the mortar. Any tangling of the rope at this juncture would probably cause it to fall short of the wreck and might involve costly delays.

The United States government, which boasts the only life-saving service in the world supported wholly at national expense, now maintains upon our coasts a chain of 277 life-saving stations, of which number 200 are located on the Atlantic and Gulf coasts, 61 on the coasts of the Great Lakes, and 16 on the Pacific coast. Each of these stations is manned by a crew of from six to eight surfmen, who in every case occupy quarters at the life-saving station, and are thus in a position to respond promptly to any call to duty. It is estimated that the United States government life savers have since the establishment of the service saved not less than 225,000 lives; and statistics carefully compiled since the year 1871 show that in the interval which has elapsed since that date, an aggregate of $200,000,000 worth of property has been saved.

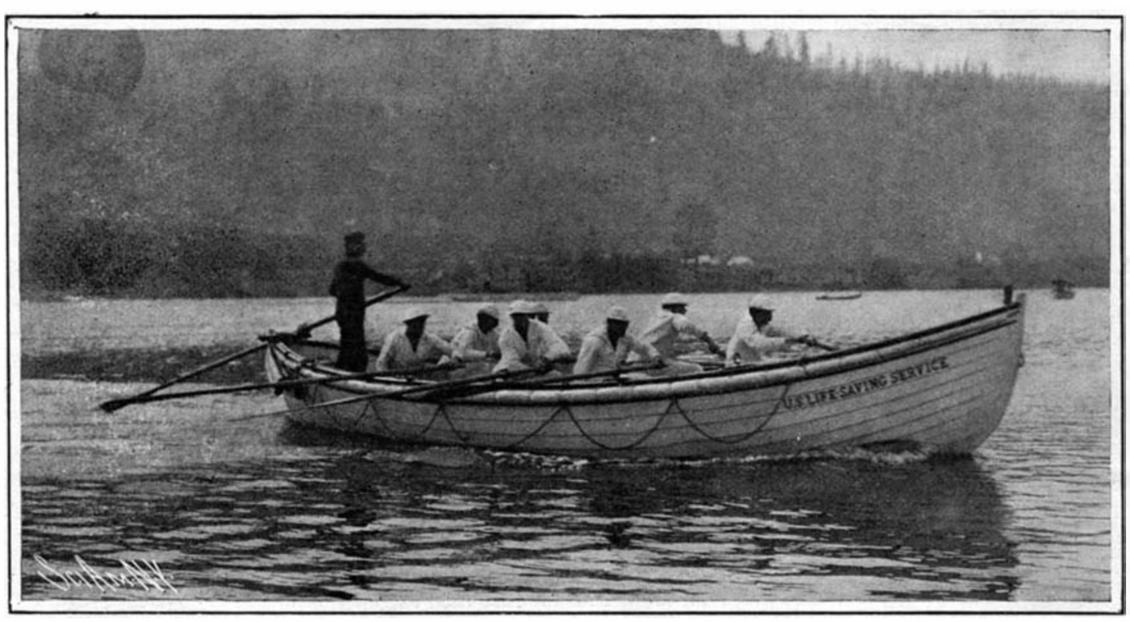


The Breeches Buoy.

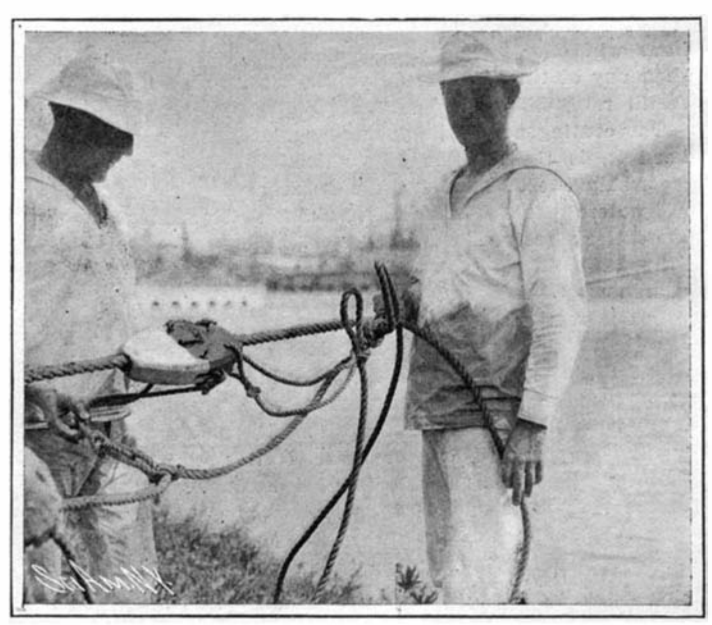
An Unsinkable Surfboat.

Liquid Air in Blasting.

In one of the largest collieries in the north of England, liquid air cartridges are being utilized for the



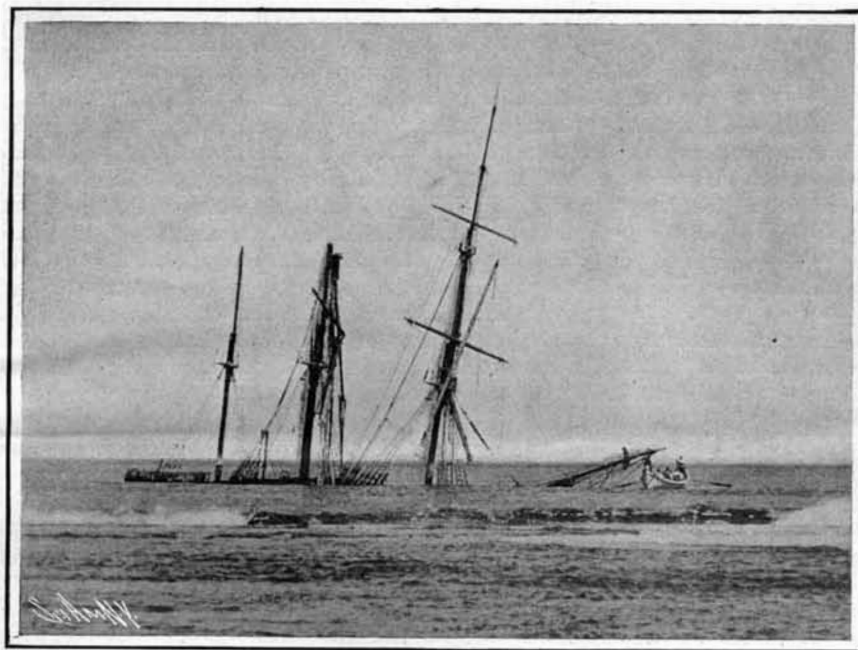
Setting Out in the Life-Saving Boat.



Using the Hawser Cutter.

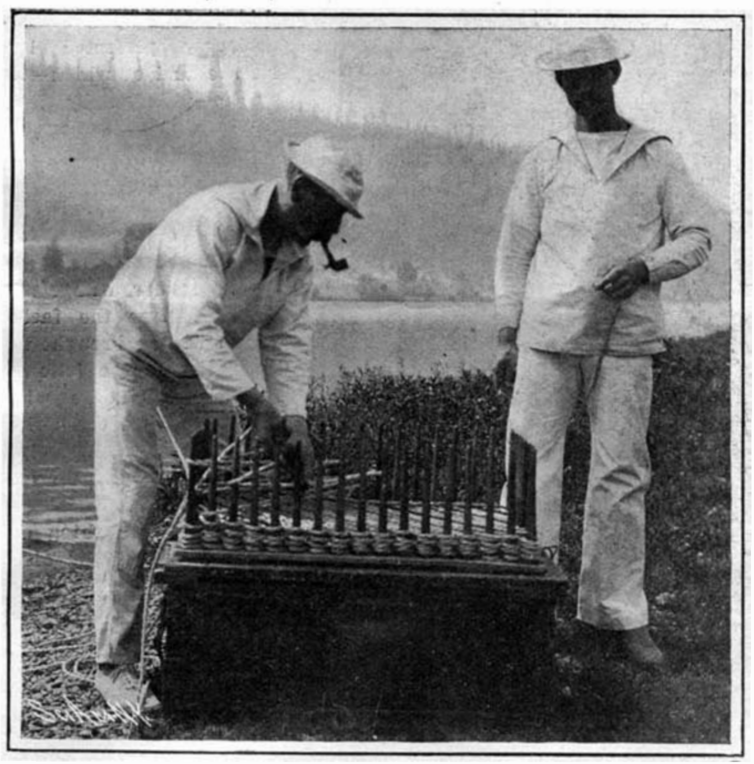
THE APPARATUS OF THE UNITED STATES LIFE-SAVING SERVICE.

purposes of blasting the coal in the lower workings. The coal face is drilled and the cartridges are tamped home in the usual manner. The cartridges themselves are of special design. The cases are made of phosphor-bronze of stout thickness. The end which is inserted in the drill hole is formed of a soft metal similar to that used in type founding. At the outer end the cap is fitted with a tube in which is a non-return valve. The cartridge is inserted in an empty condition. When all is ready for blasting, the miner charges the cartridge with liquid air from a reservoir through the inlet pipe and valve, the latter preventing the air from escaping. The liquid air vessel itself is of convenient size for portability, and the contents are insulated by specially-prepared lamb's wool. The charge inserted in the cartridge is able to exert a pressure of approximately 80 pounds per square inch. When the charge is completed, the miner retreats to a safe distance to await the coming explosion, which generally occurs in from six to eight minutes. The liquid air under the influence of the surrounding heat rapidly expands, and the inner end of soft metal affording the least resistance, it succumbs when the requisite pressure is attained, and the escaping gaseous air disintegrates the coal surrounding the cartridge for a considerable distance. The average amount of coal removed at a blast is about 30 tons, and so complete is the process of disintegration that no removed piece of coal exceeds two feet in length, the greater part being broken up into conveniently-sized nuts. In the early experiments the pressure within the cartridge was considerably higher, but it was found that the force exerted was so great that the coal was completely pulverized and rendered unfit for commercial use. By using phosphor-bronze cartridges fitted with a soft metal end, the cases can be utilized repeatedly, as the phosphor-bronze is not injured by the pressure exerted. A new soft metal cap can be quickly replaced, and the cartridge used immediately if desired. In this way the cost of the process is appreciably decreased. The employment of liquid air for such work is stated by the colliery engineers to possess many distinct advantages over the ordinary explosives generally used. In the first place, misfires are impossible, as the liquid air under the influence of the surrounding heat is bound to revert to its gaseous state, expand, and the explosion result. Moreover, owing to the absence of any flame, the possibility of any gases present in the seam being fired are avoided. The explosion too is more even, and the coal broken up more regularly. In this particular colliery liquid-air blasting is rapidly superseding the more orthodox methods, especially in the lower workings, as the men become initiated into the methods of handling the liquid air.

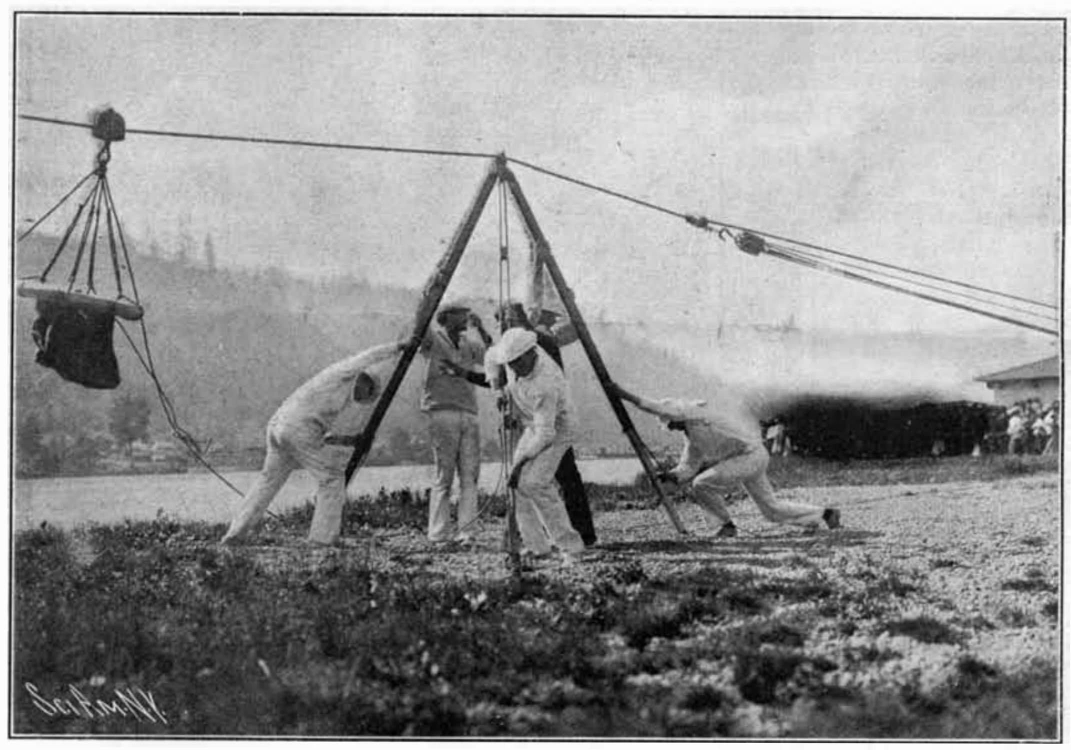


The End of Her Last Voyage.

Landing the Rescued from a Wrecked Vessel.

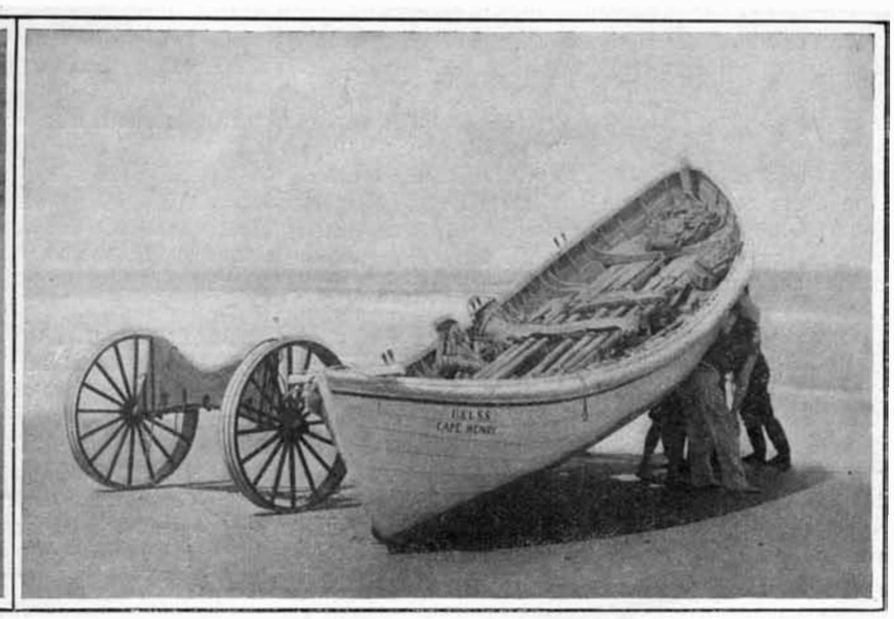


Reeling Life Line After Using the Life Gun.



Rigging a Tripod for the Breeches Buoy.

Resuscitating an Apparently Drowned Person.



Replacing the Surfboat on Its Carriage.

THE APPARATUS OF THE UNITED STATES LIFE-SAVING SERVICE

INCREASING THE POWER OF A TALKING MACHINE BY MEANS OF COMPRESSED AIR.

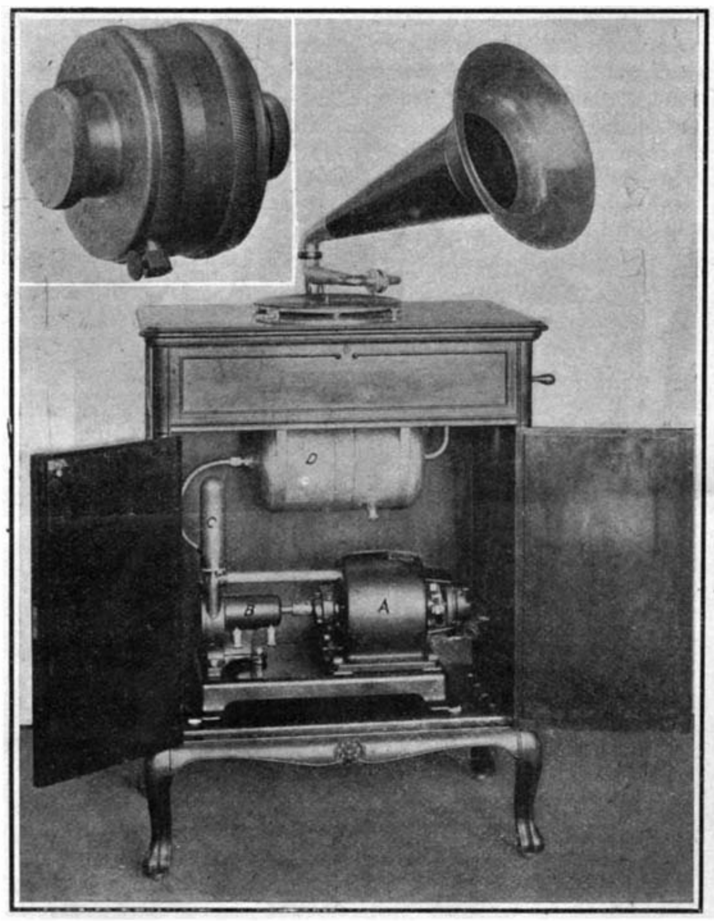
Heretofore it has been practically impossible to reproduce sounds "life size" on a talking machine. By using large horns it has been possible to concentrate the sounds produced by the diaphragm, and, by thus limiting the area over which they are projected, to give them a volume almost as great as that of the sounds originally impressed upon the record. But this concentration is secured at the expense of the quality of the tone; for to the sound waves produced by the record are added the vibrations of the horn itself, causing a harsh metallic sound.

The Victor Talking Machine Company has just perfected a machine which produces sounds of greater amplitude than can be obtained in the ordinary talking machine, avoiding the objectionable features of the large horn. The auxetophone, as the new machine is called, comprises a small air compressor and a talking machine of standard make. The usual diaphragm is, however, dispensed with in the machine, and the needle or stylus which travels over the record operates a balanced gridiron valve through which the compressed air is passed. In operation the air issues from the valve in intermittent jets, which are modified in frequency and character by the action of the needle in such a manner as to reproduce the sound originally impressed on the record. The needle and valve act merely as a relay, while the sound is actually produced by the compressed air.

To more thoroughly understand the philosophy of the machine, it may be well to discuss the form and action of sound waves. It is a common error to compare sound waves with waves of water in which, as is well known, the particles of water oscillate vertically, or at right angles to the direction in which the waves are traveling. In sound waves, however, the oscillations coincide in direction with the travel of the disturbance; that is, instead of having alternate elevation and depression, the wave disturbance produces alternate areas of compression and rarefaction. As the wave disturbance takes place equally in all directions under normal conditions, it follows that sound travels through air in a series of ever-expanding spherical areas of compressed and rarefied air which have their center in the source of the sound. In only two particulars can these sound waves vary, one being the rapidity of vibration, which governs the pitch, and the other being the amplitude of the vibration, that is, the length of travel of the vibrating particles, or the density and rarefaction, and this governs the volume or loudness of the sound. In a pure tone the oscillations are rhythmical, but various qualities of tone are produced by interference with the rhythm of the oscillation. However, these irregular movements take place in the direction in which the sound is traveling.

With this brief description of the principles of sound, we may be better able to understand the exact operation of the compressed-air attachment used on the auxetophone. In the usual form of talking machine, a diaphragm is employed which is connected with a needle in such a manner as to vibrate, causing alternate waves of compression and rarefaction to be emitted from the sound box. The compressed-air apparatus is more powerful because when the valve is opened to permit the issuing of a jet of air, this air travels through a greater distance in a given time than would the air set in motion by the diaphragm; consequently, waves of greater alternate density and rarefaction are produced, giving a much louder and rounder tone.

The accompanying illustration shows the new machine with the compressor attachment. It consists of a cabinet in the lower portion of which is a 1-6-horsepower electric motor, direct-connected to a blower. The air from this blower passes through a condenser, the office of which is to remove the moisture and oil it may contain. A flexible tube conducts the air from the condenser to a reservoir provided with a safety valve set to blow off at a pressure of 4 pounds. Thence the air is filtered and passes through a flexible tube to the sound box in which the valve connected to the needle is located. This valve is of a very delicate construction and responds to the slightest vibration of the needle. The record disk, which is of the usual form, is revolved under the needle by a spring motor, as in the regular talking machine. The electric motor which operates the compressor may be driven by power furnished from the city lighting system and may be started or stopped by means of push buttons at the side of the cabinet. One of the principal advantages of this improvement is that all the richness and mellowness of tone is retained. The new machine will, undoubtedly, prove of great value in large concert halls where machines of previous type have been of too low a power to give satisfactory results.


The Sound Box.

Front View, Cabinet Open to Show Air Compressor.


Rear View Showing Compressed Air Connection to Sound Box.

INCREASING THE POWER OF A TALKING MACHINE BY MEANS OF COMPRESSED AIR.

EYE-SPOTTING IN NATURE.

BY PERCY COLLINS.

While brilliant colors, striking contrasts, and more or less complicated patterns are common in nature, anything like a centralized design is extremely rare. One need only examine a number of birds' skins or butterflies in a museum to be convinced of this. Indeed, almost the only notable design seems to be that circular grouping of colors which, from its likeness to an eye, has been termed ocellus. Ocelli, or eye-spots, are seen at their greatest perfection upon the feathers of certain birds, such as the peacock, the peacock pheasant, and the argus pheasant. Among birds, too, and notably in the case of the peacock, we are able to gain a glimpse of the evolutionary process through which the eye-spot came into being. Before, therefore, we turn to a general consideration of the eye-spot, we will devote a few moments to the peacock's eye-spot in particular. It is, perhaps, the most lovely of all natural ornaments depending for their effect solely upon an arrangement of color. Yet this exquisite gem was not always what it is to-day. Its amazing complexity of beauty was acquired by slow degrees from a very small beginning. Moreover, we may trace, as it were, the successive steps in this wonderful progress upon the inconspicuous feathers toward the root of the peacock's tail.

If the reader will glance for a moment at the series of feathers which were taken from the skin of one Indian peacock for the purpose of illustrating this article (Fig. 1), he will notice that the first feather is pale in color, barred by darker areas; there is no sign whatever of the glorious eye-spot that is to be. It is probable that the ancestors of the peacock were completely clothed in these dull-colored feathers, just as are certain species of grouse and turkey at the present day. But Nature willed that the peacock should become of all birds the most magnificent. Thus, in the second and third feathers of the series we can trace dimly a small colored spot in the center of each. This spot is the commencement of the eye-spot; and if we continue to pass the feathers in review, we see this spot grow larger and more brilliant. The colors settle themselves, as it were, into rings, the feather itself increasing in size with every improvement, until, by closely-linked stages, each of which is represented by an actual feather in the peacock's train, the triumph of the perfect eye-spot is reached.

Now if, as seems highly probable, we have just been treated to a glimpse of the innumerable stages of gradual improvement through which this wonderful ornament was brought to perfection, we are justified in asserting that the eye-spot is far from being a thing of chance. It is obviously the outcome of intention. Some mysterious power has been constantly at work, age after age, with the definite object of producing a thing of superb beauty. So far as our present knowledge enables us to judge, this power consists in what we may call the inherent tendency to vary which is evinced by all living things. This is, as it were, the motive force; but it is harnessed, restrained, and driven along a definite channel by what Darwin called "natural selection."

So much for the production of the peacock's eye-spot; nor is there any reason for doubt that the other recurrences of the eye-spot in nature are all the outcome of a similar evolutionary process. For, be it noted, the distinction of the ocellus does not belong only to birds. The mark is present in a crude form on the hides of certain mammals, such as the jaguar, the leopard, and the ocelot. Two or three kinds of fish also show it. The North American eared sunfish, for instance, has in the breeding season a beautiful and very perfect eye-spot just where one would expect to find the ear of a higher animal. It is from this mark that the fish takes its popular name. Further, among insects, especially among certain groups of butterflies and moths, the eye-spot is extremely common; while it is again recognizable on several shells of the pretty cowrie group.

We may now ask: What is the meaning of this strange spot, so laboriously perfected by Nature, and of which—if we may judge by her constant reproduction of it—she is so proud? It is not possible to assign one reason which will explain the existence of the spot in every case. But if the reader will carefully examine the facts which will be brought to his notice in the following paragraph, he will probably share the writer's conclusion, namely, that in every case of its recurrence the eye-spot is not solely a thing of beauty, but that it also has some definite and utilitarian connection with the life histories of those creatures which possess it.

Take first the mammals. It may be said at once that the crude eye-markings on the hides of these big cats are certainly protective. To those who know the leopard and the jaguar only as captives in zoological collections, this may not be obvious. But all hunters and naturalists who have observed these creatures at home in forest or jungle agree that the eye-spots (Fig. 2) resemble closely patches of shade and sunlight, cast upon the ground through a screen of foliage. It only remains to be said that the jaguar and the leopard are both frequenters of forest land, and the protective value of their spotted hides becomes obvious. Moreover, besides hiding them from possible enemies, the eye-spots are of assistance to these beasts when they are lying in wait for their prey. Among the branches of a tree the jaguar is unobserved by its victim, which wanders unsuspectingly to its doom.

With birds, there can be little doubt that the eye-spot is an ornament pure and simple, albeit an ornament with a very definite use. It bears a most important part in bird courtship. Birds are particularly punctilious in all matters in connection with love-making, and it is invariably the male who makes the first advances. The female, especially in the case of species where the male is resplendently colored, is generally coy and watchful. She makes it clear to her suitor that she will not surrender her liberty at once; and the cock bird must make use of all the charms with which Nature has endowed him ere he may possess himself of his bride. Indeed, it may be said that as a general rule the most gorgeous and sprightly cock will find the least difficulty in providing himself with a hen. These facts doubtless account in great measure for the brilliant colors and extraordinary ornaments which are so often the exclusive characteristic of cock birds. They account, also, for the eye-spot, which is borne only by the male birds and discarded by them at the molt which succeeds the breeding season. Those who have watched peafowl at the period of their courting will know well what an important part is played by the wonderful tail of eye-spotted feathers. The peacock struts and dances before the indifferent hen, and manifests an absorbing desire to show himself off to the best possible advantage.

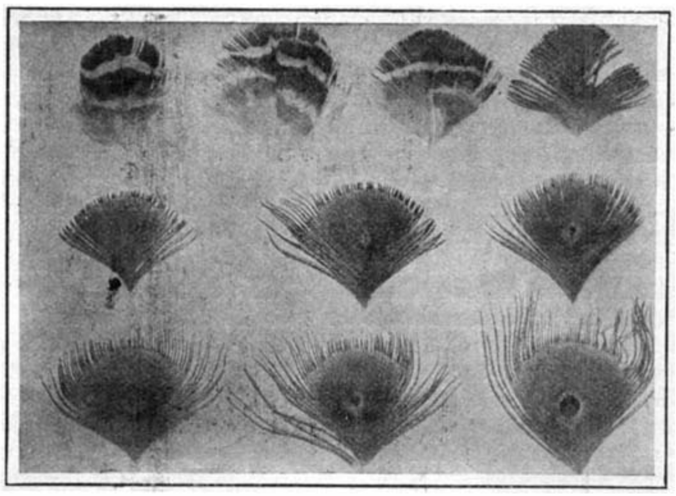


Fig. 1.—The Development of the Peacock Eye-Spot.

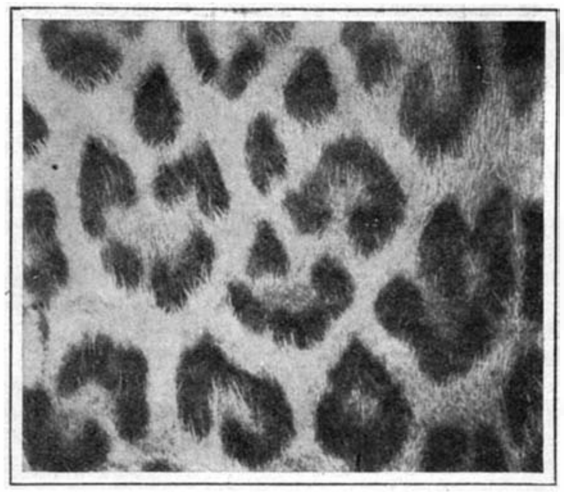


Fig. 2.—Eye-Spotting on a Leopard's Skin.

The peacock pheasant from Ceylon (Fig. 3) is said to make use of its eye-spots to attract a mate in much the same manner. Moreover, in this instance the eye-spots constitute the only ornaments possessed by the bird—the groundwork of the feathers being a uniform mottled brown, upon which the colored eye-spots stand out conspicuously, as a glance at the accompanying photograph of a "displaying" male will prove.

The recurrence of the eye-spot upon several fishes has probably the same significance as in the case of birds. The males of many fishes assume brilliant colors for the breeding season; and the ocelli are probably a highly specialized form of ornament produced with a like object. The facts that the eye-spots are small, or entirely absent, in the case of the females, and that they appear upon the males only during the breeding season, lend strong support to this theory.

The eye-spots which are so commonly seen upon certain kinds of insects are particularly interesting. In the case of certain kinds of caterpillars and beetles, there is little doubt that they are protective—rendering their possessors terrifying in the eyes of possible enemies. This theory is materially strengthened by the fact that insects usually have some trick or device at their disposal, by means of which the eye-spots become more obvious and striking when danger threatens. Bates, for example, mentions a case in which a South American caterpillar startled everyone to whom it was shown by its snake-like appearance—an aspect dependent almost entirely upon its possession of eye-like markings, coupled with the peculiar pose of its body when at rest. The same is the case with certain Old World hawk moth larvæ belonging to the family *Chaerocampidæ*. Several species which possess eye-spots upon the anterior segments of the body have a habit of withdrawing the head and first three body segments into the fourth and fifth segments when alarmed. The front portion of the body is thus abnormally swollen, looking like the head of an animal, and upon it enormous, terrible-looking eyes are prominent. The effect is greatly heightened by the suddenness of the transformation — an innocent and inconspicuous animal being suddenly turned into what appears to be an awful monster. These caterpillars are, of course, perfectly harmless; but as they are sufficiently snake-like to startle human beings, it is not unreasonable to suppose that birds and other insectivorous creatures are often equally alarmed, and pass on their way without molesting what they judge to be some dangerous reptile.

The fact that the eye-spots of these caterpillars do not, as a rule, attract especial notice while the insects are quietly feeding will bear emphasizing. But as soon as the "terrifying attitude" is assumed in response to a danger signal, the eye-spots—owing to the swelling of the body segments—become enormous and prominent.

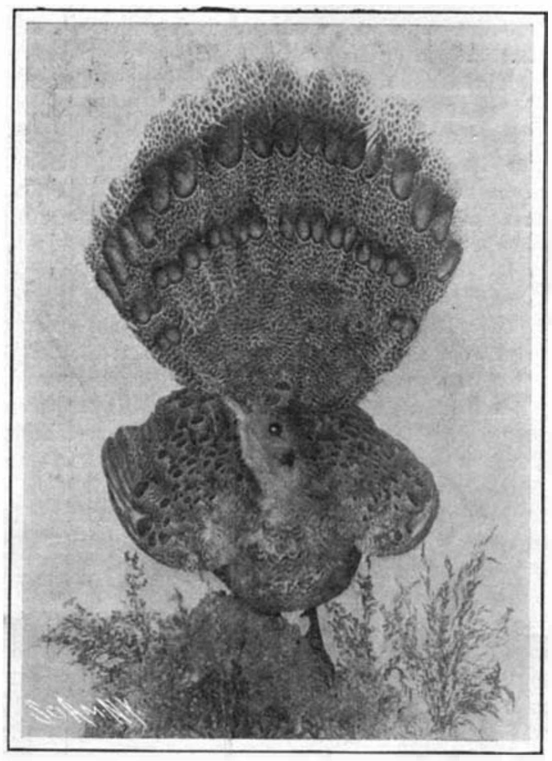


Fig. 3.—A Peacock Pheasant from Ceylon, With Tail Spread.

Very striking eye-spots are seen upon the thoraces of beetles belonging to the Central American genus *Alaus* (Fig. 4). These ocelli are delineated actually upon the hard integument, and cannot therefore be really more prominent at one time than another. Yet their power to terrify is much heightened when the beetle assumes the attitude with which it is accustomed to respond to signs of danger. It belongs to the great "click beetle" family, and has the power of hurling itself into the air when frightened, and falling to the ground with legs and antennæ tucked tightly beneath it. In this position it will remain, seeming to feign death, for an indefinite period.

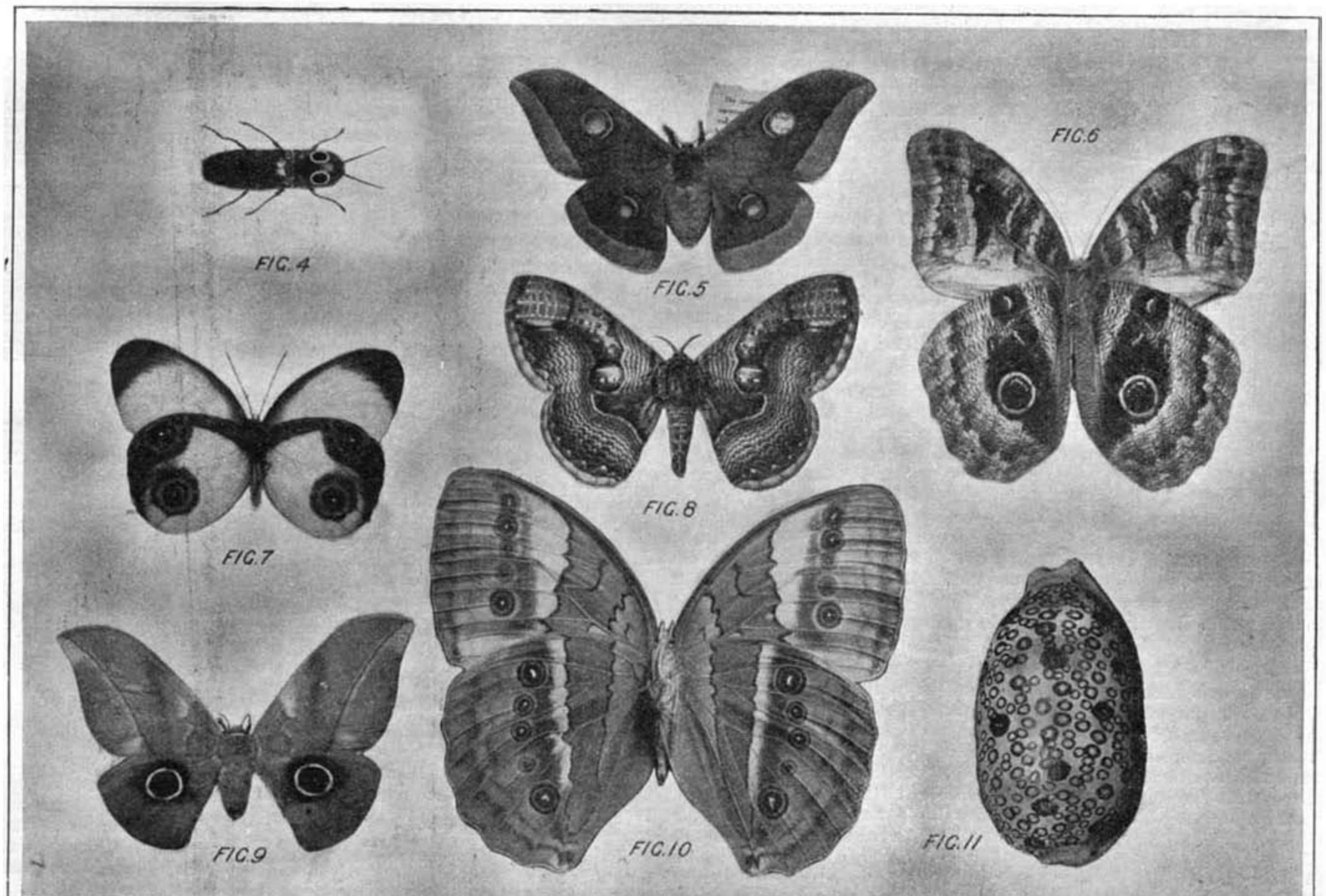
When surprised by a hungry bird, then, the beetle not only hurls itself out of immediate danger, but prepares a surprise for its enemy in the event of pursuit and discovery. For, with its legs and antennæ tucked out of sight, it has all the appearance of a dangerous and uncanny looking reptile; and the hungry but now thoroughly disconcerted bird turns away in search of some more appetizing object. Then the beetle, after waiting a few seconds to make sure that the bird has really decamped, puts out its feet and feelers and goes merrily about its business. Its strange eye-spots have been its salvation.

By far the most numerous recurrences of the eye-spot in the insect world are seen upon the wings of butterflies and moths. In some instances the distinctive mark is small and oft repeated; in others it is large, solitary, and staring. Moreover, the color and "make-up" vary as much as the size, the most curious variety being the eye-spot with a perfectly transparent center, which looks just as though a small piece of glass or talc had been let into the insect's wing (Fig. 5).

Now, such very striking and complicated markings cannot have become characteristic of large families of butterflies and moths without some important meaning attaching to the circumstance; and it has been suggested as possible that the "eye" possesses some protective value in that it would be likely to attract birds as a point at which to strike. If a bird, when in chase of a butterfly or moth, were to pierce one of its eye-spots, little damage would be done to the insect, which would gain time to evade its pursuer. On the other hand, the fate of an insect would be sealed if a bird once struck at and injured its body. This suggestion was first made by Darwin.

Moreover, in the case of solitary, staring eye-spots, such as those seen on the wings of the South American "owl" butterflies (Fig. 6) and many moths, the utility is probably to scare away inquisitive birds by giving the resting insect some resemblance to the head of a terrible monster. In the case of not a few moths, the ocelli occupy such a position upon the forewings that they are brought into particular prominence when the insect hangs waiting for its wings to expand fully after leaving the cocoon (Figs. 7 to 10). This is, of course, the most critical period of the moth's career, and any mark or device calculated to scare away enemies becomes extremely valuable.

Lastly, to the reappearance of the eye-spot on certain shells (Fig. 11) we may perhaps ascribe a meaning such as we saw to exist in the case of the



Figs. 4 to 11.—Examples of the Eye-Spotting of Insects, Moths, and Shells.

EYE-SPOTTING IN NATURE.

leopard and the jaguar. The mollusks inhabiting such shells are denizens of shallow water. Thus, the eye-spots upon the surfaces of their portable homes serve a protective office on account of their resemblance to the tiny motes cast upon the sea bottom by the light coming down through the water. Even in dark holes and crannies, too, the mottlings and eyed markings of these shells would serve to break up their outlines and cause them to resemble the sand and shingle upon which they lie.

In conclusion, it may be said that the eye-spot is a most striking example of the manner in which Nature applies a beautiful ornament to the exigencies of brute life, answering by one effort her twin demands for beauty and utility. The constant recurrence of the eye-spot must not be regarded as a mere economy of design, but rather as bearing the lesson that it is not possible to have too much of the best of its kind.

Electric Motor Troubles.

The unsatisfactory operation of a motor is usually attributed to some defect in the armature or commutator. The Street Railway Journal recently notes that many overlook the fact that the fields themselves may be the cause of the trouble. If proper attention were given to the testing of fields, it is safe to say that those mysterious troubles of motors that baffle solution would be fewer in number. Frequently attempts to test fields end in failure because the work is not done properly. Often attempts are made to test them with a voltmeter and an ammeter while they are in the motor. These tests are frequently unsatisfactory because not enough current is used to get an appreciable voltmeter reading or the current is not allowed to flow a sufficient length of time to heat the fields thoroughly. A heated field will often indicate the presence of shorted coils when the same field while cool and under a drop of potential test will show up O. K. When possible, coils should be tested while clamped in position in the motor, but if this is not possible, and they are tested on the floor of the shop, pressure should be put on them when the readings are taken. Sometimes standing on them or jumping up and down on them will cause a variation in the reading of the voltmeter; if so, the chances are great that the field is defective. In addition to the drop of potential method with direct current, fields may be tested when out of the motor by means of a transformer. A special transformer is required built in such a manner that the field to be tested may be slipped over a core and be made to serve as the secondary of the transformer. A short-circuited coil in the field makes itself evident by an increase in the primary current, by the heating of the field and by the sound given out from the transformer. As with direct-current tests, it is best to apply pressure to the coil in order to develop any shorts that would occur if the field were thoroughly heated and clamped in position in the motor shell.

Several field coil testing devices especially adapted for testing fields while they are clamped in the motor have also been developed within the last few years. When properly used, these devices usually give good results, and, further, the tests are made in a very short time. The machines are usually constructed on the principle of a Wheatstone bridge, a telephone or a galvanometer being employed to indicate when the known resistance is equal to the resistance of the field being tested. But in many instances where these instruments have been purchased, the shop man who is assigned to test the fields does not operate with the instrument long enough to get familiar with it. He seems to regard it as too complex to be understood. But if an earnest effort is made to test fields in this way it will not be long before satisfactory results can be secured. When the testing of fields is begun in shops in which it has not been carried on before, records of all tests should be kept and the condition of the fields when torn up should be noted. By so doing the proper resistance for a perfect coil may be obtained for each type of motor in use. When starting out, if there are no figures as to what the readings should be, the resistance of one field of the motor may be compared with that of another.

The difficulties in obtaining satisfactory results in testing field coils are no doubt largely responsible for the general inattention given them when the causes for the faulty action of a motor are being considered. But as there is such a great likelihood of the fields being the cause of motor troubles, certainly more attention should be taken to ascertain their condition whenever the trouble cannot be located elsewhere.

Upas Arrow Poison.

The upas tree, *Antiaris toxicaria*, which grows in Borneo and other East Indian islands, has long had an evil reputation, and it is still a common belief that birds flying within the influence of its poisonous vapors instantly perish, and that it is fatal for animals or men to rest beneath its shade. As is the case with many another fable of natural history, there is some groundwork for the exaggerated reports of the evil effects of the upas tree, for it resembles certain Rhus plants in emitting a volatile substance which affects the skins of certain susceptible persons coming near it, though others are quite unaffected. There is no question, however, as to the poisonous nature of the sap of the tree, and it is the chief substance used by the Dyaks of Borneo for poisoning the tips of their darts. An interesting account of their method of preparing and using the poison has been given by Mr. John Allen to the Manchester Literary and Philosophical Society. An incision is made in the bark of the tree and the milky exudation collected on a palm leaf and dried first in the sun and then over a fire until a thick brown mass is left. In this state it can be kept without the poison deteriorating, and when required for use it is made into a thin paste with the juice of "tuba" root (which is used to stupefy fish), or with tobacco or lemon juice, and the ends of the darts dipped into the mixture and dried. These darts are made from the middle stem of the palm leaf and are about six or eight inches in length and of about the thickness of a knitting-needle. They are used with a wooden *sumpitan*, or blow-pipe, which is about seven or eight feet in length and has an internal diameter of about ¼ inch. A bird struck by one of these little darts is instantly killed, and a pig dies in about 20 minutes. The fresh juice of the upas tree, whether swallowed or injected into the blood, acts as a violent poison, causing convulsions and death from paralysis of the heart. It was shown some years ago by MM. Pelletier and Caventou that the active principle in the juice was a substance which they termed *antiarin*, $C_{14}H_{20}O_5$. It was crystalline and soluble in alcohol, and when heated with dilute acid was decomposed into glucose and a yellow resin. Another poison prepared from the roots of *Upas tieute*, a climbing plant, is in less common use as an arrow poison. Its action is still more deadly than that of *Upas antiaris*, and its effects resemble those produced by strychnine.—Knowledge.

Determination of Ethereal Oils in Aromatic Waters.

For this purpose E. Beckmann employs the method elaborated by him and Dankwortt for the examination of foods (Pharm. Zeit.). It is based upon the depression of the boiling point and the freezing point which a liquid suffers through the substances it holds in solution. The aromatic water to be tested is shaken with ethylene bromide and the above-named constants determined for the pure ethylene bromide and for the ethylene bromide used in the shaking-out process. It should be remembered, however, that the alcohol present must be removed by shaking the ethylene bromide solution with water and that the maximum depression caused by water in the ethylene bromide is to be subtracted from the depressions obtained.

While tungsten is considered one of the rare elements tungsten compounds are of considerable use. Sodium tungstate is largely employed for impregnating fibers to make them fireproof. It is also used as a mordant in dyeing. Tungsten bronzes are largely employed as bronze powders and pigments. The chief consumption of tungsten in recent years has been, however, for high-speed tool steels and for hardened steel for armor plates and large guns.

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

RECEIVER FOR TELEPHONES.—L. Steinberger, New York, N. Y. This invention relates to telephony, the more particular purpose being to produce certain improvements in the construction of the receiver. These are partly acoustic and partly mechanical. The oblate form of the large end of the receiver enables it to be applied to the ear with great precision. The receiver presents, as a whole, no crevices, chinks or ledges in which foreign substance is liable to lodge, it permits no undue catching of dust, and its sanitary properties are therefore greatly increased.

Of Interest to Farmers.

PLANTER ATTACHMENT.—G. Weidinger, Circleville, Ohio. The improvement is particularly useful in connection with devices adapted to the sowing of corn and the like, in which a runner is provided with lateral blades to run in the furrow. The blades are adjustable horizontally and vertically. There are no external projections on the runner to prevent the scouring clean of the same by contact with the earth.

CORN-CUTTER.—H. Willits, New Boston, Ill. The object of the present invention is to produce a machine such as is used for cutting corn into short sections. The improvement concerns itself specially with the mechanism for operating the knife and agitating the hopper, as well as other mechanism for gaging the length of the section into which the ears are cut.

PLOW ATTACHMENT.—N. T. Lien, Brinsmade, N. D. The purpose of the invention is to provide an attachment to plow-beams which will act to bend down stubble or weeds during the operation of plowing, insuring their being effectually covered up, and thus preventing the weeds and stubble interfering with the subsequent harrowing of the land.

Of General Interest.

DIRIGIBLE BALLOON.—E. M. Bossuet, 49 Boulevard Haussmann, Paris, France. The principal body is constituted by two conical vessels filled with gas and having their bases opposed and to which vessels a rotary motion is imparted from a motor carried by the balloon, the latter being characterized by, first, its mode of propelling by means of helical wings arranged throughout the length of the conical vessels forming the principal body on two, three, or four lines, so as to form a screw with interrupted multiple threads, the wings of each line being stepped; second, the arrangement of framing for bracing the parts, avoiding any distortion of the whole system and making the same perfectly rigid, while preserving the balloon and car.

AUTOMATIC WINDOW-CONTROLLING ATTACHMENT.—J. B. McKeown, Union Hill, N. J. The invention pertains more particularly to windows in factories, stores, and other buildings. The object is to provide an attachment arranged to allow moving the window-sash into an open position and holding it therein for ventilating and like purposes and to permit the sash to move into a closed position in case of fire to shut off draft, and thus prevent fire from spreading.

BOX-FASTENER.—A. Suter, New York, N. Y. The improvement relates to shipping cases or boxes, the object being to provide means for lacing or securing the cover on the case. The side boards of the body of the case are provided with recesses, into which spring-plates may be pressed inward of the plane of the locking devices to permit the outward swinging of the locking devices. The heads of the plates and portions of the locking devices may be provided with perforations to receive sealing-wires.

BRIDGE.—W. E. Whiteside, Mangum, Oklahoma Ter. The bridge is especially designed as a combined railroad and wagon bridge, and may be constructed of wood, iron, or other material. In practice the bridge is designed to be a suspension built in sections with the ends of the bridge resting on abutments on the opposite banks of the stream or space to be bridged, the bridge being constructed with sections or units may be made of any suitable length within reasonable bounds.

GAGE FOR FINDING THE LENGTHS, BEVELS, AND CUTS OF BUILDING MATERIAL.—J. D. Wall, Minneapolis, Minn. The purpose of the inventor is to provide a device for the use of carpenters and others whereby to quickly and accurately obtain the lengths, bevels, and cuts of any kinds of rafters employed, especially in all kinds of roofs, and also the lengths and bevels of other work, such as hoppers, trusses, braces, and stair-runs, either dome or circular. Any angle of any piece of timber used can be readily obtained.

COMBINED BUTT AND LOCK GAGE.—J. M. Realing, Daytona, Fla. The measuring and marking means combine in a single device a square, a bevel, and a marking-gage, so that the effectiveness of one does not impair the efficiency of the others, but are designed to co-operate with each other. It is useful in hanging and trimming doors, marking off butt or lock lines, affording the use of a try-square, and also a depth-gage in door operations.

WINDOW-BLIND GUARD.—L. D. Richardson, Providence, R. I. The object in this invention is to produce a device applicable to a shutter in order to prevent the same from being dislodged by the wind or other cause. The shutter cannot be raised in such a way as to remove it from the pintle. The guard, however, does not interfere with the opening or closing of the shutters, as it simply moves with the hinge-leaf, so that the finger or dog always projects under the hanger.

CHALKING DEVICE.—P. T. Erwin, Everton, Mo. The improvement is especially useful in connection with chalking devices used by carpenters or masons to apply chalk to cord and the like. The object is to provide a device which is simple and inexpensive to manufacture and which permits the chalk to be applied to a cord expeditiously and in a cleanly manner.

Heating and Lighting.

KILN-HEATING APPARATUS.—S. O. Larkins, Roland Park, Md. Mr. Larkins's improvement has to do with heating apparatus employed in lumber kilns or houses, and has for its object peculiar, novel, and improved apparatus using steam as the heating medium. It is designed for arrangement in kilns or houses adapted for the reception of cars loaded with lumber to be dried.

RELIEF DEVICE FOR WATER SYSTEMS.—L. W. Eggleston, Appleton, Wis. This invention refers to relief-valves or pressure-regulators for water systems. It is intended to be used especially in connection with water-heating systems. The object is to produce a device which will operate to maintain a substantially constant pressure and temperature for the water throughout a water system.

Household Utilities.

COMBINED CLOTHES WASHER AND WRINGER.—O. Guitar, Columbia, Mo. The tank is partially filled with water and the clothes are placed on a presser-bed and the bed is lowered until they are immersed. By alternately elevating and depressing a presser-plate the water is alternately drawn through and expressed out of the clothes. After they are cleaned the bed is elevated so that spring-latches engage the uppermost notch of the ratchet-bar, removing the clothes from the water, and the presser-plate is again lowered to express water from the cleansed clothes. They are then removed from the pressing-bed and operation repeated. The same operation is done in wringing after clean water has been introduced.

Machines and Mechanical Devices.

FEEDING MECHANISM.—G. H. A. M. Leroy, 10 Rue Bertin-Poirée, Paris, France. The present invention relates to a system of feed in which recourse is had to an automatic wedging for firmly fixing the band in the position which it occupies at the moment of the advance, which allows it to be carried forward for a distance exactly equal to the stroke of the feeding device. The band becomes unwedged in a manner likewise automatic.

GRINDING APPLIANCE FOR DRILLING-MACHINES.—E. M. Kinsella, Bisbee, Ariz. Ter. The invention relates to hand and power drilling-machines. The object is to provide a guiding appliance for guiding the drill-bit of the machine in the drill-hole to allow easy working of the bit in seamy or fitchety ground and to permit ready escape of the sand, dirt, or other borings from the drill-hole.

Note.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Business and Personal Wants.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**

MUNN & CO.

Inquiry No. 8547.—Wanted, playing cards with raised spots for those that cannot see.

Inquiry No. 8548.—Wanted, machinery for the manufacture of alcohol from apples, molasses and sugar.

Inquiry No. 8549.—Wanted, a musical alarm clock, 7 inches high by 5 inches wide, nickel-plate brass frame with glass sides, visible works, retail price $2.48; wanted to purchase same by wholesale.

Inquiry No. 8550.—Wanted, a machine for pointing meat skewers in large quantities, such as 50,000 skewers a day.

Inquiry No. 8551.—Wanted, machinery for drilling vegetable ivory buttons.

Inquiry No. 8552.—Wanted, makers of portable sanitary closets.

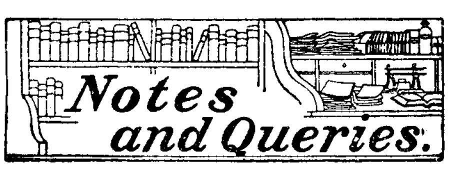
WANTED.—Copies of our "Manufacturers' Index" issued some eight years ago. State price. Munn & Co., 361 Broadway, New York.

Inquiry No. 8553.—Wanted, name and address of the makers of the Perplexity Puzzle recently sold by the Union News Co.

Inquiry No. 8554.—Wanted, name and address of wholesale dealers in galvanized corrugated iron and galvanized iron roofing.

Inquiry No. 8555.—Wanted, manufacturers of the following: trunk board, lamp colors, sheet aluminum, coal-oil burner without chimney.

Inquiry No. 8556.—Wanted, the address of a German firm which manufactures souvenir post cards and one which makes prism field glasses.



HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.
Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.
Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.
Scientific American Supplements referred to may be had at the office. Price 10 cents each.
Books referred to promptly supplied on receipt of price.
Minerals sent for examination should be distinctly marked or labeled.

(10279) M. O. C. asks: Can you inform us how to copper common iron castings without a battery so they will not rust, or how to whiten them by dipping? A. To copper iron castings, the articles must be made perfectly clean, and then dipped in a solution of $1\frac{1}{2}$ pounds copper sulphate in water to which 1 ounce sulphuric acid has been added. They are then washed and dried.

(10280) W. H. asks: Please give me the best formula for a dry primary battery. A. One of the best dry cells is said to be filled with the following mixture: Oxide of zinc, 1 part by weight; sal-ammoniac, 1 part; plaster of Paris, 3 parts; chloride of zinc, 1 part; water, 2 parts.

NEW BOOKS, ETC.

PRINTING ART. Vol. VII. Cambridge, Mass.: Issued by the University Press, 1906. 4to.; pp. 412.

The volume before us is one of the most luxuriant, from a typographical point of view, that we have ever seen. It should be on the desks of all managers of printing establishments, and every compositor should subscribe for this beautiful publication, which will teach him how to produce the most artistic composition and printing. All of the advertisements are bound in, which is an excellent idea, as they are most informing. There are a large number of inserts showing cover papers of various weights and colors. The text is devoted to articles on the printing art written by experts, and freely illustrated by examples from the very best presses. A large number of samples of commerial work are tipped in. One can see at a glance what the up-to-date printers are doing in the line of commercial work. This publication should be subscribed for regularly by all those who are in a position to buy printing, as it enables them to keep abreast of a rapidly-advancing art. The publication is highly creditable to editor and printer alike.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Issued for the Week Ending December 18, 1906.

AND EACH BEARING THAT DATE

[See note at end of list about copies of these patents.]

Accounts, means for keeping credit and instalment, I. H. Hollander 838,993
Aerial navigator, automobile, G. M. West.. 838,673
Air brake, B. Canell........ 838,520
Air filter and cooler, J. Zellweger........ 838,602
Amusement apparatus, E. S. Mitchell...... 838,797
Amusement apparatus, S. J. Hart........ 838,989
Amusement device, A. Haye........ 838,539
Atomizer, F. S. Dickinson 838,960
Atomizer and like instrument, F. C. Dorment 839,085
Auger, earth, G. Frank 838,614
Automatic sprinkler, J. H. Dixon........ 838,963
Automobile motors, etc., lubricator for, J. F. McCanna 838,565
Awning sheave block, W. G. Halkett...... 838,783
Bag-frame, Hiering & Fuller........ 838,858
Bag frame, sewed-in or English, J. Lange.. 838,553
Barbers' chairs, sanitary protector for headrests for, A. Miller 838,733
Barrel washing machine, R. Troehler...... 838,670
Battery charging system, W. I. Thomson.. 838,822
Bearing, roller, W. T. Fleming........ 839,084
Bed and guide attachment, supplemental, A. F. Heckel 838,540
Bed bottom, Donaldson & Moore........ 838,697
Bed spring raising device, C. M. Schwab.. 839,041
Bed, wall or closet folding, C. Warnecke.. 838,760
Bedsteads, collapsible crib attachment for, E. C. Smith 838,591
Beer and other liquids having a gas dissolved therein, pasteurizing, F. Knipping 838,721
Beer racking apparatus, H. L. Momburg.. 838,735
Belt clamp, G. H. Alexander 838,678
Belt guide, De Gree & McAlister........ 838,958
Belt stretcher, S. L. Porter 839,028
Belting, machine, D. E. Jones 839,001
Binder, temporary, W. S. Mendenhall...... 838,795
Binder, temporary, F. J. Schleede........ 838,813
Binder, temporary, A. Lawrence 839,010
Bit brace, angle, J. H. Ackermann 838,677
Block. See Awning sheave block.
Blower head, rotary, G. C. Hicks, Jr...... 838,541
Boiler cleaner, C. H. Prescott........ 838,898
Boiler stand, J. A. Gagnon 839,062
Book carrier, J. W. Johnson 838,786
Book cover, detachable, P. Meissner 838,559
Books, etc., apparatus for the automatic delivery, on sale or hire, of, H. Pottin.. 838,897
Bottle, S. G. Wise 838,929
Bottle, non-refillable, Schweizer & Thomas. 838,588
Bottle soaking machine, D. Wickham........ 838,927
Bowling pin setting device, J. H. Boyd.... 838,766
Box framer or former, A. Lasance 838,554
Box-lid clamp, Patterson & Ireland........ 838,745
Brace and support, E. E. Seacrist 838,911
Braiding and lace making machine, H. J. Quambusch 838,899
Brake, L. B. Williams 838,830
Brake shoes, making, W. D. Sargent........ 839,037
Brander, electric, G. J. Schneider........ 838,652
Bridle, H. A. Sievert 838,656
Broom protector, J. C. Cooper 839,057
Brush, sanitary hair, R. J. Ellis 838,527
Brush, scrubbing, F. W. Scofield........ 839,042
Buckle, cross line, N. G. Wilson........ 838,676
Buggy top support, L. W. Loving 838,632
Building block, J. H. Clayton 838,844
Buoy, breeches, J. W. Dalton 838,690, 838,691
Bustle, F. B. Kuebler 838,722
Butcher's cleaver, J. H. Sherry........ 839,043
Butter box, G. E. Woodbury........ 838,832
Button cleaning machine, C. G. Heller..... 838,991
Button, separable, G. F. Flade 838,970
Buttons and like articles, machine for turning, Embler & Diemer 838,528
Cabinet, E. M. Nolen 838,567
Cable tension apparatus, Miller & Dickinson 839,019
Calculating machine, J. T. Howieson 838,996
Calculating machine, D. J. T. Hiett, reissue 12,582
Camping lodge, S. B. Comstock 838,689
Candelabrum, A. C. Guntzer 838,619
Cane, extracting saccharine matter from sugar, M. R. Spelman 838,818
Car, box, Emerick & Bundy 838,529
Car brake, A. Koonse 838,549
Car brake beam, railway and other, S. A. Crone 838,776
Car brake, railway, S. A. Crone..838,773 to 838,775
Car brake shoe, railway, W. H. Miner..... 839,074
Car construction, S. M. Curwen........ 838,608
Car door, grain, Mitchell & Bauman........ 838,636
Car draft rigging, railway, F. L. Englehardt 838,530
Car draft rigging, railway, W. H. Miner, 838,560, 838,561
Car draft rigging, railway, J. R. Mitchell. 838,563
Car fender, A. E. Gumz 838,983
Car rail standard, J. H. Nantz 838,739
Car sign and signal, electric, Ryder & Orth 838,586
Car sign support, M. D. Batchelder 838,937
Car ventilator, A. P. Scheurman 838,909
Car wheels, manufacture of, J. K. Griffith 838,981
Cars, antifriction center bearing for railway, J. F. O'Connor 838,576
Cars, etc., means for elevating, A. V. Trust 838,594
Carbureter, J. M. Kelley 838,719
Carbureting apparatus, gas, L. C. Parker... 838,805
Carpet cleaning device, C. W. E. Boegel.. 838,943
Carpet sweeper, L. P. Halladay........ 838,620
Carrier. See Book carrier.
Cartridge, F. I. Du Pont........ 838,748
Cash register, Bockhoff & Pein........ 838,942
Casting machine, matrix, J. R. Rogers..... 838,905
Cellulose threads, manufacture of lustrous, R. Likmeyer 839,013, 839,014
Cement, roofing, M. W. Powell........ 838,580
Chafe iron, C. T. McClelland 838,883
Chimney cap, J. R. Cochran........ 838,523
Chocolate press, G. Carlson 838,841
Chromates into bichromates, converting, R. Suchy 838,757
Chuck, drill, P. McKay 838,638
Churn, B. T. M. Pemberton 838,806
Churn and butter worker, combined, M. F. Stadtmuller 838,661
Churn power, J. W. Oliver 838,577
Cigar bundling machine, J. King, Sr., 838,624, 838,625
Circuit breaker, time limit, W. M. Scott.. 839,079
Clamping tool, W. A. Fuller........ 838,705
Cleat, scenery, D. J. Cronin........ 838,846
Clock, electric alarm, L. Trede 839,918
Clutch, electromagnetic friction, Schuster & Ast, reissue 12,581
Coin freed apparatus, W. Abel........ 838,930
Column, I. W. Numan 838,571
Concrete block molding flask, J. Hamm, reissue 12,580
Concrete building block mold, J. B. Francisco 838,704
Concrete building blocks, machine for manufacturing hollow, Borst & Groscop (reissue) 12,578
Concrete construction, W. T. McCarthy..... 839,021
Concrete post mold, W. J. Moore 838,737
Conduit box, interior, F. W. Erickson...... 838,778
Connecting ring, F. H. Engeman 838,611
Conveyer, C. D. Seeberger 838,654
Copy holder, J. H. Sharp 838,590
Corrugating machine, I. W. Numan........ 838,569
Coupling device, H. Hills........ 838,859
Crown, porcelain and metallic, C. A. Davis. 838,849
Cultivator, W. W. Mitchell, Sr........ 838,798
Current heater, alternating, J. F. McElroy. 838,885
Current motor, W. A. Cairns 838,682
Curtain fastener, H. A. Hopkins 838,995
Curtain fixture, Lawson & Silvernail........ 838,627
Curtain pole, J. F. Lalus 838,867
Cutter guard, revoluble, N. M. MacLeod... 838,730
Desk pad and clip for holding papers, combination, M. Vernon 839,052
Detector bar, J. T. Hambay 838,709
Dish washing machine, Dapron & Froelich.. 838,955
Display rack, R. M. & H. M. Bowser...... 838,517
Door and window screen, J. A. Dietz...... 838,695
Door hanger, J. W. Harris 838,710
Door lock, J. Major 839,017
Door register and alarm, J. Speidler 838,660
Door, sheet metal, J. Tyra 838,672
Drill socket, multiple, J. P. Hylander ... 838,999
Drilling machine, A. Walker 838,923
Drilling machine crank, J. H. Engleman... 838,700
Dust collector, P. C. Miller........ 838,879
Dust guard, G. F. Godley 838,707
Dynamos, automatic regulator for direct current, G. S. Neeley 838,802
Dynamos, automatic voltage regulator for, G. S. Neeley 838,800
Easel frame, S. Bodinger 838,516
Edge setter iron with stitch wheel, M. F. Lindberg 839,012
Educational device, G. W. Chapman 838,840
Electric circuits, automatic cut-out device for, W. O. Taylor 839,048
Electric contact device, P. O. Pedersen... 839,027
Electric furnace, pyro, F. E. Roach 838,647
Electric generators, regulating the field density of, G. S. Neeley 838,801
Electric heater, plural coil, J. F. McElroy.. 838,884
Electric machine, dynamo, B. A. Behrend... 838,605
Electric motor and controlling the same, A. Kimble 838,547
Electric transmission of intelligence, I. Kitsee 838,788
Electrical construction, cross arm for, E. S. Hamilton 838,537
Electrical receptacle, B. E. Salisbury 838,811
Electroplating, W. S. Hutchinson 838,717
Electroplating apparatus, W. S. Hutchinson 838,716
Electrotyping, solution for use in, A. Gerstner 838,977
Elevator, G. F. Steedman 838,819
Elevator car safety apparatus, H. H. Busch 838,770
Elevator safety device, C. H. Leffingwell.. 838,726
Engine. See Gasolene engine.
Engine, J. H. Trevorrow 838,669
Engraving machine, pantographic, J. W. Lewis 839,011
Envelop and box, safety, Dobson & Gallagher 838,964
Envelop opener, J. Rindsberg 838,750
Ether receptacles and the like, closure for, R. H. Ferguson 838,969
Evener and doubletree carrier, Crouse & Orton 838,847
Excavating machine, J. W. T. Stephens.... 838,663
Excavating scoop, J. W. Page........ 838,892
Excavating shovel, J. W. Page........ 839,026
Excavator dippers, ejector for, C. Strom... 838,914
Exercising apparatus, A. P. Schmidt...... 839,040
Extension table, circular, J. E. Turner..... 838,671
Fabrics, apparatus for repairing defects in textile, Oehler & Bauer........ 838,890
Fastener, I. M. Sylvester 839,047
Feed roll, detachable, D. Crane........ 838,771
Fence post, P. E. Smith 838,592
Fence splice, wire, W. Clement........ 838,522
Fermentation of liquids, Johnson & Hare.. 839,067
Fermenting apparatus, wort, H. A. Schalk 838,812
Fertilizer distributer, E. L. Hahn 838,856
File case, A. Dixon 838,962
Finger nail trimmer, J. H. Smith 838,755
Fire escape, portable, A. S. Olney........ 838,891
Fire extinguisher, chemical, E. D. Matteson 838,794
Fire extinguishing apparatus, S. A. Collins 838,688
Fire resistive construction, B. E. Loomis.. 839,015
Fireproof building construction, C. Collins.. 838,845
Fisherman's combination tool, R. M. Varnedoe 838,920
Fishing reel, S. Sykes 838,915
Furnace, A. Box 838,679
Furnace grate, D. J. McKenzie 838,639
Furnace mouth lining for boilers, B. B. Lamprey 838,868
Fuse cutter and splitter, combined, A. Walker 838,924
Gage, G. B. Westburg 838,674
Gage, M. F. Carr 838,684
Game apparatus, Austin & Craw 838,763
Garbage receptacle and cover, J. I. Orkin.. 838,804
Garment clasp, M. Rubin 838,907
Garment hanger, A. W. Bernard 838,839
Garment hanger support, G. H. Wheary.. 838,828
Garment supporter, E. M. Silberman 839,044
Garter, R. Gorton 838,708
Gas burner, A. J. Quinlan 839,032
Gas, device for regulating the quality of, C. Matthews, Jr. 838,633, 838,634
Gas heater, E. G. Van Zandt........ 838,596
Gas lighting attachment, W. B. Carrick... 838,685
Gas producer, W. H. Bradley........ 838,946
Gas washing and scrubbing apparatus, S. Hersey 838,712
Gasolene engine, Walsh & Swanson........ 838,926
Gear case, B. L. Waters 838,598
Gin saw cleaner, R. L. Henderson 838,857
Glass gathering machine, R. D. Brown.... 838,768
Glass pressing apparatus, L. N. Loveland 838,875
Glass roofs and glass walls, U-bar for, J. Degenhardt 838,693
Glass tiles, manufacture of, W. T. Nicholls 838,889
Glassware, making light-edged pressed, F. Woodruff 839,054
Glove, Bradshaw & Downard 838,518
Glove, base ball, J. H. Gassaway........ 839,063
Glue or sizing, M. R. Isaacs 838,785
Gold dredgers, separating cylinder for, R. H. Postlethwaite 838,579
Governor for fluid pressure engines, W. H. Larkin, Jr. 838,725
Governor for internal combustion engines, F. H. Smith 838,754
Grader, road, J. W. Langfitt 839,069
Grain drill hopper, F. J. & W. F. Genet... 838,533
Grapnel, H. Roberts 839,036
Grate bar, H. C. Roller........ 838,906
Grinding machine, Lutter & Gies........ 838,556
Grinding machine, C. O. Smith 839,080
Grip, J. R. Crabill 838,952
Gymnasium apparatus, etc., rope connection for, M. B. Reach 838,584
Handle. See Saw handle.
Harrow, S. B. Arthurs 838,836
Harrow, A. Friedemann 838,974, 838,975
Harvester bundle carriers, automatic trip mechanism for, T. Thompson........ 838,668
Hatchet, K. K. Kihlmark 838,865
Hay rack and brake, combined wagon, S. F. Hughes 838,715
Head motion, A. Guionneau 838,982
Heat transferring apparatus, H. H. Tracy.. 839,082
Heating device, structure, D. W. Krellwitz. 838,550
Heating surfaces, machine for, G. H. Lutz. 839,071
Heating system, A. G. Paul 838,641
Hinge, H. J. Nagle 838,799
Hinge and closer, door, W. K. Henry..... 838,622
Hinge washer, J. F. George........ 838,976
Hitching bolt, G. Rheingans 838,901
Hoist, J. R. Sharp 838,655
Hoof nippers, H. B. Ward 838,597
Hose bracket, swinging, L. T. Foreman... 838,972
Hot air furnace, T. G. Neal 838,888
Hub, wheel, E. C. Sendelbach 838,814
Humidifier, F. B. Comins 838,951
Hydraulic power systems, means for effecting and controlling the storage of water in, F. Golwig 838,617
Ice cream freezer, A. H. Mace........ 838,557
Inductive bond, L. H. Thullen 838,916
Instantaneous wrench, E. L. Perry 838,578
Insulating electric conductors, means for, S. Berger 838,764
Insulators, die for forming, F. M. Locke.. 838,727
Jewel remover and seater, H. Straw....... 839,045
Journal bearing, F. M. Nash........ 838,566
Journal bearing, J. F. Walsh 838,925
Jug top, J. F. Haffey 838,536
Knife, J. W. Eckley 838,852
Label case, Huston & Burnette........ 838,544
Lacing tool, belt, S. Freeze........ 838,973
Ladder, extension step, F. Wilson........ 838,831
Lamp burner, L. D. Landrum 838,791
Lamp guard, incandescent, H. Hubbell..... 838,860
Lamp, incandescent electric, G. A. Nellis.. 839,023
Lamp, miner's, P. S. Keenan........ 839,002
Lamp socket adapter, Forbes & York...... 838,613
Lamp, therapeutic, Coger & Marshall...... 838,950
Latch, door, J. B. Engstrom........ 838,701
Leak stopper, C. C. Collette........ 838,524
Leg, artificial, G. A. Erickson 838,779
Lighthouse construction, T. K. Thomson.. 838,821
Linotype machine, P. T. Dodge 838,609
Liquid heating or cooling apparatus, H. Feldmeier 838,853
Liquid separator, centrifugal, C. A. Edlund 838,699
Liquid separator, centrifugal, D. W. Jordan 838,718
Lithopone having a sulfite of baryta base, formation of a, L. Brunet........ 838,769
Lock key, F. W. Schroeder 838,910
Lock mechanism, B. Phelps 838,808
Locomotive ash pan, E. E. Nettleton 838,740
Loom shuttle, Coldwell & Gildard, reissue 12,579
Loom shuttle, cotton, J. E. Lemyre........ 838,629
Low water alarm, W. I. Thomson........ 838,823
Mail carrying device, H. Pearson...838,746, 838,747
Manifolding and filing apparatus, J. Bailey 838,513
Marking apparatus, clothes, J. D. Caldwell. 838,683
Massage and manicure machine, O. C. De Selms 838,959
Mat, C. F. Doebler 839,059
Matted or felted material, machine for finishing the surfaces of, G. Goldman.... 838,616
Measuring device, foot, F. L. Kerr....... 838,720
Measuring vessel, liquid, R. C. Ricketts... 839,035
Meat hook, D. L. Walls 838,826
Metal cutting machine, G. H. White...... 838,675
Metal strips edgewise, machine for bending, G. S. Dunn 839,060
Mill. See Windmill.
Mills, etc., feed governor for, C. H. & A. J. Richards 838,646
Miner's cap and lantern holder, Lattimore & Parmley 839,070
Mirror and chip blower and flushing and spraying device, combination hand mouth, O. T. Robertson 838,648
Mirror holder, adjustable, S. E. Crane.... 838,953
Mirror, multiple, J. H. Petroskey........ 838,807
Molding machine, O. W. Schaum........ 838,908
Molding machine, N. Baldwin........ 838,935
Monkey and pipe wrench, convertible, J. T. Landers 838,552
Mop holder, J. Larson 839,006
Mortising and boring machine, J. S. Waugh 838,827
Motor, A. Charbonneau........ 838,687
Motors, limit switch for electric, S. Burrowes 838,681
Mowers, rotary cutter for lawn, A. B. Case 838,521
Mowing machine, Robinson & Cutsforth... 838,904
Music rack, U. S. G. Waldron 838,825
Nails, making cement coated, J. M. Dix... 838,526
Nut for bolts, frictional lock, G. Bryar.... 838,948
Nut lock, Magill & Polson........ 838,558
Nut lock, H. T. Moler 838,734
Nut lock, C. N. Treadwell 838,917
Nut lock, gland, V. L. Allebach........ 838,833
Oil can, Mease & Sechrist 838,635
Oil feeding apparatus, C. J. Lockwood.... 838,728
Oil waste cleaning apparatus, J. I. Orkin.. 838,640
Oils, etc., apparatus for extracting, H. A. Silvera 838,658
Oiler and wiper for piston rods, combined, Rudd & Stout .... 838,65[illegible]
Optical device, G. W. MacDonald........ 839,016
Ordnance sighting apparatus, Dawson & Buckham 838,957
Ores, treating, J. E. Greenawalt 839,065
Outlet box, M. J. McGowan, Jr........ 838,886
Overshoe, A. E. Roberts........ 838,751
Package and the like carrier, G. Staib.... 839,081
Pads of matted or felted fibers, machine for finishing garment, G. Goldman.... 838,615
Paper and folding the same, device for perforating or slitting sheets of, C. A. Sturtevant 839,046
Paper, etc., grease proofing and moisture proofing, L. P. Brown 838,607
Pea and bean hulling machine, W. E. Jones 838,862
Perambulator, G. Lauterer 839,009
Perch bracket, J. J. Dropeskey........ 838,851
Photographic prints for reproduction, preparing, J. H. Eggers 838,610
Photographic sensitized surfaces, lighttight packet for, O. Becker 838,939
Piano touch regulating attachment, L. Harriss 838,711
Pick, A. Bohy 838,944
Picture or similar frame, W. I. Sherwood.. 838,816
Pipe cover and ash retainer, A. Spiers.... 838,593
Pipe molding apparatus, collapsible core for, N. Baldwin 838,934
Pipe tongs, G. W. Baker 838,514
Pipe wrench, E. Sutherland........ 838,665
Pipes and cigar and cigarette holders, mouthpiece for, M. Borgen........ 838,606
Pipes, clean out for soil, J. J. Phelan..... 838,642
Piston rod connection, L. Anderson........ 838,603
Plow harrow attachment, sulky, K. Schaal. 839,038
Plow, motor driven, W. H. Milton........ 838,796
Plows, landing lever for sulky, W. L. Paul. 838,894
Pneumatic recoil apparatus, J. A. Deport.. 838,694
Pole, telescopic, H. H. Bremer........ 838,519
Porous hearth furnace, J. E. Greenawalt.. 839,064
Postal card, E. M. Miner........ 838,880
Power station, submerged, H. A. E. C. von Schon 838,587
Power transmission device, H. E. White.. 838,600
Power transmission mechanism, R. Symmonds 838,666
Power transmitting machine, E. Prouty.... 838,581
Printing frame, E. Gould 838,534
Printing machine, warp, A. C. Schoen..... 839,083
Printing press, C. M. Kneppler 838,790
Printing press, T. C. Sheehan 838,912
Propeller, reversible, W. C. Fischer........ 838,532
Pulley, clutch, W. J. Hilliard, reissue..... 12,583
Pulp board making machine, A. W. Case... 838,686
Pump, H. & J. E. Nagel........ 838,887
Pump, J. W. Myer 839,020
Pump, centrifugal, Lea & Degen, reissue.. 12,584
Puzzle, J. E. Van Antwerp........ 838,919
Racks. See Display rack.
Radiator, S. Drew 838,966
Radiators, construction of metal, F. Fouche 838,703
Radium, apparatus for application of salts of, H. Farjas 839,061
Rail bond, F. D. Masterson 839,072
Rail chair and anticreeper, F. L. Rager.... 838,900
Railway gate, J. B. Hockersmith........ 838,992
Railway purposes, interlocking machine for, J. B. Struble 838,820
Railway signal, B. & D. Samuels........ 838,752
Railway signal, G. P. Finnigan........ 838,780
Railway signaling apparatus, A. J. Hitch.. 838,542
Railway tie, O. O. Fore........ 838,971
Railway tie plate, W. F. Gould 838,618
Railway track gage, O. Renstrom........ 839,034
Railway track tie, J. F. O'Connor........ 838,575
Railway tracks, composite metal and wood tie for, Miner & O'Connor........ 838,562
Railway tracks, composite metal and wood tie for, J. F. O'Connor........838,572, 838,573
Railway tracks, metallic tie for, J. F. O'Connor 838,574
Railways, electric block signal system for, G. P. Finnigan 838,854
Rake clearer, Hebert & Brown 838,990
Range rod, N. Lafon 839,005
Razor, safety, F. H. Arnold........ 838,762
Reamer, W. Turney 839,051
Reflector, C. J. Klein 838,789
Rein holder, E. Masurath 838,731
Resilient wheel, Oldfield & Schofield....... 838,803
Riding attachment, H. L. Parrish........ 838,743
Rotary engine, M. L. Williams........ 838,928
Rotary engine, C. McQuown........ 839,022
Rotary kiln, W. R. Warren........ 839,[illegible]53

Rotary reciprocating engine, M. J. Hinden 838,713
Routing rack, G. W. Hurd 838,543
Rubber reclaiming apparatus, waste, E. R. Solliday 838,756
Rule, engineer's slide, W. F. Doherty 838,696
Sad iron, W. E. Hoyt 838,997
Safety trip, J. W. Gray 838,980
Sash balance, J. L. Best 838,515
Sash, reversible window, J. G. Robbe 838,585
Sash weight, Lyons & Clark 838,876, 838,877
Saw guide, W. C. Renie 838,645
Saw gumming or setting machine, W. Van Buskirk 838,595
Saw handle, T. A. Smith 838,817
Saw handle, W. C. Birdsall 838,941
Saw handle, crosscut, G. W. Doxsie 838,698
Saw set, E. Chainey 838,843
Saws, straight-edge for circular, B. Lafleur 838,551
Sawmills, holding down rolls for, D. Crane 838,772
Scale, J. A. Rishel 838,902
Scale, H. B. Osgood, Jr. 839,025
Seat for circuses and the like, W. H. Curtis 839,058
Sectional boiler, A. Hage 838,782
Seeder, M. H. Browning 838,947
Semen carrier, J. C. Seeland 838,753
Separating tank, E. B. Kirby 838,626
Sewing machine, L. Onderdonk 839,078
Sewing machine, chain stitch, L. Onderdonk 839,077
Sewing machine feeding mechanism, L. Onderdonk 839,076
Sewing machine looper operating mechanism, L. Onderdonk 839,075
Sewing machine needle chart, J. H. Boye 838,945
Sewing machine presser foot, R. C. Woodward 839,055
Shaft, flexible, R. L. Morgan 838,882
Shaft support, A. T. Moore 838,736
Shafts, top bearing for vertical, F. Klingner 839,004
Sheet metal bolt structure, J. S. Rapson 838,644
Sheet metal corrugating machine, I. W. Numan 838,568, 838,570
Shoe, J. Abramowitz 838,931
Shoe form, A. G. Legge 838,874
Shoe form, C. S. Pierce 838,896
Shoe polishing stand, W. O. Beck 838,938
Shoe, water, F. I. Hannan 838,986
Shutter fastener, J. B. Williams 838,829
Shutter operating device, G. L. Preacher 839,030
Signal device, J. S. Cunningham 838,848
Signals, receiving system for wireless transmission of, V. Poulsen 839,029
Silk, apparatus for the manufacture of artificial, E. Thiele 838,758
Silver cleaning compound, W. H. Roome 838,810
Sink attachment, A. A. Ficener 838,775
Skate, J. King 838,623
Skirt, K. Vernon 838,922
Skiving machine, D. N. Robertson 838,903
Sled, C. A. Lang 838,724
Sluice, free roller, F. W. S. Stokes 838,664
Smoke consumer, C. H. Shepler 838,913
Sound record and sound record tablet, V. H. Emerson 838,968
Spark plug, R. O. Hood 838,994
Spark producing device, F. A. Thurston 839,049
Spring. See Vehicle spring.
Stage illusions, means for producing, H. Goldin 838,978, 838,979
Staple puller, E. Hanking 838,987
Steam engine, W. Loeffler 838,702
Steam trap, E. A. Sikes 838,631
Steel, producing a black oxid on the surface of, E. Jabulowsky 838,657
Steering gear, E. Bentley 838,546
Stereotype plates, means for casting, T. M. North 838,940
Stick pocket, C. G. Holz 838,741
Stocking supporter, A. Levy 838,714
Stocking supporter loop pad, J. H. Pilkington 838,555
Stone crusher, W. L. Velten 838,643
Storage cells, system for charging, I. S. Raymer 838,921
Stove, gas heating, B. C. Bartlebaugh 838,583
Stove, heating, E. G. Thomas 838,936
Stove or furnace, W. Kline 838,667
Strawberry huller, A. W. Stephens 839,003
Street crossing indicator, Palmer & Coben 838,662
Sweetmeat, such as chocolate, manufacture of, V. Hain 838,893
Swingletree, G. Laube 838,985
Switch controlling device, automatic, Shaaber & Selling 838,870
Switch operating and locking mechanism, A. Anderson 838,589
Table support, V. C. Luppert 838,834
Telegraphy and telephony, multiple, Hutin & Leblanc 838,793
Telephone lines, testing system for, W. W. Dean 838,545
Telephone system, H. L. Reber 838,525
Telephone system with central battery, G. M. T. Piltz 838,749
Telephones, attachment for acousticons permitting use of ordinary, K. M. Turner 838,809
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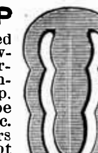

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Metal polish, P. J. Zehnder............... 58,512
Milk, condensed, Borden's Condensed Milk Co. 58,577, 58,627, 58,628
Milk, modified cow's, Inland Milk Laboratory Co. 58,586
Molasses, syrup, and sorghum, New Orleans Coffee Co..............58,609, 58,654 to 58,657
Musical instruments, certain named, Regina Co. 58,661
Nails, wire, J. Hassall.................... 58,487
Neckties, Hellenberg & Co................. 58,584
Neckwear supporters, Blumenkrohn Crochet Button Works 58,576
Needles and bodkins, hand sewing, Abel Morrall Limited 58,461
Needles, crochet hooks, and bodkins, hand-sewing and knitting, H. Milward & Sons 58,462
Nets, hair, A. G. Jennings................ 58,606
Nitrogen fixing bacteria, Ray Chemical Co. 58,500
Oil and lubricants, cylinder, White & Bagley Co. 58,533
Oil, olive, Bisi & Caprini................ 58,623
Oils, greases, and compounds, lubricating, Ironsides Co. 58.491, 58,492
Overalls, jumpers, and trousers, Fort Worth Overall Co. 58,580

INDEX.

ILLUSTRATIONS.

MISCELLANY.

Figures preceded by a star (*) refer to illustrated articles.

Overcoats, coats, vests, pants, and reefers, Schloss Bros. 58,599
Painters' materials, certain named, Murphy Varnish Co. 58,497
Paints and painters' materials, certain named, Lowe Bros. Co. 58,562
Paints, mixed paints, and enamels, Holzapfel's Compositions Co. 58,489
Paper bags, Union Bag & Paper Co., 58,617, 58,618, 58,667 to 58,669
Paper, certain named, Mittineague Paper Co. 58,607
Paper, wrapping and bag, Detroit Sulphite & Pulp Paper Co. 58,638
Pens, stylographic and fountain, Sanford & Bennett 58,613
Periodicals, Munn & Co. 58,653
Pianos, J. T. Wamelink & Sons Piano Co... 58,647
Pianos, Lyon & Healy 58,650
Pianos and organs, D. S. Andrus & Co.... 58,603
Pickles and branded fruits, Passano & Co. 58,611
Pillows, cushions, and mattresses, Sanitary Feather Co. 58,663
Pins, safety, H. B. Claflin Co. 58,441
Pins, toilet and glass-headed, Abel Morrall Limited 58,432
Powder, explosive, Laflin & Rand Powder Co. 58,557
Pumps, steam, Union Steam Pump Co. 58,456
Punch, George F. Hewett Co. 58,484
Radiators, American Radiator Co., 58,434, 58,435, 58,473, 58,474
Razors, shears, and pocket scissors, knives, and manicure blades, H. Clauss 58,478
Rubber boots and shoes, Akron Rubber Shoe Co. 58,619
Sausages, Gomprecht Sausage Co. 58,581
Sausages, Jones Dairy Farm 58,590, 58,648
Scissors and shears, M. T. Smith 58,505
Sheetings, J. E. Reynolds 58,598
Sheetings, cotton, Minot, Hooper & Co.... 58,596
Sheetings, shirtings, and drills, R. A. Suffern 58,570
Shoes, men's and boys' leather, Barker, Brown & Co. 58,621
Shovels, picks, spades, and scoops, Wyoming Shovel Works 58,472
Signs, advertising, Illuminated Novelty Manufacturing Co. 58,585
Silver lead, or plumbago foundry facings, and pulverized graphite, United States Graphite Co. 58,531
Soap, David Brown & Son 58,438
Soap, Haskins Bros. & Co. 58,443
Soap, Wiehle Soap Co. 58,457
Soap, Johnson & Johnson 58,463
Soap, Lever Brothers Co. 58,464, 58,465
Soap, N. K. Fairbank Co. .... 58,466 to 58,469
Soap, laundry, William Waltke & Co. 58,458
Soap, liquid, Wm. B. Riker & Son Co. 58,471
Soap, toilet, J. H. Woodbury 58,459, 58,460
Spices, A. Schilling & Co. 58,664
Sporting goods, certain named, A. J. Reach Co. 58,534
Sputum cups, Aseptic Drinking Cup Co. 58,436
Steam regulating devices, pumps, and engines, Mason Regulator Co. 58,494
Steel, raw or in blocks, bars, sheets, or plates, F. Bischoff 58,437
Sugar, S. Ewart & Co. 58,604
Surgical bandages, M. Picot 58,449
Sweaters, Kahn & Mossbacher 58,592
Tea, Acme Tea Co. 58,548, 58,549
Tea, Lappin Tea Co. 58,558
Tea, S. C. Smith & Co. 58,569
Thread, spool and sewing cotton, American Thread Co. 58,573
Tire protectors, Adwear Auto Tire Sleeve Co. 58,513
Tobacco, chewing, H. B. Scott Tobacco Co.. 58,442
Tobacco, smoking and chewing, H. Rippen.. 58,451
Tobacco, smoking and chewing, Independent Snuff Co. 58,490
Tobacco twists, Robards Tobacco Co. 58,501
Tools, wooden cases and cabinets for, Cleveland Twist Drill Co. 58,635
Toy stone building blocks, F. A. Richter.... 58,567
Turpentine, artificial, Gardiner & Percy Co. 58,483
Type casting and composing machines, paper ribbons or controllers for, Lanston Monotype Machine Co. 58,649
Typewriter ribbons and carbon paper, Wyckoff, Seamans & Benedict 58,672
Typewriter ribbons and pads and carbon papers, J. Underwood & Co. 58,666
Vending machines, coin controlled, Shaw & Ludington 58,470
Ventilators, Merchant & Evans Co. 58,448
Water, aperient, Standard Bottling Co.... 58,600
Water, drinking, Strawbridge & Clothier.. 58,543
Water, mineral, Buckhorn Lithia Water Co.. 58,629
Water, mineral spring, E. P. Sanford 58,568
Whisky, R. H. Cate 58,476, 58,477
Whisky, Freiberg & Workum 58,481, 58,482
Whisky, A. Menn, Jr. 58,496
Whisky, Old "76" Distilling Co. 58,498
Whisky, Schaefer & Driehorst Co. 58,503
Whisky, Shea-Bocqueraz Co. 58,504
Whisky, Woodford Distilling Co. 58,510
Whisky, W. A. Ross 58,530
Whisky, Jas. R. Ross & Co. 58,556
Wines, H. Obernauer 58,564
Wrenches, bit braces, and shovels, Russell & Erwin Manufacturing Co. 58,502
X-ray tubes, H. Green 58,440

LABELS.

"Black Devil," for hosiery, Seder Brothers 13,274
"Ganargua," for canned corn, Wayne County Preserving Co. 13,264
"George Eliot," for sauce and catchup, R. J. Smith & Sons 13,262
"Indian Hair Restorer," for a liquid hair tonic, L. Berdy 13,266
"Lemaire Paris," for opera glasses, Baille-Lemaire et Fils 13,277
"Prussian Stock Tonic," for stock tonic, G. Phipps 13,267
"Skiddoo," for a card game, C. H. Smith.. 13,278
"Sylvan," for soap, Armour & Co.. 13,269 to 13,272
"Three Minute Plum Pudding," for plum pudding, A. T. Knapp 13,265
"Union Manilla No. 1," for manila wrapping paper, Gray, Ewing & Co. 13,276
"Unique Typewriter Carbon," for typewriter carbon paper, O. R. Brown 13,275
"Uno, is a Life Preserver," for a medicinal compound containing soluble sulfur, Empire Soluble Sulphur Corporation 13,268
"Violet Talc Powder," for talc powder, Colgate & Co. 13,273
"Walker's Club Whiskey," for whisky, L. W. Walker 13,261
"Winsom," for canned corn, Wayne County preserving Co. 13,263

PRINTS.

"Men's and Boys' Apparel," for men's and boys' apparel, H. C. Lytton 1,862
"Motor Back, Bicycle Playing Cards," for playing cards, United States Playing Card Co. 1,866
"Quick Repair," for pumps, Red Jacket Manufacturing Co. 1,864
"Rustlers," for playing cards, Willis W. Russell Card Co. 1,865
"Sapolin Varnish Stain," for varnish stain, Gerstendorfer Bros. 1,867
"So Easy to Fix," for pumps, Red Jacket Manufacturing Co. 1,863

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