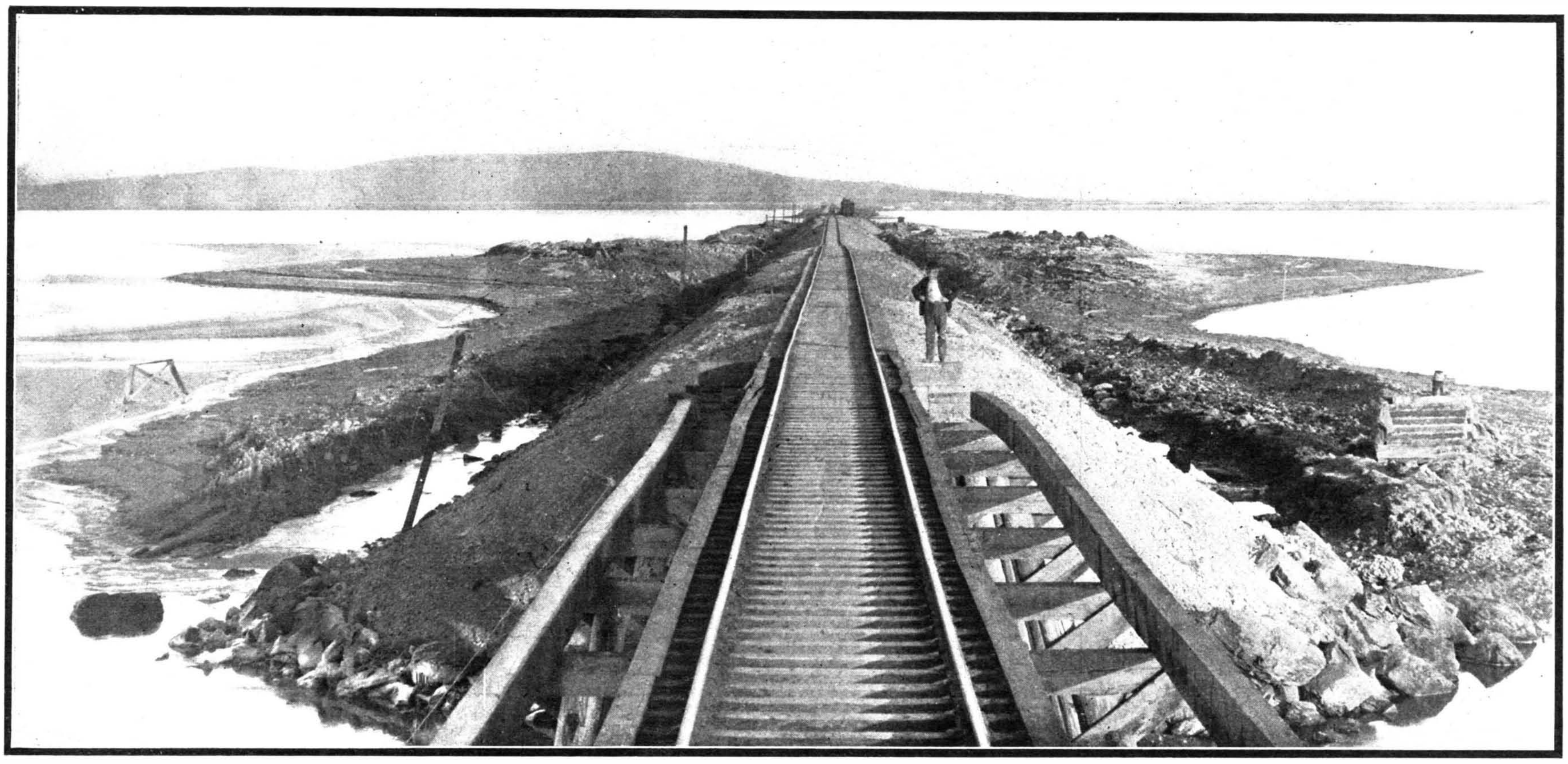
SCIENTIFIC AMERICAN SUPPLEMENT. No 1481

Entered at the Post Office of New York, N. Y., as Second Class Matter. Copyright, 1904, by Munn & Co.

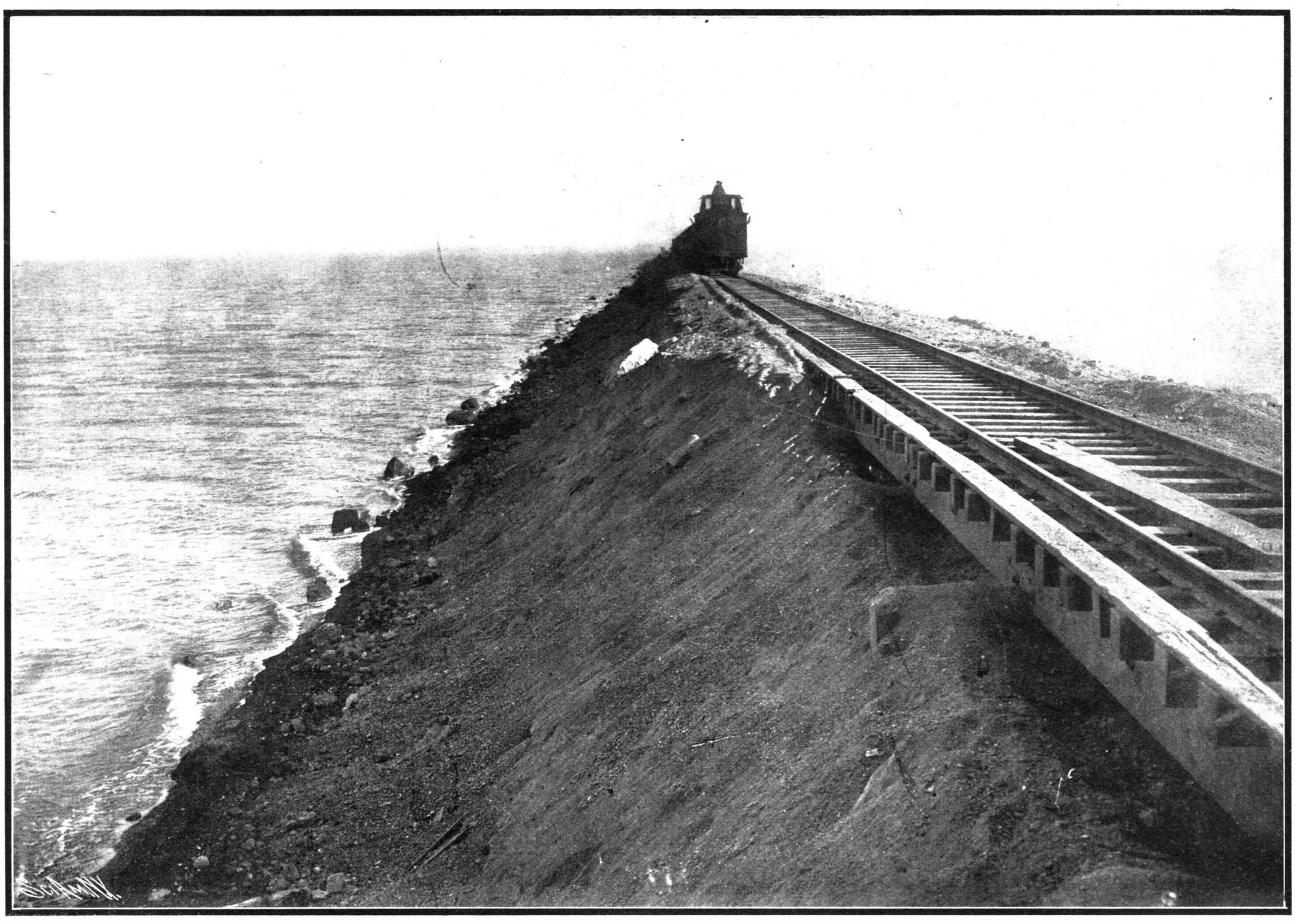
Scientific American, established 1845.
Scientific American Supplement, Vol. LVII., No. 1481.

NEW YORK, MAY 21, 1904.

Scientific American Supplement, $5 a year.
Scientific American and Supplement, $7 a year.



BEAR RIVER AND SINK FROM THE BRIDGE.



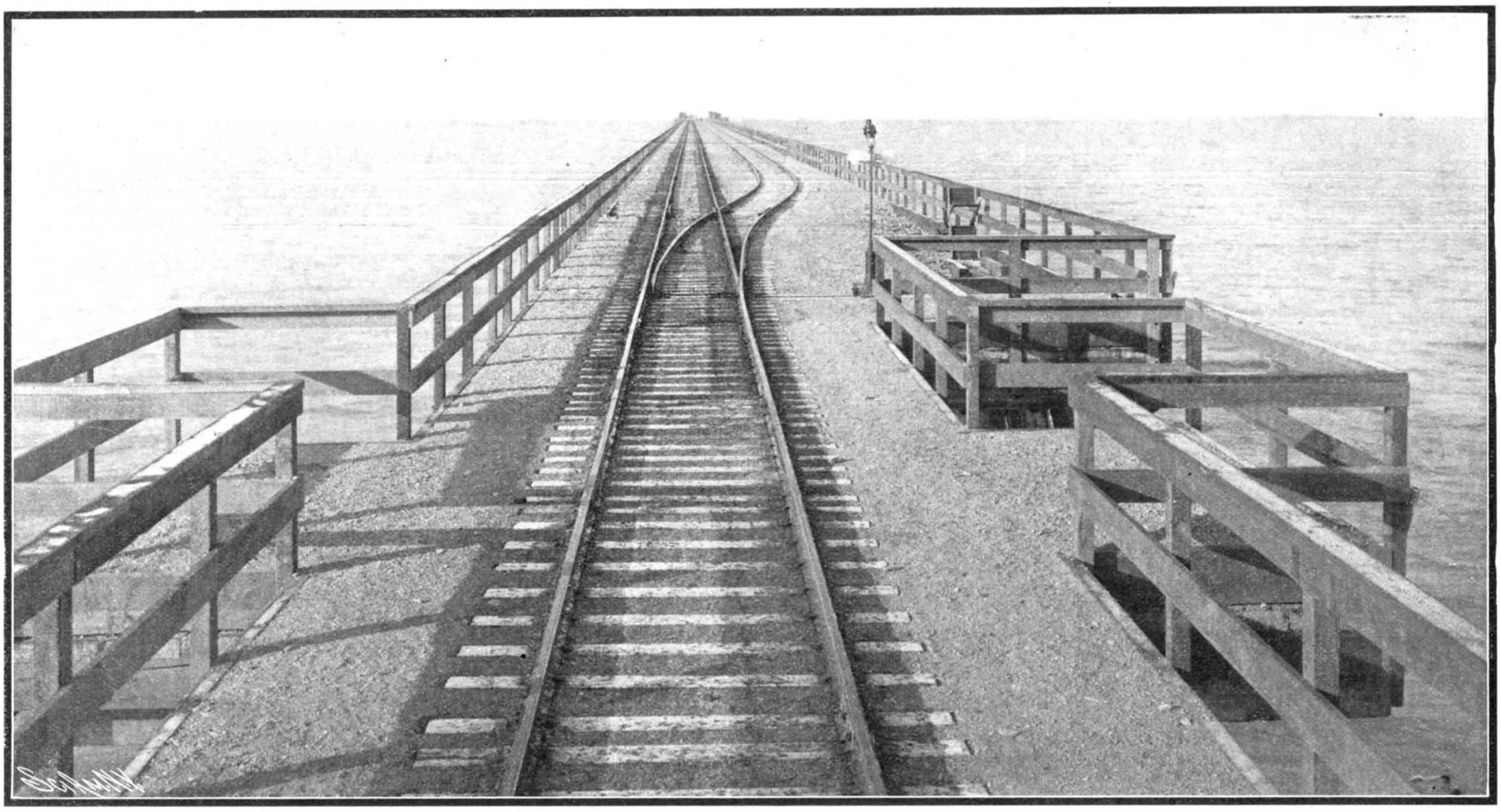
THE FILL.—TRAIN GOING OUT TO DUMP ITS LOAD.

RAILROADING ACROSS GREAT SALT LAKE.

RAILROADING ACROSS GREAT SALT LAKE.*

By HERBERT I. BENNETT.

THE Southern Pacific Company, in constructing the Ogden-Lucin cut-off over the north arm of Great Salt Lake, between Ogden and Lucin, on the Central Pacific division, has accomplished perhaps the most noteworthy engineering achievement ever attempted in bridge-and-fill work. The major portion of the credit for this feat can be given to William Hood, the skillful chief engineer of the Southern Pacific system. Mr. Hood has, in the Ogden-Lucin cut-off, demonstrated great possibilities in trestle-and-fill railroad building, and this work will ever stand as a fine monument of achievement to its builders.



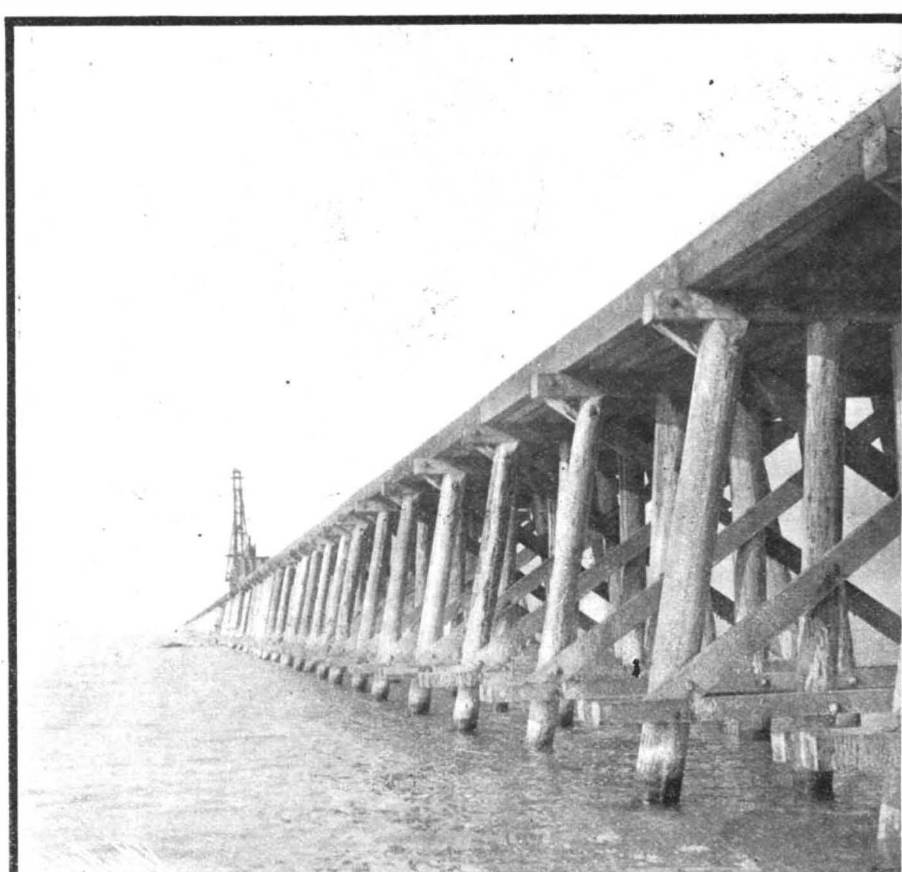
FINISHED TRACK EAST OF MID-LAKE.

Without delving deep into elaborate detail, the writer will endeavor to tell the advantages to be gained by the Ogden-Lucin cut-off, and also to state a few interesting figures and data pertaining thereto. In the first place, New York and San Francisco are to be brought into closer and quicker railroad relations by the elimination of many miles of track over steep grades now encountered on the old line around the north shore of Great Salt Lake. The actual construction work involved in this piece of engineering between Ogden and Lucin, Utah, represents 102.91 miles of new track, to replace 146.68 miles of old track around the north shore via Promontory. It can thus be seen that the "cut-off" effects a saving of exactly 43.77 miles. This may not seem a great saving of distance as compared to the magnitude of the bridge and fill, but it is, nevertheless, when it is understood that besides the 43.77 saved in mileage, it also saves 3,919 degrees of curvature and 1,515 feet vertical of grade. The sharpest curve on the Ogden-Lucin cut-off is but 1½ degrees, as compared to a 10-degree curve on the old line around the lake.

The illustrations showing various parts of the "cut-off," published herewith, are from recent photographs taken by the official photographer of the Southern Pacific Company.

The cost of the Ogden-Lucin cut-off is said to be close on to $5,000,000, but the improvement is certain to prove of inestimable value to the Southern Pacific Company and to the traveling public, while a new epoch has been made in modern railroad construction. The cut-off effects a large reduction of grade, too, inasmuch as the heaviest encountered is 21 feet to the mile, as against 90 feet to the mile on the old stretch of track. One of the most noteworthy facts in relation to this subject is that all work on the building of trestling, filling, and embankment has been accomplished since June, 1902, and the last spike, of solid gold, marking the official completion, was driven by President E. H. Harriman on last Thanksgiving Day, November 26, away out in the middle of Great Salt Lake's northern arm, in the presence of a notable assemblage of railroad men from all over the United States. There are 22.94 miles of trestling, of which 11.10 miles are permanent and 11.84 miles temporary, the latter to be filled in as a solid embankment. In the construction of the permanent and temporary trestling 38,256 piles were driven, and if placed end to end they would stretch out exactly 534.986 miles or 2,824,723.6 lineal feet. The permanent trestle lies in from 30 to 34 feet of water at the present level of Great Salt Lake, which is one foot below the zero point, as shown by the gage at Garfield Beach, Utah.

One of the most interesting facts is that the building of this line over the lake has been attended with less loss of life and injury to the men employed on the construction work than is usual on ordinary railroad track of equal mileage. Furthermore, no locomotives or cars have been lost during the construction, while few cars were even derailed. Reports circulated from time to time, telling of peculiar disasters and locomotives suddenly disappearing in bottomless pits out in the lake, were absolutely false, as nothing of the sort has ever occurred.



THE TRESTLE OF THE OGDEN-LUCIN CUT-OFF.

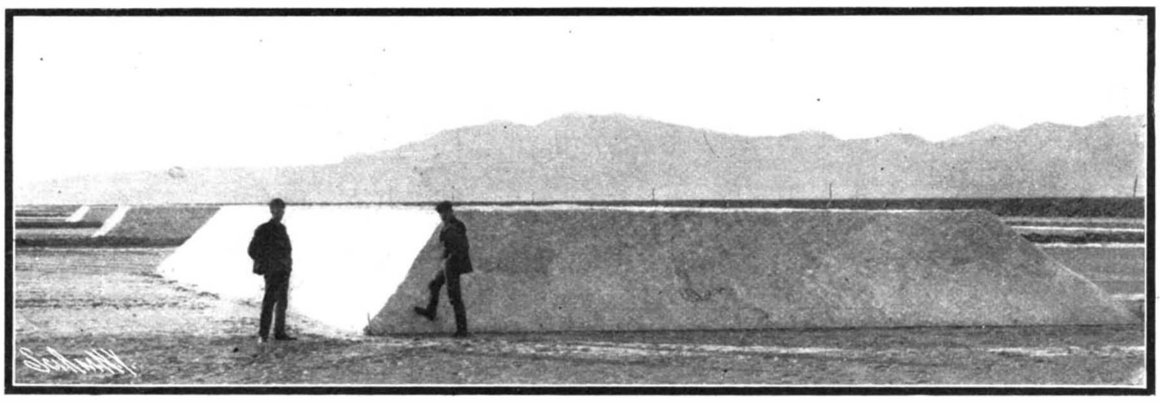
A LOG-BOOM FOR USE IN CONSTRUCTING THE TRESTLE.

RAILROADING ACROSS GREAT SALT LAKE.

* Specially prepared for the SCIENTIFIC AMERICAN SUPPLEMENT.

The track has sunk slightly in a few places, but no more so than is experienced in any railroad embankment that is built in water. Such a piece of work always settles at first, or until a solid basis is reached, and all that can be done in such a case is to simply keep dumping rock and dirt in until the thing stops settling. This rule has been observed in the Ogden-Lucin cut-off, and the track will be as solid as Gibraltar. As far as the so-called bottomless pits are concerned, it is in order to state that no scientist or engineer has ever been able to locate them in Great Salt Lake; therefore it is safe to assume that such places do not exist. The trestle portion of the Ogden-Lucin cut-off is perfectly treated, and the traveler rolling over it will never know, if it be night, when his car runs from solid ground on to the bridge. Instead of an open trestle, this one is ballasted with 15 inches of gravel under the ties, and trains run over it without the least sign of rumble or vibration peculiar to trestle bridges. The ballasted deck trestle is 16 feet wide on the single-track portion, and to look along the splendid roadbed surmounted with 80-pound rails, one can scarcely realize that he is on a bridge over Great Salt Lake, instead of on a regular solid-ground right of way. Track sidings, single and double, either side of the main line, are an important feature of the trestle, as are also numerous extension platforms at the sides for the accommodation of hand-cars. Here is a railroad track running out to sea, and at times the train seems almost beyond sight of land.

There is nothing in the world like the remarkable Ogden-Lucin cut-off, which stands as a strong testimonial for western railroad engineers, who already have made some of the most important chapters in railroad history by boring paths for the steam caravans over and through both the Rocky and Sierra Nevada mountains. Now, after having mastered the wall-like western ranges, they turn their attention and energies to the bridging of Great Salt Lake and accomplish it in a trifle over a year. By the completion of the Ogden-Lucin cut-off the running time will be reduced several hours between the Atlantic and Pacific coasts, while the cost of operation will be much less for trains, on account of the straight track and slight grades on the new route over the Dead Sea of America.



SALT BEDS, EAST OF PROMONTORY POINT, ON THE OGDEN-LUCIN CUT-OFF.

RAILROADING ACROSS GREAT SALT LAKE.

The piling of the trestle is covered with a pure white coat of salt and soda from the wave wash and dense salt air; but this is a splendid preservative of the wood; in fact, it is said that no wood will rot nor will iron rust in the briny waters of Great Salt Lake.

One of the difficulties encountered during the building of the cut-off, and perhaps not generally appreciated by eastern railroad engineers, lay in the fact that all of the water consumed by the locomotives, the engines of the steam shovels, and by the workmen had to be hauled in tank cars for great distances, and much of it for over 100 miles. In conclusion, it is in order to say that the Southern Pacific, by building the Ogden-Lucin cut-off, has crowned the science of long-distance trestling-and-fill embankment construction, which is looked upon with deep interest by the engineering and scientific world.

THE MODERN STABLE.

THIS is looked upon as the age of material and beneficial advance to man and beast. Endless pages have been written to prove the fact, and the few observers who point out the deficiencies are either scoffed at or frowned down. Possibly to no other item connected with the horse and horseman are these remarks so pertinent as to stables and stabling. Within the last few years there have been erected stables for millionaire owners on which no expense, trouble, or time was spared to make them structurally and practically perfect, yet in two cases out of four they have been lamentable failures, and the other two are yet to be heard from. Why was this? Mainly because the average architect is not a practical horseman; too self-centered to hunt around for practical hints or practical criticism, and still more because in his effort to produce the hitherto unapproached, he has entirely lost sight of the first principles of utility. The owner of the stables being simply a wealthy man fond of horses, desirous of obtaining the best, and willing to pay for it, is beyond criticism on this point.

In the one case a stable was produced, the like of which had never been seen. It was an immense and imposing building, eight hundred and seventy feet in length, inclosed in an exterior wall of brick and glass, containing an earth track sixteen feet wide, four laps to the mile, and right down the center were eighty-odd box stalls, and in each were water and feeding appliances, perfect drainage, and apparently all that could be desired. To the layman it was simply perfection. In practice it was anything else. When the winter came, catarrhal and lung fever swept through the place, not an animal escaping, and to-day the stable is practically out of use—a tremendous and an undeserved disappointment to the owner.

Why was this? To answer, one must theorize to some little extent. In the first place, its extreme length made drafts which increased to a gale when the wind set from either end; these carried chilled air, or, when sickness appeared, carried contagion to an extent impossible in a smaller or differently arranged edifice. In the center of the stable, in the upper floor, were wonderfully comfortable and complete exercise jockeys' dormitories, school, dining, and reading rooms, kitchen, etc., and these being heated, made the center of the stable below hot, with ever-varying radiations of heat toward each end, according to the set of the drafts. Also, although each box stall was perfectly ventilated, the outer casing wall precluded the ventilation which should have been semi-direct. There are also a number of other pertinent reasons which need not be entered into here. Corresponding defects existed in another expensive stable; and to show the utter lack of practical knowledge, when this stable was completed and the horses placed therein, there was no place for storing hay, and an additional building had to be erected, which, while completing the effective department, entirely ruined the "plan" of the *tout ensemble.* Here were instances of too much elaboration. In countless thousands of other cases the errors are utter want of that very important item.

THE WEAKEST PART OF A STABLE.

The strength of a chain is equal to its weakest link, and in the stable chain the weakest link is generally the man, the helper. Given a stable satisfactory in most respects, with good drainage vent, with correct exposures, or unavoidable errors in this connection in city stables remedied by simple devices, and horses may be taken from Cuba to the snow-clad plains of Montana by slow stages without sickness or ill results; if, however, such startling transitions are made four or five times in the twenty-four hours, what can a reasonable man expect? Yet such is the case in many instances.

The ideal stable should have the horses facing north to obtain even temperature, it should not be too large, so as to keep the animal heat under control, and not have the stable temperature either materially raised or lowered when half a dozen animals are either taken out or brought in. The ventilation should be perfect and as strong as possible up to the iniquitous "draft" point. Let the ceiling be as high as convenient, and if the wise builder has left an inch or so open all around the upper edge, where the stablemen cannot stop it up, all the better. No matter where the ventilation comes from, get it, and here comes in the weak link—the uncontrollable desire of the stablemen to keep the place too hot, much too hot, neglecting the horse for the comfort and convenience of the humans.

Drainage is another essential. It is idle to discuss drainage methods and facilities, simply because all are good if properly attended to; their efficacy all depends on the man. One of the great troubles of the stable architect and of the amateur owner who puts his finger in the specification pie, is that they will persist in planning the drainage as if to be operated by the most efficient set of men in the world, instead of by a passably inefficient one. Given sloping stalls and gutter, what can be better than the world-old central open cistern which holds the accumulation of say twenty-four hours, and overflows when full, compelling attention? This, with free flushing of gutters, either direct from the faucet, or by premeditated automatic direction of all horse toilet and wagon or carriage washing and sluicing, should be sufficient for all practical purposes.

As to the toilet of a horse, much depends on surroundings. In the winter at Saratoga, for instance, the horses are taken out in the deep snow, galloped, and then, still sweating, turned into their stalls, without danger. In the city, for carefully groomed horses, however, the sweating should be done, and then the toilet made progressive under cover from the sluicing to the stall, or, when going out, the reverse. This was one of the initial defects of the millionaire's stable alluded to above; when the horses were toileted, it was a semi-exposure with no gradation.

In the city the stables are generally of brick, only the more important structures in the country being of brick, the majority being of wood. Brick or stone is generally damp in this country, as shown by the plaster, and frame buildings, well seasoned and clapboarded, will be found more satisfactory. This, however, is a point which need not be italicized, as it must give way to convenience. Dry, wholesome flooring under foot is an absolute necessity. Brick floors once were tabooed as unsanitary, likely to let a horse slip, liable to "sweat," to chip and cut a horse, etc., but most of these defects have disappeared. The new vitrified brick does not chip or fray; it insures perfect drainage, does not hold moisture, and consequently does not sweat, and being roughed and remaining so, is better footing than anything else but ground. In many places properly arranged slats, capable of proper care, cleansing, sun baths, etc., are satisfactory; in others, beds of gravel topped with eighteen inches of earth, which can thus be constantly changed, are in use, but as usual dependent on the grade of "help" employed.

HAY RACKS OBSOLETE.

Hay racks are obsolete, the hay being fed from the floor these days. Mangers and troughs should be interchangeable, to admit taking out, scrubbing, and sunning. There should be abundance of water, not standing to be fouled, but fed from buckets (used for no other purpose), and especially should horses be watered the last thing at night. For working horses, use the "clock" feeding system instead of feeding a horse and then jumping him into the shafts before his mouth is empty. Hay should not be kept over the stable when there is facility for keeping it elsewhere, as it accumulates odor like tea or butter. Neither should men's sleeping quarters be above a stable where it can be avoided; a horse does not thrive when sleeping under the sounding board of a cheap Harlem flat.

Stall division should not go to the floor, but an inch or so should give base ventilation, sending odor upward, and keeping the feet and legs cool. The partitions can otherwise be built solid, and should not be too high to permit the horses to see each other. A stalled horse gets very lonely staring hours at a blank wall, which is enough to drive a strong man to drink or suicide. No wonder the animal makes close friends with a cat, a goat, or whatever living thing he can attract for companionship. In other cases the English "bail" separation is good—two planks dovetailed, hung down from rafters, by ropes or chains at head or foot, ending a foot and a half from the ground, the upper edge being not less than four feet and a half. These separate horses effectually and, what is more, are apt to cure stall kickers.

No stable has any business to smell unduly strong. If it does, it is either badly constructed or badly kept, generally the latter. An automobile house should smell worse than a horse stable. The trouble is that thousands go for building and equipment, and only tens for wages, although it must be admitted that with the bulk of help to-day, stable and otherwise, it seems a case of the help getting all he can, and doing as little as he can; the old honored principle of taking a pride in one's work seems dead and passed. Still a good man can make a poor stable more healthful and more effective than a poor man can keep a perfectly equipped stable, and one is ever reaching for the higher attribute. Nevertheless, if the horse is thin, lame, or generally amiss, look first into stable surroundings, then into the help, then into the food, not forgetting the realm of perquisites! That, however, is another story. Food should be varied. Not oats and hay, year in and year out, but scores of changes which common sense or experience suggest. It is to be regretted that so many horse owners and stablemen get into a rut. They have been accustomed to do things this or that way for so long that a change never occurs to them, and, what is worse still, when any idea is brought to their notice they take it as a direct insult, possibly as reflecting upon the lack of thought which they acknowledge, but none the less resent.

Just at present there seems to be a tremendous leaning to English ideas, and while many of these are good, the result of long years of practical experience around horses of all degrees, it must be remembered, when adapting these items, that there is a tremendous difference in climatic surroundings. In England there is not the great difference between the extremes of heat and cold which we get here, and the transitions are not so rapid or so marked. The weather one awakes to in England is likely to exist all day in the majority of cases, and rare indeed is any violent change.

Columns could be written upon this subject, but here it is only possible to give bare hints on a few of the more important points. If the stable under consideration is a private one, out of the city, personal supervision will do much, if it only be the supervision of an amateur who looks wise, keeps his mouth shut, and uses his common sense before he speaks. If it is a city stable, the difficulties increase, especially if a public stable. The help is overworked and underpaid; in some cases tips will bring what is desired; in other cases tips are simply water poured down a rat hole. It is disheartening to say that in 90 per cent of the public stables the individual horse does not get more than 40 per cent of the care, attention, or consideration due to him, and the consequence is that, except in the cases of the more robust, he does not do well or look well; he is tender, nervous, and erratic, for reasons which need not be gone into here. As to his grooming, look at the underskirts of your riding coat, at the under edge of the lady's habit skirt. It is written in letters of Filth!—Evening Post.

COMBINED GASOLINE MOTOR AND ELECTRIC GENERATOR FOR RAILROAD TRACTION.

By the English Correspondent of SCIENTIFIC AMERICAN SUPPLEMENT.

A NEW phase in electric traction for trunk railroads has been introduced upon the North-Eastern Railroad of Great Britain. Hitherto, in such power schemes, the electric energy has been drawn from a live rail laid down either between or outside of the running track. Such a system, although reliable and efficient, is limited in its scope to those sections of the track equipped with the necessary third rail. This provision entails a considerably expensive initial outlay. In the system adopted in the North-Eastern Railroad, the car carries its own electric generator, the power being generated by means of a generator coupled to a gasoline motor. By this arrangement the car, being solely dependent for its tractive force upon the generator carried, can travel over any section of a trunk railroad.

This ingenious combination has been designed by Mr. Worsdell, the chief mechanical engineer to the railroad, to whose courtesy we are indebted for particulars and the illustrations accompanying this article.

The car is of the ordinary bogie type, measuring 52 feet in length, with an interior width of 7 feet, 11 inches. The vehicle is divided into three compartments—one at the forward end, in which is placed the gasoline motor and electric generator, and another similar compartment at the opposite end containing the machinery for operating the car from that end. In the center is provided the passenger compartment, with a passage giving admittance to the saloon or that the driver may be able to accelerate the engine from either end of the car, an auxiliary hand throttle is supplied. The ignition is by means of the usual high-tension system with accumulators and coils. The motor is direct-coupled to the generator, which is a separately excited, compound-wound, direct-current type machine of 55 kilowatts capacity, specially designed for operating over a range of voltage from 300 to 550 volts. This machine operates at a normal speed of 420 revolutions per minute, and is supported on an extended bed plate, the armature being pressed on to the extended engine shaft provided with a flanged coupling between the generator and motor.

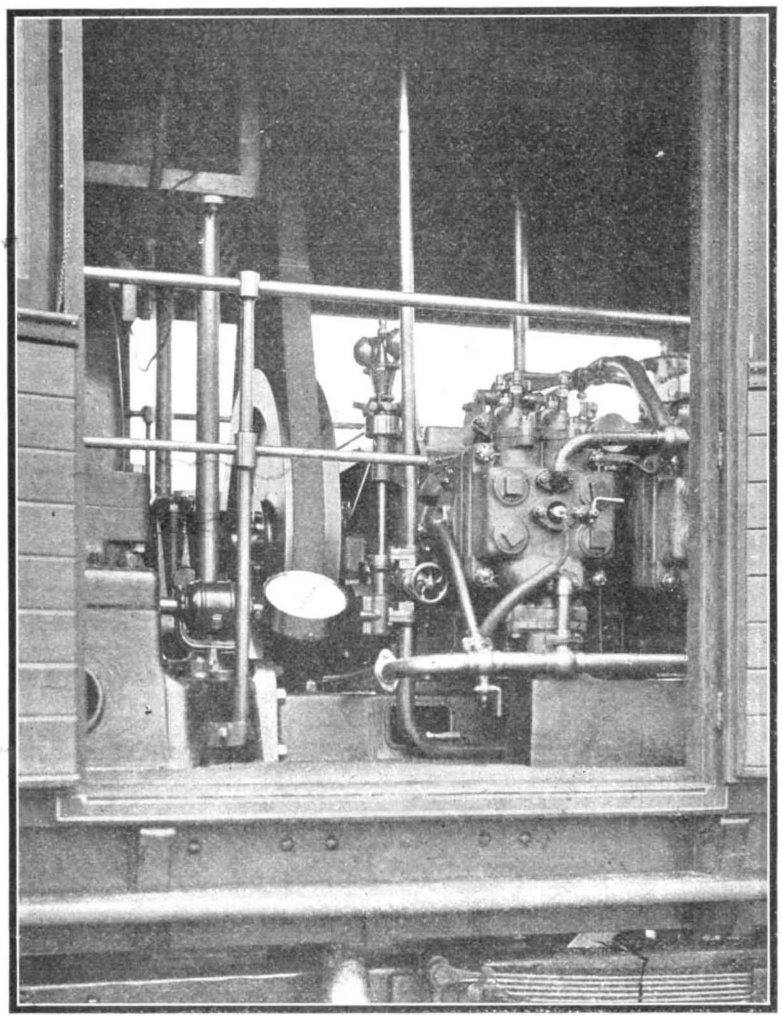
The field of the generator is split horizontally, so that the upper half may be removed to allow access to the armature or field coils through an opening in the roof of the car, fitted with a removable cover. The exciter is a 3.75-kilowatt, standard, 72-volt, shunt-wound, belt-driven, multipolar generator, mounted above the main generator and belted to a pulley on the extended shaft. This machine is capable of exciting the main generator and of supplying current for lighting thirty 72-volt, 16-candle-power, incandescent lamps. The voltage of this machine may be increased to 95 volts for charging the accumulators when not required for lighting purposes. Two Westinghouse 55-horse-power standard railway motors with single reduction gears, ratio 18 to 64, are mounted on the front bogies by means of a nose suspension bar with spring attached to the bogie frame. These motors are series wound and are of the standard type usually employed for operating heavy, high-speed, street railroad cars.

The controllers are of the standard series-parallel taining a constant pressure in the air reservoir which supplies the whistle.

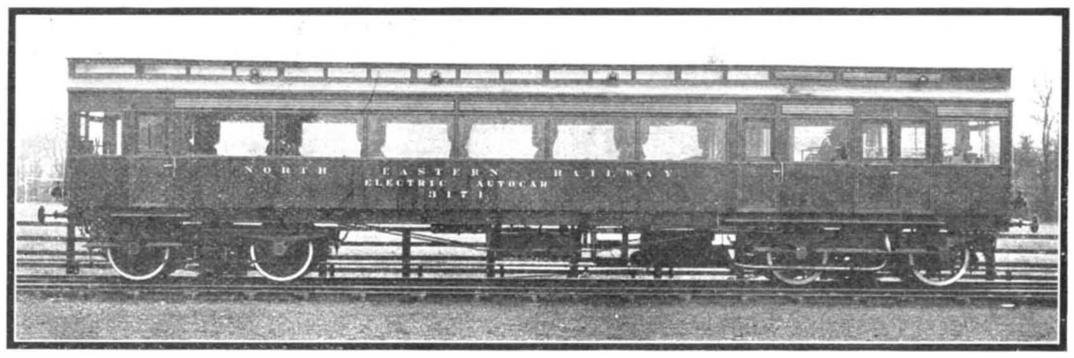
The whole of the electric equipment has been supplied by the British Westinghouse Electric and Manufacturing Company, Limited.

The system of working is as follows: The current passes from the generator through an automatic circuit breaker to the two controllers, and the voltage of the generator is adjusted by means of a rheostat in the field circuit placed near the controller at each end of the car. The generator is used as a motor supplied with current from the storage battery for starting the gasoline motor. After the engine and generator have come up to speed and the pressure has reached 400 volts, the car is started in the usual way by turning the handle of the series-parallel controller to the series point for slow speed and to the multiple point for high speed. Afterward the voltage of the generator is gradually increased to 550 by manipulating the field rheostat near the controller. At this pressure the car will accelerate until a constant speed of 36 miles per hour is attained. In stopping the car the controller handle is moved back to the "off" position, and then in a reverse direction over the braking points, thus applying the magnetic track brake. As soon as the car is brought to a standstill, the generator field rheostat is readjusted to give 400 volts, and it is then in a position for restarting.

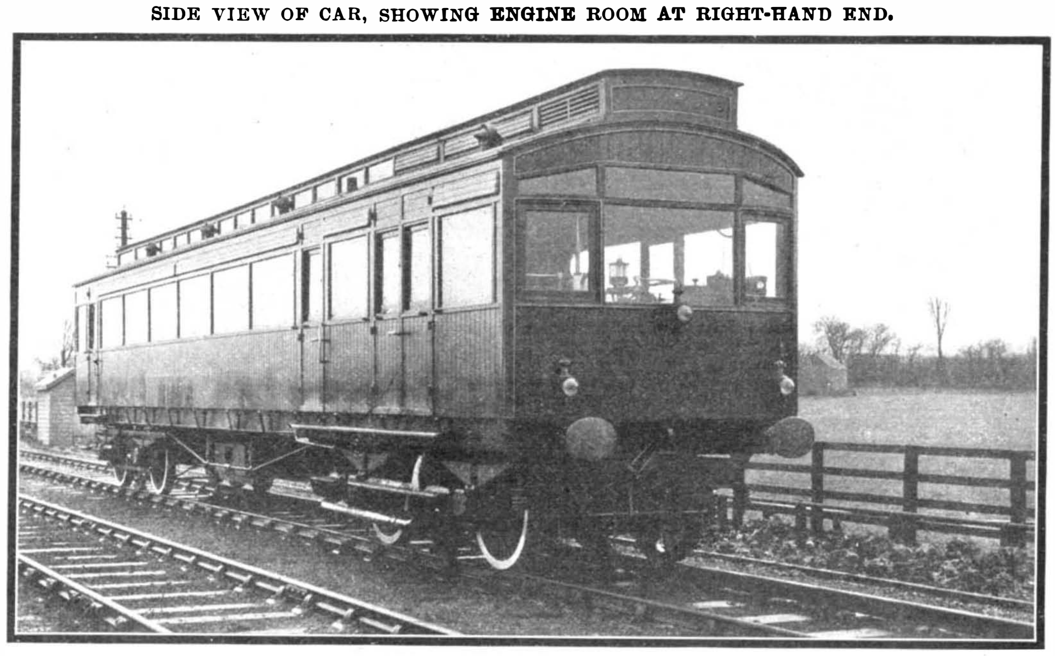
If it is desired to operate the car at half speed, the voltage may be raised to 550 volts by adjustment of the rheostat with the controller handle at the full series point. From this it will be seen that a range of speed is obtainable by variation in the voltage of



THE ENGINE AND DYNAMO AS SEEN THROUGH THE SIDE OF CAR.



SIDE VIEW OF CAR, SHOWING ENGINE ROOM AT RIGHT-HAND END.



END VIEW OF CAR, LOOKING INTO ENGINE ROOM.

A 90-HORSE-POWER GASOLINE-ELECTRIC AUTO-CAR FOR THE NORTH-EASTERN RAILWAY, ENGLAND.

machinery compartment. The seating arrangement comprises two rows of reversible seats on either side of a central aisle, and affords seating accommodation for 52 passengers. The car is illuminated by means of twenty-four 16-candle-power incandescent lamps, the current for which is supplied from accumulators carried under the center of the car. If desired the car can be attached and run with the ordinary rolling stock, the necessary buffers, couplings, etc. for this purpose being provided.

The engine compartment is 13¼ feet in length, and the propelling machinery it contains comprises one 80-brake-horse-power, four-cylinder, horizontal, gasoline motor, built by the Wolseley Tool and Motor Car Company, of Adderley Park, Birmingham.

The cylinders are 8½ inches diameter by 10 inches stroke, and the normal speed of running is 420 revolutions per minute, which can be accelerated to 480 revolutions per minute for starting the car quickly. At the latter acceleration, the motor develops 91 brake horsepower.

The cylinders are overhung on a stiffly constructed cast-iron crank chamber, the inspection covers being on the top, and the oil trough beneath. Forced lubrication is used for all the main bearings. The flywheel, which is truly balanced, is 3 feet in diameter. All the valves are mechanically operated by cams on the two cam shafts, and these shafts are driven by means of spiral gearing and lay shafts from the two-throw crank shaft. The engine cylinders and valve boxes are water-cooled, a Clarkson radiator and a fan being employed for the cooling of the water.

The engine is governed on the throttle, and, in order surface railroad type, arranged for electric braking. Resistances are provided in connection with the controllers for gradually increasing the voltage of the motors in starting the trains and for graduating the electric brake in stopping. These resistances are mounted beneath the car. The storage battery comprises 38 cells in ebonite jars, assembled in a wooden box which is suspended beneath the car. Each cell has a capacity of 120 ampere hours.

The electric brake equipment consists of two electro-magnets suspended beneath the wheels of each truck and immediately above the track rail. It is so constructed that the magnetic circuit is completed through the track rail, so that when the coils are energized, the magnet is attracted to the rail, thus causing friction between the magnet and the rail and retarding the motion of the car. This retarding action brings pressure to bear upon the brake shoe applied to the wheel, which further retards the motion of the car, and this friction of the magnet on the track and the brake shoes on the wheels is sufficient to bring the car to a stop in an extremely short distance. The brake coils are energized by the current from the motors operating as generators, and this action further absorbs energy in starting the car and adds to the braking power. This feature also renders the brake perfectly reliable, as it does not depend upon the generator plant for the supply of power.

An air compressor is located on the rear bogie and supplies air for blowing an alarm whistle. The compressor is driven by a 1-horse-power electric motor, and is started and stopped by means of pressure-controlling switches and cutouts, thus automatically main- the generator at two points, viz., approximately half speed and at full speed. The cars carry sufficient supply of both fuel and water for a full day's work, and they can be driven from either end with equal facility. The weight of the car in full working order is 35 tons.

Two of these electric railroad auto-cars have been placed in service, and in the preliminary trials they have proved highly satisfactory, a speed of 40 miles per hour being attained.

This combination of the gasoline motor and electric generator opens up a new range of possibilities with the system of propulsion for coping with short-distance traffic and feeders to the trunk railroad train service. The experiments are being followed with great interest, and if, after a prolonged term of service by which an estimate of their reliability, durability, and cost of maintenance can be gathered, they prove successful, the system will be extended.

PNEUMATIC TOOLS FOR RAILROAD WORK.*

THE pneumatic hammer is the most widely used and best known pneumatic appliance in shop service, employed for chipping, calking, beading flues, and riveting. Averaging 10 to 13 pounds in weight and operating at a speed of 1,100 to 2,000 blows per minute, it may be readily calculated how powerful an agent this tool becomes in the hands of a competent operator—and competence is readily acquired by an ordinary grade of labor, a peculiarly advantageous feature applicable to

* Extract from paper read by Mr. Thomas Alcorn before the New England Railroad Club.

all air tools. The value of the hammer as a saver of time and labor is so universally conceded that the time has passed when it was deemed necessary to submit comparative figures, especially as much depends upon the conditions of operation and the efficiency of the air plant; but we may say, briefly, that one man with a pneumatic hammer, in chipping, etc., will do as much as three to four men working by hand. A ⅜-inch chip has been removed by one of these hammers from a boiler plate ½ inch thick at the rate of 7 inches in 58 seconds.

In addition to the chipping of metals and calking of seams and joints, the hammer is naturally utilized for a wide variety of purposes requiring a rapid percussive blow—from the dentist's mallet to the driving of drift bolts. Among special uses for the hammer of particular interest to railroads may be mentioned the driving of spikes and removing scale from locomotive crown sheets. For spike driving the ordinary long-stroke hammer held by the hand is provided, with a set suited to the spike head, but for the removal of scale from crown sheets, the hammer (or jam riveter, as it is technically called in this instance) is adjusted between grate and crown sheet by means of a pipe extension, and in the stationary position so provided quickly performs the work by the rapid succession of blows which it strikes. In riveting on a standard fire-box leg containing 253 ¾-inch rivets, a long-stroke hammer will drive all of them in 9 hours at a cost of 48 cents per hour, or a total for the entire fire box of $4.32. This same job by hand work will take 15 hours at a cost of 73 cents per hour, or a total for the entire job by hand of $10.95; or if the same job was done by hand-snapping the rivets, it would take 12 hours at a cost of 63 cents per hour, or a total cost of $7.56. Thus it will be seen that a saving is made on this particular job of $6.63 over the hand-driven rivets, or $3.23 over the hand-snapped rivets. In another instance 1¼-inch rivets were driven in a boiler which stood 360 pounds pressure, with a pneumatic hand hammer, at about one-third the cost of old methods.

The air drill (or reamer), next to the percussive hammer, is the most widely known pneumatic appliance, and has an extensive range of utility. Almost numberless are the shop operations the labor and time in performing which have been reduced by this portable, compact pneumatic motor, that will fit in almost any space, employing an angle gear if necessary, and which is always ready at the instant. Easy to hold and guide, wonderfully lightening arduous tasks, it is not surprising that this tool does not share the customary antipathy of the workman to labor-saving devices. Among special uses for the drill motor is its adaptation as a casting cleaner, portable emery wheel, polisher, and for driving cylinder boring bars, valve facing machines, motor hoists, operating turntables, jib cranes and elevators.

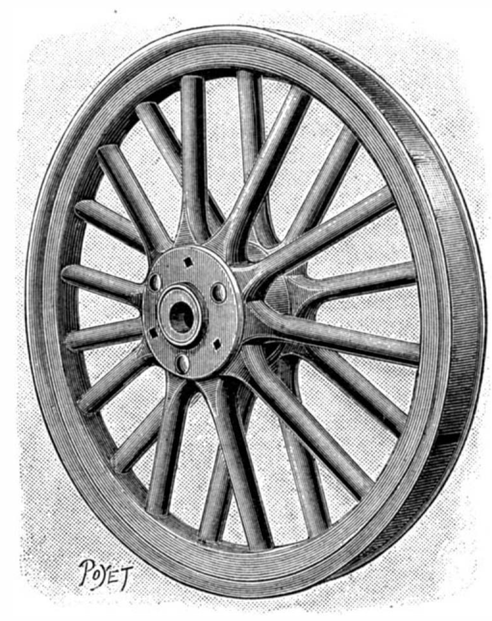
In the car shops, working in wood, the pneumatic drill, running at a higher speed than the one used on metal and weighing from 10 to 25 pounds, will bore a 2½-inch hole through 5 inches of oak in less than 20 seconds, an excellent record, as all will agree who have ever attempted to bore a 2½-inch hole in oak. The foreman of car construction of one of the leading railroad shops in the country states that by the use of a wood boring machine his men are able to bore all the holes necessary in the erection of a standard coal car, 192 in number, in 15 minutes. Allowing 3 minutes for shifting the air supply from one side of the car to the other, this leaves a net period of 12 minutes for the boring of the holes. This he considers a remarkable performance, and so far in advance of hand work as to make comparison out of the question.

One of the newest pneumatic devices, with which doubtless many are not familiar, is the hydro-pneumatic wheel press, consisting of an air cylinder operated in conjunction with an oil-filled piston carrying tail rod or intensifier, the arrangement affording an unusual effect in power concentration. It is not the intention to enter here into a detailed description of this device, which must be seen to be appreciated, but its value in any form of work and in any position where an extraordinary amount of power must be exerted in a quick operation is unique. For removing crank pins, or as a punch, or for hoisting, or as a car jack, this machine covers a wide range of usefulness. Occupying less space and working with a considerably less consumption of power, this device represents a marked advance over any form of tool heretofore employed for the purpose.

In the Monthly Weather Review Mr. Albert Matthews discusses elaborately the origin and use of the term "Indian Summer." From a careful study of American and English literature he concludes that the term first made its appearance in the last decade of the eighteenth century. During the next decade the phrase was "second summer." This indicates that the spell of weather known by this name was not generally noticed much before 1800. The term "Indian summer" became established about twenty years after its first appearance, which was in western Pennsylvania, and spread to New England by 1798, to New York by 1799, to Canada by 1821, and to England by 1830. The term is, then, not an Americanism; to write in praise of Indian summer is now a literary convention of three continents. It is by no means easy to account for the origin of the term. The principal characteristics of the season which it describes are haziness, smokiness, and high temperature. Some explanations of the origin of the term are (1) that the red Indians predicted such spells of weather; (2) that the smokiness was produced by Indian fires; (3) that this was the last season of Indian attacks on the settlements of the whites; (4) that the season partook of the Indian character of deceptiveness; (5) that the name was given because one of the seasons of East India was similar in character. Horace Walpole used the term in 1778, not in reference to America, but in relation to weather in the tropics. "Squaw winter" was a name for the spell of cold weather preceding the Indian summer, and perhaps the key to the nomenclature is to be sought in this latter term.

A NEW ARTILLERY WHEEL.

WHAT is meant by the term artillery wheel is a wheel that has been invented for gun carriages and



A NEW ARTILLERY WHEEL.

ammunition wagons, and that possesses great resistance, and the wooden spokes of which are mounted in an elastic hub. But if the felly of the wheel happens to strike an obstacle laterally in consequence of the sliding of the vehicle in the direction of the axis of the hub, the spokes will be submitted to a violent and abrupt wrench in a direction at right angles with their axis and a breakage may result. Such an inconvenience is partially remedied by giving the wheel a dish by inclining the spokes more or less upon the axis of the hub. Such a wheel, however, which has the general arrangement of a very flat cone, is apt to become twisted if the weight that it supports is very heavy. A better solution of the problem has been sought in constructing an artillery wheel with two series of spokes, each having a proper dish. Each series is arranged according to a conical surface, and the spokes that compose it are mounted at one of the ends of the hub, which has a considerable length. So, from whatever side comes the shock to which the felly is submitted, there is always a series of spokes to convert it into components that are exerted at right angles with the hub and also according to the axis of the spokes. On the other hand, no weight, however heavy it may be, will be able to twist the wheel, since each series of spokes is supported by the other, and the arrangement, as a whole, is, so to speak, indistortable. The inventors of this new type of wheel are the Mulliner Motor Body Company, of Accrington.—Translated from La Nature for the SCIENTIFIC AMERICAN SUPPLEMENT.

Paper Money Wanted in Paraguay.—United States Consul J. N. Ruffin, of Asuncion, Paraguay, on February 24, 1904, writes that the Paraguayan government has authorized a new issue of paper money, and bids for printing the same will soon be asked for. About 5,000,000 notes will be printed. Particulars may be obtained by addressing the Minister of Finance, Asuncion, Paraguay.

SUBMARINE NAVIGATION.*

THIS is a compilation of the available information relating to submarine boats, and an interesting history of the attempts in construction. The author has been untiring in his efforts after everything that has a bearing upon his subject, either in books or articles, or in the opinions of experts or the press. The result is that anyone who desires to know the history and development so far of the submarine will have recourse to Mr. Burgoyne's two volumes.

Because it is a collection or abstract of the writings upon the subject and not full of the author's own theories, we have called it a compilation. It is, however, a very readable book, and will be especially useful because previous books have been few and generally in a foreign language. It might, perhaps, have been more attractive had it been arranged in chapters. For the purpose of reference, too, the index is not full enough, and it is none too easy to find the way about the book.

The first object of the author is to trace the history of submarine invention from its earliest conception to the present time. This naturally occupies a good deal of his space, and is a most useful and interesting part of his book, with the short descriptions and illustrations that are given. He then deals with the Lake submarine boats, in a reprint of their pamphlet; the submarines of the great powers; and his own proposed armored submersible. Vol. II. is devoted to the Holland submarines, a discourse on the theory of the submarine boat, and on its military value. Press articles and opinions of experts of all kinds are given on submarine navigation, and even the poets are pressed into the service, Erasmus Darwin and Ben Jonson both being supposed to have made subtle reference to the future submarine!

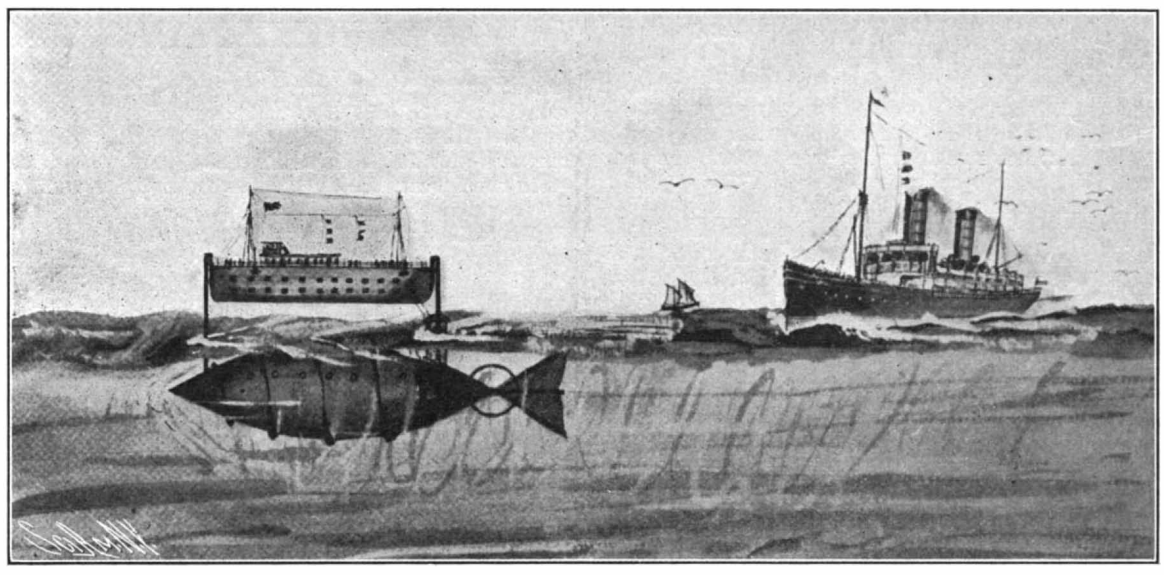
Whatever may come or not come of the submarine boat, this book is an entertaining and exhaustive record of long-extended attempts to perfect it.

The first submarine boat was constructed by a Dutch physician, Cornelius Van Drebel, in 1620. His boats were of wood, and were rendered watertight by stretching greased leather over the hull. In one of them James I. made a lengthy trip.

David Bushnell, an American engineer, achieved the first real success in 1775, his boat taking the form and name of the "Turtle."

Robert Fulton, also an American, made many attempts to get his various inventions taken up by several governments, including that of Napoleon, who did give him encouragement to build the "Nautilus." In that boat he remained submerged for five hours. But his efforts met with repeated rebuffs, though the protest of the French Minister of Marine is particularly worthy of note: "This type of warfare carries with it the objection that those who undertake it and those against whom it is made will all be lost. This cannot be called a gallant death." Such was the morality of war a century ago; now all nations give themselves up to the study of the submarine boat, comments Lieut. Duboc. In 1827 Castera took out the first patent, in France, for a submarine boat, which was a prototype of Lake's explorer "Argonaut."

Wilhelm Bauer, the most persistent inventor, from 1850 made attempts to secure the adoption of his plans in Germany, Austria, England, and Russia. For Russia he built "Le Diable Marin," and at the coronation of Alexander II. "Bauer remained submerged during the whole ceremony with a band of four musicians, who, when the first gun of the royal salute was fired from the flagship in the harbor, played the Russian imperial hymn, accompanied by the voices of the whole crew."



THE APOSTOLOFF SUBMARINE.

Marié-Davy, in 1854, was the first to propose electric power for a submarine boat.

In 1863 was launched the "Plongeur," the well-known invention of Bourgeois and Brun, and the results of its various experiments, though not highly successful, yet, the author says, established two things: (1) the facility of navigating on a level with the surface of the

* "Submarine Navigation, Past and Present," by Alan H. Burgoyne, F.R.G.S. Illustrated, 2 vols. London: Grant Richards. New York: E. P. Dutton & Co.

water; and (2) the facility of sliding over sandy or muddy bottoms in depths not exceeding 35 feet.

The American civil war was the cause of many attempts at the submarine, and one of these boats was almost successful in blowing up the Federal ship "Ironsides." In 1864 the "Housatonic" was destroyed in Charleston Harbor by another of these "Davids," commissioned by the Confederates.

The American invention of Raeber (1866) on the other hand was not designed for offensive purposes; and in 1869 a French doctor, Lacomme, designed a submarine cross-Channel railway. Out of this, it may be said, has recently been evolved the submarine ferry-boat of M. Goubet.

There have been inventors—and sometimes several—in nearly every year, and they have their place in the author's chronicle. In 1877 Drzewiecki, a Russian engineer, constructed his first boat, which he followed up with six others of improved pattern; the last, partly submersible, now receiving the attention of the French government. In 1878 Mr. G. W. Garrett took out his first patent, and the trial proved successful. In the following year he commissioned his second boat "Resurgam."

"One of the most ingenious and interesting vessels ever designed" was Berkley and Hotchkiss' submersible, in 1880, but not much notice was taken of it.

One year later Mr. Garrett's third boat (in conjunction with Mr. Nordenfelt) was patented. It employed steam for under-water propulsion.

Another "Nautilus" was invented in 1884 by Messrs. Campbell and Ash, and was successfully tried, but the invention has not apparently been heard of since.

The "Porpoise" was invented in 1885 by Mr. Waddington, and carried out a great number of valuable experiments. It was "vastly superior to anything that had gone before it."

In 1887 Lieut. Hovgaard, of the Danish navy, designed a boat, which is fully described in his own booklet on submarine boats. It was not constructed, so no opportunity was given for testing its practical utility.

The Turkish government in 1887 purchased two Garrett and Nordenfelt vessels (No. IV.), which were built at Chertsey.

In 1888 M. Gustave Zédé produced the "Gymnôte," fully described in the author's second volume. M. Apostoloff took out a patent in 1889 for a wonderful invention of high speed. Results are not yet available. The Garrett and Nordenfelt submarine (No. V.) in the same year proved a failure.

From this time onward there have been repeated inventions, as Sir Gerald Strickland's, Degli Abbati's (a marine explorer), and those of Admiral Ammen, U. S. N., the "Katahdin;" and Seymour Allen, of Sydney. For all these and the many others Mr. Burgoyne's book must be consulted.

In 1901 Mr. T. H. Williamson approached the Admiralty with a new invention, claimed by him as having "novelty in shape, construction, armament, air supply, and motive power." His application was "laid before the Board."

M. Jacovenko, a Russian, like Apostoloff, has also designed a submarine of very high speed—60 knots an hour.

Finishing this chronicle with a patent taken out in December, 1902, Mr. Burgoyne passes to the "Lake" submarine boats.

The invention of Mr. Simon Lake, fully explained in his booklet, "The 'Argonaut,' her Evolution and History," had primarily an entirely peaceful object. The first boat was built in 1894 and the second in 1897. The inventor claims that they will be invaluable for submarine wrecking, recovering gold from river and sea-coast bottoms, in laying submarine foundations, and as scientific and pleasure boats.

There is an interesting record of one day's experience in the copy of the logbook, the boat having been submerged during ten hours and a quarter. There are many plans and illustrations to this section.

The submarines owned by the great powers are then described. France practically began with the invention of M. Goubet, the first boat being built in 1885.

The "Gymnôte," primarily conceived by M. Dupuy de Lôme, was modified several years later by M. Gustave Zédé, and accepted by the French Naval Minister. It was launched in 1888.

In 1893 was launched the "Gustave Zédé," from the designs of Engineer Romazotti, and named after the inventor of the "Gymnôte," who has just died.

The "Morse," also designed by Romazotti, was launched in 1899, and was "an undoubted improvement on the 'Gustave Zédé.'"

Of the French submersibles, the "Narval" is particularly noteworthy. Designed by M. Laubeuf, it was built at Cherbourg and launched in 1899, and successfully tried.

The British submarines began with the notification in the Estimates for 1901-1902 that five of the "Holland" type had been ordered. They were all launched by June, 1902. Another was ordered, and later on three more. This policy has been the subject of much controversy.

The American submarines of the "Holland" type are eight in number.

The Russians, Italians, Portuguese, Germans, Swedes and Spaniards have all experimented with the submarine.

The author then sets out his own design for an armored submersible.

The "Holland" submarine boats, the invention of Mr. John P. Holland, of Paterson, N. J., date from 1875. The first was built in that year, the second two years later, and the third was launched in 1881. No. 9 is the prototype of the submarines ordered by Great Britain and the United States government, "and is also, without doubt, the commencement of the 'really successful' submarine." The specification is given, and numerous illustrations. No. 10 was ordered by the United States in 1900, after exhaustive trials with No. 9, commonly known as the "Holland." The opinions of important naval men—Admiral Dewey, Admiral Hichborn, and others—and some of the correspondence between the United States government and the contractors, is set out at length in Vol. II.

"The Theory of the Submarine Boat" is then discussed, and the author's definition of an ideal submarine is as follows:

"A vessel of special type, the shape to be determined, but with no specialty of form essential, capable of navigating not only on the surface as an ordinary ship, but also beneath the surface of the sea, and continuing its course in a direct line for the object it is desired to reach, while retaining stability in every sense and being under the complete control of its commander; and besides conforming with these conditions, it must possess the maximum of speed, safety, offensive power, and habitability, a trustworthy means of propulsion, and a complete independence of all exterior help while in action."

Having laid down this definition, Mr. Burgoyne proceeds to deal with these various points of submersion, stability, form, illustrated by comparative diagrams, orientation (with a detailed description of the "Gathman" tower, etc.), direction, security, habitability, motive power, and armament. Under this heading is a short history of the torpedo, from Bushnell's early idea to Mr. Whitehead's, and Messrs. Orling and Armstrong's "Actinaut," more properly a submarine boat controllable from without. The "Actinaut" is fully explained in a pamphlet issued by the inventors.

Explosives is the last point treated in this connection, before the author passes to his final section, the military value of the submarine. This he approaches with some hesitation, recognizing that here everything is a matter of conjecture. The Admiralty, he says, ordered the five "Holland" boats, not because they could be of any use in the event of a European war, but "to quell the popular clamor." They are not an efficient reply to the enormous French programme of these vessels, were they in themselves desirable.

"Life on a destroyer is to that on a submarine as Paradise is to Hades. It is a bare existence, a nerve-shattering, pluck-destroying tension. The 'Narval' was experimentally sunk for 12 hours with her crew; at the end of the time they had to be helped home. And yet we, the nation whose firm intention it is, in the event of war, to take the offensive, build submarines of the 'Holland' type."

Yet to neglect submarines altogether would be a fatal step. "Large, submersible, sea-going torpedo boats present glowing features," and a development of that type may be expected. The author quotes the opinion of Mr. F. T. Jane on the French boats—the "Narval" is probably the boat of the future—and says if the "submarine is of little use, the 'submersible' may prove very valuable." There are many defensive uses for the submarine, and Sir John Hopkins thinks it quite possible that in a short time no battleship will be without a pair of small submarines. But "what would happen if two opposing fleets each launched a dozen or so submarines before going into action is too awful to contemplate; a veritable holocaust would result."

The submarine is, then, a "defensive" instrument; the "submersible" an "offensive" instrument. So England, the author concludes, does not require submarines. Some nations, as France, Germany, and the United States, should possess both.

We do *not* "all know that it is France's dearest wish to plant her army corps on the shores of *perfide Albion*," but that question we need not discuss here. We can join with Mr. Burgoyne in his hopes for more energetic and sympathetic action on the part of the Admiralty toward all inventions and improvements.

In conclusion, the author has reprinted several articles, interviews, and press comments; as "The Tactical Value of Submarine Boats;" "Defense Against the Submarines," dealing with the destroyers of all nations. "The Value of Submarine Boats," by Admiral Sir John Hopkins, who thinks the submarine has "come to stay, that its value in the future as a defensive weapon against harbor attacks or a blockading force is undeniable, that its development is a certainty, and that when for defensive purposes it is pronounced efficient, the genius which treated it will soar toward the higher ambition of making it equally effective for offensive work in blue water, with every probability of succeeding." Mr. F. T. Jane says finally, "I have no evidence that a single submarine has yet done anything under *war* conditions. This being so, it still remains in the experimental condition."

Colonel Cuniberti, Chief Constructor to the Italian Navy, when interviewed, thought no country in the position of England required such "mechanical toys" as the "Holland" boat, but large submersibles.

Mr. A. F. Yarrow, asked for his opinion on the French movement in favor of submarine boats, replied, "With our present knowledge they are both dangerous and ineffective, and, I may add, the more money the French spend on them the better for the rest."

Mr., now Sir John, Thornycroft also said, "On one point I can speak with confidence. I would rather not go in a submarine boat myself; and that being the case," he added more seriously, "I feel reluctant to put other men on board such a craft."

Sir W. Laird Clowes, in an article in the New Liberal Review, June, 1901, referring to recent patents, said, "My contention is that, knowing of these inventions, and of the experiments which have been made with them, the Admiralty was not justified in pursuing the will-o'-the-wisp of the submarine boat, but should, instead, have followed up the clue, the end of which has been supplied by the ingenuity of the young Swede, Axel Orling, and the knowledge of Mr. J. T. Armstrong."

There are many other valuable opinions and articles collected here, but for these and all the many other points of interest we must now refer the reader to Mr. Burgoyne's book itself. The two handsome volumes are excellently printed, and contain many photographs and diagrams, one of which we reproduce here.—Engineering Times.

COLOR PHOTOGRAPHY AND DARK-ROOM ILLUMINATION.

By C. F. TOWNSEND, F.C.S.

THE sensitiveness of the ordinary photographic dry plate to the different constituents of white light is entirely different to the sensitiveness of the eye to these rays. In the latter case the greatest effect is produced by the yellow and green rays; while in the photographic plate, on the other hand, it is the violet end of the spectrum which causes the greatest reduction on the plate. The yellow orange and red rays have very little action upon the ordinary plate, and for this reason a red, orange, or yellow light is employed in the dark room to work by. At the same time it must be remembered that the sensitiveness of the plate to the different rays is only comparative and that what is considered the safest dark-room lamp will fog a plate if it is exposed to the light sufficiently long. Some years ago I made a large series of experiments upon the different materials—glass, fabrics, and papers—used for giving a safe light in the dark room, and I found that, speaking generally, the best light to use was a yellow orange. In many instances the red glass, when examined through the spectroscope, was found to let through a certain amount of violet light and not to be nearly so safe or reliable as orange yellow. This, of course, is for the ordinary plate or bromide paper. For the latter quite a bright canary medium can be used.

It is most important to have a good light to work by when developing bromide prints, as the risk of an unsafe light is small compared with the risk of wasting paper through under or over development. In developing a negative a little extra density is not a matter of much consequence, but in bromide prints it is absolutely essential that the development be stopped at exactly the right point. On the whole, I think that the gloomy dark room is the greatest possible mistake. Most of the dark rooms I have been in have been like miniature reproductions of the black hole of Calcutta in regard to ventilation and illumination. My own plan is to have a "safe" light well under control and use either none at all or plenty of light. It is far better to keep the room almost in darkness in the early stages of development and then to use plenty of light for a rapid examination of the plate at a reasonable distance from the light, than to have such a poor light that the plate has to be held close up against the glass of the lamp for a considerable period before its progress can be ascertained. In developing color-sensitized or isochromatic plates, as they are usually called, no light is really safe, and I always take great care while having a reasonably good light in the room for the purpose of examining the plate, to keep the dish covered with a cardboard box while development is proceeding, removing the box only for a moment to examine the plate at intervals.

When photographed upon the ordinary dry plate, the colors in a landscape do not appear in their right relation. The red poppies and the yellow corn appear almost equally black, while the corn flower appears almost as white as the daisy. Also the clouds, the blue sky, and the distant hills usually appear as a monotonous stretch of white in the print. Similarly, in photographing a picture, the same difficulties present themselves. There are two ways of remedying the defects in the sensitiveness of the photographic plate. First, it has been found that by the addition to the film of certain dyes the sensitiveness, which in the ordinary way stops practically in the green, can be extended to the yellow, orange, and even to the red part of the spectrum. The addition of ammoniacal eosin extends the action of light on the plate right up to the yellow green; ammoniacal erythrosin extends the action to the green-blue, where there is a rapid falling off, but the plate is sensitive again to the yellow and orange; ammoniacal rose Bengal gives a very similar result, but the action extends farther into the red; cyanin (quinoline blue) sensitizes the plate up to the yellow-green, misses the yellow and orange, but allows a considerable action in the red.

Other dyes, such as cœrulein, alizarin blue, chlorophyl, chrysanilin, are used also as sensitizers for different parts of the spectrum. All these dyes although they render the plate sensitive to other rays than the blue and violet, do not stop the action in that part of the spectrum, which still remains very much greater than in any other part. Consequently, it is not sufficient simply to sensitize the plate for other colors than the blue and violet, but something must be done to diminish the force of the violet rays. This is effected by introducing a light filter, composed of aurantia, or some other orange or yellow dye, such as Manchester yellow, in the path of the light before it reaches the plate. The light filter may consist of a strip of dyed collodion, either stretched on a metal

frame or mounted on glass, or a glass screen flashed on the surface with the requisite tint, or a cell full of colored liquid. The light filter may be placed either behind the lens or in the diaphragm slot.

On the whole, the cell is the most scientific arrangement, as a standard solution of the dye can be made and used fresh every time; whereas the dyed collodion or gelatin gradually fades, and there is a good deal of uncertainty in its use. A solution of potassium bichromate forms a very good filter. Great care must be taken in the adjustment of the screen to see that the cutting out of the blue and violet rays is not overdone, or the result on the sensitized plate will be quite as false to nature as a photograph on an ordinary untreated plate. By the use of a proper combination of dyes and the judicious employment of the yellow light filter, a plate may be rendered almost equally sensitive to all the rays of the spectrum. Such a plate is very useful for copying pictures or for scientific work, where accurate equivalence of color is desirable; but for ordinary landscape work a plate sensitized for the yellow and green, as is the case with most of the isochromatic plates on the market, is quite sufficient. This plate can be developed with comparative safety in a dull ruby light, although it is advisable to expose it even to this light as little as possible. For the panchromatic plate, which is sensitive right through the spectrum, the ruby light is as unsafe as any other. At first sight it would appear that such a plate must be developed in absolute darkness. Fortunately, however, there is a little gap in the blue green to which the plate is not rendered sensitive, and a dark-room light accurately corresponding with this gap can be used with safety.

Isochromatic plates are no more trouble to work than ordinary plates, and the results secured upon them are certainly very much better. In addition to rendering the landscape more in conformity with nature, they frequently allow the clouds to be well represented, as well as the distant hills. In portrait work, also, they render the texture and coloring of the skin and of the hair very much better than the ordinary plate. Their only drawback is that they do not keep in good condition quite so long as the ordinary plate, but the difference is not sufficiently great to make much difference to the average photographer.—Pharmaceutical Journal.

SOLDERING OF METALS AND THE PREPARATION OF SOLDERS AND SOLDERING AGENTS.

THE object of soldering is to unite two portions of the same metal or of different metals by means of a more fusible metal or metallic alloy, applied when melted, and known by the name of solder. As the strength of the soldering depends on the nature of the solder used, the degree of strength required for the joint must be kept in view in choosing a solder. The parts to be joined must be free from oxide and thoroughly clean; this can be secured by filing, scouring, scraping, or pickling with acids. The edges must exactly fit, and be heated to the melting-point of the solder. The latter must have a lower melting-point than either of the portions of metal that require to be joined, and if possible only those metals should be chosen for solder which form alloys with them. The solder should also as far as possible have the same color and approximately the same strength as the article whose edges are to be united.

To remove the layers of oxide which form during the process of soldering, various so-called "fluxes" are employed. These fluxes are melted and applied to the joint, and act partly by keeping off the air, thus preventing oxidation, and partly by reducing and dissolving the oxides themselves. The choice of a flux depends on the quantity of heat required for soldering.

Solders are classed as soft and hard solders. Soft solders, also called tin solders or white solders, consist of soft, readily fusible metals or alloys, and do not possess much strength; they are easy to handle on account of their great fusibility. Tin, lead-tin, and alloys of tin, lead, and bismuth are used for soft solders, pure tin being employed only for articles made of the same metal (pure tin).

The addition of some lead makes the solder less fusible but cheaper, while that of bismuth lowers the melting-point. Soft solders are used for soldering easily fusible metals such as Britannia metal, etc., also for soldering tin-plate. To prepare solder, the metals are melted together in a graphite crucible at as low a temperature as possible, well stirred with an iron rod, and cast into ingots in an iron mold. To melt the solder when required for soldering, the soldering iron is used; the latter should be kept as free from oxidation as possible, and the part applied should be tinned over.

To make so-called "Sicker" solder, equal parts of lead and tin are melted together, well mixed, and allowed to stand till the mixture begins to set, the part still in a liquid condition being then poured off. This mixture can, however, be more easily made by melting together 37 parts of lead and 63 parts of tin (exactly measured).

According to a German law, the interior of drinking and cooking utensils and of fluid measures may only be soldered with solder containing not more than 10 per cent by weight of lead. Zinc solder for soldering cast-iron articles is made of equal parts of zinc, lead, and bismuth. The iron must first be made thoroughly clean, hydrochloric or nitric acid being, if necessary, used for this purpose. If the iron does not take the solder readily, the article may be placed in a concentrated solution of tin-salt in water or into hydrochloric acid containing as much tin as it can hold in solution.

Tin solder for soldering lead, zinc, tin, tin-plate, also copper and brass when special strength is not required, is prepared as follows:

10 parts tin, 4 parts lead, melting-point 180 deg. C.
10 parts tin, 5 parts lead, melting-point 185 deg. C.
10 parts tin, 6 parts lead, melting-point 190 deg. C.
10 parts tin, 10 parts lead, melting-point 200 deg. C.
10 parts tin, 15 parts lead, melting-point 223 deg. C.
10 parts tin, 20 parts lead, melting-point 240 deg. C.

The last of the above mixtures is the cheapest, on account of the large quantity of lead contained in it.

Bismuth solder or pewterer's solder fusible at a low temperature is prepared by melting together:

2 parts tin, 1 part lead, 1 part bismuth, melting-point ....130 deg. C.
3 parts tin, 4 parts lead, 2 parts bismuth, melting-point ....145 deg. C.
2 parts tin, 2 parts lead, 1 part bismuth, melting-point ....160 deg. C.

When brass articles are soft-soldered, the white color of the solder contrasts unpleasantly with the brass. If this is objected to, the soldered part can be colored yellow in the following manner:

Dissolve 10 parts of copper sulphate in 35 parts of water; apply the solution to the solder, and stir with a clean iron wire. This gives the part the appearance of copper. To produce the yellow color, paint the part with a mixture consisting of one part of a solution of equal parts of zinc sulphate and water (1 part each) and two parts of a solution of 10 and 35 parts respectively of copper sulphate and water, and rub on with a zinc rod. The resulting yellow color can, if desired, be improved by careful polishing.

The quality of soft solder is always judged in the trade from the appearance of the surface of the castings, and it is considered important that this surface should be radiant and crystalline, showing the so-called "flowers." These should be more brilliant than the dull background, the latter being like matt silver in appearance. If the casting has a uniform whitish-gray color, this is an indication that the alloy contains an insufficient quantity of tin. In this case the alloy should be remelted and tin added, solder too poor in tin being extremely viscid.

Hard solders are distinguished as brass, German silver, copper, gold, silver solders, etc., from the metals or alloys for the soldering of which they are intended.

Brass solder consists of brass fusible at a low temperature, and is made by melting together copper and zinc, the latter being in excess. A small quantity of tin is often added to render the solder more fusible. Hard solders are usually sold in the form of granules. Although many workers in metals make their own solder, it is advisable to use hard solder made in factories, as complete uniformity of quality is more easily secured where large quantities are manufactured.

In making hard solder the melted metal is poured through birch twigs in order to granulate it. The granules are afterward sorted by passing them through sieves.

Silver solder is cast in the form of ingots, and the latter are hammered or rolled into thin sheets, from which small chips or "links," as they are called, are cut off. The melted solder can also be poured, when slightly cooled, into a dry iron mortar and pulverized while still warm. The solder can also be filed and the filings used for soldering.

Copper or brass is the best solder for iron. For soldering copper, a solder composed of 2 parts copper and 1 part zinc is generally used.

Composition of various hard solders:

I. Yellow solder for brass, bronze, copper, and iron: 5 parts sheet-brass chips and 3 to 5 parts zinc, easily fusible.

3 parts sheet-brass chips and 1 part zinc, refractory.

7 parts sheet-brass chips and 1 part zinc, very refractory and firm.

II. Semi-white solder, containing tin and consequently harder:

12 parts sheet-brass, 4 to 7 parts zinc, and 1 part tin.
16 parts copper, 16 parts zinc, and 1 part tin.
20 to 30 parts yellow solder and 1 part tin.

III. White solder:

20 parts sheet-brass, 1 part zinc, and 4 parts tin, or
3 parts copper, 1 part zinc, and 1 part tin.

A very fusible solder is made of 1 part sheet-brass and 1 part zinc.

A very strong solder for soldering brass tubes to be drawn, etc., is composed of 18 parts brass, 4 parts zinc, and 1 part fine silver.

The following very strong solder is frequently used for soldering silver articles, but can also be used for soldering other metals such as brass, copper, iron, and steel band-saw blades, etc.:

66 parts silver, 24 parts copper, and 10 parts zinc, or
4 parts silver and 3 parts brass.

A very refractory silver solder, which, unlike the silver solder containing zinc, is of great ductility and does not break when hammered, is composed of 3 parts silver and 1 part copper.

A soft silver solder for resoldering parts already soldered is made of 3 parts silver, 2 parts copper, and 1 part zinc, or 1 part silver and 1 part brass, or 7 parts silver, 3 parts copper, and 2 parts zinc.

A readily fusible silver solder for ordinary work:

5 parts silver, 6 parts copper, and 2 parts zinc.

A cheap solder, resembling silver solder, can be made by melting together 76 parts brass, 18 parts zinc, and 6 parts silver.

German-silver solders are characterized by remarkable strength, and are therefore used not only in soldering German silver, but in many cases where special strength is required. As German silver can be made of the color of steel, it is frequently used for soldering fine steel articles.

Solder for ordinary German silver can be made of 1,000 parts German-silver chips, 125 parts sheet-brass chips, 142 parts zinc, and 33 parts tin, or of 8 parts German silver and 2 to 3 parts zinc.

A very fusible German-silver solder is composed of 9 parts copper, 2 parts nickel, and 14 parts zinc, or 70 parts copper, 17 parts nickel, and 113 parts zinc.

A refractory German-silver solder (also called steel solder) consists of—

70 parts copper, 113 parts zinc, and 19 parts nickel, or
38 parts copper, 50 parts zinc, and 12 parts nickel.

The last-named solder can only be melted by a blow-pipe. The solder can be best used in the form of fine powder. It is poured when melted on a large iron plate, so as to form thin sheets, which are at once broken up with a hammer and thrown into a mortar, previously well heated. The powder is then passed through a hair sieve.

Gold solders, for soldering gold or platinum articles, are composed of gold, silver, copper, and zinc. The first three of these metals are melted together in a crucible under a layer of coals, and the zinc is added when the mixture is somewhat cooled.

Composition of some gold solders:

For 24-carat gold: 22 parts gold (24-carat), 2 parts silver, and 1 part copper; refractory.

For 18-carat gold: 9 parts gold (18-carat), 2 parts silver, and 1 part copper; refractory.

For 16-carat gold: 24 parts gold (16-carat), 10 parts silver, and 8 parts copper; refractory.

For 14-carat gold: 3 parts gold (14-carat), 2 parts silver, and 1 part copper; more fusible.

Gold solder for alloys containing smaller quantities of gold are composed of—

8 parts gold, 10.5 parts silver, and 5.5 parts copper, or
10 parts gold (13.5-carat), 5 parts silver, and 1 part zinc.

The following easily fusible solder is used for ordinary gold articles: 2 parts gold, 9 parts silver, 1 part copper, and 1 part zinc. Articles soldered with this solder cannot be subjected to the usual process of coloring the gold, as the solder would become black.

A refractory enamel solder for articles made of 20-carat and finer gold, which can bear the high temperature required in enameling, consists of 37 parts gold and 9 parts silver, or 16 parts gold (18-carat), 3 parts silver, and 1 part copper.

Fine gold is also used for soldering platinum articles.

For soldering aluminium articles, a solder is used consisting of 95 parts tin and 5 parts bismuth. The aluminium must be cleaned by scouring, not by using emery paper, and the surfaces to be joined tinned and soldered with a clean hot soldering-iron. A flux is useless. Aluminium bronze containing not more than 5 per cent of aluminium may be soldered with ordinary tin solder. If there should be a greater quantity of aluminium, the joint must first be slightly coppered, or a freshly-prepared mixture of rosin, tallow, neutral zinc chloride, and sublimate used as a flux.

As a hard solder for aluminium, an alloy composed of 52 parts copper, 46 parts zinc, and 2 parts tin is used with borax as a flux.

The fluxes generally used in the soft-soldering of metals are powdered rosin or a solution of chloride of zinc, alone or combined with sal-ammoniac. A neutral soldering liquid can be prepared by mixing 27 parts neutral zinc chloride, 11 parts sal-ammoniac, and 62 parts water, or 1 part sugar of milk, 1 part glycerine, and 8 parts water.

A soldering fat for tin-plate, preferable to ordinary rosin, as it can be more easily removed after soldering, is prepared as follows: 150 parts beef-tallow, 250 parts rosin, and 150 parts olive oil are melted together in a crucible and well stirred, 50 parts powdered sal-ammoniac dissolved in as little water as possible being added.

Soldering fat for iron is composed of 50 parts olive oil and 50 parts powdered sal-ammoniac. Soldering fat for aluminium is made by melting together equal parts of rosin and tallow, half the quantity of zinc chloride being added to the mixture.

Soldering paste consists of neutral soldering liquid thickened with starch paste. This paste must be applied more lightly than the soldering liquid.

Soldering salt is prepared by mixing equal parts of neutral zinc chloride, free from iron, and powdered sal-ammoniac. When required for use, 1 part of the salt should be dissolved in 3 or 4 parts water.

Borax is the flux most frequently used for hard-soldering; it should be applied to the soldering seam either dry or stirred to a paste with water. It is advisable to use calcined borax, i. e., borax from which the water of crystallization has been driven out by heat, as it does not become so inflated as ordinary borax. Borax dissolves the metallic oxides forming on the joint.

Finely-powdered cryolite, or a mixture of 2 parts powdered cryolite and 1 part phosphoric acid, is also used for hard-soldering copper and copper alloys.

Muller's hard-soldering liquid consists of equal parts of phosphoric acid and alcohol (80 per cent).

A mixture of equal parts of cryolite and barium chloride is used as a flux in hard-soldering aluminium bronze.

A flux used in soldering iron with cast iron is composed of equal parts of cast-iron filings and calcined

borax. This black, glassy mixture is pulverized, and the powder spread on the seam.

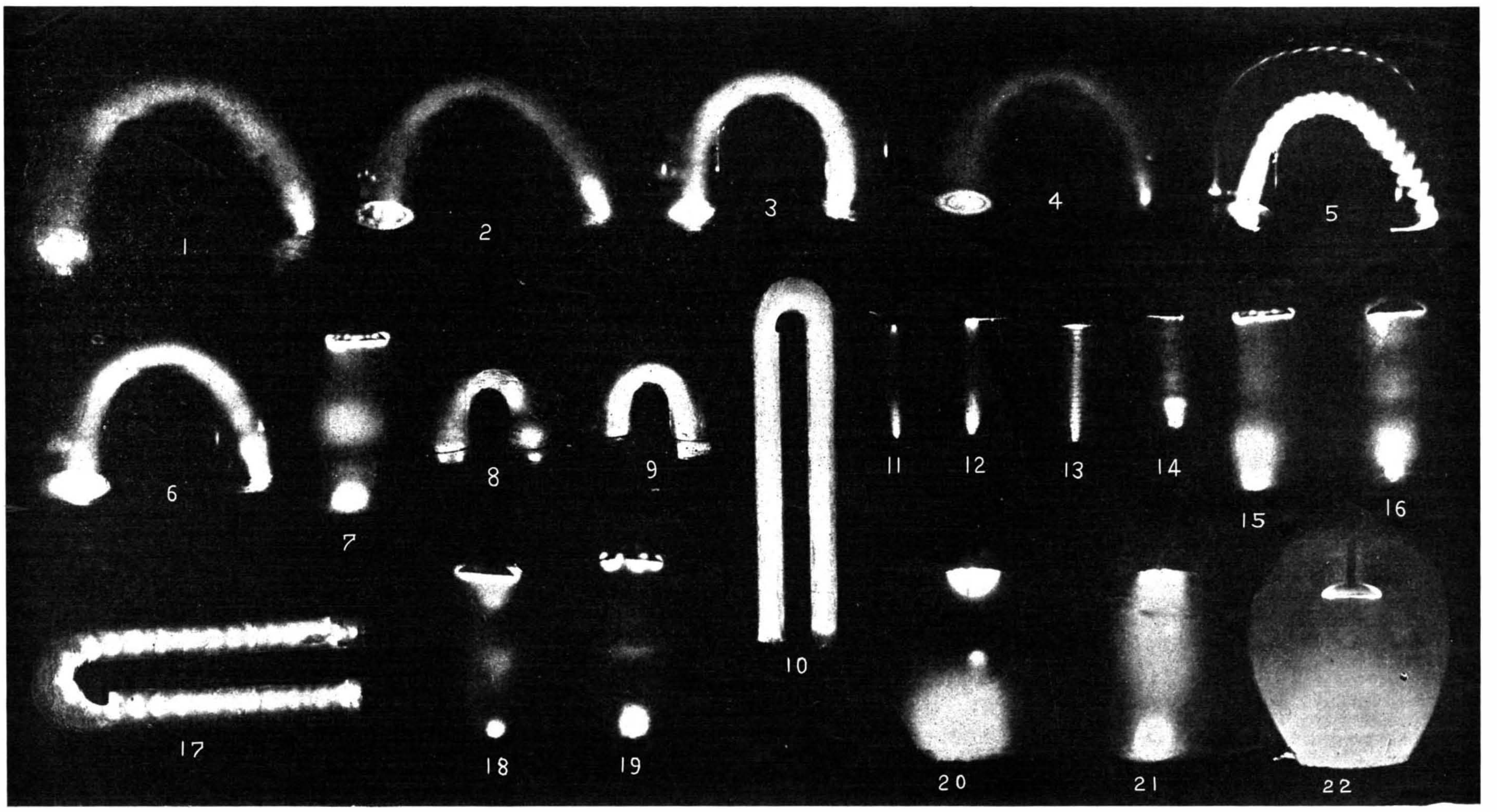
It only remains to mention the so-called cold-soldering, in reality a joining of the edges by means of a copper amalgam. The parts to be joined are well cleaned, and a substance made by triturating 1 part of metallic sodium with 50 to 60 parts of mercury rubbed in. This substance may to some extent be used for the same purpose as soldering fluid, as it causes the firm adhesion of the copper amalgam employed as solder.

To make copper amalgam, dissolve copper sulphate in water and add some zinc-plate chips. A fine powder consisting of pure copper is deposited, which should be filtered off, washed, and triturated in a heated porcelain bowl with a double quantity by weight of mercury. The amalgam, which resembles 18-carat gold in color, is formed into little pellets or bars, which are made soft by heating when required for use.—Deutsche Goldschmiede Zeitung.

SOME EXPERIMENTS WITH THE MERCURY ARC.*

By EMILE GUARINI.

AFTER the admirable experiments made by Mr. Cooper Hewitt and the brilliant results obtained by him, it was but natural that extensive researches upon the mercury arc should be undertaken. All the investigations in this domain are most interesting and equally so are the experiments recently made by Lieut. de Valbreuse, which are illustrated in the accompanying figures, for which the writer is indebted to the courtesy of the editor of L'Eclairage Electrique.



EXPERIMENTS WITH THE MERCURY ARC.

These show the various aspects that the mercury arc exhibits, according to the extent of the pressure in the interior of the receptacle in which it is produced. The pressure is measured in millimeters of mercury. The first experiments were made upon two kinds of tubes, viz., those with two electrodes of mercury, and those with an anode of iron and a cathode of mercury. In the first, the arc begins to remain stable when the internal pressure is 4.2 millimeters. The difference of potential at the terminals is 450 volts for a current of from 0.3 to 0.4 ampere. The color of the arc is bright red at the outset, but this quickly becomes a violet-rose hue, and finally white.

At the start the anode has a uniformly luminous appearance, but it soon becomes covered with extremely brilliant little stars forming regular and changeable geometrical figures (Figs. 1 and 2). If the current be interrupted, the location of the stars will be marked upon the surface of the mercury by black points of oxidation. The size of the stars increases in proportion as the electrode becomes heated. Each one often assumes the form of a luminous spherical bead of the size of a pea lying upon the surface of the mercury. The stars afterward become conglomerated into a disk surrounded by rings (Figs. 3 and 4). The thickness of the dark intermediate rings gradually diminishes and nothing remains but a uniformly luminous surface (Fig. 6).

During this time the violaceous hue of the arc leaves the cathode and slowly reaches the anode, whence, in a few seconds, it entirely disappears. The arc is then of a milky white. The pressure has fallen from 4 to 2 millimeters, and the tension at the terminals from 450 to 200 volts. There occurs a transfer of mercury from the anode to the cathode, and a condensation of the vapors into small drops at the anode and into large ones at the cathode.

Between 1.5 millimeter and 0.05 millimeter, and with a current of less than 0.4 ampere, the luminous vein is completely striated and forms a succession of rings like those of a caterpillar (Fig. 5). The anode is at first capped with a very luminous cone, which afterward becomes converted into a disk that slowly reaches the cathode, followed by other and similar disks. The rings, after the series of them is once formed, are nearly stationary in space, but tremulous and undulating (Fig. 7). Above 0.4 ampere, the striæ disappear. In proportion as the pressure diminishes, the rings become thick and finally consolidate. The production of striæ is analogous to that exhibited by ordinary vacuum tubes. It is explainable, it seems, only on the theory of a series of alternate contractions and expansions of the gaseous medium.

Below 0.05 millimeter the striæ become consolidated and disappear (Fig. 8). Above the luminous spot that surmounts the negative star, there is produced a dark space which becomes more and more elongated (Fig. 9). If the current be then increased by 5 or 6 amperes, the difference of potential at the terminals will fall abruptly to about 15 volts and remain at that figure. It establishes itself as a function of the pressure and also of the temperature and current. The minimum current necessary for the maintenance of the arc increases in proportion as the pressure decreases, and passes from 0.15 to 0.5 and even to 1 ampere. If the energy expended is not too great, an equilibrium will be exhibited, and it will be possible for the tube to operate for a very long time (Fig. 10). If, on the contrary, the current be too intense for the radiating surface of the walls, the glass will become heated, the internal pressure will rise above 10 millimeters, the arc will become unstable, the fall of potential will increase, and the intensity will diminish (Fig. 9). Finally, the glass will become soft and be pierced. It is well not to lower the pressure in the tube below 0.005 millimeter, since below this figure the starting of the tube becomes very difficult. In fact, unless we have very large self-induction coils to use, it is scarcely possible to obtain a difference of potential greater than 7,000 or 8,000 volts at the terminals of the tube. For starting the tube, however, it requires about 3,500 volts for 2.5 millimeters of pressure, 1,500 for 1.5 millimeter, 800 to 100 for 0.05 millimeter, 5,000 to 6,000 for 0.01 millimeter, and 8,000 for 0.006 millimeter. When the pressure is comprised between 6 millimeters and 1.5 millimeters and the electrodes are slightly warm, more or less complete self-starting phenomena occur. Upon submitting a tube, without starting it, to a difference of potential of from 550 to 600 volts, a violet stratum forms at a few millimeters above the cathode and a greenish arc above the anode. The light often fills a part of the tube. The current that passes is then from 0.01 to 0.02 ampere. Sometimes, the normal arc succeeds in forming spontaneously. A slight shock generally suffices to bring about the passage of the arc in other cases.

With tubes having an iron anode and a mercury cathode, the spark leaps between an iron cup and a mercury cup placed in a glass bulb. It remains stable only when the pressure is less than 5 millimeters. Its color is at first violet, and it is very thin (Figs. 11 to 14). The extra starting current, however, will jump through the tube as soon as the pressure descends to 15 millimeters. It is impossible to start the arc by taking the mercury as anode and the iron as cathode. Since the anode is not continually cooled by the vaporization of the mercury, it becomes greatly heated. Despite the long and thick iron rod that forms the anode, the platinum wire that connects with it attains such a high temperature as to often break the glass where it passes through it.

The phenomena observed in these arcs have the same general trend as previously. The anodic stars seem to exist, but are rare and difficult of observation with equal pressures. The starting is easier than in tubes using mercury alone. At all degrees of vacuum the phenomena of self-starting at 550 volts are met with, provided that the tube be slightly warm when the pressure is very low (Fig. 22). At pressures comprised between 0.6 millimeter and 0.15 millimeter the phenomenon is manifested by a superb violet light that seems to float 5 millimeters above the cathode, and by a dim, greenish light that borders the anode. The arc almost always starts spontaneously at the end of a few minutes at the pressures at which vacuum tubes exhibit their maximum conductivity. At lower pressures, the preliminary phenomenon is always the same; but the cathodic light diminishes in intensity and becomes white, the spontaneous excitation becomes rarer, and a shock is necessary to produce the normal passage of the arc.

Whenever a tube does not start readily, the difficulty may be overcome by shaking it. Tubes which, on account of too great a vacuum, often offer an insurmountable obstacle to the current, are sometimes easily started when the surface of the mercury is agitated while the interrupter is operated rapidly. The results obtained by jarring the tube are to be explained, according to Lieut. de Valbreuse, by the presence of a superficial membrane that offers an opposition, especially when cold, to the passage of the current. He explains in the same way the production of the rings and stars above mentioned, which are produced in the tubes using mercury only.

The arc between iron and mercury, during almost the entire operation, exhibits striæ starting from a luminous sheath that surrounds the anode. Such striæ, which are at first compact, become spaced wider and wider apart in measure as the pressure decreases. They are always very movable and tremulous. When the vacuum has advanced to a certain point, there is no longer anything produced but a single stratum in the form of a dish with upturned edges that occupies the center of the tube (Figs. 15, 16, and 17). If the intensity of the current be raised to 4 or 5 amperes, the striæ will always make their way toward the anode and seem to concentrate themselves there into a luminous ball (Fig. 20).

When the pressure is very low and the current weak, the glass flask is entirely filled with a light gray homogeneous light of but slight luminosity. If the strength of the current be increased, the light will become more intense, but be localized in the vicinity of the two electrodes, the rest of the tubes being nearly dark (Figs. 18, 19, and 20). When the intensity exceeds 10 amperes, the arc is continuous and very luminous, and the anode becomes red and melts at the edges (Fig. 21). In a short time the heating brings about a

*Specially prepared for the SCIENTIFIC AMERICAN SUPPLEMENT.

super-pressure, and the arc becomes thin and very unstable.

All these phenomena are, as may be seen, very interesting; and will perhaps make valuable contributions to the knowledge that we already possess upon the difficult subject of discharges in vacuum tubes.

PROGRESS IN THE USE OF ELECTRICITY.

WE have time and again referred to the fact that the principal obstacle to the general use of electricity has been that created by the municipal authorities; who, while themselves frequently unwilling to embark on the somewhat speculative procedure of constructing central stations for the public supply of electric energy, have imposed such difficult terms upon private enterprise that it became hazardous, even for capable promoters, to undertake the supply. Parliament assisted in the entrenchment of local authorities; and it is certainly a tribute to the commercial instinct and progressive energy of capitalists in this country that electricity has now such a firm hold. Unfortunately, however, these splendid commercial traits of character have not altogether had their reward, because, although private companies demonstrated the superiority—alike as regards illumination and economy—of electricity, they have not, taking them in the aggregate, had the recompense that was their due. The areas which were reserved, as the result of Parliamentary and corporate action, were naturally the most lucrative; and thus, if we except the metropolis, most of the large electrical undertakings in the country are municipal enterprises. The result is that, in later years, the progress, as measured by the number of the Board of Trade units sold, is very much greater in the case of municipalities than in that of companies. Thus, of the thirty million units sold in 1896, two-thirds were produced by companies; in 1899, the municipalities and the companies each generated one-half of the 85 million units used; and for the past year the municipalities have produced two-thirds of the total of 344 million units. It will thus be seen that the output from municipalities has increased at a very much quicker ratio than that from company power-stations. Last year marked an increase of practically 100 million units on the total quantity sold in the United Kingdom, and of these 78 million units were credited to the undertakings of public authorities. It should, however, be made clear that there are 226 municipal stations, as compared with 130 company schemes; so that the average annual output per corporation station is considerably greater than the mean output from the companies' stations—1,030,000 units as compared with 856,000. But an indication of the superiority of the town stations is afforded by the fact that the total units sold in 1903 per 8 candle-power lamp in the case of municipal stations was 23, as compared with 16 for company stations; the mean annual amount of electrical energy consumed in the United Kingdom per 8 candle-power lamp, being practically 20 Board of Trade units.

The cost of generation is decreasing; the details given in Garcke's "Manual of Electrical Undertakings"* show that, in the case of sixty undertakings in 1896, the total cost per Board of Trade unit, exclusive of depreciation, interest, sinking fund, and capital charges was 4.07d.; it was reduced in 1900 to 2.67d., in the case of 118 stations; last year it was only 2.30d., although 216 were included in the analysis. Under the head of generation alone the reduction has been 1d., from 2.45d.; while under the head of distribution it has been equally satisfactory, from 0.36d. to 0.21d. Although the companies have not the same lucrative business as the local authorities, they have, by economy and by liberal action toward the consumer, maintained a fairly good dividend, although the rate has been decreasing in recent years. Apart from the 27.79 millions sterling borrowed by municipalities, the total capital invested in electric light and power companies is now about 24½ million sterling, of which 28 per cent is on loan and debenture capital, the average return on which is 4.43 per cent, which marks a decrease from 4.69 per cent in 1897; 21 per cent is preference capital, and here the decrease in the rate is more marked: from 6.05 per cent in 1897 to 5.36 per cent in the past year; but this latter figure shows a slight recovery on the totals of the two preceding years. The ordinary capital, which represents about half the total invested in electric light undertakings, earned last year an average of 5.29 per cent. This is necessarily a fluctuating return, owing largely to the beginning of new stations, involving, as they do, a capital expenditure without any immediate return on ordinary stock. Naturally, the demand has to be cultivated; it is in the development of this demand that the private company excels the corporation; and the practice, which is adopted now in many cases, of the company putting in a wiring and charging a rent, has certainly increased materially the use of electricity. It would assist matters still further if some such arrangement could be made whereby, after the lapse of a certain period of time, this rent should cease; and an even more extensive development would follow if the companies could induce the owners of houses to put in the wiring in all existing property (under an agreement with the tenant), whereby the cost might be spread over a period of ten years, instead of the tenant, whose occupancy is determinable upon a three years' lease, being called upon to bear the expense.

In electric traction we find a corresponding development has taken place. Mr. Garcke, in his admirably-arranged details, shows that the total capital of 156 electric traction undertakings is now £61,606,509, which is 17 million more than in the previous year, and ten times the total of eight years ago. Municipal undertakings, however, are still in a minority; for here, more than in lighting, the municipalities have hindered development by refusing to grant a renewal of the leases to old companies, so that they might with some degree of security of tenure apply the new method of haulage to their existing lines. This refusal has delayed the development of electric tramways long after untrammeled private enterprise had carried out schemes in less populous places. There are now 92 municipal undertakings, with a loan capital of 21¾ million sterling, which is a little more than one-third of the amount involved in company schemes. The total mileage of electric tramways and light railways in 1903 was 5,348 miles of single track, and 3,584 route miles; the former showing an increase of 633 miles, and the latter of 368 miles as compared with the previous year. The number of cars in use has increased in one year from 5,528 to 7,343. As to the return of capital for the electric traction schemes, it may be noted that of the 61.6 million sterling, 24 per cent is loan and debenture capital, and on this the return for the past year has averaged 4.53 per cent, which is about the mean for the past five years; 22 per cent of the total is preference capital, the return on which has been 4.81 per cent, showing a slight decrease during the past five years; the remaining 54 per cent is ordinary capital, on which the return has been 4.13 per cent. But, as a matter of fact, 5 million sterling of the ordinary capital for traction has not yet reached the dividend-paying stage, whereas in the case of lighting only 1¾ million sterling receives no dividend; so that it may be assumed that traction is in a more experimental stage from the commercial point of view than lighting.

In addition to the mileage given there is 18¼ miles of deep-tunnel railways in London now in operation; 26½ miles under construction, 91 miles in process of conversion to electric traction, and 19 miles authorized. The total for the metropolis alone is 154¾ miles, as compared with 58¼ miles a year ago. It is further interesting to note that the electrification of standard-gage surface railways, to the extent of 127½ miles, is either in course of construction or has been authorized; the mileage authorized, but not yet commenced, making up a total of 47 miles.

In addition to supply and traction undertakings, a very large amount of money is invested in electric schemes. Thus, there are 35¾ million sterling devoted to manufactures, showing an increase of six million sterling as compared with the preceding year, and of ten million sterling compared with two years ago. On telegraphs there are 33½ million sterling invested, and on telephones 10½ million sterling, of which only £318,000 sterling is due to municipal undertakings, three in number. Miscellaneous schemes involving 12 million sterling bring the total subscribed capital of all electric undertakings, numbering 1,121, to the enormous amount of close upon 227 million sterling. This is exactly double what it was four years ago. It would appear from an examination of the average rate of dividend on capital invested that manufacturing is the most profitable, as the average rate in this case is 5.85 per cent; for telephones, 4.80 per cent; for telegraphs, 4.76 per cent; and for traction, 4.41 per cent. In view, however, of the speculative nature of the undertakings, and of the large amount of propagandist work that must be done before final success is realized—apart altogether from the great uncertainty consequent upon municipal aggrandizement—this return can scarcely be regarded as high, although under the circumstances it is satisfactory.—Engineering.

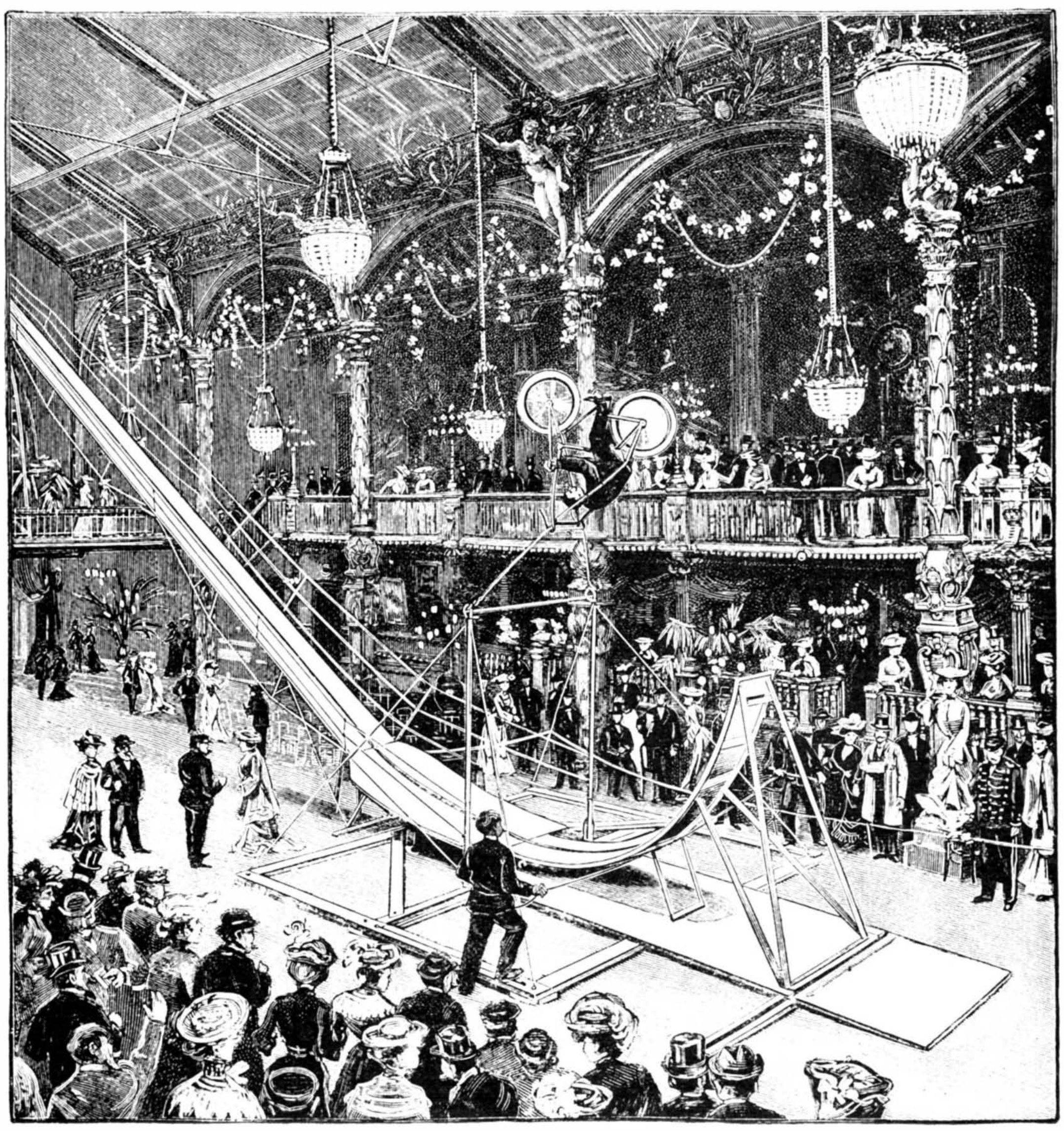
* "Manual of Electric Undertakings and Directory of Officials," compiled under the direction of Emile Garcke. Vol. viii. London: Publishing offices, Mowbray House, Norfolk-street, Strand, W.C., 1904.

DOING THE "GIANT SWING" ON A BICYCLE.

UNDER the name of the "Human Whirlwind," the Paris Casino is offering a new attraction that might better be called the "human sling," since here a bicyclist and his machine, suspended from the end of a rope, describes a complete circle without the necessity of any track such as is used in the exhibition of "looping the loop."

Things are arranged as follows: The track necessary to give the proper speed is, as usual, a long inclined plane, the upper end of which nearly touches the ceiling of the immense hall of the Casino, and which, after descending nearly to the floor, turns upward in the form of a semicircle, but only to a height of about 8 feet. At the bottom there are two posts 13 feet in height, which are rigidly placed and are provided at the top with specially-shaped hooks to which are fastened the ends of a rope that hangs in the form of a V between them. Again, the bicycle carries a frame that extends to a height of about 12 inches above the head of the rider, and is provided on each side with a large hook, which is designed to engage with the rope at the moment at which the velocity of the machine is at its maximum. The bicycle and its rider, after descending the inclined plane, continue their course for an instant upon the semicircular part of the track, and then, held by the rope, finish describing the circle in the air. At the moment at which the wheels of the bicycle resume contact with the ground, the rope becomes detached automatically, owing to the special form of the hooks that sustain it at its ends, and it is possible for the bicyclist to continue his journey in a straight line, the curved part of the track having been removed and the straight part lowered to the level of the ground during the short time that he was in the air. The curved part is mounted upon two rails on which it is slid to one side, and the level part is supported by a metallic horse that is folded up when the pedal is pressed by the attendant. These two parts are manipulated at the same time by one man.

In "looping the loop," the bicyclist, at the proper moment, has to turn his handle bar so as to cause him to deviate slightly from a straight line in order to follow the helicoidal track that permits him to make



THE HUMAN SLING.

his exit. Here it is necessary to have coolness enough not to deviate nor to incline in the least to the right or the left, since then the hooks of the machine, or, at least, one of them, would pass alongside of the rope and the rider would be thrown upon the side.—Translated from La Nature for the SCIENTIFIC AMERICAN SUPPLEMENT.

THE FIG: ITS HISTORY.*

By GUSTAV EISEN, Ph.D.

THE English word "fig" is of very ancient origin, and is derived from the Latin "ficus" and the yet older Hebrew name "feg." The English word must have originated during the Roman invasion of England, when probably the first fig trees were planted in English soil. As early as 1250 the word was in general use in a commercial sense, as "figges" or "fegges" constituted one of the products regularly imported into England, especially from Portugal and Spain.

The wild fig, the ancestor of the edible fig race, is unknown in English-speaking countries, except, of course, where found as botanical specimens. In the semi-tropical Mediterranean districts this wild fig is met everywhere except in the north of Italy and the Riviera and in the south of France. In Italy the wild fig is known as the "profico," "fico selvaggio," or "caprificus," the last name being derived from capra (goat) and ficus (fig), and indicating the worthlessness of the fruit for eating purposes. From "caprificus" is derived our name "caprifig" and the French "caprifiguier." In Spain it is known, in some districts, at least, as the "caprahigo." In Greece it is called "erineos," while the edible fig is there known as "sycon" (σνκον). In Hebrew the edible fig was "teena," in Aramaic "tena," and in Arabic it is "tin." It may not be out of place also to note that the name of another celebrated fig variety, the "sycamore," of Egypt, is derived from the Greek "sycon" (fig) and "moro" (mulberry), meaning mulberry fig, on account of the peculiar arrangement of the fruit. What we in the United States incorrectly call "sycamore" is really not a sycamore, but a plane tree.

The various crops of the fig, as well as of the caprifig, are also given different names in different countries. In these pages reference is made to the wild fig as "caprifig," meaning thereby only the male tree of *Ficus carica* L., while the word fig will always refer to the edible fig, or the cultivated race of the same species.

HOME AND DISTRIBUTION OF THE FIG INDUSTRY.

The probable home of the edible fig† is in the fertile part of southern Arabia, where at present the caprifig is wild, and where there are no traditions of its introduction. From South Arabia the Bahrâ tribe‡ is said to have brought the fig to ancient Idumæa and to Cœlesyria,§ whence it was carried by other tribes and races to Syria and the Mediterranean shores. The march of the fig was slow, and it undoubtedly required many centuries to reach the shores of the Mediterranean coast. Once there, the facilities for transportation and the extensive trade and voyages of the maritime nations greatly facilitated its further distribution.

But while it is probable that the home of the edible fig is to be found in Arabia Felix, it is even more likely that the home of the fig industry is to be looked for elsewhere. Nearly all the southern cultivated fruits which we now possess appear to have originated somewhere in western Asia. Almonds, nuts, apricots, peaches, olives, Asiatic grapes, dates, figs, prunes, etc., all seem to have been brought to great perfection in a country somewhere in Asia but now unknown to us. The bringing to great perfection of so many varieties of fruit indicates a very high state of civilization of very old date, compared to which the republics of Greece and Rome must be considered modern. Through the very latest archæological discoveries we now know that such a civilization existed as far back as ten thousand years ago in western Asia, in the valleys of the Euphrates and Tigris. Nowhere else have archæologists been able to trace such an ancient and remarkable civilization; and, as the origin of so many of our best fruits, vegetables, cereals, and domestic animals points to a west-Asiatic origin, it is not too much to presume that in the most ancient civilization of Nippur dwelt the originators of nearly all those economic vegetables, as well as animal products, on which man, in all temperate regions, is now dependent for his sustenance.

From the motherland, Asia, the fig was carried over the Western World by two different peoples and by two distinct routes. These two peoples, in ancient times the great colonizers of the world, were the Phœnicians and the Greeks, and to both of these may be traced the spreading of the culture of the fig. The older colonizer of the two was the Phœnician. At the end of the fourteenth century‖ before Christ these thrifty merchants had finished the colonization of the great islands of the Mediterranean, their colonies and trading posts being by that time securely planted on Cyprus, Rhodes, Sicily, Malta, and Corsica. The further course of their trading and colonization enterprise lay along the southern shores of the Mediterranean over the coast of Africa, while on the opposite side of the great sea it stretched along the shores of France and Spain¶ and through the Pillars of Hercules, along the coast of Portugal, and as far north as to the

* Abstracted from "The Fig: Its History, Culture, and Curing," by Gustav Eisen, Ph.D., published by the U. S. Dept. of Agriculture.

† Solms-Laubach (2), pp. 77-78.

‡ Lagarde, 3 c., p. 383.

§ Ibid., p. 377.

‖ Dunker, 74, c. v., p. 39.

¶ Mooers, vol. II, 512, and Meltzer, I, p. 37. Gades, the present Cadiz, founded earlier than 1,100 before Christ.

Channel, with its islands and comparatively favorable climate. There can be no doubt that to all these places the fig tree was carried in many varieties at a very early date, even previous to the introduction of the fig into Greece and Italy proper.

The real history of the fig industry begins after the introduction of the fig into the Mediterranean region outside of Asia, and particularly into Greece. Historical references are few and far between. The tree and its fruit constituted at first merely a luxury for the rich. Later, mention of the fig becomes frequent, and not merely as a luxury during the ripening period, but as an important article of diet for the people during the winter months.

The time of the first introduction of the fig into Europe is very uncertain. In the Homeric songs, the oldest European literature extant, the fig is hardly mentioned. In the Iliad, describing the Trojan war, the greatest national undertaking of the Greeks, no reference to the fig is found. In the Odyssey, describing the wanderings of Odysseus after this war, the fig is mentioned three times. In the part descriptive of the agonies of Tantalus in the lower world we read how in vain he tried to reach the fruits almost within his grasp, "pomegranates, pears, apples, sweet figs, and dark olives."* The composition of the Homeric songs is generally conceded to have been accomplished before the ninth century before Christ, but later investigations make it probable that the verses mentioning the fig in the Odyssey are interpolations of much later date. Hesiod, who lived in the ninth century and after Homer, has nothing to say about the fig. The earliest mention of undoubted genuineness is by the poet Archilochus, who lived about seven hundred years before our era. He tells about the fig being cultivated on the Greek island of Paros, and there greatly contributing to the enjoyment of life. The introduction of the fig in Greece must, therefore, have occurred some time in the eighth century before Christ, and undoubtedly it then came from the Semitic nations across from Palestine and Asia Minor. Later on Attica and Sikyon, the latter place named after "syke" (fig), had become famous for their excellent figs, the origin of which was attributed to the goddess Ceres (Demeter), who caused the fig tree to spring up at Phykalos as a reward for the hospitality extended to her by the inhabitants of the place.

The cultivation of the fig soon extended all over Greece, and the fig gradually became an important article of diet of both poor and rich. The Athenians were especially chided for their fondness for figs, and nicknamed "sykophants" (fig-eaters), a name afterward applied with a different meaning to those spies who informed the authorities about the unlawful exportation of figs from Attica. So famous became the figs of that province that Xerxes, the King of the Persians, daily procured Attic figs for his table in order that they might constantly remind him of the desirability of adding to his domain a country which could produce such fine fruit.† From this time the fig is constantly referred to in the Greek literature, and Theophrastus, Aristotle, and other writers describe the caprification process, then extensively practised.

From Greece the fig tree and its culture spread along the northern shores of the Mediterranean and the Adriatic until it gradually reached the southern parts of Italy. There it must have been established at an early date, as it figures in the earliest Roman mythology, the she-wolf having nursed the infants, Romulus and Remus, under the spreading crown of a certain fig tree, which was thought to be in existence and pointed out as a sacred object in the time of Pliny. Certain it is that from remotest times fig culture was a cherished pursuit among the Romans, who, through seedlings and culture, originated numerous varieties. So different and characteristic had these become in the time of Pliny (23 to 79 A. D.) that they excited the special attention of that great naturalist. He wrote: "We see from this how the universal law which preserves the types of species may vary"—a most remarkable expression, which clearly foreshadows the modern theory of evolution.‡

The many varieties described by the ancient writers, such as Theophrastus, Cato, and Pliny, can not now be identified with any certainty. Many of these varieties originated from seed, some accidentally, others as the result of efforts made for that purpose.§ Their identification has been attempted by several modern investigators, such as Porta, Gasparrini, and Gallesio, and while their efforts have been highly interesting, they have brought no conclusive results. When we consider how quickly varieties are discarded for others of greater value, it becomes probable that most of these ancient figs became extinct centuries ago. From the many varieties mentioned by the Greek and Latin authors‖ we may, however, conclude that fig culture was extensively distributed and considered of great importance. But notwithstanding the many varieties, the best and choicest figs were those imported from Syria, as we are told that during the reign of the Emperor Tiberius (B. C. 42 to A. D. 37)¶ considerable trade existed in Syrian figs, these figs being generally valued higher than those of Italy and other Mediterranean districts.

At the end of the Roman Empire, near the close of the fifth century A. D., the fig may be considered as

* Od., η, 115, 116; λ, 589; η, 120-121; ω, 339-340; ω, 245.

† Willkomm, pp. 6, 9.

‡ Ibid., p. 7.

§ Varro, lib. 12, cap. xi., 5.

‖ Theophrast., cap. III, 6; v., 2, 8; Cato, vol. I, cap. 8, 1; Pliny, lib. xv, cap. 19.

¶ Willkomm, p. 7.

distributed along the coast of the Atlantic as well as along the shores of the Mediterranean. Toward the south the coast of Africa abounded in fig trees, while on the other side fig culture stretched over the wild coast region of Portugal, France, the Channel islands, and perhaps over the southern part of England. But nowhere else had the cultivation and the drying of figs reached such a height of development as in Syria.

Nearly seventeen hundred years after the Phœnician colonization the Arabic conquest began to follow that same route. The Arabs in their turn carried with them the fig tree, now developed into many new varieties, and raised fig culture to a degree of importance which it has never since attained outside of its old home, Syria. The Arabic invasion extended through northern Africa to Spain and Portugal, and in these countries fig culture began to flourish and rapidly became of even greater importance than in Italy and Greece. The Arabs held the fig in the highest esteem and considered it superior to any other fruit. It is even related by Zamakhschari,* an Arabian commentator on the Koran, that Mohammed, the prophet, himself, in his enthusiastic enjoyment of the delicious figs, once exclaimed: "If I should wish a fruit brought to Paradise it would certainly be the fig." The Arabic invasion, during the medieval ages, has indelibly stamped its mark on fig culture in the territory it occupied, and to this day the varieties of figs grown there are to a great extent different from and superior to those grown in countries colonized by the Greeks and Romans. Thus Portugal, the most southern province of Greece outside of the Pillars of Hercules, became especially famous for its figs. Algarve, with an almost perfect climate, produced a most superior article of dried figs, the commerce in which became of the greatest importance. Algarve almost exclusively supplied western Europe with dried figs for over one thousand years, and until late in the present century Portuguese figs dominated the English markets. It is only comparatively of recent date that the Smyrna figs have supplanted all others in English and American markets. Even as regards names, Arabic fig culture has left is influence to this day in the various countries of the ancient Arabic caliphate. Thus in Portugal the caprifig is known as "fico de toca," the Arabic name being "tokkar," while in Malta the name "tokar" is yet in use and almost unchanged.†

If we again turn to the extreme Orient we find that the fig tree traveled much more slowly toward the east than toward the west. In the time of Herodotus, when all Greece had for centuries enjoyed the fig, and where it had long since become a necessity and an important article of diet, the fig tree and its culture had not yet reached Babylon, and neither Media nor Persia was acquainted with its use. According to Herodotus, Sandanis warned Kroisos not to make war with "barbarians who knew neither wine nor figs."‡ Still, wild varieties of figs, not very different from the caprifig, are found in Persia and India, from which another race of edible figs might have been originated by any intelligent agricultural race.§

Gradually the fig tree spread over Asia Minor and Syria to parts of Mesopotamia and Persia, and to the several oases in the great Arabian desert. In the lowlands between the Euphrates and the Tigris fig culture was yet unknown.‖ In the mountain districts of Taurus, Armenia, and in the Iranian table-lands fig culture long ago reached a high development. Toward the east it has spread to Khorassan, Herat, and Afghanistan, as well as to Meru and to Chiwi. But India did not possess fig culture in the fourteenth century, though native figs of good quality and resembling our edible fig are growing wild in the hills of the Punjab.¶

The fig is supposed to have reached China during the reign of the Emperor Tschang-Kien, who fitted out an expedition to Turan in the year 127 A. D. The fig is first mentioned by Chinese writers in the eighth century. Hia-tscheng-Shi, in his work, "Yu-yang-tsa-tsu," treating of the Chinese trade, speaks of a fruit as "tin-tin" in a country—"Fo-tin" (Palestine). "Tin" is the Arabic name for the fig. This writer mentions that the fruit originated without a blossom, etc. This early introduction of the fig to China may, however, be only a myth. It seems that in the fourteenth century figs were growing in China, but it is not certain if these figs were identical with our own. In 1550, however, the fig is described by the celebrated Chinese writer, Le-Shi-tschen,** as growing in Chinese gardens, and from that time we may conclude that fig culture was properly established in the extreme eastern part of Asia. Now many varieties of figs are cultivated in China, some being of very good quality. In Egypt fig culture never assumed any prominent place, undoubtedly on account of the climate, which permits no plants to grow without irrigation, which, if given in any excess, is especially injurious to the quality of the figs. In the old tombs at Benihassan may be seen a wall painting illustrative of a fig harvest, in which the fig tree is characteristically and unmistakably pictured. The hieroglyphical word for fig was "bak-ou," and Syria was often referred to as a country rich in wine, oil, and bak-ou.††

With the discovery of the New World the edible fig

* O. Celsius, c. II., 371, according to Solms-Laubach, p. 82.

† Solms-Laubach, p. 83.

‡ Herodot., I, cap. 71, according to Hehm.

§ Solms-Laubach (2), p. 45. From the following pages are taken many of the remarks on the eastern geographical distribution of the fig.

‖ Solms-Laubach (2), p. 80.

¶ The Chinese history of the fig is according to letters and manuscripts of Dr. Bretschneider in Peking to Solms-Laubach.

** Unger, pp. 83, 110.

†† Chabas, p. 105.

obtained a foothold in all the countries visited by the Spanish and Portuguese missionaries. Figs of different and distinct species were found by them growing in the tropical parts of Mexico, Central America, and South America, but these native figs were inferior to those brought over the Atlantic. It is to these Spanish missionaries that we owe the introduction of figs into California, and the "Mission" black fig is yet the most important and most widely distributed variety in all American countries Christianized by missionaries from Spain. This "Mission" fig is extensively distributed over the northern parts of Mexico as well as over Baja and Alta California, Peru, and Chile, while a smaller and slightly different variety is found in the highlands of Mexico and Central America.

To the Southern States of the United States the fig was brought principally by the French in the earliest days of their occupation, while later many varieties were imported from English nurseries. Of late years California has been the great distributing point of fig trees, some enterprising growers having made many direct importations of varieties from the Mediterranean districts, and these varieties have since found their way to Florida and other States.

It is interesting to note that while California has progressed enormously in fig culture and now possesses over a hundred varieties of figs imported from various parts of the world, its neighboring States, Sonora and Baja California, which are so pre-eminently suited to fig culture, are yet ignorant of the existence of other figs than the "Mission."

MOOR CULTIVATION AND PEAT INDUSTRY IN GERMANY.*

AMONG the various specialized conventions and exhibitions which fill the calendar of an ordinary year in Berlin, the most notable and interesting event of last winter has been the first exposition of the Association for the Promotion of Moor Culture in the German Empire, which, after a most successful and interesting display, closed on the 20th of February. The purpose and functions of this society, which was founded in 1883 and has now a membership of 776, including many men of national reputation, form an apt illustration of the patient, thorough, and systematic German method of dealing with an important economic problem. There are in Germany about 6,400 square miles of peat moors, which, under the primitive method of cultivation that prevailed until recent years, was practically Berlin, the most notable and interesting event of this here and there be derived from it.

But as nothing valuable is permitted to go to waste in this country, practical men with scientific instincts, soon after the organization of the Empire, took hold of the problem of utilizing by various methods the waste places of the Fatherland. The exhibition of last winter has been an epitome of their work during a period of twenty years, and as such deserves the distinguished recognition which it has received here and the interested attention of other countries where similar natural conditions exist.

The exhibition included 904 numbers, a large majority of which were composite and included a whole group of articles or products displayed by one exhibitor. It was divided into three general groups, or classifications, as follows:

I. The peat moor as a subject of scientific study, its flora, fauna. geology, and scientific attributes.

II. This group included all that pertains to the redemption, cultivation, and agricultural development of moorlands, their products and methods of culture.

III. All that pertains to the industrial uses of peat as fuel, fiber for various purposes, fodder, etc.

The wide range of the exhibition will be inferred from the fact that the first of these groups comprised 9 classes, or subdivisions, the second group 18, and the third one 5. It is impossible within the limits of a consular report to do more than sketch briefly some of the more notable features of the display, particularly those which have a definite industrial value. The exhibition included, besides the various exhibits made by members of the German association, a comprehensive and interesting display by the Moor Culture Association of Sweden, and another of similar scope and variety by the Austro-German Moor-Verein, which has extensive properties in Bohemia and Hungary.

A study of these various exhibits showed beyond doubt or question that by far the most important method of utilizing European moorlands is through their reclamation and cultivation for agricultural purposes. This includes draining, clearing, fertilizing, plowing or spading, and preparation for cereals, vegetables, and fruits. So different are the requirements of moorland from upland, especially in respect to fertilizing, that the experience of these several associations during the past thirty years may be said to have developed a new branch of agricultural science. How successful it has been this first exposition has abundantly demonstrated. More than fifty moor-culture stations have shown products that prove the efficacy of their methods. Bundles of wheat and oats 5 and 6 feet in length, potatoes of large size and excellent quality, beets, turnips, squashes, onions, apples, cabbage, celery, hay and forage grasses, all the various produce of a fertile and well-cultivated farm or market garden, were shown in endless profusion. The educational value of these exhibits was greatly enhanced by samples of the soil in which they grew and analyses showing its original constituents and the kind and amount of fertilizers used to enhance its fertility. Other analyses placarded in large type showed the chemical composition of the various products—the percentage of starch in potatoes and wheat, the product per hectare, etc. Large photographs framed and hung on the walls showed the appearance of the moor before and after reclamation, growing crops at various dates in spring, summer, and autumn, and the implements and methods employed in cultivation.

DRAINAGE AND CULTIVATION OF MOORLANDS.

One of the most extensive departments of the exposition was that of apparatus and implements adapted to the drainage and cultivation of moorlands, and here was found the one exhibit contributed by the United States, namely, a full line of steel plows, headed by the "Prairie Breaker," together with cultivators, disk harrows, wing and spade harrows, etc., from the Wiard Plow Company, of Batavia, N. Y., and exhibited by an agency in Posen. There was also a full display of wind motors and pumps for draining marshes, all of which were of German manufacture.

The fertilization of moorlands for the production of various crops constitutes a distinct branch of agricultural chemistry, the details of which would lead to technicalities beyond the scope of this report. The substances which have been found most effective in this country are the crude potash salts, kainite and kieserite, phosphates, Chile saltpeter, Thomas slag, lime, marl, sea ooze, and wood ashes, each systematically applied in such manner and quantity as to correct the known deficiency of the natural soil. Another important use of reclaimed moorlands in Germany is forest culture, which is carried out under the admirable forestry system of this country. The exhibits in this department included photographs and models of nurseries and culture stations, sections of trees and samples of sawn and hewn timber produced on drained moorlands, and a complete reproduction of a moor-laborer's cottage, with the clothing, furniture, crockery, cooking utensils, and beds of peat wool which are peculiar to that class of working people.

INDUSTRIAL PRODUCTS FROM PEAT.

To the average visitor by far the most interesting portions of the exposition were those devoted to the various industrial products, such as peat straw and wool, fuel briquettes and coke, paper and pasteboard, tiles and bricks for paving and building purposes, and even fodder for animals, for, as we shall see, a German scientist has succeeded, by treating the cleansed vegetable fibers of peat moss with the waste molasses of beet-sugar manufacture, in producing a compound that serves acceptably as food for domestic animals.

Peat straw is simply the woolly fiber cleansed, dried, and baled for various uses. It is generally of a light brown color, spongy in texture, light, clean, and with an extraordinary power of absorption for gases or liquids. It has long been used in preference to straw, leaves, or any other material as litter in stables for horses or cattle. It will absorb ten times its weight of ammoniacal liquids—more than three times as much as wheat or rye straw—and, when saturated, is piled and allowed to rot, by which it forms a humus of the highest value as a fertilizer. Another form of the same material known as "torfmull" is used as a disinfecting absorbent for purifying the air of closets and stables, and when filled is mixed with earth and sand and used as manure. It is also the best material known for protecting trees and plants from frost in winter. Walls filled or padded with peat mull are rendered warm and dry, and beds made of it are clean, dry, and sanitary, so that it is extensively used in asylums and hospitals. It is made at many places in Germany and Sweden, one of the largest and most enterprising factories being at Stargard, in Pomerania.

"Heloxyle" is the name given to peat fiber compressed and hardened by a special process into sheets, tiles, plates, and blocks for various building purposes. It is used for lining walls, ceilings, window and door frames, to underlay wooden flooring, and even as flooring itself. It has about the consistency and atomic weight of sound cork, and, being an almost perfect non-conductor of heat, moisture, sound, and vibration, it is of great value in locations where warmth, dryness, and protection from noise or jar are especially desired in dwellings and other constructions. It is impregnated with some material which renders it practically incombustible, so that even the German building police approve and recommend its use. It is one of the cheapest of all building materials in Germany, is light to transport, clean and easy to handle, can be painted, nailed, or glued together, and from a sanitary standpoint is a nearly ideal building material. A floor of heloxyle, covered with a rug or carpet, is a luxury of warmth, stillness, and comfort in a modern dwelling.

Pasteboard made of 40 per cent peat fiber and 60 per cent wood shavings is a standard product both in Germany and Sweden, being stronger, lighter, and cheaper than pasteboard made in the ordinary way.

PEAT AS A FUEL.

It remains to speak of peat fuel, which in the forms of briquettes and peat coke was exhibited by several manufacturers who employ different processes, and, finally, of peat excavation for all purposes, since it is upon the economy and efficiency of excavating and drying that the industrial success of the whole operation will inevitably depend.

Raw peat as it comes from the bog in all but exceptionally high and dry locations contains usually 85 per cent of water. Experience has shown that the remaining 15 per cent of peat substance, if dried and burned as fuel, contains only heat units sufficient to evaporate 28 per cent, or one-third, of the 85 per cent water which the crude material originally contained. This is the fatally weak point in all artificial peat-drying processes. They consume more heat units than they can produce. The essential point is to eliminate by drainage and air drying every possible atom of water. This is done by two methods, dependent somewhat upon the use for which the prepared peat is designed.

In all cases, however, good management includes as a first step the drainage of the bog by ditches, cut at intervals to a depth of about 18 inches below the bottom of the peat bed which it is designed to work. Into these at least 50 per cent of the water settles and either flows off by gravity or is pumped out by the wind-driven pumps. The drained peat is then excavated, either in blocks, cut with an angle spade specially designed for the process, which are hauled away in hand cars and laid out on the ground to drain and dry by wind and sun, or by machines which by means of steel scoops or diggers running on an endless chain dig out the peat, carry it up to a sufficient height, and dump it into hand cars, which transport it to the machines, by which it is further treated and prepared.

HOW THE PEAT IS PREPARED.

A complete plant of this kind, which was exhibited in constant operation by Mr. C. Schlickeysen, of Rixdorf-Berlin, formed a prominent feature of the recent exposition. The excavating machine, which was driven by an electric motor, was mounted on a portable track of light rails, designed to be moved over the moor as the peat is exhausted by excavation. The machine digs out, elevates, and drops into the dump cars a ton of raw peat every five minutes. It is transported to the machine, conveniently located at the edge of the bog, which tears, pulverizes, kneads, and presses the plastic mass out into long masses or "strains," which are cut into sections a foot long and dried in the open air to hard, tough blocks, which resist rain and bear transportation to any distance. The secret of this part of the process seems to be that the crushing and grinding action of the machine releases the fluid organic elements of the raw peat, which, mixing with the solid fibrous portion, forms a matrix or binder which when dry holds the whole mass firmly together. In drying, the strains shrink to about one-half their size when in a plastic state. If mixed while in a soft condition with 20 to 30 per cent of anthracite or bituminous coal dust, they form, when dry, an excellent fuel of high caloric value. Otherwise they may be carbonized by heat into peat coal or coke.

Both the latter are pure and free from sulphur or phosphorus, and are therefore valuable fuel for the finer processes of metallurgy, but they are inevitably too expensive to compete on a large scale with ordinary coal and coke. Any form of peat fuel, in fact, represents the recovery of a small percentage of crude vegetable matter from a large proportion of water and the preparation of this residue by processes which are inevitably so laborious and expensive that unless the most improved and economical methods are employed at every stage the cost exceeds the fuel value of the product.

Notwithstanding all difficulties, however, progress in the preparation and use of peat fuel is steady and constant, and Sweden, according to recent reports, has succeeded in utilizing it for locomotives. On the government railway from Elmhut to Malmö specially constructed freight locomotives have been fired during the past year either wholly with peat fuel or a mixture of the same with English coal, and the engineer's reports claim for the experiment both a mechanical and economic success.

* Samples of the peat fiber and circulars (in German) relating to the same are on file in the Bureau of Statistics for examination.

EXPERIMENTS ON WHEAT.

WITHIN the last few years it has gradually been recognized that, although our wheat fields produce a large bulk of grain, it is, if used alone, unsuitable for the manufacture of the light white bread now generally demanded. In consequence, increasing quantities of the harder and more suitable wheats grown in Canada, the United States, and other countries are imported yearly, and the price of the inferior home-grown grain has fallen considerably. More or less concurrently with this, greatly improved methods of milling have come into vogue, and the farmer, perhaps not unnaturally, associates the two facts, and all too frequently blames the miller for his reduced margin of profit. A little closer examination of this complicated problem shows that the tendency for the last thirty years or so has been for the yield per acre of grain to rise, and the quality, as estimated by the percentage of gluten present, to fall.*

Now in some way or other, precisely how we do not know, the capacity of wheat to yield a strong flour, or its "quality," is bound up in this mysterious mixture of proteids grouped together as gluten, so that if the blame must be apportioned, it rests on those who injudiciously selected wheats for cropping power in preference to quality. Meanwhile, such fine old varieties as Golden Drop, Red Lammas, and Nursery wheats are steadily being driven out of cultivation by varieties slightly superior in yield, but far poorer in quality.

The great importance of making the most of our home wheat supply has been insisted on time after time by the National Association of British and Irish Millers, and one of the methods they have suggested is to raise improved strains of these good varieties, either by hybridizing or by selection. Experiments along these lines have been carried out for the last three seasons by the Cambridge University Depart-

* The figures are set out in detail in Girard and Lindet's "Le Froment et sa Mouture," p. 101. (Paris, 1903.)

ment of Agriculture. In the first place wheats known to yield a good quality grain have been crossed together with the object of finding more vigorous races among the progeny of the hybrids. Further, varieties selected from a collection of several hundreds for possessing such characters as a strong, resilient straw, a short period of maturation, and freedom from various diseases, have also been used as parent wheats.

So far it is early to predict any results of technical value, but a number of results of scientific interest have already been arrived at in connection with Mendel's laws of inheritance. The flowers of wheat being autogamous are specially advantageous for such work, as Spielman's careful researches on wheat-breeding, carried out without any previous knowledge of Mendel's work, have shown. Spielman has already recognized that lax ears, the lack of awns, velvety chaff, and red color are dominant characters, while dense ears, the presence of awns, glabrous chaff, and white color are the corresponding recessive characters.

These results have already been amply confirmed.

Thus from crosses between beardless and bearded wheats the resulting hybrids have invariably shown the beardless character, while their progeny have consisted of beardless and bearded forms in the proportion of three to one. Similar results have been obtained on crossing lax and dense eared races, rough and smooth chaffed, and red and white, though in the last case it has so far been impossible, owing to bad ripening, to distinguish clearly enough between red and white chaff to establish their proportions.

unexpected forms appear in this generation showing characters unrepresented in either parent. The commonest of these, so far, has been a spelt-like wheat with peculiarly lax ears, thick glumes, and the typically closed spikelets of *T. spelta*. Many of these exceptional forms are sterile—probably owing to imperfectly developed pollen.

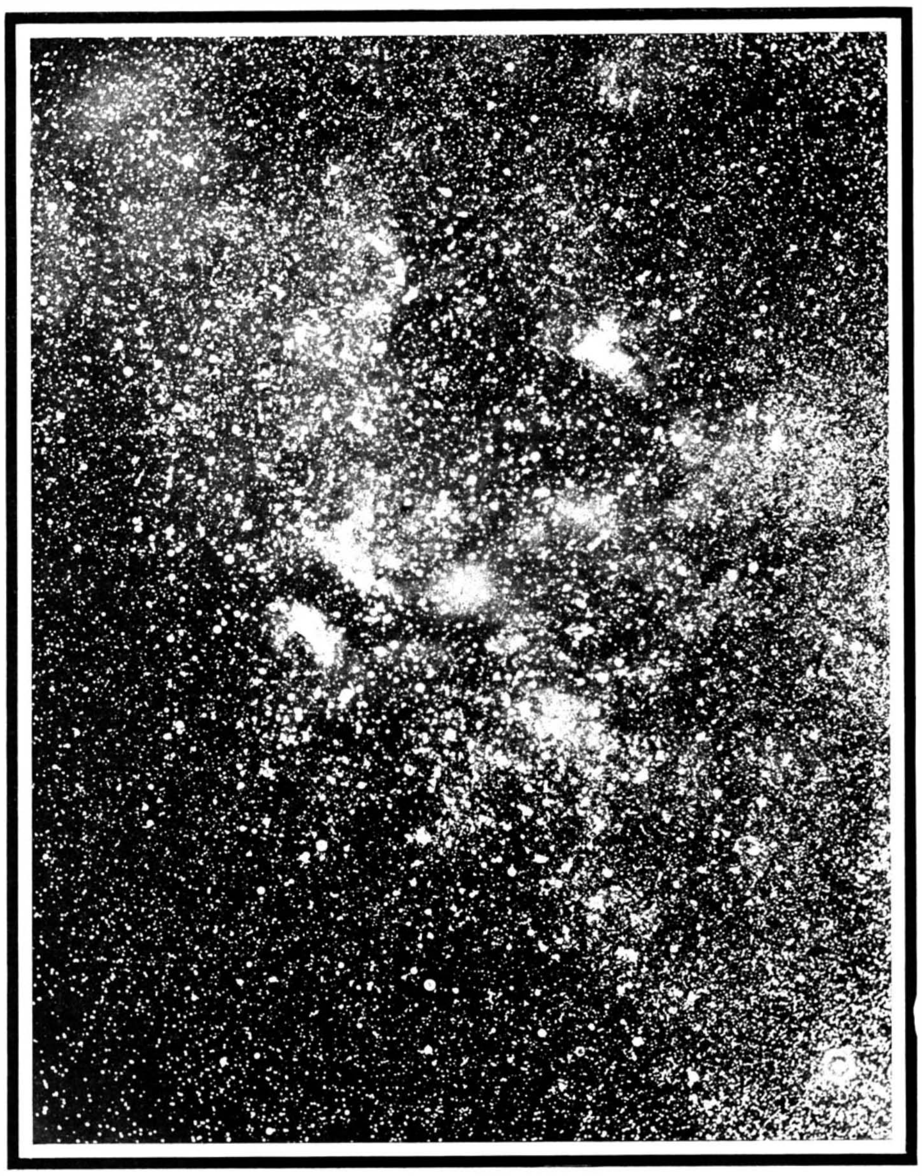
These botanical characteristics are, however, of little importance technically, the farmer and miller being concerned chiefly with the quality, yield, hardiness, time of ripening, susceptibility to disease, etc., characteristics, at present practically unexamined, which one might term "constitutional."

The quality of the grain can, to a certain extent, be judged by the hardness and translucency of its endosperm, the poor starchy grain being soft and opaque. Accepting this as a guide, then, good quality is a dominant character, at all events so far as an examination of the first generation of the hybrids goes. The late ripening habit is also dominant over the early ripening habit. As an example, *T. polonicum*, ripening early in August when sown about the middle of March, was crossed with Rivet wheat ripening late in August when autumn sown. The hybrid grains were sown on March 15, and produced plants which ripened their grain about the middle of September—simultaneously with Rivet wheat sown on the same date.

Experiments on the susceptibility to disease are also being carried out. This point is being investigated both with rusts and mildew, the two serious wheat diseases, inasmuch as they are untreatable. For the purpose of the experiment, in 1901 Michigan Bronze and a wheat with the Michigan Bronze strain in it, viz., Red King, both liable to rust, were crossed with Rivet wheat, which is practically immune. Reciprocal crosses were made in each case. The following year the hybrids were the most badly rusted plants among the experimental plots, and there was nothing to choose between the plants with Rivet wheat as male or female. Incidentally, then, it might appear to anyone who accepted Eriksson's views that in the case of Rivet wheat ♀ × Red King or Michigan Bronze ♂, the so-called "mycoplasma" had reached the hybrid grain by way of the generative nuclei. But is such an interpretation possible? I think not.

On harvesting the plants the grain was found to be badly shriveled, the Michigan Bronze crosses only producing three grains, none of which germinated. From about three hundred grains of the Rivet and Red King crosses, two hundred and sixty plants were raised. The rust appeared on these as early as March 16, and by June 15 many plants were orange-colored even on the highest leaves. On counting out the plot, 78 plants were found to be free from disease, 118 were slightly infected, and 64 were badly attacked. By June 29 the epidemic seemed to be at its height, and a second count showed that the number of disease-free plants was reduced to 64, while 195 were infected, for the most part badly.*

* One plant overlooked.



THE NEBULOUS MASSES IN THE REGION OF γ CYGNI.

At the same time it has been shown that the sharply keeled glumes found in *Triticum turgidum*, e. g., are dominant over the glumes with rounded bases occurring commonly in the varieties of *T. vulgare*, that the gray color of glumes and paleæ is dominant over red and white, that broad leaves are dominant over narrow, and rough ones over smooth, that certain groups of bristles on the ridges of the stem which distinguish some varieties are dominant over the ridges without bristles, and that hollow stems are dominant over pithy stems. With regard to grain characters, the long and narrow type is dominant over the short and round, and the red over white. At the same time certain complications have been met with which will entail further investigation. Thus, the rough-chaffed gray Rivet's wheat, when crossed with a smooth-chaffed white or red wheat gives hybrids which vary considerably both in the roughness and color of the chaff, some being almost glabrous and showing decidedly the red or white color as well as the gray. The same impure dominance of the rough chaff and color is found in the following generation, where other rough-chaffed wheats have been made use of in the place of Rivet wheat, though this character has been purely dominant.

Further, particularly among the progeny of the hybrids, there is a marked tendency for the various characters to become intensified. Medium lax, for instance, becomes very lax, the gray color becomes almost black, and the red a deep brown. At the same time,

These figures seem to be too close an approximation to the Mendelian ratio of 1 : 3 to be a mere accident, especially when taken in conjunction with the results of the first generation. The susceptibility of wheat to the attacks of rust is therefore a definite Mendelian character.

If further researches should show that this capacity for resisting the attacks of disease-producing fungi is in reality a tangible characteristic, the plant-breeder, at all events, will have definite lines to go upon in attempting to solve one of our most important agricultural problems, namely, that of producing disease-resisting strains.—R. H. Biffen, in Nature.

THE NEBULOSITY IN THE REGION OF γ CYGNI.

In 1891 Dr. Max Wolf, of the Heidelberg Observatory, discovered large nebulous masses in the region of γ Cygni. Some two and a half years ago he succeeded in obtaining a good photograph of these masses with a 16-inch Brashear lens. Our illustration has been made from a contact print from the original plate, which was exposed for nearly seven hours on the nights of July 16 and 17, 1901.

The bright star surrounded by a nebulous halo in the center of the plate is γ Cygni. α Cygni is not included in the picture; its position, however, is somewhat to the outside of γ Cygni, at the upper left-hand corner. It will be observed that a nebulous stream runs diagonally across the plate, joining γ and α Cygni. By far the most striking feature of the entire region is the broken nebulosity near the center of the plate.

The dense mass of stars is astonishing. Here and there they crowd upon each other so that they form one blur of light. Sometimes bright stars, small stars, and nebulous masses are all mixed together; and sometimes the intervals between the stars are quite free from all halo. The irregular dark holes in the nebulous patches to the west of γ Cygni and the clouds to the east and northwest of that star are noteworthy. A straight line of stars crosses the plate north of the center.

We are indebted to Dr. Wolf for the accompanying photograph and description.

TELLURIUM.

The element known as tellurium cannot be said to have made any substantial progress toward recognition during the last century, as far as its employment in the arts is concerned. References to it have, however, become somewhat numerous of late years in connection with the metallurgy of gold and silver, and perhaps a few remarks on the subject may be of use, not as a contribution to scientific literature so much as a finger-post to those who may wish to gain some salient facts without having recourse to numerous indices. Although from its appearance there is some reason for putting tellurium among the metals, yet in its compounds and reactions it shows so much similarity to sulphur and selenium that it has found a definite place with these elements in chemical text-books, and from this position there seems no probability of its removal.

The pure substance is a gray body with a metallic luster; the specific gravity is 6.24, and, being of extreme brittleness, it can easily be powdered. Though occurring in small quantities in the native state, it is generally in combination with metals that it is found. The most important of these compounds are sylvanite—telluride of gold and silver; nagyagite—a complicated mineral containing the element in combination with gold, lead, antimony, and sulphur; white tellurium—a telluride of silver; and tetradymite—telluride of bismuth.

With regard to the geographical distribution of these minerals, it is noteworthy that they only occur, or, more correctly speaking, tellurium only occurs in any quantity in three districts, which are—Kalgoorlie, in West Australia, Colorado, and Schemnitz, Offenbanya, and other places in Hungary. In these districts the element has achieved a certain amount of notoriety, not at all on account of its intrinsic virtues, but because of the special metallurgical treatment to which the gold and silver ores containing it have had to be subjected. A considerable amount of work has been done at Schemnitz in recent years in the way of isolating tellurium as a marketable product; but the very small, we may almost say the negative, success which has attended the experiments with the body in medicine, porcelain painting, and thermo-electricity, has naturally acted as a cold douche to the efforts of its would-be producers. We may take it then that the interest in tellurium is almost entirely scientific, for the present at all events.

To the practical metallurgist tellurium comes more as a nuisance than anything else, particularly where it is contained in gold ores which it is desired to treat by the cyanide process. In the amalgamation processes its presence is not so much felt, but in the ordinary cyanide treatment it is apt to cause a good deal of trouble, and numerous experiments have been made with a view of overcoming the difficulties which its presence involves. It cannot be said, however, that the much-vaunted bromo-cyanogen treatment has proved altogether the success that has been freely attributed to it, though it is, no doubt, a step in advance. A chemical process, known as Löwe's, has been adopted at the Zalathner mine, in Hungary, to separate tellurium from other elements in a complex ore, a product being obtained consisting of 71.21 per cent tellurium, 12.45 per cent copper, and 5.43 per cent lead. The pure

tellurium is obtained by adding sulphurous acid to the solution of the above in *aqua regia*. A few years ago it was announced that a deposit of telluride of bismuth, associated, as usual, with gold, had been discovered in Bulgaria, but we are unable to say what resulted from the attempted sale of the property in London.

Turning our eyes from Europe across the Atlantic, we would draw the attention of those specially interested in the subject to the work which has been done by C. Whitehead, whose papers are to be found in the Journal of the American Chemical Society for 1895. Copper bullion is shown to contain tellurium as a common impurity, though not in anything like large quantities. It is entirely separated in the electrolytic refining process. The American copper obtained by smelting, which tests 98.5 of the metal, contains 0.04 per cent tellurium. Considerable quantities of tellurium have been obtained at American copper works in recent years, and a year or two ago Mr. Otto Hehner, in showing some specimens of the product at the London Section of the Society of Chemical Industry, suggested that its applications might form a productive field of study for some of the younger members of the society. So far, however, as we have indicated above, there are no applications to which we can point with confidence. Not unnaturally, it was thought that, owing to its chemical analogy to sulphur, its acids might have some similar application, but the experiments of T. Bokorny showed that tellurous acid was much inferior to sulphurous acid as a germicide and disinfectant. In contradistinction to the failure which has attended the attempted use of tellurium in the arts, we may point to the largely increased adoption of selenium by the optical instrument makers, the substance being obtained as a by-product in the manufacture of sulphuric acid from Spanish pyrites. The future may have in its grasp applications on a similar, if not extended, scale for tellurium, but it cannot be said that the present time offers much encouragement to those interested in its production.—Engineering.

PREPARATION OF CALCIUM, STRONTIUM, BARIUM, AND SILICIUM FOR EMPLOYMENT IN METALLURGY.

THESE metals are prepared for industrial use by reducing the oxides, the carbonates, or the nitrates of the three alkaline earthy metals, and the metaloid SiO with charcoal under the influence of an appropriate flux, and with the flame of a detonating gas.

First Example—Calcium.—A mixture is produced of 84 parts of quicklime of fine quality and dehydrated, or of pure nitrate of lime, with 16 parts of wood charcoal, preferably with the wood charcoal used in the composition of gunpowders.

This mixture, very finely pulverized and sifted, is agglutinated with a little tar and formed into briquettes of three or four centimeters, under a pressure of 100 to 150 kilogrammes per square meter.

These briquettes are introduced into an iron crucible lined with basic materials. The crucible is surrounded with masonry in the sides of which there are passages for the charging, and for the exit of gases and dust. The crucible in which fusion of the briquettes takes place has a bottom formed of pieces of charcoal 10 millimeters thick. It is sufficient to introduce into the central part of the crucible a blow-pipe of large caliber, worked with the aid of the detonating gas, and fed with air and oxygen in suitable proportions, according as a neutral, reducing, or oxidizing flame is desired for operating the fusion of the briquettes, and thus obtaining a large quantity of reduced calcium of the size of a pea, or in the form of a fine powder, very energetic as an agent of reduction of the oxides, carbonates, and chlorides of the metals, such as lead, copper, chromium, molybdenum, tungsten, and nickel.

Composition of the Detonating Gas.—Formene (marsh gas), 35 parts; hydrogen, 39 parts; acetylene gas, 26 parts; this composition to be varied according to the temperature to be obtained, while by increasing the quantity of oxygen with the formene and the acetylene gases excessively hot flames are produced.

It should be remembered that to burn completely one volume of marsh gas and one volume of acetylene, requires two volumes and a half of oxygen.

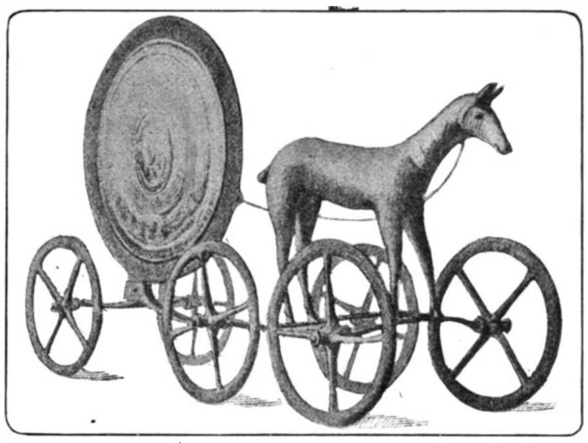
Second Example—Silicium.—The production of silicium is based on the reduction of silica by charcoal, sodium chloride in the presence of an alkaline silicate acting as a flux. These substances, finely pulverized and sifted, are introduced into a crucible similar to that described above and heated with the detonating gas, which quickly produces fusion, separating the silicium in the form of black grains having the appearance of iron.

Third Example—Barium.—The preparation of barium being similar to the preceding, it may be concluded that, in the presence of the hard charcoal at the bottom of the crucible, the flame of the detonating gas will reduce readily and wholly the oxide and the nitrate of barium. Barium is thus obtained in the form of grains of the color and luster of iron, having a density a little above 4.—Translated from La Revue des Produits Chimiques.

A new type of quick-firing gun which will fire a projectile weighing 3 pounds is to be introduced into the British navy. The weapon is designed by Vickers Sons & Maxim, and although somewhat similar to the weapon of this caliber already in service it is much more powerful. The charge is fired with modified cordite and the gun is capable of an exceptionally rapid aim and fire. Furthermore it is fitted with automatic sights. The weapon has been subjected to a series of particularly severe tests by the Admiralty and these have proved so successful that it will supplant the present 3-pounder in the navy.

A SUN IMAGE FOUND IN DENMARK.

LAST autumn a most interesting find, which has attracted much attention in antiquarian circles both in and outside Denmark, was made in a peaty soil at a place called Trundholm, in northern Zeeland. Near



SUN IMAGE FOUND AT TRUNDHOLM, DENMARK.

the surface of the soil a workman discovered what at first sight appeared to be a toy thrown away, a tiny bronze horse dragging a circular disk inlaid with gold and placed on wheels. Notice of the finding of the object, which had been damaged on purpose to preserve its intention of being a votive offering to the gods, was made at once to the director of the National Museum at Copenhagen, Dr. Sophus Müller. After its reconstruction a most minute study of this unique object took place, and a full description of it has since appeared in Danish. It has been clearly proved an image of the sun being dragged round on a chariot as an object of worship, an idol of the sun worship dating from about 1000 B. C., and the best of its kind found anywhere, both as regards design and execution. In Egyptian and Oriental mythology, as well as in Grecian, the sun was represented as a round disk, often inlaid with gold. Several pictorial representations of the sun are known from the same period, but none that has any close resemblance to this find.

Everything seems to indicate that the find belongs to the older Bronze Age, and is of purely Scandinavian origin in its rich ornamental style and artistic workmanship, which appears in northern bronzes of that period. All the ornaments on the disk have been done by means of punching with a bronze chisel in zigzag lines or circles, appearing clearer and fresher where gold plates covered the surface on the one side until the discovery of the find. The decorations on the horse answer to the same style as on the sun image. Ornamental bands run round the head and over the forehead of the animal; the eyes are formed of a round and somewhat arched piece filled with concentric ornaments; the center seems to have consisted, judging from the dark material found, of resinous matter so often employed at that period for filling out spaces.

Two things make this image of the sun quite different from the various Egyptian and Grecian images—the rich ornaments, used in the Danish Bronze Age on weapons and objects of personal wear, and the fact that there is no actual chariot and only one horse. The idea of the sun god driving over the heavens with his horses seated in a chariot is evidently of much later date, after the time of Homer, who makes no allusion to horses and chariot when speaking of the sun. Everything is here on wheels, but no chariot; and the orb of the sun drawn by one horse, a small ring on the horse's neck and one on the edge of the sun-dial facing the animal, clearly showing that a small rein had its place there. Dr. Müller rejects the idea that the numerous signs in shape of a small circle, chiefly found on rocks in Sweden, are meant to be the sun as a wheel rolling round. Instead of this, they are the sun-dial itself, and the find from Trundholm throws a clear light on what was hitherto a matter of great doubt, it being clearly proved that the sun has been worshiped to a large extent during the Scandinavian Bronze Age.

The wheels are plainly made to go round, not immovable like in other objects of bronze, viz., vessels that several times have been found placed on wheels.

The image is 1 foot 1½ inches broad and 8 inches high. Only in fragments was the find taken up from where it lay, half a foot under the surface, but it was easily put together, when the investigation commenced, by Dr. Müller and his assistants. The weight of the horse is 2,640 grammes, the disk 1,550 grammes.—W. R. Prior, in The Reliquary and Illustrated Archeologist.

SUN IMAGE FOUND AT TRUNDHOLM, DENMARK.

A NEW MINERAL FROM CEYLON.*

SINCE writing last week, I have made further experiments on the cubical mineral, and have myself carefully examined the earth constituents. The statement made last week, that there is only an insignificant amount of thorium present, must be modified. On redetermining the equivalent of the crude oxalate, prepared after the yttrium metals had been separated by treatment with potassium sulphate, it has come out higher than I expected; indeed, assuming the metal present to be a tetrad, its atomic weight is even higher than that of thorium—about 240, as the mean of two closely concordant determinations. The lower equivalents mentioned in the previous letter were determined as fractions of the double potassium sulphate, prepared on a large scale. This high atomic weight points to the presence of unknown elements of higher atomic weight than thorium; indeed, the mineral appears to be of very complex composition. It may be incidentally remarked that the crude oxalate mentioned above must have contained all the cerium group, and if any considerable proportion of the elements of this group is present, the amount of the element with higher atomic weight than that of thorium would have to be proportionately increased. The high radio-activity would point to the presence of the elements obtained from thorium residues mentioned by Prof. Baskerville, which he states to be radio-active.

The equivalent was determined by comparing the weight of oxide from a known weight of oxalate with the percentage of oxalic acid, as determined by titration of another sample of the same preparation.

WILLIAM RAMSAY.

The letter dealing with the composition of a new mineral from Ceylon, contributed by Sir W. Ramsay to Nature of April 7 (p. 533), reveals certain discrepancies between the analytical results obtained with this material at University College and those of the Imperial Institute recorded in Prof. Dunstan's letter on this subject (March 31, p. 510). Sir W. Ramsay's results indicate that this mineral is practically free from thoria, whereas those recorded by Prof. Dunstan show that it is particularly rich in this oxide. As Prof. Dunstan is at present abroad, and therefore unable at the moment to comment on Sir W. Ramsay's letter, I may be permitted to direct attention to two observations mentioned by Sir W. Ramsay, which appear to be open to question.

He states that the oxalate obtained from a solution of the mineral is soluble in excess of a solution of ammonium oxalate, and that this reaction excludes the

* Nature.

presence of thorium or metals of the cerium group, and points to the presence of zirconium. This inference is not in harmony with the observation by Bahr (Annalen, 1864, 132, 231), that thorium oxalate *is soluble* in excess of ammonium oxalate, a fact since confirmed by Bunsen and by Brauner (Jour. Chem. Soc., 1898, 73, 951). Further, the solubility of the thorium salt in excess of ammonium oxalate has been used by Hintz and Weber (Zeit. Annal. Chem., 1897, 36, 27) and by Glaser (ibid., p. 213) as a method of separating thoria from monazite and similar minerals. It would appear, therefore, that the principal evidence brought forward by Sir W. Ramsay in support of his conclusion that the mineral contains no thoria in reality supports Prof. Dunstan's statement that it is rich in this oxide. It may be added that the solubility of the oxalate obtained from the mineral in ammonium oxalate had already been observed in this department.

Sir W. Ramsay appears to be of opinion that the principal constituent of the mineral is the oxide of a new tetravalent element with an equivalent of about 44.7. If this were the case the specific gravity of the mineral would probably be less than 8.2, whereas the determinations of this constant made here and at University College indicate that its specific gravity is about 9, and this figure agrees fairly well with that required for a mineral containing 75 per cent. of thoria. T. A. HENRY.

Scientific and Technical Department, Imperial Institute, S.W., April 11.

CONTEMPORARY ELECTRICAL SCIENCE.*

SPINTHARISCOPIC PHENOMENA.—T. Tommasina confirms Becquerel's contention that the sparking observed in Crookes' spinthariscope is due to the cleavage of the zinc sulphide crystals provoked by the impact of α-rays. He finds that when the sparking screens are stood in a dark drawer for several days, and then placed under the microscope in the immediate vicinity of a charged rod of glass or resin, the sparking is restored, apparently by the renewal of the process of cleavage. The effect is better shown by a bare sulphide screen than by a screen kept under a glass cover. The author supposes that the slight agitation of the sulphide crystals produced by the presence of the electrified body exposes fresh surfaces for cleavage. Microscopic examination shows that the sparks are best focused in the plane containing the most exposed edges of the sulphide crystals. Barium platinocyanide also shows the sparking, but less distinctly than zinc sulphide.—T. Tommasina, Comptes Rendus, November 9, 1903.

THE MAGNETIC STORM OF OCTOBER 31.—T. Moureaux reports on the magnetic storm as observed at the Val-Joyeux station. It began suddenly at 6.12 A. M. by a simultaneous rise of the declination and the horizontal component and by the lowering of the vertical component. Great oscillations of the *D* and *H* magnets commenced about 7 A. M., and continued without interruption till 10 P. M. *H* began to fall again as early as 10 A. M. or 11 A. M., but the phase of maximum intensity was not reached till midday. At that time the vertical component *Z*, hitherto little affected, increased rapidly, and the other two elements showed sudden variations of great amplitude. Large oscillations were also noticed at 4 P. M., 5.30 P. M., and 7 P. M. The magnets were in a disturbed state all through the night. Indeed, it was not till 2 A. M. on November 1 that the vertical component passed through its minimum. The maximum variation of the horizontal component amounted to 1-29 of its normal value. The declination varied by a maximum of 2 deg. 4 min. An important group of sun spots, followed up since October 26 at the Parc St. Maur observatory, crossed the central meridian on the day of the storm. Without being so large as the group observed on October 5 to 17, which could be seen with the naked eye, it measured in its greatest length about 1-11 of the sun's diameter. No trace of an aurora was seen that night, but the sky was overcast from 7 P. M. The magnetic storm was also observed at the observatories of Lyon, Nice, Perpignan, and Pic du Midi.—T. Moureaux, Comptes Rendus, November 2, 1903.

SPINTHARISCOPIC PHENOMENA.—H. Becquerel has studied the phenomenon described by Sir W. Crookes in order to determine to what kind of radium rays it is due, and what physical process the scintillations represent. For the screens he used the hexagonal zinc blende or diamond dust. In a strong magnetic field he found that the rays producing the scintillations were not deflected. This confirms Crookes' supposition that the rays producing the sparks consist of positive electrons. As regards the nature of the scintillations, they are in general the more pronounced and vivid the smaller the crystals are which compose the screens. If a comparatively large crystal is placed near a grain of sodium chloride it becomes phosphorescent, and shows a general luminosity without sparks. Occasionally a luminous point appears on the fragment, grows, and then slowly disappears, sometimes recurring several times in the same place. If the same crystal is broken into smaller fragments, certain pieces present several variable points of light, and on powdering the fragments the usual Crookes phenomenon is produced. These facts go to show that the sparks are most likely due to cleavages taking place in the crystal, and not to the mere impact of the positive ions. There is here an obvious analogy with the scintillations observed on breaking a piece of sugar.—H. Becquerel, Comptes Rendus, October 27, 1903.

* Compiled by E. E. Fournier d'Albe in the Electrician.

ENGINEERING NOTES.

The experiments of Prof. Hof, of Witten, Westphalia, in determining the effect of compression on finely-divided metals, were briefly reviewed in a recent issue of Engineering (London); the results of these experiments are interesting and may possibly prove of practical value. Prof. Hof confined his studies to the compression of powdered or finely-divided particles of one and the same elementary or compound substance, and his results are of interest to the engineer, as well as to the scientist. He took turnings of steel, copper, bronzes, and chiefly of a white bearing metal which has the composition—83 parts of tin, 11 parts of antimony, and 6 parts of copper. His experiments have, as a rule, been made with about ½ pound of material, which he compresses in a steel cylinder of 2 inches bore, gradually increasing the pressure to 50 tons. With a piston pressure of 10 tons, acting on the circular base of 2 inches diameter, the structure of the turnings still remained distinguishable. But the final pressure of 50 tons produced a perfectly homogeneous block, demonstrating, as the author expresses it, that cohesion is nothing but strongly increased adhesion. Another shallow block, made in a cylinder which had a wider bore below than above, assumed the exact form of the chamber so perfectly that the block could be nickeled without further finishing. This is an important point, and Prof. Hof considers that it may prove profitable to press bushes instead of casting and afterward finishing them. The compressed material is, moreover, denser than the casting. The presence of pores in ordinary white metal indicates that compression must be possible. In the specimens previously alluded to, the density rose from 5.67 to 6.85 and 7.15, the height decreasing from .90 to .74 and .69 inch under the pressures of 10, 30, and 50 tons, respectively. In further experiments the pressure was slowly increased by ten steps of 5 tons, beginning with a pressure of 5 tons. The specimens had in this case a diameter of 1.59 inch. The limit of compressibility was nearly reached when the pressure became equivalent to 25 tons per square inch. When turnings of white metal such as can be bought are melted down, there is always a considerable waste, owing to oxidation, and the waste is, of course, much smaller when blocks are fused. Prof. Hof has observed that this difference in the loss by oxidation of the finely-divided mass and of solid blocks almost disappears when the material has been subjected to heavy compression.

The removal of mine water by hoisting in tanks instead of pumping, while somewhat a reversion to the methods of the ancients, has come very rapidly into favor in the anthracite region of Pennsylvania during the past few years; in fact, so much so, that at the present time there are at least eight large collieries at which all the water is hoisted, and six more plants were in preparation during the past year. The earliest regular hoisting, the writer believes, was done by means of semi-cylindrical tanks attached under the regular shaft-carriages, taking in water through six large clack-valves in the bottom and discharging through an end-gate opened by a lever which was operated by a guide-piece on the shaft head-frame. Similar tanks are still used in emergencies at several shafts. They have a capacity of 1,300 gallons (174 cubic feet) each, and 50 per hour is an ordinary dump, so that the total capacity from a shaft 1,000 feet deep is about 750,000 gallons (8,700 cubic feet) per day of twelve hours. According to present methods, however, the hoisting is done in separate water shafts or compartments, thus avoiding the drawbacks of the earlier arrangements, which were that a very large sump was required, greatly limiting the water capacity of the plants; that the alternate wetting and drying of the shafts did considerable damage to the timber; and that the collection of ice in the main shafts, which are invariably down-takes for the ventilation, endangered the men in going up and down in their work. These reasons, with the gradual increase of water beyond the capacity of the plant, led to the abandonment of this method of hoisting, so that now these tanks are used only in emergencies. The method was, however, probably one of the cheapest ever devised for handling a moderate amount of water from deep shafts, as practically the only cost was for the steam used, the extra wear and tear of engines, ropes, shaft-guides and timbering, and the extra oil required for lubrication. The hoisting engineers being required by the Pennsylvania mine law to be in the engine houses at all times, and night firemen being necessary at all colliery plants, there is really no additional labor cost to this method of hoisting. The summary of the operating costs of three water-hoisting plants for which data were compiled by the writer shows that the cost of hoisting the water is much less than the average cost of pumping it, being $61.86 per horse-power year, 24 hours per day, in the case of the hoisting plants and $89.79 per horse-power year in the case of the pumping plants. In both cases, however, the steam costs could, if desired, be reduced by the use of compound engines, condensing or non-condensing, or even by running the present simple engines condensing. Aside from the question of cost, however, there are many very great advantages in hoisting water, particularly from deep shafts: (1) in the simplicity of the construction; (2) having all the operating machinery on the surface, with the resulting low cost of repairs, which are practically confined to tanks and ropes; (3) the almost total absence of slip, which under mining conditions reduces materially, from the quantity calculated from "plunger displacement," the actual quantity of water pumped; (4) the avoidance of underground steam lines, with their large condensation losses, damage to roof and timbering from the heat and exhaust steam, and the danger of fire incident to their use; (5) the almost total freedom from danger of falls or squeezes in the mines; and (6), most of all, because the operating plant cannot be flooded.—R. V. Norris, in Cassier's Magazine.

ELECTRICAL NOTES.

The Eureka Lighting Company of San Francisco has concluded to begin at once the development of its power water rights on the Trinity River for the purpose of generating electricity for power and light. The rights are sufficient for the production of 6,000 horse-power, which is at present fully double the amount that can be utilized. The plans contemplate an expenditure of nearly half a million dollars, and the result will be a power line passing through Korbel, Blue Lake, Arcata and Eureka, a distance of fifty or sixty miles, and thence on into the Eel River Valley. It will do away with the steam-generating plants for current in use in Eureka at present, and will furnish an almost unlimited quantity of electricity for all purposes within Eureka. An electric road through Trinity County to the Sacramento Valley is one of the possibilities of the plan, as the power plant will be but twenty miles from the present Hay Fork Road in this county. The enterprise means a great deal for Eureka and Humboldt County, for it is the intention to develop thoroughly the proposition and furnish light and power to every place to which the line can be extended. The cheap power which the company expects to be able to furnish will undoubtedly foster manufacturing in Eureka and open up considerable of the outlying country. —N. Y. Evening Post.

At the present time the electric arc is by a very perceptible amount the cheapest all-around illuminant, and this fact is the strongest ally of incandescent lighting. For, while cheap gas in mantle burners can undoubtedly beat out the incandescent lamp, candle for candle, in mere cost, it cannot meet the arc on even terms, and if the consumer is deaf to all arguments based on hygiene and color blindness to boot, the central station still holds a trump card in the arc. The intensing mantle burners in their various forms can beat out the arc indoors, so far as price is concerned, but are at a disadvantage out of doors, and require some species of local plant which works to their disadvantage in the matter of convenience. It is safe, then, to say that the electric arc will keep a strong position among illuminants for a long time to come, and that it will be steadily improved along lines which are already blazed out. It is in the field of incandescent lighting that the fiercest battle will rage. In spite of all the experimental work of the past few years, the glow lamp retains its supremacy, and its reign is not yet even seriously threatened. Until the Nernst lamp runs without attention, and the vapor lamps cease to be green, these, the most promising recent innovations, will be seriously handicapped. Evidence goes to show that no amount of talking will persuade the general public that green is a desirable or becoming color for lights—or make it so. If argument could blind the eye to that uncanny shade, the mantle burner would long since have had the glow lamp "in chancery" in spite of every effort at defense. Let the vapor lamp once escape from the color difficulty, and it will immediately assume a most commanding position in the art, even if it should only be available in rather large units of great intrinsic brilliancy.—Electrical World and Engineer.

A mercury-vapor electric lamp of a new type has been devised by two English engineers, and is now in operation. So far as the external appearance and size of this Bastian lamp, as it is designated, are concerned, it resembles somewhat the now familiar Nernst lamp. The glass tube which acts as the illuminating section is in the shape of an H, the lower extremities of which are formed into bulbs with platinum wires fused through the bottom and projecting inward. The air is exhausted from the tube, and a sufficient quantity of mercury is inserted to fill the bulb and just to flood the cross tube, which is slightly curved downward. The latter hangs in a frame pivoted horizontally, and in such a position that the legs are normally vertical. Above the globe is a small solenoid in the metallic cylinder connected in series with the mercury in the tube. The current enters and leaves the tube through platinum wires. The closing of the switch attracts an iron armature, which tilts the tube, and this action causes the mercury therein to divide, some of it running into the lower leg. Across the gap thus created a short arc results, and this gradually extends in length, forcing mercury up the vertical tube until a balance of pressure is obtained, the arc at this point being some 3 inches in length and yielding a brilliant light. The Bastian lamp, however, resembles all mercury-vapor lamps, inasmuch as it lacks the red rays, and in order to meet this deficiency, the inventors have devised a small red glow lamp which is fitted beside the tube. If desired, two or more mercury tubes may be fitted within the same globe. Each tube consumes about 0.65 ampere continuous current, and works at a potential of from 40 to 60 volts. A feature of the lamp is that the length of the arc automatically adapts itself to any variations that may arise in the voltage. The lamps require no attention, and any complicated starting device is dispensed with. A number of these lamps have been maintained burning continuously and intermittently for more than 1,500 hours, and the inventors estimate that the average life is about 3,000 hours.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Berlin as a Market for Food Products.—Year by year the German capital—which, including its closely annexed suburbs, has now become a city of 2,500,000 souls—continues to make larger and farther-reaching demands upon the world for food and drink. Germans as a race are robust and vigorous; they are healthy, liberal eaters, and among the well-to-do class in towns and cities the prosperity of recent years has developed a corresponding tendency toward varied, generous, and luxurious diet.

The Province of Brandenburg, at the center of which Berlin is located, is for the most part a sandy plain of limited fertility and not especially productive of the fruits and vegetables which are required among the food supplies of a great modern city. The interior rivers of Germany yield only a moderate supply of fish, and by reason of Berlin's remoteness from the sea salt-water varieties are uniformly dear in the local markets.

For these and other reasons the enterprise of those who cater to the city's needs has been stimulated to new and farther-reaching quests in foreign countries for the raw materials of its daily fare. In a report of this series written in October, 1900, it was stated that the arrivals in Berlin of live geese from Russia averaged, during the late autumn and winter months, about 15,000 daily. The whole import of live geese to Germany amounted to 6,220,055 in 1900, 6,431,247 in 1901, and 7,254,145 (valued at $5,513,492) in 1902, a steady increase which is typical of most food imports which supply the great middle classes of the German people. Similarly, the importations of eggs, which come mainly from Austria-Hungary and Russia, increased from 118,169 tons in 1900 to 128,153 tons in 1902. American fresh apples, the importation of which to Germany began in 1896-97, reached last year a total of 5,835 metric tons and will this year far transcend all previous records. By the middle of October, an unusually early date, American apples were on sale throughout the markets and provision stores of Berlin, and the daily press reports Rheinland and Westphalia as "ueberschwemmt" (flooded) with them. Being hardly more expensive than the ordinary native fruit and far superior to everything except the choicest and very costly Tyrolese and French apples, they are consumed here in constantly increasing quantities.

But it is in respect to the new and hitherto inaccessible forms of food materials that the movement of recent years has become notable and interesting. The flesh of reindeer, brought in a frozen state from Lapland and Finland, may be found in the Berlin market throughout the winter, and its use is steadily increasing. The importation of salted beef from Siberia in through cars direct to Berlin is an innovation of the past six months which promises to reach important proportions. Several large dealers of this city have their own specially constructed cars in which live fish are brought from Scandinavia, Russia, and the German seaports. A special steamer, the "Bianca," is now on its way from Nicolajewsk, at the mouth of the Amur in eastern Siberia, with a cargo of salmon for a Berlin firm which has purchased, under a time contract, the catch of the fishermen in that region. The "Bianca," which left Nicolajewsk on the 30th of September and is due at Hamburg early in December, is equipped with apparatus which will bring the fish through in a frozen condition and, it is anticipated, will be kept permanently in that service.

Still more original and remarkable is the enterprise of a Hamburg firm which has an agency in Berlin and makes a specialty of eels, a species of fish so highly prized in Germany that the supply is usually inadequate to cover the demand.

The new waters to be worked for the supply of eels for Berlin includes a group of fresh-water lakes in Egypt near the mouth of the Nile. These lakes and ponds are for the most part old channels of the branching water courses of the lower Nile Delta, and, as has been recently found, swarm with eels, which the natives are either too indolent to catch or do not esteem highly as food. Having obtained a suitable concession, the German firm has sent down an active and capable Baltic fisherman with the nets, traps, and other paraphernalia of his trade, and he is now engaged in educating the Egyptians in the science of eel catching. The industry is centered at Matarieh-Mensaleh, a station on the railway, where a large depot has been established, to which the eels are brought for sale by the fishermen, who receive for them about one cent each, or $10 per thousand. They are then cleaned, rubbed with salt, and packed in casks between layers of ice impregnated with formalin, a benign antiseptic derived from formaldehyde. Thus prepared, the casks are shipped by rail to Alexandria, where a large cellar warehouse will receive them pending shipment, the first lot having been recently sent by Austrian-Lloyd steamers to Trieste and thence by rail to Hamburg. This shipment included 25,000 eels, weighing altogether about 8 tons; but it is expected, when the scheme is fully organized and in working order, to handle weekly about 60 tons, or 150,000 eels, which will, at least during the winter months, be sent from Alexandria to Hamburg by sea.

Fresh-water crabs, formerly abundant in the rivers of Germany, and esteemed here a great delicacy, have of late years been decimated by a pestilence against which no effective remedy could be found, and since that calamity the deficit has been supplied by importations, principally from Russia, the Berlin market taking eagerly all that the Russian fishermen can provide.

Among the newer articles which have found a ready market here during the past few years is the cactus fig, which comes from Mexico, Central America, and Brazil, and was sent here originally as an experiment by some of the German merchants located in those countries.

Thus far no country has profited more from the robust appetite of the Fatherland than Italy. The importations of Italian poultry, fruits, wines, olive oil, macaroni, and vermicelli are now so enormous as to constitute one of the chief sources of revenue for the St. Gothard and Brenner Pass railways. Berlin has scores of Italian provision stores, restaurants, and wine depots which import their own supplies and deal exclusively in southern products. Within the past month a new company, with a capital of 5,000,000 lire ($965,000), has been organized by Signor Piso, backed by a leading bank of Milan, for the express purpose of exporting wines, alimentary pastes, and other food products to Germany and Switzerland.—Frank H. Mason, Consul-General at Berlin, Germany.

Suggestions for American Exporters.—It is unpleasant to be obliged to report that while American food products, almost without exception, have been found excellent and have met with ready and profitable sale in Germany, there is a very general complaint among importers about the unreliability of American exporters. Not only are the goods sent often found to be inferior in quality to the samples on which the sale was based, but in numerous cases shippers, who have meanwhile found a market at home, not only neglect to fill European orders, but forget to notify would-be purchasers of their refusal or give any explanation or reason for it. It has come to be a rule of the trade that the German importer of food products can not safely depend exclusively on an American source of supply.

For example, genuine English Chester cheese, which is largely consumed in this country, costs, landed at Hamburg, about 18 cents a pound. American Chester, considered here nearly or quite as good as the English, is handled in New York for 9 cents to 10 cents per pound, and German importers would gladly pay such prices if they could secure reliable connections. Two importing firms—one at Berlin, the other at Hamburg—did some time ago form such a connection and imported several lots with entire success. Then the price advanced in America, and although they had a firm contract for three or four months' delivery, and in two cases had sent checks with their orders, they claim that the goods did not arrive, they were left without supplies, and to save their trade had to go back to the London market. Good American-made Limburg cheese, which is handled in the States at 5 and 6 cents per pound, would bring 11 to 12 cents c. i. f. Hamburg, and there are importers who would gladly buy large quantities of all the standard American varieties of cheese if it could be purchased and paid for at a German port.

There is also here a ready market for canned and cured salmon, and especially for smoked sturgeon, an insufficient supply of which is obtained from Russia and sold here for 75 cents per pound. If the sturgeon that are caught by the pound-net fishermen along the shores of the Great American Lakes were cured in the same manner as that prepared by the Russians of the Volga, the whole product could doubtless be profitably sold in Germany.

Another promising article would be the kernels of peach and apricot seeds, which are largely used here as a substitute for bitter almonds by makers of macaroons and other confectionery. Almonds cost at wholesale in Hamburg from 15 to 18 cents per pound, whereas peach and apricot kernels, in so far as they can be obtained, bring from 11 to 13 cents, which is enough cheaper to give them a ready sale. If the great fruit canneries of Maryland and the Pacific States could employ machinery that would crack their waste peach and apricot pits in such a way as to save the kernel, they could sell their entire output in this country.

Dried American apples, apricots, pears, and prunes are now so well known and so highly appreciated here that the only improvement to be suggested is a better and more direct plan of bringing them into the German market. Here, as has been already noted, there are numerous more or less well-founded complaints about delayed shipments, broken promises, goods not up to sample, and the hard, unaccustomed American conditions of "cash against bill of lading." There are large dealers in Berlin who would gladly confine their entire trade to American dried fruits if they could only form reliable and satisfactory connections, or, what would be still better, buy their supplies from a great wholesale depot at Hamburg, where they could place contracts in advance and see what they are paying for. Again and again the suggestion has been made that such a depot, opened and maintained at a German seaport by an American firm or by an organization like the Fruit Growers' Association of California, would double the sale of such products in Germany within a year. As it is, many dealers continue to handle dried cherries, prunes, and apricots from Dalmatia, Servia, Hungary, and other southern European countries that are inferior to the American and relatively much higher in price, but can be easily and surely obtained and bought under European conditions of delivery and payment.—Frank H. Mason, Consul-General at Berlin, Germany.

United States-China Parcel Post.—The parcel post between the United States and Shanghai *via* London, which went into effect last year, does not offer the facilities for trade that should exist between the United States and China. By that route it takes from two to three months to receive a package from the United States, which is at least three weeks to two months longer than if a parcel post were established *via* one of the steamship lines leaving the Pacific coast, or if our Post Office Department would adopt the parcel-post system in vogue in the leading countries of the world, allowing 11 pounds to pass through the mails instead of 4 pounds. Goods up to 11 pounds are sent through the parcel post of the leading countries. These packages can be inspected and returned by the post if not satisfactory. The large mail-order trade that could be built up by the United States with this side of the Pacific (many times what it is now) should be a sufficient inducement for those interested in increasing their export trade to use their influence in having these facilities for rapid transit of American parcels to China introduced. It would not only increase the mail-order business now existing, but it would be the means of introducing many American articles of commerce that weigh over 4 pounds (the limit of our parcels post) to the consumer in the Far East, and would be the means of bringing about more intimate relations between the United States exporter and the native Chinese importer, which would lead to the opening up of a large market for other classes of goods.

As all European countries will send their mail *via* the trans-Siberian route, and thereby "cut in two" the time required to send and receive orders by the all-water route, it makes it all the more necessary that the United States should be more alert in competing with Europe as well as Japan for Chinese trade. French, German, and Japanese agents are exploring every corner of China for the purpose of increasing their trade in this empire.—L. S. Wilcox, Consul-General at Hankau, China.

American Opportunities in Liege.—There is a good opening here for an American dentist equipped with the latest devices and possessing the necessary ability to perform good work.

A modern steam laundry would, I believe, fill a long-felt want. The laundering is done by women, who call for and take the work to their homes, returning the same irregularly. The work is, of course, inferior to that of steam laundries.

There are opportunities for the manufacture of the smaller articles of iron and steel which our advanced machinery could turn out beyond double the capacity of the local manufacturers, who still employ antiquated machines. Using this province as a place of manufacture, where labor is cheap and every facility is offered for making sundry articles, the supply could be sent into all the European countries with very little expense for transportation.—James C. McNally, Consul, Liege, Belgium.

Market for American Food Products in Germany.—In a report written one year ago (Advance Sheets No. 1503, November 24, 1902), the attention of American exporters was invited to the fact that there is in Germany a practically unlimited demand for many kinds of dried, smoked, and salted fish, as well as for fresh fish, which are caught either in salt water or fresh water under conditions which permit them to be exported to this country by cold-storage vessels in a fresh or slightly cured condition. As a result of this announcement there was received here early in January last a letter from a citizen at Urbana, Ill., stating that large quantities of eels were caught in that region, but as they are not highly esteemed as food there, they must be either wasted or sold for nominal prices. He would therefore prefer, as the letter stated, "to dispose of the products in a country where a market already exists, rather than incur the expense of creating one at home. I can furnish the product in any desired quantity up to 50 or 100 tons." This seemed reasonable; the letter was turned over to a merchant here, who organized a company or firm for the special purpose of importing whatever quantity of eels the Illinois dealer could supply. A letter was sent containing a small check to evince good faith, and propositions asked for on a large scale, but the supply of eels must have failed, for the letter of the Berlin company was never answered nor its remittance returned.—**Frank H. Mason**, Consul-General at Berlin.

INDEX TO ADVANCE SHEETS OF CONSULAR REPORTS.

Other Reports can be obtained by applying to the Department of Commerce and Labor, Washington, D. C.

SCIENCE NOTES.

The flood-damaged lands in the Kaw River Valley have been investigated by the United States Department of Agriculture, and it is interesting to learn that forestry is recommended as the remedy for the damages done last year. About 5,000 acres of plowland were covered so deeply with sand as to be worthless for agriculture for years to come, and these, it is suggested, should be planted with cottonwood saplings, about 1,200 to the acre. In twenty years the trees may be cut for saw logs. The land from which the fertile soil has been partly eroded may be planted with black walnut and hardy catalpa, 1,300 to 1,800 seedlings to the acre. These trees will not be successful if there is more than two feet of sand over the soil. Much of the land which had several feet of surface soil eroded and was then covered with silt can be built up by planting it with willows and cottonwoods. In places where the flood left vertical banks, the department's ac ice is to slope the banks and plant them in willows, tying the poles two feet apart with woven fence wire, which will hold them in place even if there is considerable sliding of the banks. Work to reclaim these lands should begin at once, if the former fertility is to be restored. The immediate returns from the work will be small, but after half a dozen years some income should be obtained. The cottonwood is the best fuel tree in the Middle West, and catalpa plantations in Kansas yield six per cent interest on land and labor, and about $10 a year profit per acre.—Eng. Record.

D. Berthelot, in Annal. Chim., discusses a new optical method of measuring temperatures. This rests on the assumption that if the density of a gas is lowered in the same ratio either by isopiestic rise of temperature or by isothermal lowering of pressure, its index of refraction alters by the same amount. The method consists in breaking up a beam of light into two parts, passing one through a tube containing air and isopiestically heated to the required temperature, and the other through a tube containing air of which the pressure can be varied, receiving both beams in a telescope, and varying the pressure in the second tube till the interference bands return to the position they occupied before the first tube was heated. A pair of Jamin's thick plates were employed to separate and recombine the two parts, and, in order to increase the distance between these parts to 9.2 centimeters so that the experiment might be carried out, they were passed through exactly similar totally reflecting Fresnel prisms. Details of the necessary precautions to be taken and of the calculations to be made, of experiments made to test the method at the boiling-points of ethyl alcohol, water and aniline, of an electric furnace (made of a Pt spiral) for high temperature heating, and of a preliminary study of Pt—PtIr thermocouples, are given at length, as also of the experiments resulting in the following determinations (estimated to be correct within ± 2 deg.): Boiling-points: Se 690 deg., Cd 778 deg., Zn 918 deg. Fusing points: Ag 962 deg., Au 1,064 deg. The variation of the boiling point for every centimeter of pressure is 1 deg. for Se, 1.11 deg. for Cd, and 1.25 deg. for Zn.

Before the Chemical Section of the British Association, Dr. F. Clowes presented a paper on the action of distilled water on lead. When some years ago it was proposed to bring large volumes of soft water from Wales to London, the possibility of the action of this water on leaden pipes had to be investigated. Dr. Clowes had experimented with large sheets of very pure commercial lead. This lead was not acted upon by distilled water in a vacuum nor in an atmosphere of hydrogen; at any rate, the action, due probably to the last traces of oxygen, was infinitesimal. But supply waters always contain oxygen and also other gases. Of these gases, oxygen when alone present attacks the lead worst; carbon dioxide has a very slight effect; in equal mixtures of oxygen and carbonic acid the effect is quantitatively that of the oxygen, and when more CO_2 is present the action becomes less pronounced. The corrosion of the lead is hence primarily due to oxygen; the carbon dioxide acts in the second place by forming a carbonate with the oxide first produced. The action is rapid at first, and a white deposit is formed, while some lead passes in solution; the deposit is some hydroxycarbonate of variable composition. It has been suggested that the presence of bacteria was required to start the attack, or would hasten it; but heated lead corroded as quickly in water which had long been kept boiling as under ordinary conditions. These experiments demonstrated, however, the inhibitory influence of certain salts in the water. When water is distilled with the aid of a glass condenser tube, some silicate passes into the distillate, and this silicate protects the lead against corrosion. The water was therefore distilled from copper vessels and passed through copper coolers in some experiments. Sulphates also protect the lead, carbonates and carbonic acid are less efficient, lime is doubtful, and may even increase the corrosion if sufficiently concentrated. It is also due to this protective power of salts that distilled water does not acquire its full corrosive activity on subsequent aeration by exposure. The paper was briefly discussed by Prof. Letts, who spoke of the bad corrosion in some districts of Belfast, and by Mr. Th. Fairley, of Leeds, who mentioned that the effect was well known in the peaty districts of the West Riding, and that experiments had been made with soft water in America. In partly immersed lead plates, Dr. Clowes added, the corrosion of the immersed portions proceeds slower, but is finally the same.

THE

Scientific American Supplement.

PUBLISHED WEEKLY.

Terms of Subscription, $5 a Year.

Sent by mail, postage prepaid, to subscribers in any part of the United States or Canada. Six dollars a year, sent, prepaid, to any foreign country.

All the back numbers of THE SUPPLEMENT, from the commencement, January 1, 1876, can be had. Price, 10 cents each.

All the back volumes of THE SUPPLEMENT can likewise be supplied. Two volumes are issued yearly. Price of each volume, $2.50 stitched in paper, or $3.50 bound in stiff covers.

COMBINED RATES.—One copy of SCIENTIFIC AMERICAN and one copy of SCIENTIFIC AMERICAN SUPPLEMENT, one year, postpaid, $7.00.

A liberal discount to booksellers, news agents and canvassers.

MUNN & CO., Publishers, 361 Broadway, New York.

TABLE OF CONTENTS.