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THE SMITHSONIAN EXHIBITS FOR THE ST. LOUIS EXPOSITION.*

By Randolph I. Geare.

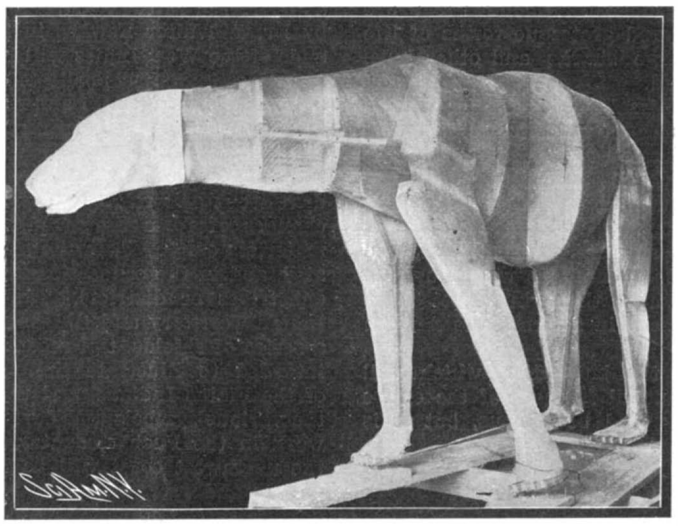
Out of the $800,000 which Congress appropriated for the preparation and installation of exhibits by the several departments and bureaus of the government at the Louisiana Purchase Exposition, the sum of $110,000 was allotted to the Smithsonian Institution for the preparation of its exhibit and those of the bureaus under its charge; namely the National Museum, the Bureau of American Ethnology, the Zoological Park, the Astro-Physical Observatory, and the Bureau of International Exchanges.

Congress also gave $450,000 toward the erection of the government building, and it is noteworthy that the largest share of floor space has been assigned to the Smithsonian Institution by the Board of Management.

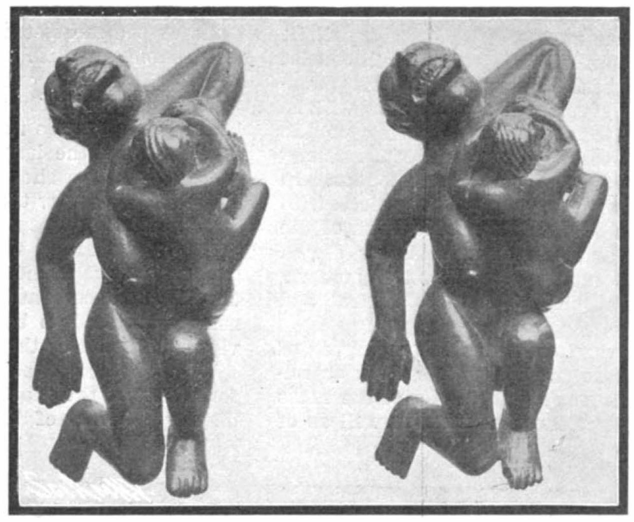
The exhibit of the Smithsonian Institution itself will include memorials of its founder, James Smithson; portraits of the secretaries and the chancellors; and full sets of the publications of the Institution, as well as objects and books which indicate how the Smithson fund has been and is being expended in promoting scientific research.

The exhibit of the Department of Anthropology, under the management of Mr. William H. Holmes, will be of peculiar interest, as illustrating the achievements of the native American peoples in the field of esthetics. The more cultured American nations, according to Mr. Holmes, had made more progress toward civilization than is generally supposed, and the

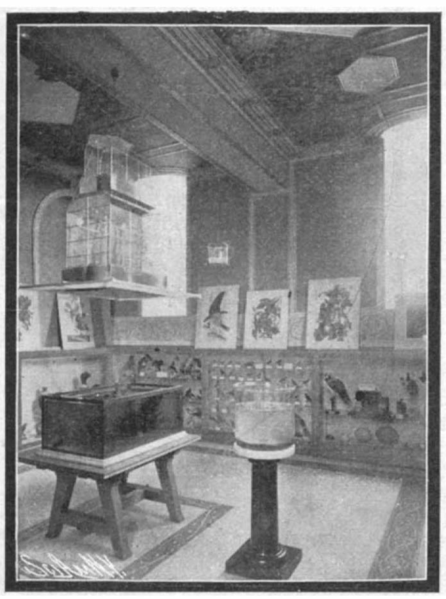
* Specially prepared for the Scientific American Supplement.



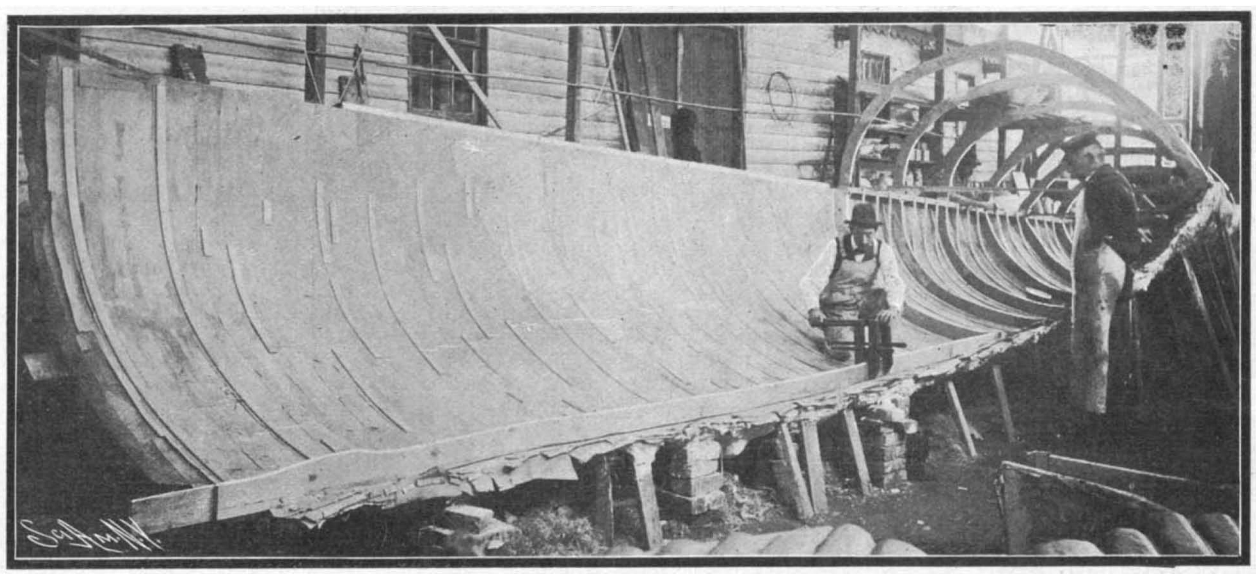
FRAME ON WHICH THE SKIN OF A POLAR BEAR IS TO BE MOUNTED.



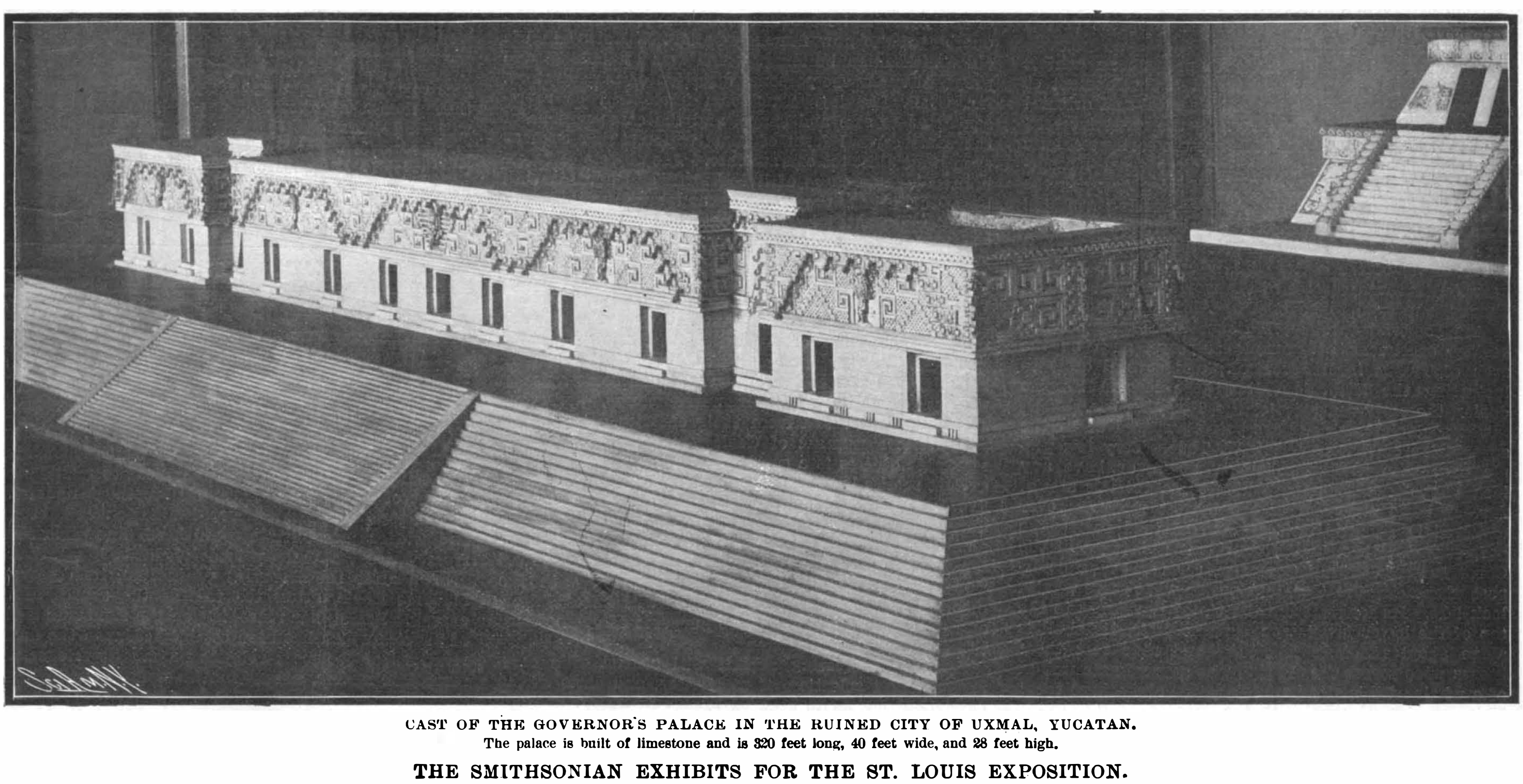
CAST AND ORIGINAL OF BEAR MOTHER.
Original carved in slate by a Haida Indian.



THE CHILDREN'S ROOM.

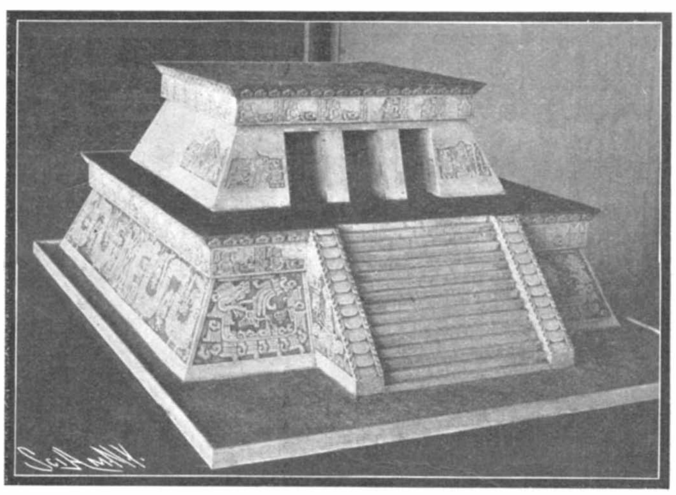


BUILDING UP CAST OF SULPHUR BOTTOM WHALE.



CAST OF THE GOVERNOR'S PALACE IN THE RUINED CITY OF UXMAL, YUCATAN.
The palace is built of limestone and is 320 feet long, 40 feet wide, and 28 feet high.

THE SMITHSONIAN EXHIBITS FOR THE ST. LOUIS EXPOSITION.



CAST OF THE RUINED TEMPLE OF XOCHICALCO IN THE STATE OF MORELOS.

THE SMITHSONIAN EXHIBITS FOR THE ST. LOUIS EXPOSITION.

arts of taste had received a surprising amount of attention. Indeed, it is doubtful if any other race at an equal stage of progress toward a higher level of civilization was so fully imbued with the art-sense and with the impulse to model, to carve, and to paint; and, so far as they had gone, their development was in the main in accord with the standards of good taste accepted by the civilized nations. The art of architecture had made remarkable progress, and in Mexico, Central America, and Peru striking examples of stone structures, temples, palaces, and tombs still remain to surprise and delight the visitor. These buildings probably represent the highest achievements of the race in the arts, and this exhibit will include models of many of the prominent temples and palaces, which represent distinct architectural styles, and will stand as types of the architecture of the more cultured native tribes. They are reproduced complete in every detail, the over-door pieces embodying statuary, ornaments, and glyphs being especially complex in character. In addition to the models, the architectural series will comprise numerous photographs and drawings, and the whole will constitute a more complete demonstration of native American architecture than has ever before been prepared for public exhibition.

The other arts of the natives will, in general, be treated in like manner, but the illustrations will consist not so much of reproduction as of the objects themselves. In this branch the modern tribes also will be in a measure represented, since the carving of the tribes of the northwest coast takes a high rank among the art products of the tribes ancient and modern. In ceramics also a series of originals will be selected, to convey a definite notion of the remarkable work of the natives in the plastic art, the material being drawn from the tribes of the Southwest, ancient and modern, and from the ancient peoples of Mexico, Central and South America.

The textile art had reached a marvelous degree of perfection among the more cultured tribes, Peru especially excelling; and specimens of the fabrics of the Incas and of the feather work of the Mexicans, as well as of the better modern products of various tribes, will be brought together.

Examples of the graphic arts and of the glyphic manuscripts will form a fifth section for the exhibit. These will serve to convey an idea of the progress of the Indian tribes in these directions.

Efforts are also being made to prepare an exhibit of originals and casts illustrating the development of sculptural art among the several classical and oriental peoples in various epochs. Among the most interesting objects included in this plan are the earliest Asiatic relief in the form of a circular altar from Mesopotamia; the famous "Dying Lioness" from Assyria; the celebrated statue from Baalbek, representing a seated female divinity; illustrations of architectural sculpture recently brought from Northern and Central Syria; casts of the statues lately taken from the sea near Antikythera; a cast of the world-renowned sarcophagus, supposed to be that of Alexander the Great, in the Imperial Ottoman Museum in Constantinople; besides specimens of Roman sculpture, such as the arch of Trajan in Beneventum; and several casts illustrating the Mithraic cult in the Roman Empire during the early centuries of the Christian era.

The zoological exhibits are being prepared under the supervision of Dr. Frederick W. True. Very few people have seen a sulphur-bottom whale, or have any idea of the enormous size which these animals attain. A very large one—one of the largest monsters ever captured in Atlantic waters—was obtained during the past summer, through the courteous assistance of the Cabot Steam Whaling Company, for the express purpose of showing the American people what these whales look like. Its length from the tip of the flukes to the top of the lower jaw is seventy-nine feet. Its skull is alone about nineteen feet long and nine feet three inches wide across the orbits. The approximate weight of a whale of this size is not far from sixty-three tons! This species of whale is the largest of all living creatures.

A picture showing the process of building up the cast of the body of this gigantic creature is here shown, from which an idea of its size can be gained. As it will not be "put together" till the several parts reach St. Louis, it is impossible to show the whole whale here.

Some of the other rarer forms of mammals, too, are not yet completed. One of the illustrations shows the manikin of a Polar bear, covered with netting and ready for a coating of *papier-maché*, after which the skin is fastened on. It is thought that this may be of interest, as most people have a very vague idea as to how these lifelike objects are "made up." The Mammal department will also exhibit specimens of large game from various remote regions of the world.

A special effort is being made to produce an attractive series of the game birds of America, the beautiful birds of paradise, the gorgeous pheasants, and some of the larger wild birds, such as the vultures, ostriches, cassowaries, etc.

Taxidermists have always found it extremely difficult to make satisfactory reproductions of fishes, but it is believed that the specimens now being prepared for this exposition will prove to be of unusual interest. The denizens of the abyssal depths have been chosen as the special theme for this exhibit, and they will be represented by enlarged models. Among them are some of the most strange and grotesque forms of life imaginable. Models of large sharks and other huge fishes will also be exhibited.

There are probably no animals which inspire the beholder with a more real sense of revulsion and disgust than some of the larger kinds of reptiles. A number of these will be shown, such as the python from the Philippine Islands, the South American anaconda, the deadly cobra, whose victims in India are numbered annually by many thousands, the peculiar flat-tailed sea-snakes of the Indian Ocean and the waters around the Philippine Islands, where these huge poisonous snakes are said to be present in swarms, the African viper, and many others.

In direct contrast are the butterflies, which will form one of the most beautiful features of the entire display. A list of them would be tedious, but it is certain that the largest and most brilliant kinds seen in the tropical regions of America and the Old World will be represented.

Last, but by no means least, among the exhibits of the Biological Department will be a faithful reproduction of the now famous "Children's Room" in the old Smithsonian building, which was established and prepared under the personal direction of the secretary, Mr. S. P. Langley. The room itself will be represented as to size and shape, and the cases will be of the same careful form of construction, being such as even the tiniest tot can see into. The objects to be exhibited include cages of living birds and aquaria with beautiful fishes, the "largest and smallest birds of prey," represented by the great condor of the Andes, the bald eagle, and, by way of contrast, a sparrow-hawk. Next a numerous display of "curious birds," which Nature has provided with aprons, crowns, armor, veils, etc., as though dressed up for a masquerade ball. Bright-colored birds are represented by the parakeets, the rose cockatoo of Australia, the crimson-winged lory, etc. A very interesting exhibit in this room illustrates the almost magic power which some animals possess of imitating their surroundings, and thus shielding themselves from their enemies.

In the Department of Geology one of the most remarkable objects is a complete restoration of the huge extinct reptile known as the "stegosaur," about twenty-five feet long. It somewhat resembles an enormous horned toad, with a double row of large flat spines along the tail. By its side will be exhibited the singular three-horned fossil creature called "triceratops." To prevent this animal being confounded with the mastodon, a skeleton of the latter will be exhibited, and alongside of that, for the purposes of comparison, the skeleton of an elephant.

Another interesting exhibit will consist of a carefully-selected selection of meteorites, and casts of the Greenland meteorite secured by Lieut. Peary, and the "Bacubirito," or Sinaloa meteorite, found in the northwestern part of Mexico. Credit for the rediscovery of the latter meteorite is due to Prof. Henry A. Ward, of Rochester, N. Y. These meteorites are believed to be two of the largest objects that ever visited our earth from unknown worlds.

A series of the most brilliant minerals from all parts of the world will be richly installed, supplemented by collections showing various forms of silica and of carbonate of calcium. The object of such exhibits becomes evident when it is remembered that quartz, agates, and a large variety of other beautiful stones, are nothing more than different forms of silica. The carbonates of calcium are prominent for their exquisite colors. Fossil tree trunks from the petrified forests of Arizona and Montana, and great agatized tree-ferns, which flourished in the vegetation of bygone ages, will be of special interest to all who are given to speculating as to what our continent looked like some millions of years ago.

BUREAU OF AMERICAN ETHNOLOGY.

The exhibit of this bureau, under the charge of Mr. William H. Holmes, is intended to illustrate the results of its researches, and at the same time to teach some interesting lessons regarding the early stages of the evolution of art. The special subject chosen is the symbolism of the tribes which are now being studied, as expressed in their art. The explorations carried on by Dr. J. Walter Fewkes in Porto Rico and other islands of the West Indies will be represented by a series of interesting objects collected by him, and so arranged as to convey a definite and full idea of the symbolism embodied in the sculpture, plastic art, and carving in shell, bone, and wood of the native tribes. Where intricate devices or designs occur, they will be so drawn out and related to one another as to show the changes of form that result from differences in the materials employed, in the shapes of the objects decorated, and in the conceptions and methods of the different tribes or districts. The work of the bureau in Indian Territory and Oklahoma will be represented by a series of shields, tipi models, paintings on skin, etc., intended to illustrate the peculiar heraldic systems of the Plains Indians, and their method of embodying the various symbols and devices in the native art. The work in the Pueblo country and among the tribes of the northwest coast will be illustrated by a series of objects and representations of paintings and drawings expressive of the symbolic art of the various peoples, as developed in their architecture, painting, sculpture, weaving, and other arts.

The National Zoological Park will probably confine its exhibit to the erection of a huge cage for living birds. It will be about two hundred feet long by one hundred feet in width. In it will be seen a thousand or more birds of North America and from the tropics, chosen for the brilliancy of their colors, the sweetness of their song, or for some peculiarity of form. Nothing of the kind has ever been attempted before in connection with previous expositions, and this departure is expected to meet with general approbation.

The operations of the Astrophysical Observatory, while difficult to illustrate in a popular way, will be explained in as graphic a manner as possible. The bolometer, an instrument invented by the secretary of the Institution, Mr. S. P. Langley, will be represented by an enlarged model. This is a kind of electrical thermometer capable of detecting variations of 1-1,000,000 of a degree. The instrument will be so arranged that a person will be able to see for himself that by holding his hand near it, the indicator will be affected, although of course only to a very slight extent. A large chart of the solar spectrum will be shown, and especially that part known as the "infra-red," upon which a great deal of work has already been accomplished in this observatory.

The Bureau of International Exchanges will show charts and other objects explanatory of the useful work that it accomplishes in connection with the distribution of scientific publications throughout the world.

The curators, preparators, and others charged with the preparation of the exhibits are bending their energies to the work, and there is every reason to believe that when the exposition opens its doors the public will find installed for their edification and pleasure in the government building, a series of collections which for intelligence of conception and perfection of finish have not been equaled in any of the numerous expositions in which the Smithsonian Institution has taken part.

Correspondence.

A NEW THEORY OF RADIO-ACTIVITY.

To the Editor of the SCIENTIFIC AMERICAN:

It is probable that no scientific discovery has ever so aroused curiosity and wonder as have the radio-active substances, especially radium.

Here is a body which is said to be capable of maintaining its temperature about 2½ deg. F. above surrounding bodies indefinitely; a body which it is claimed emits light and evolves sufficient heat to melt its own weight of ice every hour, and all without undergoing any change or suffering any diminution of substance, and without any visible or hitherto knowable source from which that energy is derived.

Soon after the discovery of radium, its discoverer, Madame Curie, attempted to find the source of this energy. Basing her reasoning on the fundamental law of physics which has been established upon the demonstrations of the most reliable human experience, that force, like matter, can neither be created nor destroyed, she knew, of course, that the energy evolved by radium, if it had its source in the radium itself, could only be maintained at the expense of the body in some way. She soon found that the radium underwent no

change, either in character or in weight. She then knew that the energy must be derived from some external source. But the theory that radium owed its visible effects to its capacity for altering ether vibrations also appeared untenable, because the radium rays differed widely from light and heat rays and all other rays with which science had been acquainted. It was found that radium rays could not be reflected, deflected, or focused. It was discovered also that the radium rays have the peculiar property of discharging electrically-charged bodies, and that they possess a peculiarly high penetrating power, passing through almost any substance. This strange body seemed to defy and mock all human discernment and understanding.

Many have advanced the opinion that radium will require a complete revision and reversal of all hitherto accepted laws of physics and the conservation of energy—that radium has proven wrong all our established ideas of force.

One experimenter ascertained that the loss to the radium itself, in the emission of heat, is so infinitesimally small that even if it does lose any substance at all, it would last long enough for a pound to melt several cubic miles of ice.

Others figured out that radium must have stored up within itself energy millions of times as great as that stored in nitroglycerin, and accounted for this well-nigh infinite force by the assumption that the molecular structure of matter holds in a latent condition this astounding quantity of energy. In other words, that molecules are endothermic, that in their formation in past time all this energy was absorbed, and that radium has a property of breaking itself up into its infinitely small original particles, with the simultaneous liberation of the stored energy. But this theory is untenable because it is so unreasonable; because it is so absurd as to be assuredly impossible, all of which is obvious to the scientific mind.

Some two and a half years ago, I wrote an article for the Electrical Age, in which I discussed the subject of radio-activity, and undertook to account for its luminous and heat-giving effect by assuming that radium has the property of opacity to ultra-violet light rays, and that these high etheric vibrations, impinging upon a radio-active substance, are slowed down to vibrations of lower pitch, some corresponding with visible light and others with heat, in the same manner that an opaque body, like a piece of smoked glass, will get hot in the direct sunlight by slowing down the higher light rays to the lower pitch which we sense as heat. In this way I attempted to account for the luminosity of the phosphorescent or light-giving organs of deep-sea animals which are known to possess them. I believe the higher rays capable of penetrating to the ocean deeps from which ordinary light is barred by the mass of intervening water. At this time I did not know of the theories and experiments of Madame Curie in her attempts to solve the mystery of radio-activity.

Several months ago, and about two years after the appearance of my article in the Electrical Age above mentioned, Lord Kelvin, in a paper which he read before the science branch of the British Association, presented the same theory that I had presented, using nearly identical illustrations; one, for example, the opaque body exposed to sunlight.

Now, it is the object of this article to present what the writer believes to be an entirely new theory, not only of radio-activity, but of another sort of activity as well, utilized by chemists in producing certain chemical reactions. This new theory of radio-activity, to my knowledge, has never before been presented.

Some time ago, I discussed the subject of radio-activity with Mr. Francis I. du Pont, of Wilmington, Del., a noted inventor and expert practical chemist. This subject has always been of intense interest to him, and it is to him that we are indebted for the new theory of radio-activity here presented. It is his opinion that radio-active substances are catalytic agents; that radium is a very powerful catalytic agent; that radio-activity is a form of catalysis, and that the action which radium has upon surrounding bodies is due to this cause.

What is a catalytic agent? It is a body which, by its mere presence, accelerates chemical reactions or causes chemical reactions to take place within other bodies which would not react upon each other, or would react very slowly, except for its presence.

Let me give a very simple illustration. In the manufacture of sulphuric anhydrid, sulphurous acid gas, SO_2, is mixed with oxygen or air and passed over platinum sponge. The SO_2 is incapable of combining with the oxygen of the air until brought in contact with the platinum, but on the instant of coming in contact with or into the sphere of influence of the platinum, the radical SO_2 combines with the oxygen of the air; that is to say, the radical SO_2 takes on another molecule of oxygen, forming SO_3. The platinum is wholly unchanged. It undergoes no loss to amount to anything. It plays absolutely no chemical part in reaction. It merely acts as the priest to marry the radical SO_2 to another molecule of oxygen. How does it do this? No explanation has heretofore been given which can account for this mysterious action.

After receiving the key to the explanation of radio-activity from Mr. du Pont, it occurred to me that by reversing the order, radio-activity might be used as a key to the solution of the problem of catalytic action. It is well known that radium has the peculiar effect of discharging electrically-charged bodies. Riecke, professor of physics at Göttingen University, regards atoms as electrically-charged bodies.

Now it is probable that molecules and atoms are electrically-charged bodies, that like ponderable bodies they have their charges of positive and of negative electricity. It is conceivable that the radical SO_2 cannot combine with the additional atom of oxygen, owing to negative electricity, which holds them apart, until they come in contact with or come within the influence of the platinum, which, acting like radium, discharges the negative electricity and allows them to unite.

Is it not probable that the effects of radium upon animal tissues may be due to the discharging of negative electricity, which holds certain molecules from uniting with other molecules, thereby bringing about chemical reactions which, under normal condition, are impossible of being effected?

As we look at a small particle of bromide of radium in a spinthariscope, the emanations do not resemble light rays thrown off from a luminous body. There is a dodging about and an irregular vibratory movement of brilliant particles. In other words, it is something like a meteoric shower. It is something like a lot of miniature bombshells exploding. It is an effect similar to that frequently produced by fireworks. This is what has led to the conclusion by many that radium is continually sending off luminous particles from its own substance.

How does this new discovery of catalytic action serve to throw light upon the strange phenomena? Let me explain. We are all familiar with the theory of the thunderstorm. Small aqueous vesicles forming the clouds, each vesicle charged with a small amount of electricity, unite with one another, forming larger vesicles. These vesicles being spherical in form, the larger vesicles contain a smaller amount of surface in proportion to their mass than they did when divided into smaller vesicles or particles, and consequently the electrical tension upon the surface becomes greater and greater as the vesicles grow into drops of water, and it is the uniting into one great electrical spark of an infinite number of small electrical sparks passing from drop to drop that produces the lightning flash and the clap of thunder.

Radium, acting upon the atmosphere in contact with it, or in its immediate vicinity, discharging the electricity from certain molecules to certain other molecules, produces miniature reactions. Possibly it is these miniature electrical discharges that make the light. They are miniature flashes of lightning, and had we ears so acute as to distinguish sounds infinitely small, we should be able to hear the infinitely little claps of thunder.

The appearance of a piece of radium bromide in the spinthariscope is certainly analogous to heat lightning. It looks like a miniature display of heat lightning.

The production of helium from radium Mr. du Pont believes to be due not to the conversion of any portion of the radium into helium, but to the production of helium from the atmosphere or other medium by the catalytic action of the radium. According to this view, the energy does not come from the radium, but exists in the atmosphere as potential energy, and is merely allowed by the radium to become kinetic energy, in precisely the same manner that in an atmosphere of SO_2 and oxygen at certain temperatures, platinum will allow the potential energy contained therein to become kinetic, producing heat and a chemical change.

Possibly radium, in addition to being a catalytic agent, may have an attractive or selective power for certain elements, among which may be helium, thereby enriching the atmosphere in its own immediate vicinity with a larger proportion of helium than the atmosphere normally holds. It would be interesting to conduct a line of experiments with radium immersed in different atmospheres of varying density and different chemical constitution, and compare these results with similar tests of radium in as nearly a perfect vacuum as possible. Such experiments might throw some light upon the catalytic nature of radium. HUDSON MAXIM.

891 Sterling Place, Brooklyn, N. Y.

THE MOTOR TRUCK PROBLEM.

To the Editor of SCIENTIFIC AMERICAN SUPPLEMENT:

"To be or not to be" is the problem of the vehicle for general street or road transportation of merchandise in large bulk, without horses. The wide adoption, fair satisfaction, and large interest secured by horseless pleasure vehicles has suggested a natural and supposedly easy step to their adaptation to the general handling of merchandise. Many attempts are being made. A small proportion reach the stage of actual test on the streets. The problem is one of very general interest, and of vast importance to many business men. Aside from the extravagant expectations of the total elimination of horse traction, the field is a vast and most attractive one, and the reward awaiting the really successful design is alluring enough to tempt many having more or less knowledge of the matter. Engine builders, bicycle builders, expert designers, speculators, and men of nearly all professions and occupations are apparently eager to secure these tempting prizes.

Has it ever occurred to anybody that among all these the real wagon maker is conspicuous—by his absence? Among the mass of discussions and opinion in the press, practically none is by, or of, the wagon maker—or rather, truck builder. If these be facts, is there significance therein? Is the truck builder so lacking in enterprise and intelligence as to let opportunity knock vainly at his door, until fortunes are reaped by outsiders?—or does he perceive fallacies and difficulties to which the greenhorn is blissfully oblivious?

In tendering some views on the subject, I admit whatever bias may reasonably be suspected in one who is of two generations of builders of horse-drawn vehicles for handling merchandise. But the connection of fifty years of my family and name with this industry, precludes stultifying myself, by other than fair and honest presentation of what the truck builder sees from his biased viewpoint. As all in this line are presumably biased, this does not discredit any, and indeed the several biased views may disclose the truth better than any one of them could impartially present it.

The horseless pleasure vehicle was an evolution from the bicycle, bicycle builders and bicycle factories naturally taking up the new industry as the old one declined. The bicycle was the best example of vehicle strength and endurance in proportion to its own weight. The ideas and the methods so successfully applied therein are indelibly reproduced upon all automobiles, however variant they may seem to the ordinary observer. Perhaps for pleasure vehicles in general, this extension and transformation of bicycle construction is as good or better than any other. If so, it might naturally seem to most persons only another step to enlarge, strengthen, and evolute into a motor truck. If the automobile and the motor truck are of the same genus, the plan is theoretically feasible. If of a different genus, however seemingly alike, it is impossible.

The attempts so far made seem to me to suggest the mule "without pride of ancestry or hope of progeny." For engine builders, inventors, and capitalists to devote time, energy, skill, and money with only freaks in prospect seems a bootless quest—to the truck builder.

The modern truck as seen in Greater New York is the result of many years' development. There are reasons for many things about it that are known to truck builders, and unknown to some others. The idea that a motive force applied in any sort of way to any sort of vehicle constitutes a satisfactory invention is fallacious—absurd.

The horseless truck must meet certain requirements, and vital points cannot be ignored or slurred. While vehicles defying or evading them may possibly serve for advertising purposes, or in limited spheres, for general use success is absolutely and forever impossible on the lines of bicycle construction, however the vehicle may be magnified in size, or whatever devices may be adopted to mask its natural limitations.

Natural laws and practical requirements under actual physical and business conditions, seem to me to require the meeting, fairly and squarely, of the following propositions, or the inventor may as well "forever hold his peace," and save his money. Briefly stated, and I think carrying their own reasons by obvious deduction, these essentials are:

First—The motive power must be so applied that its operation shall not call for a skill which in another field would command a high salary. Men will be duly educated for reasonable demands, just as motormen were.

Second—Rubber tires are an insuperable obstacle, at present cost. For the tires alone, lasting scarcely a year under service conditions, to equal in cost that of a complete horse-drawn truck, is a monstrous handicap.

Third—Wheels must dish, and the use of a dished wheel precludes the use of a revolving axle. This is a vital fact and a fact self-evident to any practical truck builder. Too much stress cannot be laid on this feature.

Fourth—Machinery must be accessible. For ordinary attention, a skilled machinist and tedious taking apart of engine and vehicle cannot be afforded.

Fifth—Weight of vehicle must be within some reasonable proportion to freight load.

Sixth—While the heavy merchandise motor truck will ordinarily move slowly, its weight and momentum will necessitate brakes of quick, sure, and powerful action.

Seventh—The vehicle must not be a freak construction, but reasonably conform to styles which shall best serve business conditions and wants, substantially as does the horse-drawn truck.

Eighth—It is very desirable, if not essential, that the truck shall turn within its own length. Backing and filling to turn, or get into position, would be impossible in many localities.

Ninth—The pivotal point on which the decision for or against the motor truck must turn is dollars. A low-priced vehicle is not essential, and perhaps had better not be sought at any risk of missing strength and fitness. But in one way or another, and in the long run, it must show the dollars earned or the dollars saved. Value as an advertisement is already gone with the novelty. It must be a profitable investment, based on original cost, operation, and repairs, to be offset by work performed. Large users of horses know with much greater exactitude than does any inventor the present cost of hauling merchandise. It is mere trifling to expect from them consideration of any vehicle that merely moves itself without horses, or carries a load ridiculously incommensurate to weight and cost of vehicle.

The prospect of attainment may seem to the well-informed distant and difficult, but any one who saw at the Chicago World's Fair, the freakish designs in early locomotives, and utter ignorance of railway traction possibilities, and compares those exhibits with the locomotives of to-day, should not be discouraged in an intelligent pursuit of the solution of the problem of a motor vehicle for heavy merchandise. To one or many seekers in this path may come gratifying and rich reward, with benefits to others at the same time.

One immense advantage the motor truck will have over the horse-drawn truck is that the latter is practically limited to what three horses, harnessed abreast, can draw; in practical usage, we find that the load will not average more than six to seven tons, and the distance traveled per day will not be over twenty miles. Against this the motor truck will be limited, as to weight, only to what can be borne by the roadway, and in distance covered, only by speed ordinances, but which, in the judgment of the writer, can safely be put at forty miles per day.

But the will-o'-the-wisp haunts the path, as many now know to their cost, and many others as yet in blissful ignorance will discover—at least so it seems to the truck builder, who does not yet see himself in prospect relegated to innocuous desuetude along with his equine friends.

The enthusiasm or credulity which begins by building or leasing a factory, setting up costly machinery, employing costly labor, superintendents, experts, and company officers, to develop an invention, in many cases merely in an inventor's head; or something whose drawings themselves would show a competent critic the hopelessness of the prospect; the docile submission to the guidance of a mechanical expert who will develop anything you assign him to, spending anything you appropriate, for any length of time the money lasts, with his positive assurance of success ultimately (barring the unheard-of contingency of the assurance giving out before the money does)—all these are good ways to learn (something of) the motor truck business. They can be repeated indefinitely with no risk of failure—to spend the money. They are absolutely secure as permanent investments.

Although the fuel or power question is scarcely within the scope of this article, I may add that I have watched with much interest, and some kindly and favorable opportunities afforded me to study the different ones, and am convinced that there is great and hopeful opportunity for use and development of steam, electricity, or gasoline. While for the moment gasoline seems to be most readily adapted and satisfactory, it would be an undesirable limitation to the enormous possible development of the motor vehicle industry, were it the only source of power. Steam has certain advantages, and the objections to it seem surmountable. With all signs pointing to a phenomenal development in the economical production of electricity from water powers and its successful transmission and use in storage batteries, there seems great and reasonable hope for this ideal power. The development of kerosene, or of crude oil, or even of some new source of power, is not perhaps hopeless. At attempt to make an explosive gas by passing air through a dry chemical was not wholly without results experimentally.

But on many grounds, sanitary especially, such substitution for the horse will be in line with progress.

W. OSCAR SHADBOLT.

Brooklyn, New York, March 10, 1904.

RADIUM.—I.*

THE discovery of the phenomena of radio-activity is a result of the researches that, ever since the discovery of Roentgen rays, have been making upon the photographic effects of phosphorescent and fluorescent substances. The knowledge of the properties of Roentgen rays, in fact, has induced various scientists to endeavor to ascertain whether the property of emitting very penetrating rays is not intimately connected with phosphorescence. In 1896, M. H. Becquerel, in studying the rays emitted by phosphorescent bodies, observed that, among them, the salts of uranium were the source of a special radiation having close analogy with Roentgen and cathodic rays. As this emission of rays does not derive its energy (apparently at least) from the previous absorption of calorific, luminous, ultra-violet, cathodic, or Roentgen rays, scientists were confronted by an absolutely new phenomenon, very different from that of phosphorescence and fluorescence, since in these latter the material does not behave as a transformer of rays of short wave-lengths into rays of greater wave-lengths. Uranium and its metallic compounds have the property of emitting such rays spontaneously and continuously.

These new rays act upon photographic plates, protected from the light; they are capable of traversing all solid, liquid, and gaseous substances, provided that their thickness be not too great; and, in traversing gases, they cause the latter to become conductors of electricity.

In 1898, M. Schmidt and Mme. Curie found, independently, that thorium was possessed of analogous properties. Mme. Curie gave the name of "radio-active substances" to such bodies as uranium and thorium, and of "Becquerel rays" to the rays that they emit spontaneously. Resuming the studies of M. Becquerel, she confirmed, in addition, the hypothesis proposed a few years previously by this scientist, viz., that the radio-activity of the compounds of uranium and thorium exhibit themselves as an "atomic property." The phenomena observed, in fact, depend only upon the element uranium or thorium contained in the compound.

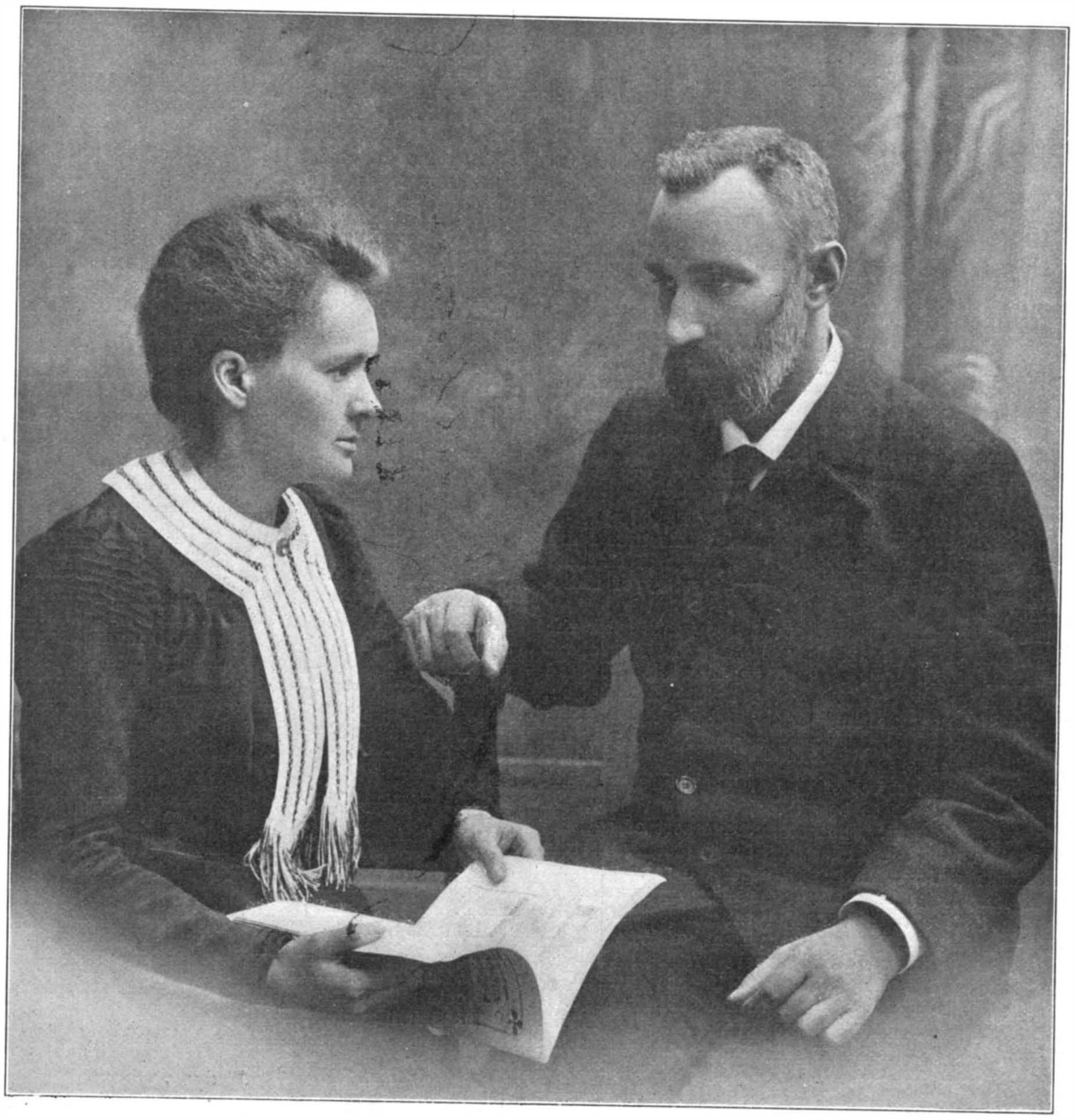
During the course of her researches, Mme. Curie noticed that certain natural compounds exhibited an activity entirely out of unison with the preceding results. Hence, pitchblende (protoxide of uranium) shows itself to be four times more active than metallic uranium, and chalcolite (crystallized phosphate of copper and uranium) two times more active than the same substance.

Now, according to the considerations mentioned above, granting to radio-activity the character of atomic property, none of these substances should have shown itself more active than uranium. On the other hand, chalcolite prepared artificially according to Debray's method, by means of pure products, possessed only a normal activity two and a half times less than that of metallic uranium.

The excess of activity made evident in these minerals could, therefore, be due only to the presence of a small quantity of strongly radio-active matter, different from uranium, thorium, and the simple bodies then known. It was found possible to solve the problem by making an analysis of pitchblende by the wet process, and measuring the radio-activity of all the products obtained; and in 1900, M. and Mme. Curie, after some long, troublesome, and costly work, discovered two new elements a million times more active than uranium, viz., *polonium*, a body allied to bismuth, and *radium*, a body allied to barium. Subsequently, M. Debierne separated *actinium*, a new radio-active substance belonging to the group of rare earths.

Radium constitutes a new element, which has been obtained in a pure state, and has powerfully contributed toward the development of the study of the phenomena of radio-activity. It alone will form the subject of this paper.

The discovery of polonium and radium, and the numerous researches made upon these substances, were effected by M. and Mme. Curie in their laboratory at the Ecole de Physique et de Chimie Industrielle, of Paris, under the auspices of the late M. Schützenberger, and of the present superintendent, M. Lauth.



MADAME AND MONSIEUR CURIE, THE DISCOVERERS OF RADIUM.

MEASUREMENT OF THE INTENSITY OF RADIATION.—In order to study the radio-activity of the various radio-active substances, it is possible to use either a photographic or an electric method. The former, which has the great advantage of requiring no special apparatus, does not, properly speaking, constitute a measuring method, and the results that it furnishes are not comparable with one another. Nevertheless, it is capable, in certain cases, of affording a valuable means of investigation, and, for example, of being used advantageously in researches upon radio-active minerals. Such an application, which was suggested by Sir William Crookes, permits of bringing to light the presence of radio-active minerals and, in these, of distinguishing the active from the inactive parts. For this purpose there is formed, upon the substance to be tested, a plane surface which is afterward applied to a photographic plate either directly or with a thin sheet of black paper interposed. After an exposure of several hours in darkness the plate is developed (Figs. 2 to 6).

The plate is acted upon wherever there are radio-active substances. The presence of the radio-active matter is indicated upon the plate by a small black spot, which is so much the blacker in proportion as the matter is more active. It is afterward easy to compare the various parts of the same mineral with each other from the standpoint of their activity.

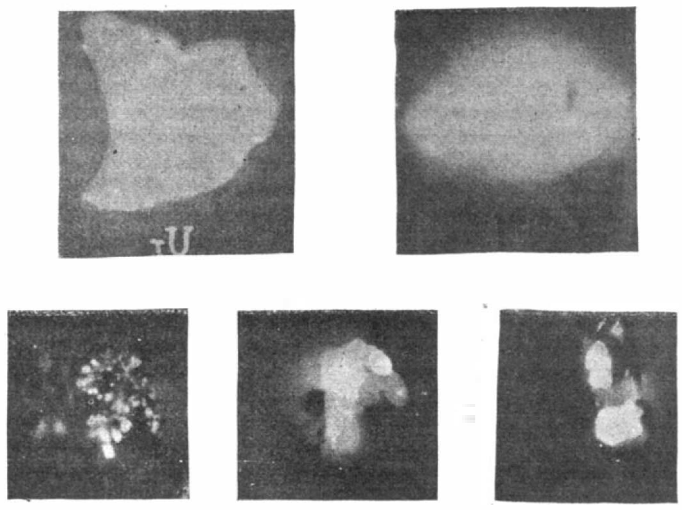
The electric method is a genuine measuring one. It consists in determining the conductivity acquired by the air under the action of radio-active substances. This determination can be effected in a very simple manner by observing the velocity of discharge of a charged electroscope. For this purpose the arrangement shown in Figs. 7 and 8 is employed.

The two plates, *A* and *B*, of a condenser are connected, one of them with the ground, and the other with a gold-leaf electroscope charged with electricity. Under ordinary circumstances, the air comprised between the plates is insulating, and the electroscope remains charged; but, if the active material, finely pulverized, be placed upon the plate, *B*, the charge of the electroscope will flow to the ground, and that, too, so much more rapidly in proportion as the matter is more active. It suffices to measure the falling velocity of the gold leaf in order to obtain the value of the activity of the substance. The determination of the falling velocity of the gold leaf is effected very simply by observing, as a function of the time, the displacement of one of the leaves of gold by means of a microscope, *M*. During the experiment, the plates, *A* and *B*, are surrounded with the casing, *C*, which is fixed to the ring, *c* (Fig. 7). This method, which is very easy of application, gives pretty accurate results. For more delicate measurements, it is preferable to substitute for it an infinitely more sensitive electrometric method. The arrangement for this purpose consists, as in the preceding apparatus, of a condenser formed of two plates, *A* and *B* (Fig. 9). One of these, *B*, is raised to a high potential by connecting it with one of the poles of a battery of accumulators, *P*, of a large number of elements, the other pole of the battery being grounded. The other plate, *A*, is maintained at the potential of the ground, *T*, by the wire, *C D*. When a radio-active substance is placed upon the plate, *B*, an electric current is set up between the two plates.

The potential of the plate, *A*, is indicated by an electrometer, *E*. If the communication with the ground be interrupted at *C*, the plate, *A*, will become charged, and the charge will cause a deflection of the electrometer. The velocity of the deflection will be proportional to the intensity of the current, and may serve for measuring; but it is preferable to make the measurement by counterbalancing the charge taken by the plate, *A*, in such a way as to keep the electricity at zero. The charges to be measured are extremely small, and may be counterbalanced by means of a electro-piezo quartz, *Q*. This latter, devised by MM. J. and P. Curie, constitutes a perfectly constant standard of electric quantity. The apparatus is based upon the following principle: If, upon a crystal of quartz, there be exerted a traction at right angles with both the optical and binary axis, the crystal will become polarized electrically in the direction of the binary axis, and the

* Translated for the SCIENTIFIC AMERICAN SUPPLEMENT from the French of Jacques Danne, preparator to M. Curie, in Le Genie Civil.

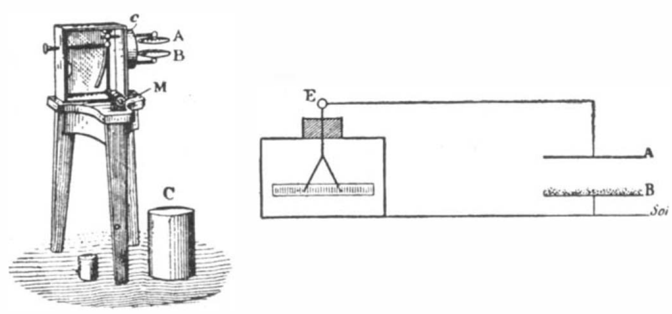
two faces that are at right angles with this axis will seem to be charged with two strata of electricity of contrary polarity. By covering these two faces with tinfoil, a condenser is formed that will become charged with electricity when a traction is exerted. If, after discharging the tinfoil, the traction be discontinued,



FIGS. 2 TO 6.—PHOTOGRAPHS OBTAINED BY MEANS OF RADIO-ACTIVE MINERALS.

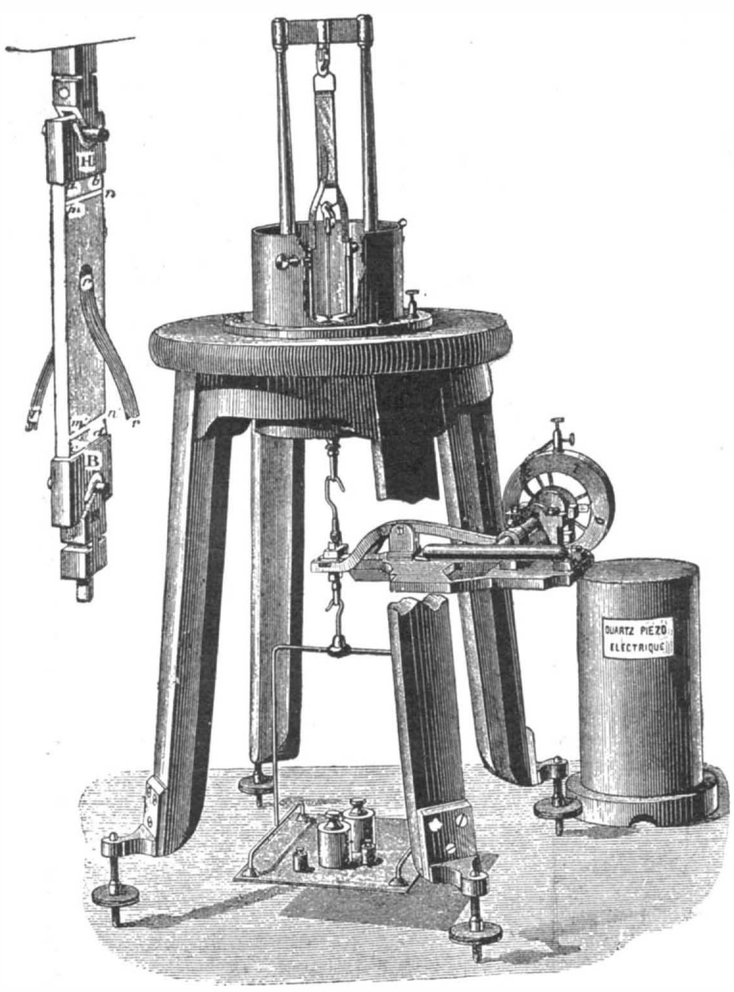
the condenser will become charged anew; but this time, the charges upon each face will be equal and of the opposite polarity to those obtained in the first experiment.

The apparatus is formed of a long and thin strip of quartz, properly cemented at its two extremities, at *H*



FIGS. 7 AND 8.—ELECTROSCOPIC MEASUREMENT OF THE ACTIVITY OF RADIO-ACTIVE SUBSTANCES.

and *B* (Figs. 10 and 11), in metallic pieces, which serve for transmitting a traction exerted by means of weights placed in a scale pan. The end, *H*, is suspended from a stationary hook, while attached to the lower end, *B*, is a hooked rod that transmits the tractive stress. The opposite faces of the quartz are cov-



FIGS. 10 AND 11.—THE CURIE QUARTZ ELECTRIC PIEZOMETER.

ered with insulated sheets of tinfoil, such as *m n*, *m′ n′*, upon which the electricity is disengaged. Two small, light springs, *r* and *r′*, put these sheets of tinfoil in communication with the electric apparatus.

The quantity of electricity disengaged by the quartz is proportional to the weight of the tension device. In order to counterbalance the current produced in the condenser, the strip of quartz is submitted to a known tension, produced by a weight placed in the pan, *H* (Fig. 9). At *C*, the communication of the plate, *A*, with the ground is cut off, and the weight of the pan, *H*, is gradually lifted by hand. This operation causes a progressive disengagement of a known quantity of electricity during a period of time which is measured. The operation may be so regulated that there shall be at every instant a compensation between the quantity of electricity that traverses the condenser and that of opposite polarity which the quartz furnishes. It is thus possible to measure accurately the quantity of electricity that traverses the condenser during a given time, that is to say, the intensity of the current. The measurement made under such conditions is independent of the sensitiveness of the electrometer. This method is extremely sensitive, and it is possible thereby to detect, for example, the radio-activity of a product where it is but 1-100th of that of metallic uranium. The activity that it is possible to measure by this method is, however, quite limited. In fact, it may happen that the quartz can no longer furnish a sufficient quantity of electricity in the proper length of time. In such a case, the difficulty is surmounted by causing the surface of the active material placed in the condenser to vary. The greater the surface, the more intense is the current that traverses the condenser. The relative value of the currents measured is determined once for all, for each of the surfaces employed, by bringing them both to the same area. This operation is performed very simply by measuring the currents obtained with the same product for different surfaces.

For very active products it is necessary to employ

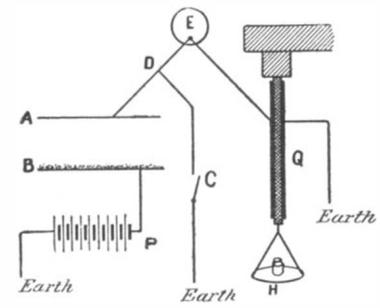


FIG. 9.—ARRANGEMENT EMPLOYED IN THE ELECTROMETRIC METHOD.

very small surfaces. As a result of this there is apt to be quite an error in the measurement, since it is difficult to obtain a very definite surface. In this case, preference is given to a slightly different arrangement, which consists in placing the product beneath the condenser, at a greater or less distance from the latter according to the activity of the substance to be measured. The radiation that traverses the plates of the

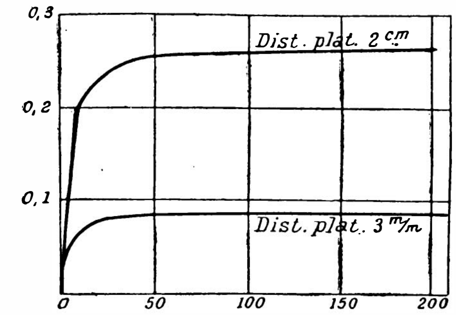


FIG. 12.—DIAGRAM OF CURRENT INTENSITIES AS A FUNCTION OF THE DIFFERENCES OF POTENTIAL BETWEEN THE PLATES OF THE CONDENSER.

condenser may thus be considerably diminished. The current might also be measured by means of a sensitive galvanometer. Such a method, however, is quite a long one and is difficult to employ. It is necessary, in fact, to verify the sensitiveness of the galvanometer after every measurement. If, with the same condenser and the same radio-active substance placed between the two plates, we vary the difference of potential between

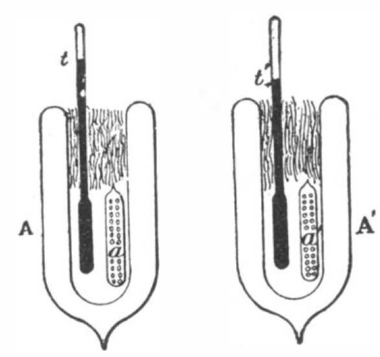


FIG. 13.—DISENGAGEMENT OF HEAT FROM RADIUM SALTS.

the two armatures, we shall find that the current measured increases with the difference of potential. For strong differences of potential, however, the current tends toward a limit-value which is sensibly constant. It is this current that is taken as a measurement of the radio-activity. The magnitude of the limit-currents obtained with the compounds of uranium is 10^{-11}

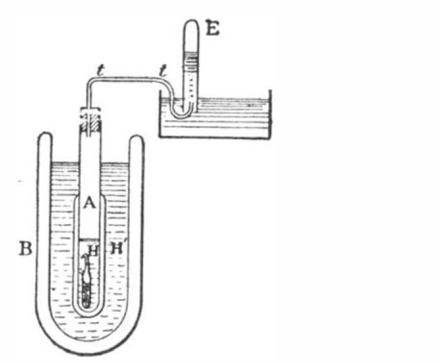


FIG. 14.—EBULLITION OF LIQUEFIED HYDROGEN PRODUCED BY RADIUM SALTS.

amperes with a condenser having plates 8 cm. (3.149 inches) in diameter and 3 cm. (1.181 inch) distant. This is the intensity taken as unity in the diagram in Fig. 12. If we adopt as the unit of activity the current obtained with metallic uranium, the activity of the other substances will be expressed as a function of

the activity of the uranium. This is the method employed by M. and Mme. Curie at the beginning of their researches in the experiments on the concentration of active products. They measured the radio-activity of a product and with this effected a chemical separation. They afterward measured the radio-activity of all the products obtained, and thus ascertained how and in what proportion the radio-active substance was distributed between the various separate parts. They thus obtained indications that were in part comparable with those that spectral analysis would have furnished.

This method of research had, in the case of radioactivity, the great advantage of being considerably more sensitive than the spectral one.

Extraction of the Salts of Radium.—*Ores.*—Radium is found in traces in a certain number of minerals, such as pitchblende and carnolite. In these it accompanies uranium and barium, but it is never found in the barium minerals that contain no uranium. M. and Mme. Curie endeavored to elucidate this fact by assuring themselves that the chloride of barium of commerce contains no chloride of radium. For this purpose they undertook the fractional division of a large quantity of commercial chloride of barium, by a method to be described further along, hoping thereby to concentrate any trace of chloride of radium that might be found therein. The product obtained exhibited no radio-activity, and therefore contained no radium. This body consequently does not exist in the ores that furnish the barium of commerce.

In Europe, it is from the pitchblende of Joachimsthal, in Bohemia, that, up to the present, radium has been extracted. This substance is something like two or three times more active than metallic uranium, and permits of obtaining from 1.54 to 3.08 grains of bromide of uranium per ton of ore treated. The complexity of the raw material, in addition to the small proportion of radium that it contains, made the researches extremely laborious. Pitchblende is an ore of oxide of uranium accompanied with a large number of metals, such as iron, aluminium, calcium, lead, bismuth, copper, arsenic, antimony, and some new radioactive materials, such as radium, polonium, and actinium.

Extraction.—The treatment of the pitchblende is divided into three very distinct phases. In the first, the blende is in the first place freed from all the uranium that it contains. Up to the present, this operation has been performed at the place where the ore is extracted. The residua of the operation contain the strongly radioactive substances. A new treatment effected at the works is designed to separate and purify the portions rich in radium, polonium, and actinium. This operation constitutes the second phase of the treatment. Each of the portions is afterward treated separately with a view to obtaining the radio-active substances that it contains. The portion that contains the radium is about sixty times more active than uranium, and the radium is extracted from it by a series of fractional divisions effected upon the radiferous barium bromide. These operations, performed in the laboratory, form the third and last phase of the treatment. We shall now examine in a little more detail the various parts of this treatment.

The ore, broken up and crushed, is roasted with carbonate of soda. The material resulting from this treatment is first washed in hot water in order to remove the soluble salts of soda, and then with dilute sulphuric acid. This latter solution contains all the uranium. The insoluble residuum, formerly valueless, is now collected with care, since it contains all the strongly radio-active substances. Its activity is four or five times greater than that of uranium.

The main contents of this residuum are sulphates of lead and calcium, silica, alumina, and oxide of iron. There is found in it, in addition, in varying quantities, almost all the metals (copper, bismuth, cobalt, nickel, vanadium, etc.) The radium is found disseminated through this mixture in the state of sulphate, and constitutes the least soluble sulphate in it.

The first operation performed upon these residua consists in treating them with concentrated hydrochloric acid. The material is strongly disintegrated and passes in part into the solution. From this solution polonium and actinium can be extracted. The first is precipitated by sulphureted hydrogen, and the second is found in the hydrates precipitated by ammonia, in the solution separated from the sulphides and peroxidized. As for the radium, that remains in the insoluble portion, which is washed with water, and then treated with a concentrated and boiling solution of carbonate of soda, the object of which is to convert into carbonates the sulphates not attacked in the preceding reaction. The material is then washed very thoroughly with water and afterward treated with dilute hydrochloric acid free from sulphuric. The solution which contains the radium, with a little polonium and actinium, is filtered and precipitated with sulphuric acid. In this way are obtained crude sulphates of radiferous barium containing also lime, lead, and iron, and a small quantity of actinium. A ton of residuum furnishes about 20 or 40 pounds of crude sulphates, of which the activity is thirty to sixty times greater than that of metallic uranium. Next comes the purification of these sulphates. This consists in boiling them with a concentrated solution of carbonate of soda and converting the carbonates obtained into chlorides. The solution, treated with sulphureted hydrogen, gives a slight precipitate of active sulphides containing polonium. Then the solution is filtered, peroxidized with chlorate of potassium, and precipitated with pure ammonia. The precipitated oxides and hydrates are very active, and still contain a little actinium. The filtered solution is precipitated with carbonate of soda. The alkaline-earthy precipitates are washed and converted into chlorides, which are evaporated to dryness and washed with concentrated and pure hydrochloric acid. The chloride of calcium dissolves almost completely, while the radiferous chloride of barium remains insoluble. The supernatant solution consequently contains the lime and a little radium. Upon being precipitated with sulphuric acid, there gradually deposits a very active sulphate, which is submitted to a new treatment. As for the radiferous chloride of barium insoluble in the concentrated hydrochloric acid, that is taken up by the water. The solution is again precipitated with carbonate of soda, and the washed alkaline-earthy carbonates are this time treated with hydrobromic acid for the purpose of converting them into bromides.

After this long series of operations, there is obtained, per ton of raw material treated, from 17.63 to 22.04 pounds of radiferous bromide of barium, of which the activity is about sixty times greater than that of metallic uranium. This bromide is then ready for fractional division. The object of this is to obtain radiferous bromides of barium richer and richer in radium. The process consists in submitting the mixture of bromides to a series of crystallizations in pure water at first, and then in water to which hydrobromic acid has been added. The process is based upon the difference of the solubility of the two bromides, since that of radium is more soluble than that of barium. At the inception of their researches upon the separation of radium, M. and Mme. Curie effected the division upon the chlorides, but M. Geisel found that the separation of the radium and barium by fractional crystallization of the bromides was much more advantageous, especially at the beginning of the division. The bromides are dissolved in distilled water and the solution brought to a state of saturation at the temperature of ebullition. It is afterward left to crystallize by cooling in a covered dish. In this way, there is obtained at the bottom of the latter a quantity of beautiful crystals, which are separated from the supernatant liquid by decantation. These crystals are about five times more active than the bromide in solution. The salt has thus been divided into two portions, and upon these, identically the same operation is repeated. The solution of the bromides is evaporated and brought to saturation by heat, and the salts are redissolved, and then again set aside to crystallize.

After the crystallizations are finished, we have four new portions. The supernatant solution of the most active part (crystals) is united with the crystals of the least active part (solution), these two having substantially the same activity. There then remain three portions, which are submitted to an analogous treatment. The fractional division is thus proceeded with, always by the same method. After each series of operations, the saturated solution derived from one portion is poured over the crystals derived from the following. It follows that the more active products and those less and less active follow a path of opposite direction. The number of the portions is not allowed to increase, however. When the impoverished products have no longer anything more than an insignificant activity, they are eliminated. The same is the case with the enriched portions when the number of portions desired has been obtained. The operation is then performed with a constant number of portions. The elimination is effected progressively, and, in measure as the number of fractional divisions increases, we have, on the one hand, products of very slight activity, and, on the other, products very rich in radium.

The small quantity of product that is at present disposable has not permitted of very completely studying the chemical properties of the radium salts. Such a study might doubtless lead to some modifications that would be interesting from the viewpoint of the rapidity of preparation of this body. A certain number of radium salts—the chloride, bromide, and nitrate—has been obtained, but radium in a metallic state has not yet been prepared. It would nevertheless be easy to effect such preparation, which presents little interest, by the method that Bunsen employed for that of barium.

Characteristics of the Salts of Radium.—*Chemical Characteristics.*—The bromide of radium thus obtained has an activity about a million times greater than metallic radium. All the salts of radium have the same aspect as those of barium when they are prepared in a solid state. They are then white. They become progressively colored yellow, and even violet, in time, however. From a chemical point of view, all the radium salts possess properties that are absolutely comparable to those of the corresponding salts of barium. The bromide and chloride of radium, however, are less soluble than the bromide and chloride of barium. It is this important property that is utilized in the separation of radium and barium. M. Geisel has found that chloride of barium, in a solid state or in solution, continuously produces hydrogen. Moreover, a chloride of radium that has been inclosed in a bulb for some time, disengages a strong odor of chlorine when the bulb is broken.

Coloration of the Flame and Spectrum.—The salts of radium communicate to a flame a magnificent carmine color. At the beginning of M. and Mme. Curie's researches upon radio-active substances, the late M. Demarçay was kind enough to take upon himself the spectroscopic examination of these substances. The aid of so distinguished a spectroscopist was of great advantage in confirming the hypothesis of the existence of new radio-active elements. Spectral analysis completely confirmed such hypothesis in the case of radium. The study of the spectrum was afterward resumed by MM. Runge, Pacht, and Crookes. The spectrum of radium is very characteristic. Its general aspect is that of the alkaline-earthy metals, viz., wide lines with some nebulous ones are found in it. With a spark and a solution of pure chloride of radium, M. Demarçay obtained a spectrum all the lines of which were clearly defined and narrow. The principal ones are in the blue ($\lambda = 434.06$), one in the violet ($\lambda = 434.06$), and one in the ultra-violet ($\lambda = 381.47$). These lines are strong and equal, and the most intense of those at present known. There are also observed in the spectrum two strong nebulous bands, one in the blue and the other beginning in the indigo-blue and shading off toward the ultra-violet.

According to M. Demarçay, radium may figure among the bodies that have the most sensitive spectrum reaction. We begin to perceive the principal line of radium ($\lambda = 381.47$) with materials fifty times more active than uranium. The sensitiveness of the spectroscopic method, however, is in nowise comparable to that of the electric one previously described. The latter, in fact, permits of ascertaining the presence of a radio-active substance even though its activity reaches but 1-100th of that of uranium. The spectrum of the radium salts examined by M. Giesel contains two beautiful red bands, one line in the blue-green, and two faint lines in the violet. The spectrum is very brilliant.

Atomic Weight.—The atomic weight of radium as determined by M. and Mme. Curie is 225. In order to make this determination, Mme. Curie employed the classic method that consists in determining, in the state of chloride of silver, the chlorine contained in a known weight of anhydrous chloride of radium. The chloride employed in the last measurements was carefully purified and completely freed from the barium that accompanied it, by repeating the fractional divisions a large number of times. Examined by M. Demarçay spectroscopically, it contained, according to him, only infinitesimal traces of barium, incapable of appreciably influencing the atomic weight.

Radium constitutes a new element of the alkaline-earthy group of metals. According to its atomic weight, it is to be placed in the Mendeleeff table next after barium in the column of alkaline-earthy metals, and in the row that already contains uranium and thorium.

Luminosity of Radium Salts.—All the salts of radium are luminous in darkness. Such luminosity is particularly intense in the chloride and bromide after the product has just been heated, but diminishes as soon as the salt becomes humid again. As the chloride and bromide are very hygrometric, they have to be placed in sealed tubes in order to preserve the brilliancy acquired by them after being heated. The light emitted by the radium salts recalls, as regards color, that of the glow-worm (Lampyrus). It is strong enough to be seen in daylight.

Disengagement of Heat by Radium Salts.—The salts of radium spontaneously and continuously give out heat. One gramme (15.432 grains) of bromide of radium that has been prepared for several months gives out an average of 100 gramme-calories (.00396 B. T. U.) an hour, or, in other words, a gramme of this substance will, in one hour, melt a little more than the same weight of ice. This disengagement of heat is so strong that it can be shown by a simple experiment made with a thermometer. A thermometer, *t*, and a bulb, *a*, containing 10.8 grains of bromide of radium, for example, are placed in a vessel, *A*, calorifically isolated (Fig. 13). After a thermic equilibrium has been established, the thermometer, *t*, constantly indicates an excess of temperature of 3 deg. C. more than the readings of another thermometer, *t'*, placed under the same conditions, but with a bulb containing some inactive salt such, for example, as chloride of barium.

The quantity of heat given out is estimated by means of a Bunsen calorimeter—by placing in the latter a glass bulb containing the radium salt. There is then observed a continuous output of heat, which ceases as soon as the radium is removed to a distance. It is likewise possible to employ the apparatus shown in Fig. 14, in which is utilized the heat produced by radium for boiling a liquefied gas. This experiment succeeds particularly well with liquid hydrogen. A tube, *A*, closed at the lower part and surrounded with a thermic insulator (vacuum), contains a little liquid hydrogen, *H*. An escapement tube, *t*, permits of collecting the gas in a graduated test tube, *E*, filled with water. The tube, *A*, and its insulator both dip into a bath of liquid hydrogen, *H'*. Under such circumstances, no disengagement of gas occurs in the tube, *A*; but if, into the hydrogen of this tube, there be introduced a bulb containing a salt of radium, a continuous disengagement of hydrogen will take place and can be collected at *E*. Seven decigrammes (10.8 grains) of bromide of radium disengage about 70 cu. cm. (4.27 cubic inches) of gas a minute. A recently prepared salt of radium disengages a relatively slight quantity of heat. That disengaged in a given time afterward continually increases and tends toward a determinate value, which is not entirely reached at the end of a month.

When a salt of radium is dissolved in water and the solution is inclosed in a sealed tube, the quantity of heat given out by it is at first slight; but it afterward increases and tends to become constant at the end of a month. When the limit-state is reached, the radium salt inclosed in a sealed tube gives out the same quantity of heat in the solid state as it does in solution.

Variations of Activity of Radium Salts.—The salts

of radium, kept in the same physical state possess a permanent activity that exhibits no appreciable differences, even at the end of several years. When, however, a radium salt has just been prepared in a solid state, it has not in the first place a constant activity; but the activity continues to increase with time and reaches a sensibly invariable limit-value at the end of about a month. The limit-activity is four or five times greater than the initial activity. A contrary phenomenon occurs when a salt of radium is dissolved in water. The activity of the solution is at the outset very great; then, if the solution is left to the free air, it rapidly loses a part of its activity and finally reaches a limit-activity which may be considerably less than that of the initial product. When a radium salt is heated, its activity diminishes, but such diminution does not persist when the salt is brought to the degree of the surrounding temperature.

Radiation and Induced Radio-activity Produced by Radium Salts.—The radium salts spontaneously and continuously emit a special radiation capable of causing phenomena of remarkable intensity. They are capable, in short, of communicating their properties to all bodies placed in their vicinity. This phenomena is what is called "induced radio-activity." These properties are of considerable importance, both from the viewpoint of the phenomena themselves, and of the effects that they are capable of producing. They are worth devoting considerable space to in a study of the phenomena produced by the radium salts, and this we shall do in the notes that follow.

(To be continued.)

PRESENT STATE OF THE SULPHURIC ACID INDUSTRY IN EUROPE.*

From the French of PROF. G. LUNGE, of Zurich.

THIS review gives the progress of the industry since the Congress of 1900.

The raw products have remained the same. However, England utilizes more and more the pure sulphur of Sicily, especially on account of the poisoning caused by the arsenic in products obtained with sulphuric acid containing arsenic. On the contrary, sulphur is less and less employed in Germany. It is not to be feared that the quantity of pyrites will become insufficient; one million of tons are roasted every year in Spain, without recovery of the sulphurous acid.

Nitric acid, the indispensable agent in the production of sulphuric acid, has been recently prepared in a new way—from nitrates by assimilation of atmospheric nitrogen by the electric method. But this process is still in an embryonic state, since it does not yield pure nitrates, but a salt contaminated with nitrite. The latter compound being poisonous for plants, the product of this industry cannot be used as a fertilizer, and the salts are not readily transportable on account of their hydroscopicity. On heating these salts, nitrate of lime or nitrate of magnesia, in a current of superheated air, all the "nitric nitrogen"† may be extracted and recovered in the form of nitrate. I am now occupied with the study of this process.

The pyrites ovens have not undergone any material change. Along with ovens of the Malctra type, the Macdougall mechanical ovens have commenced to be employed; as also the Hereshoff ovens, whose shaft is cooled by the air, and the Frasch ovens, cooled by water. The great inconvenience of these ovens lies in the enormous quantity of dust produced. This is remedied by the employment of large chambers, slackening the movement of the gases; thus centrifugal apparatus is employed, as O'Brien has done, serving for retaining the dust.

The lead chambers have reached their greatest perfection in France. Generally, a single process, giving good results, is adopted; the introduction of sprayed cold water, according to the Sprengel method, and the introduction of air. At Aussig, in Austria, as well as in some German factories, this system has also been adopted. The French factories still produce the largest quantity of acid with the same chamber space. But it is especially in Germany that a bold reform of the old processes of lead chambers has been received with favor, still without accepting the contact process; thus the Meyer tangential chambers are being introduced, and will find more adherents, in proportion as the work is conducted with injections of air and sprayed water. The Lunge towers are also in favor; 142 towers had been furnished up to March, 1903. These towers diminish the space occupied materially; a single lead chamber and three or four of them are sufficient; the investment is therefore less. The Glover and the Gay-Lussac towers have not been appreciably modified. The chemical theory of the reaction of the lead chambers has also not been changed.

The purification of sulphuric acid for eliminating the arsenic has been much discussed; it is still carried on with hydrogen sulphide. In the concentration apparatus, the Ganner vat is to be noticed; it is placed on the gas conduits of the ovens, which thus concentrate the acid without any expenditure of combustible.

Of platinum apparatus, the Hæræus vat prevails, but at the same time the Kessler apparatus is more and more used, as well as the ingenious oven radiator of the same inventor.

The monohydrate industry by frigorific action, the Lunge-Griesheim process, has been the first victim of the contact processes in the production of sulphuric acid. The first who produced the acid by contact was Peregrine Phillips, an Englishman, in 1831. In 1875 Winckler renewed the study, and Knieysch, director of the Ludwigshaven factories, has recently introduced it in an effective manner.

Two processes are in use; one works with platinum, the other with ferric peroxide; it cannot be said which will prevail. The factories of explosives employ with advantage the acids produced by these processes in the reconcentration of their acids; as well as the establishments of aniline colors.

The cost price of the concentrated acid is less by the contact process, but the immense quantity of acid utilized in the manufacture of superphosphates, which do not necessitate a high concentration, is produced cheaper by the lead chambers. If these are constructed with new apparatus, mechanical draft, reaction towers, working with air and sprayed water, they may well compete with the process of contact for the production of an acid of 55 deg. to 60 deg. Bé. But for the production of acids highly concentrated, the latter process has the advantage.

Statistics prove that the production of sulphuric acid is still the preponderating chemical industry, as will be seen from the following figures: Great Britain, 1,100,000 tons; Germany, 880,000 tons; the United States, 870,000 tons; France, 500,000; Italy, 200,000; Austria-Hungary, 200,000; Belgium, 164,000; Russia, 125,000; Japan, 50,000. There are also factories in other countries, as Spain and the Scandinavian states, but the production is much less.

* Condensation of Communication to the Fifth International Congress of Chemistry.

† A favorite location of the French chemists, used in distinction from "ammonia nitrogen," or nitrogen from organic sources.

METHODS OF COLLECTING ANTHROPOLOGICAL MATERIAL.*

By HARLAN I. SMITH, American Museum of Natural History, New York.

THERE are at least three distinct methods of collecting anthropological material that have been followed by the museums of this country. They aim chiefly at two totally different results—first the increase, and second the diffusion of anthropological knowledge. Two of these methods may be defined as systematic efforts to produce these results.

The first method is a systematic attempt to secure material upon which to base original research that will result in the increase of knowledge. This may be called "research collecting."

The second method is an intelligent and aggressive attempt to provide specimens to systematically illustrate known anthropological facts or to diffuse existing knowledge. This may be called "synoptic collecting."

The third method is simply the amassing of a collection of objects which may be found casually, or which may be presented for preservation by persons not a party to any systematic effort or plan of the museum. This may be called "the preservation method."

Research collecting can be best carried on by the larger museums unless limited, for instance, to provincial areas; and the best results are attained by intrusting the work to individuals who will devote a considerable time to it, and not only amass material for research, but master the existing knowledge of the subject and carry on the original investigations, so that they become authorities on the areas and subjects attacked.

Secrecy regarding the fields, applied locally and toward populations having vandalistic tendencies, may be advisable; but for economical reasons it is best to inform the entire profession of the areas and subjects being or about to be investigated. In this way unnecessary duplication of work, such as might happen if secrecy were employed, is avoided, and the energy of co-laborers is reserved for some of the many other problems of original research awaiting attention. Such publicity, within the profession, should never cause loss to science, or raise the fear that sister educational institutions or honorable brother investigators will usurp the fields and subjects already being properly worked.

Parties who follow the research method may usually be made up advantageously of people native to the fields of research, and who know the country, its climate, customs, roads, etc. The scientific head may, of course, be an exception to this general rule, as also may be a photographer, castmaker, or other special worker, in cases where the leader is unable to perform such duties.

The leader of such a collecting party should have charge of the unpacking, cataloguing, publication of the results of the research, arrangement of the specimens for exhibition as evidences of the newly-discovered facts and labeling of the research collections. The arrangement and labeling may often be facilitated by following the order and legends of the publication, or at least such reports should be referred to.

Research-collecting parties naturally must secure many specimens of each kind, and in some cases as many specimens as can be found. This is necessary to eliminate the element of chance or luck in finding evidences, and also to enable the student to determine the average type as well as to note exceptional objects, and for the study of variation. In the case of osteological specimens, this feature is of especial importance.

The publications, and specimens arranged with labels, which latter are needed as evidences of the increment of knowledge, constitute a synoptic collection illustrating known facts. After such a collection is completed for the institution financing it, the great mass of duplicate specimens may serve as a store from which to draw to supply sister educational institutions with synoptic collections for the diffusion of existing knowledge.

Synoptic collecting may be carried on by any museum, and may be either limited to provincial areas and few subjects by small institutions, or unrestricted by large ones. It naturally appeals to a greater number of people than the research method, as it serves to illustrate by actual objects the things shown by pictures in text-books and other general publications. The best results are attained by enlisting the services of research collectors, who, being authorities, can select the best available specimens and avoid the expenditure of funds on other than typical material. If the illustrative specimens can be secured from among the duplicates of a research museum, the expenses of a trip to the field may be saved, thus a considerable sum can be reserved which may be used for securing a more extensive series, or a synoptic collection of some other subject. From the synopsis of the original research collection the method of arrangement may be copied, thus saving the useless labor of working it out again; and labels may be quoted, or possibly even secured, from the duplicates kept for replenishing soiled labels in the research collection.

In case any specimens can not be obtained by this method the services of dealers may be enlisted; but if many specimens are required, a field trip will usually be more economical, especially if an experienced research collector can be secured to do the work on an economical side trip or even on a main trip. In nearly every case the labeling, which should be insisted upon, will give greater satisfaction if done by the research collector. Such a collector will often be glad to make a synoptic collection while on a research trip, so as to divide the financial burden of the expedition. Intelligent persons native to a region, from which specimens are sought, may often be engaged to secure them at a reasonable expense, especially if they may do the work supplementary to their regular vocation.

The third method may diffuse or even increase anthropological knowledge or it may do both; but, it may be dismissed by the mere statement that, not being a systematic attack to produce such a result, it proves of any value only by accident. Its only commendable feature is, that occasionally it may be a means of preserving valuable objects that otherwise might be lost to the world.

It is evident, that for economy, efficiency, and accuracy in diffusing knowledge, the synoptic method of collecting should be replaced as far as possible by a method of exchange between institutions desiring synoptic collections and those making research collections. In many cases research museums can well afford to present synoptic collections, made up from the duplicates of their research collections, to the smaller museums, which are widely distributed, and thus able to widely diffuse knowledge gained by the research museum.

The research method of collecting is certainly of the highest type, as it not only advances knowledge, but, with exchange, correspondence, and co-operation between museums, may furnish all the material results produced by the other methods.

* Presented at the Joint Meeting of the American Anthropological Association and Section H, Anthropology, of the American Association for the Advancement of Science.

IMPROVEMENT IN YARN MANUFACTURE.

AN invention has been recently made by an English manufacturer which relates to improvements in yarns such as are to be used in the manufacture of textile goods, the object being to construct a serviceable yarn from material which has hitherto been considered of little or no value, or to construct an exceptionally strong yarn at a very cheap rate. The invention consists of a yarn having a core or center thread around or upon which is the body or yarn proper. The core yarn may consist of one or more materials, such as cotton or worsted, or a combination of the two, and the body of cotton or other material, such as silk, wool, shoddy, mungo, flax, waste, or a combination of any of these. According to this invention, the core thread (consisting, say, of cotton) is covered entirely with any other desired fiber (say, of wool), so combining the strength of the core with the utility or appearance of the body. By combining the core and body as described, fibers, such as waste or mungo of such short staple as to be of practically no spinning value, may be utilized in the manufacture of textile goods possessing equal or greater strength and being similar in appearance to goods manufactured from high-class fiber. The core and body constituting the improved yarn are combined in the following manner:

The fiber forming the body of the yarn is removed from the swift, or carder, by means of a condenser doffer and card and iron strippers in the ordinary way, and the core thread is brought from any adjacent point to and between the card stripper and the iron stripper, from which point the two together pass between the rubbers and the body is rubbed around the core sufficiently to keep the two together when on the condenser bobbin, from which the yarn is spun in the ordinary manner.

Cryostase.—A curiosity of the physico-chemical domain is cryostase, a mixture of equal parts of phenol, saponin, camphor, and a little turpentine oil. This body possesses the astonishing property of liquefying in the cold and solidifying in the warm. True, albuminoids also have this peculiarity, but in distinction from these, the process can be repeated any number of times with cryostase. Solidified albumen cannot be liquefied again by means of cold.—Deutsche Medizin Zeitung.

A CHAT ABOUT SPOONS.*

THIS is an age when it is considered possible to trace the evolution of nearly everything. In this article I purpose showing not only the evolution of our modern spoon from the primitive shell spoon, as used by prehistoric man, but also the wide distribution of this common yet useful utensil of our everyday life. The objects selected for illustration are all in the Horniman Museum.

Prehistoric man most probably first used the half-closed palm of his hand as a means of conveying liquid foods to his mouth. This being very unsatisfactory, he no doubt soon found that a clam or scallop shell, used either without or with a handle, was a vast improvement. Such spoons are used even to-day by primitive people in some of the South Pacific Islands, as will be seen in Fig. 1, which shows spoons (*a*) made from a pearl oyster shell, (*b*) a shell spoon made from one of the Turbo family from the Solomon Islands, and similar examples come from the New Hebrides, and are used also in neighboring islands; spoons made from the Nautilus shell come from the Maldive Islands; *c* is a spoon made of a scallop shell bound to a piece of bamboo; *d* is a primitive spoon made from a gourd. These are used in various parts of the world. The specimen illustrated came from Mandingoland, on the west coast of Africa.

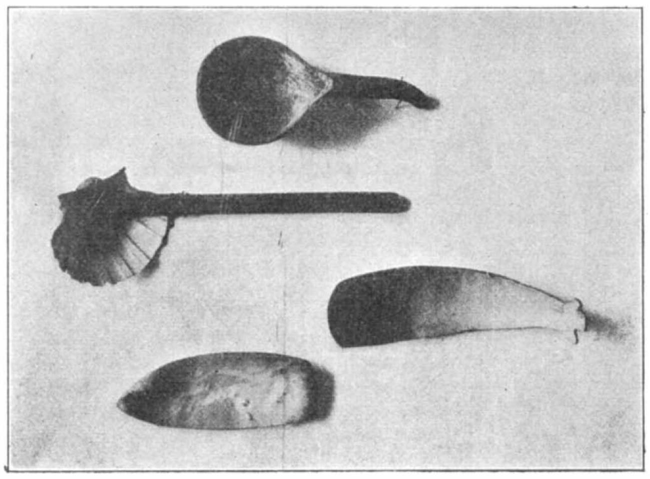


FIG. 1.—PRIMITIVE SPOONS.

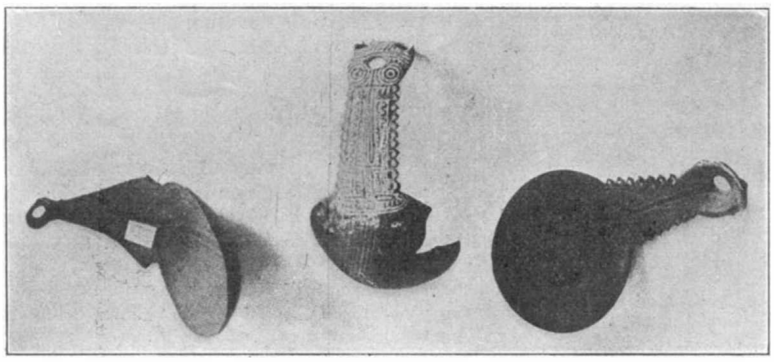


FIG. 2.—COCONUT SPOONS FROM NEW GUINEA.

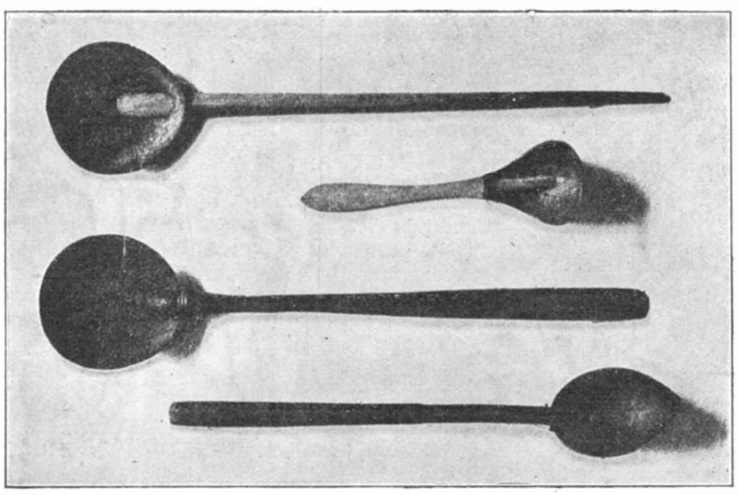


FIG. 3.—COCONUT SPOONS WITH WOODEN HANDLES.

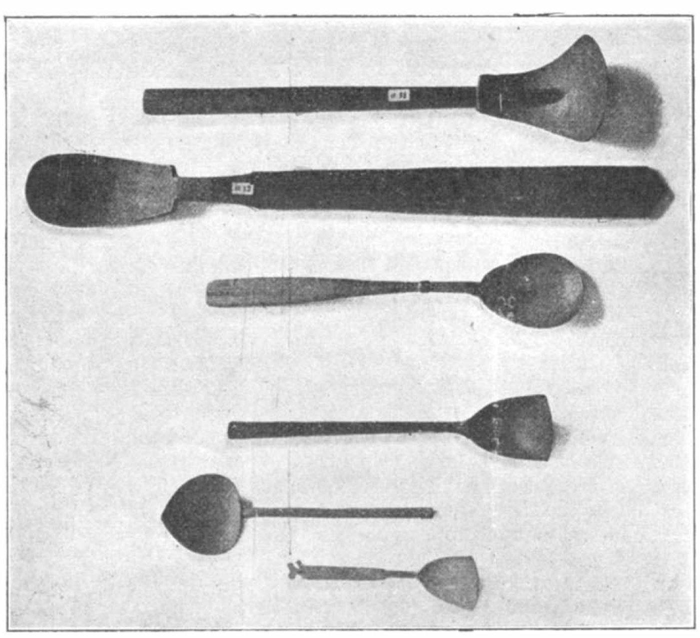


FIG. 4.—SPOONS FROM BORNEO AND MADAGASCAR.

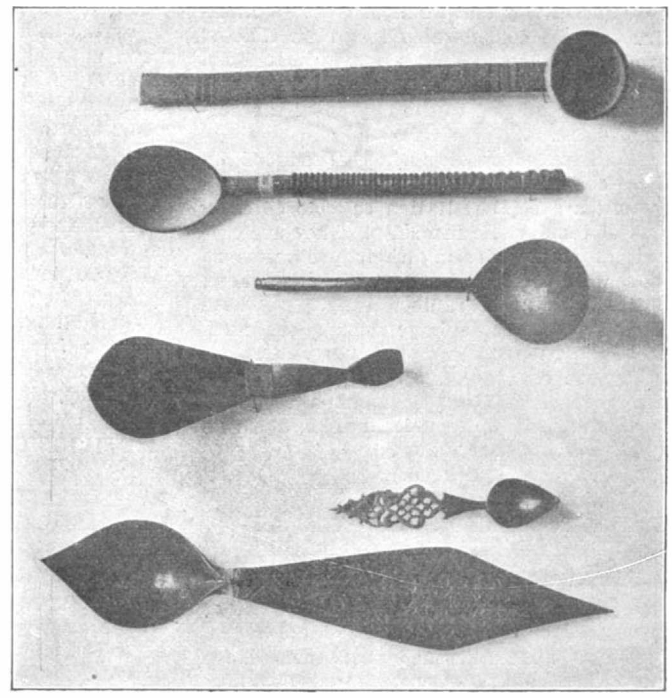


FIG. 5.—SPOONS FROM AFRICA AND PERSIA.

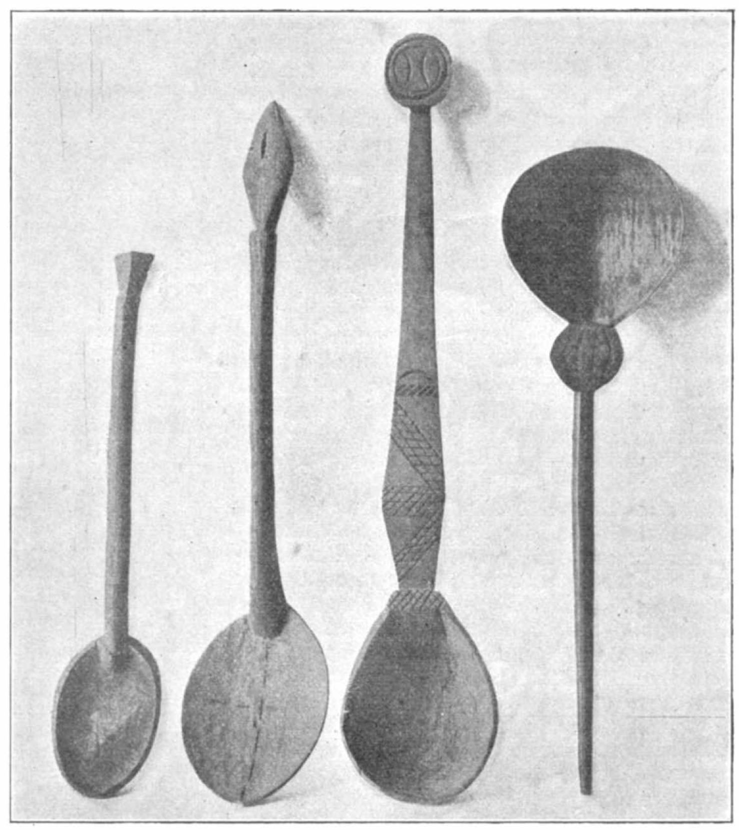


FIG. 6.—KAFFIR PORRIDGE SPOONS.

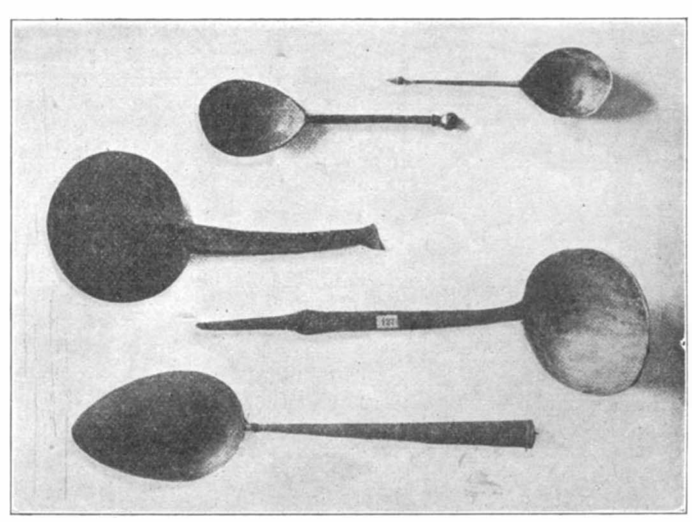


FIG. 7.—METAL SPOONS.

Many primitive people make their spoons from the coconut. A piece of the shell is cut from the nut, as in the case of those from New Guinea (see Fig. 2). These spoons are used for eating sago, and are without a separate handle. The Papuans, however, are not content with the plain spoon, but carve and perforate the handle with elaborate designs, the cut-out part round the pattern being filled in with lime.

Dr. Haddon, in his "Decorative Art of British New Guinea" (p. 132), says: "The upper part of the handle is intended to represent a face, and the rest of the design is very characteristic." The late Rev. J. Chalmers says of a man whom he saw carving one of these spoons: "His only tools being a small shell and a piece of flint brought from the East;" and in another place, where he saw one being made: "The only instrument was a piece of fish-skin, attached to a stick, and which served as the file."

Then, again, we have the coconut spoon improved upon by adding a longer handle of wood, as will be seen by referring to the next two groups of illustrations.

Let us next take those which I have selected for illustration in Fig. 3. The uppermost one came from Ceylon, and is of a common type in that country, though some of them are carved and perforated. The second is from the Maldive Islands. Both have the handle attached in the same manner—by letting the

* The Reliquary and Illustrated Archæologist.

wood handle through a hole in the coconut bowl of the spoon. The lower two specimens came from the South Pacific Islands (I do not know the exact locality), and they are lashed to their handles by fine plaited cane. The longest is 1 foot 2 inches in total length.

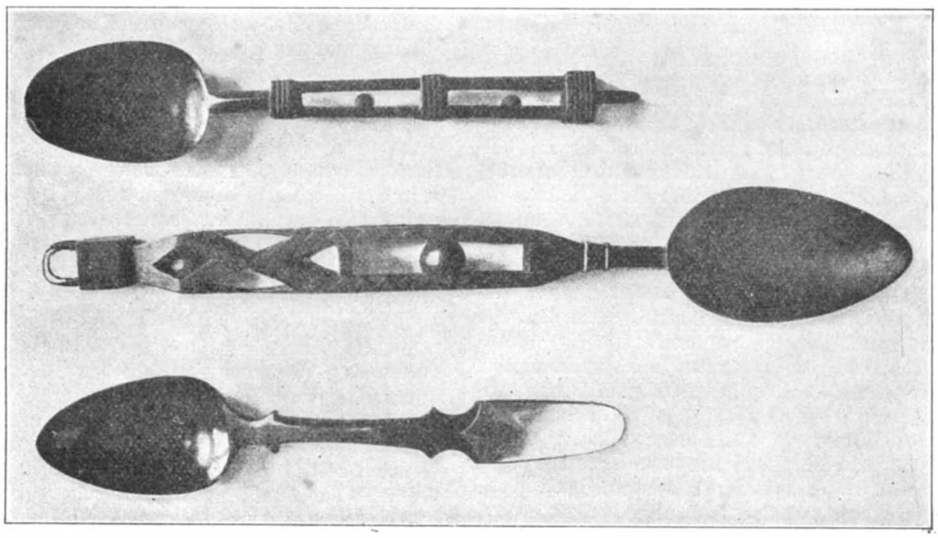


FIG. 8.—OLD ENGLISH WOOD AND HORN SPOONS.

In Fig. 4 (0.11) the top spoon is from North Borneo, with handle fastened in the same manner as the last two in Fig. 3. The next (0.12) is from the same district, and is made entirely of wood, somewhat resembling its coconut prototype, and is curved in the same manner; the length of this one is 1 foot 6 inches. The next is also from Borneo; the handle is more shapely in its formation, and is fastened to the coconut bowl (which is slightly curved) by pins or nails. In this illustration I have included another type of spoon from the same island. It has a flat front edge like a shovel; is made of dark hard wood, and is carved where the handle joins the bowl. The last two in this group are from Madagascar, one very similar in shape—a sort of flat scoop—the other more like a Cornish spade, heart-shaped, with a straight handle. These are made of a light colored wood.

Now, if we turn to Africa proper, we find the natives making their spoons like their smoking pipes—large and bountiful of wood, bone, horn, and hide in various forms in different localities. The Kaffirs, Zulus, and Basutos make their spoons very large (as will be seen in Fig. 6), many being from 1 foot 8 inches to 2 feet 6 inches long, and 5 inches in the longer diameter of the bowl; they are used for serving and drinking beer and porridge.

Those from Lake Tanganyika are small and round in the bowl. The top one in Fig. 5 is from this locality, and is not unlike some of the old English punch ladles. The second one is from East Africa, its handle also being carved; the black marks on it are caused by pressure with a hot iron. It is used for eating porridge.

The Zulu spoons have a characteristic bend, or, rather, angle in the handle, and are generally carved or ornamented with a kind of "poker work" (see Fig. 5, *d*); they are very deep in the bowl, resembling the Persian sherbet spoon, which I have placed next to it for the sake of comparison. Some of the spoon handles of the latter country are beautifully carved and perforated with open-work, as will be seen in the illustration, and are very often embellished with color, as in the large specimen shown, which measures 16 inches long. Here we have an evolution, I think, from the shell scoop spoon.

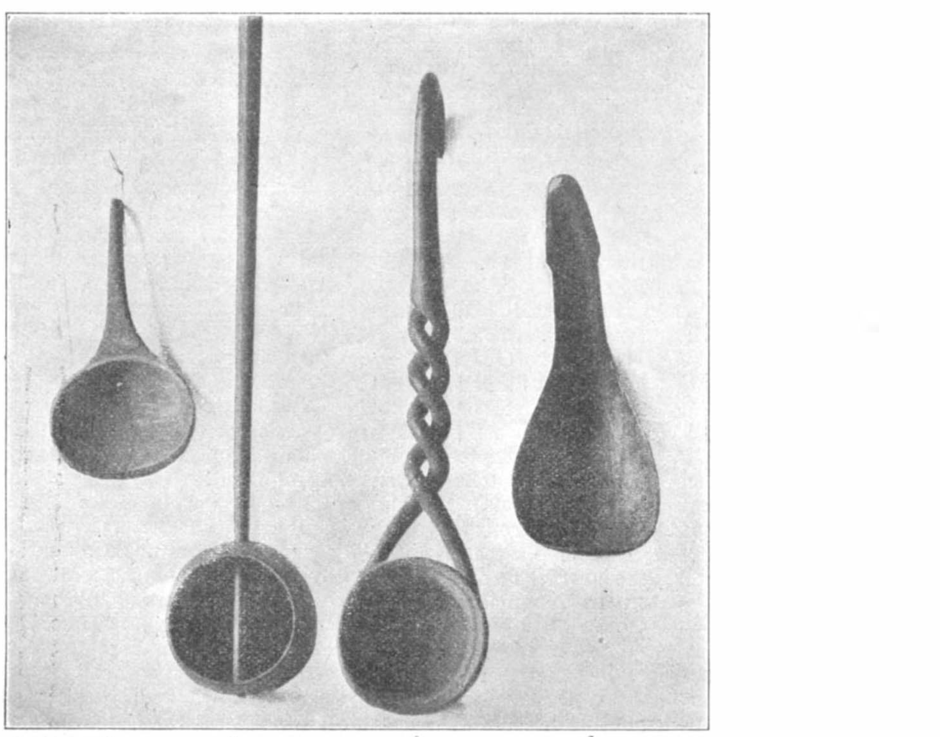


FIG. 9.—LADLES FROM VARIOUS PARTS.

In Fig. 5, *c*, I have placed one of the characteristic Zulu bullock horn spoons.

In the next illustration (Fig. 6) are shown four of the large wooden spoons of the Kaffirs. The bowls of the first two spoons, for example, instead of being almost in the same line with the stem, are bent forward at a slight angle, and in place of being rather deep are quite shallow. They are almost incapable of containing liquids, and are adapted only for conveying to the mouth thick porridge, of which the Kaffirs are so fond. The Rev. J. G. Wood, in his "History of Man," says: "The Kaffir takes a wonderful pride in his spoon, and expends more trouble upon it than upon any other article which he possesses. Although there is a great variety of patterns among the spoons manufactured by the Kaffir tribes, there is a character about them which is quite unmistakable, and which (to the student) points out the country of the maker as clearly as if the latter's name were written on it."

In Fig. 7 I have grouped a number of metal spoons. *a* is a silver spoon which was dug up in Kent, with the acorn knob to the handle, which is characteristic of the fifteenth century; it is 5½ inches long, and next to it (*b*) a lead one unearthed in London, and of a type commonly used in the sixteenth and seventeenth centuries. *c* is a brass spoon from Western China, round and flat—a sort of copy of the coconut type, as will be seen if compared with those in Fig. 3. *d* is somewhat similar in form and material, and is from Burma. The handle is slightly ornamented by punch-marks; (*e*) while the last is a bronze oval spoon with round handle, which Mr. Horniman obtained in Mandalay. It shows a decided improvement in design, and is certainly quite elegant and European in form; in fact, quite the type of spoon shown in my next illustration.

Fig. 8 contains a group of old English spoons. Two are carved wooden spoons; their handles are pierced right through the thickness of the wood, and in each handle are two small round balls which slide in a slot, the whole being cut out of the solid—as an exhibition, no doubt, of the carver's skill. This peculiar feature occurs frequently in wooden spoons of the early part of the nineteenth century. The center specimen shown measures 1 foot 2½ inches. Both have a loop carved at the end of the handle for suspension. For further illustration of this kind of spoon, I would refer the reader to The Reliquary for July, 1903, p. 165.

The lowermost example is an old horn medical spoon, with a silver plate on the handle for placing on the tongue, the bright silver acting as a mirror and reflecting the light on to the roof or back of the mouth. (Nowadays the modern doctor uses the electric light for such purpose.)

In the Museum collection there are several lead spoons, found while digging at Austin Friars in 1892, and are of about the sixteenth century. Numbers of such spoons have been found in different parts of London, and many good specimens of them will be seen in the Guildhall Museum.

Another form of spoon, or, rather, more correctly speaking, ladle, is deep and cup-like in form. The coconut type is used by many primitive people, just as we have seen in making a spoon, and we also get from them a true ladle. See Fig. 9. (*a*) This is made from a coconut furnished with a redwood handle, and is from Africa. Next to it (*b*) is one entirely of wood; the bowl is round, coconut like, and deep, with a carved twisted handle, and curved at the end, forming a hook by which to hang it up. This came from South Africa (but I do not know from which tribe), and measures 1 foot 6½ inches long. *c* is a ladle of wood, a common type throughout China and is used for serving out rice. *d* is a ladle made from the horn of the musk ox, and is characteristic of the northwest coast of America; this specimen came from Queen Charlotte Islands. The end of the handle is carved with a conventional head of a bear and a human figure; it is 11 inches long. The Indians often make them much larger; in fact, we have a specimen which measures 1 foot 6½ inches, the full size of the horn.

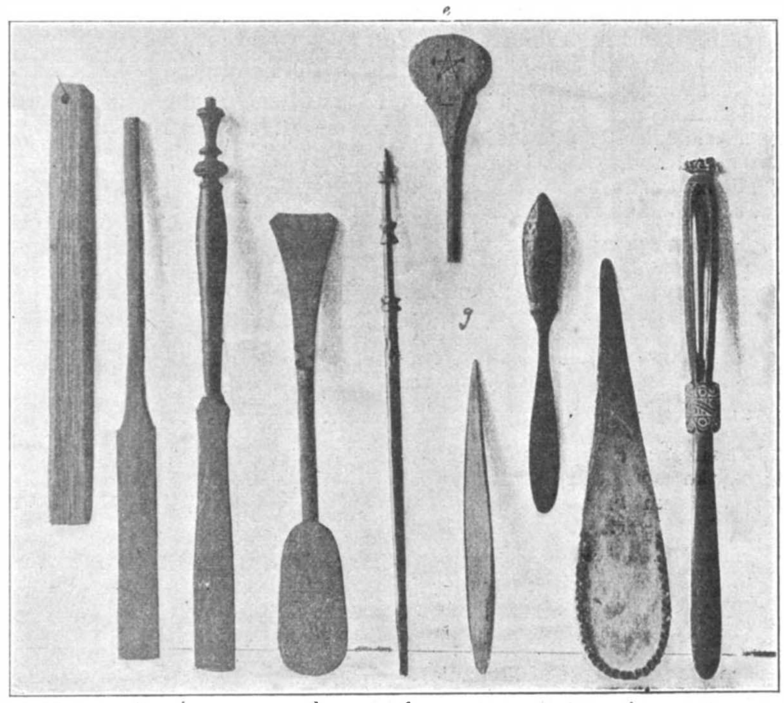


FIG. 10.—WOODEN SPATULÆ.

Ladles are made by the natives of the Maldive Islands by bending and binding round a palm leaf, so as to form a scoop. Small brass spoons are used by the Hindus in their religious ritual.

We now come to another type of spoon or spatula, used principally for stirring and mixing while cooking, etc., though some of them for conveyance to the mouth. In Fig. 10 will be seen a number of these articles. *a* is a common bamboo spatula used in Western China for mixing opium and in serving it out for sale. *b* is a wooden specimen used by the Kachins of Burma, for mixing and stirring rice; similar oar-like implements are used by the natives of the Maldive Islands. *c* is a wood spatula, with carved handle and oar-like blade, and is from the Straits Settlements of the Malay Peninsula, and shows a decided improvement on the first two examples. *d* is of wood, flat, but has rather more of the spoon form, with two notches in the handle; it is from Upper Burma and measures 1 foot 1½ inches. *e* is a curious light wood spatula from the Maldive Islands, and is used for stirring and making (sweetmeats) toddy. *f* is a long thin wooden spatula from New Guinea, and is used in conveying lime to the mouth from gourds when chewing the betel (areca)

nut; the lime is kept in gourds. *g* is a similar specimen made of turtle shell, and *i* is made of the bone of a whale, and is decorated with small shell disks. *h* and *j* are characteristic types of dark wood spatulæ elegantly carved; these domestic implements are characteristic of the southeast of New Guinea. Dr. Haddon says of them in his work mentioned before, p. 202: "These are usually made of ebony, and are cleverly and variously carved; and as a rule the design is picked out by the intaglio portions being filled up with lime, the contrast of the white and black being very pleasing." (For further particulars on these spatulæ I would refer the reader to Dr. Haddon's book, pp. 204-212.)

These spatulæ are often called "chunam spoons" ("chunam" is an Anglo-Tamil word for quicklime). These lime spoons are also made of the leg-bone of the cassowary.

We now come to snuff spoons. These are made by the Kaffirs and Zulus, and are of horn, bone, brass, etc. They are used for taking out the snuff from the snuff gourds, and are often carried behind the ear, or in the hair (as the opposite end of the spoon is generally cut with teeth like a comb), or in the belt. The Chinese use small silver snuff spoons, which are attached to the stopper of the crystal or jade snuff bottle employed.

In Russia some spoons are made of a peculiar kind of cloisonné enamel, the effect of which is very beautiful.

The first Biblical reference to spoons is to be found in Exodus, chapter xxv., verse 29, where Moses is commanded to have the dishes, bowls, and spoons for the Tabernacle made of pure gold; and again in the First Book of Kings, chapter vii., verse 50, spoons are spoken of in connection with the utensils for Solomon's Temple.

There are specimens of ancient Egyptian, Greek, and Roman spoons in the British Museum. The best are of gold and silver, while those in common use were generally made of bronze, iron, or wood; many show how the shell shape was still retained.

An elaborately worked gold spoon is still used at the coronations of our kings and queens. It is intended for the oil used in anointing the royal personage, and is kept with the rest of the crown regalia in the Tower of London. It is 9 inches long, the bowl being 2¼ inches by 1¾ inches.

Apostle spoons were made in sets at the beginning of the sixteenth century, and were generally used as christening presents. They were either surmounted by the patron saint of the donor, or the apostle from whom the child took its name, and in a set each spoon terminated with the head or entire figure of one of each of the twelve.

Many Americans collect silver spoons when traveling, which bear the arms of the particular city or town which they have visited. I am told by a friend, a jeweler in one of our cathedral cities, that he sells a great number to them as mementoes of their visit.

In conclusion, we may very well divide spoons generically under the following heads:

1. The clam shell—oval.
2. The coconut shell—round.
3. The gourd type—deep (the prototype of the ladle).
4. The bamboo type—flat (a sort of spatula).
5. The spoon proper—of various shapes.

RICHARD QUICK.

THE BUSINESS OPPORTUNITIES OF CUBA.*

By FREDERIC M. NOA.

THE writer, who spent the last two years as the official representative in Cuba for the American Unitarian Association, had frequent occasion, during extensive travels in that wonderfully endowed and fair island, to observe the remarkable natural resources and the commercial opportunities only awaiting the magic touch of foreign capital and enterprise. A reference to the United States military census of 1899 and to other recognized authorities has tended to confirm his impressions and observations.

A brief review of Cuba's geography and position seems indispensable, as few Americans realize that it contains an area of 48,000 square miles, or that it is equal in size to Pennsylvania. Its extreme length is 760 miles, and its greatest width 125. A backbone of hills and mountains extends from west to east, culminating in the lofty mountain ranges of the eastern province of Santiago de Cuba, the highest peak of which, the Pico Turquino, rises to a height of 8,500 feet above the level of the Caribbean Sea.

In addition to the natural fertility of its soil, Cuba is most favorably situated as regards climate. It lies just within the northern tropics, Havana being cut by the tropic of Cancer, or lying in north latitude 23½ deg. The trade winds affect every part of the island, while the fact that Havana is separated from Key West by only eighty-six miles of the warm waters of the Gulf Stream, tempers the climate with cooling northern breezes from Florida.

Cuba, at the present moment, offers exceptional advantages to the wide-awake American capitalist. Her natural market is the United States, and the new reciprocity treaty will give a great impetus to her trade with America. Moreover, Sir William Van Horne's new trunk railway system assures, for the first time in four hundred years, rapid transportation from one end of the island to the other. One may now travel by railway, leaving Havana in the morning, and reach Santiago, on the south coast, in twenty-five hours, or a day and night. Pullman and parlor cars are run over this system, which is being constantly perfected by the construction of branch lines to all important cities and towns. Besides these advantages, there is added the indispensable one of a strong stable government under the able direction of President Estrada Palma, whose long exile of eighteen years in the United States has imbued him thoroughly with the love of American principles of constitutional order and liberty.

Although Cuba has unrivaled natural advantages as a cane-sugar and a tobacco-raising country, and these are by far her two most important industries, she has other great natural resources, which, when once developed, will eventually convert her into a leading manufacturing, agricultural, and commercial country. It is estimated that she has thirteen million acres of virgin forests, largely of valuable hardwoods—some of them so hard that, it is said, they will withstand the action of water for over one hundred years. In the eastern province of Santiago there are lofty mountains, some of whose slopes appear to be nothing but solid masses of iron. According to the military census of 1899, the ore consists principally of hematite, with a certain quantity of limonite. It is easily worked, and of excellent quality, equal to the best Swedish, since it contains 62 per cent of pure iron. In the southern portion of Santiago province, at Cobre, there has been discovered a very rich deposit of copper. As, geologically speaking, Cuba has never been scientifically surveyed, and its soil is still scarcely scratched, it is highly probable that it contains many hidden sources of great mineral wealth. Among the minerals already discovered, asphalt is by no means insignificant, a sufficient quantity, for many years, having been extracted from the neighborhood of Santa Clara (an inland city of 28,500 inhabitants) to serve for the manufacture of gas for municipal lighting. In the Isle of Pines, off the southern coast of Havana province, there are fine quarries of marble and jasper.

In cotton, Cuba offers a very promising field for development, especially along the south coast, where wild cotton of good quality grows abundantly to the height of four or five feet. Mr. George Reno, writing to that progressive American newspaper, the Havana Post, states that successful experiments have proven Cuba to be admirably adapted for the cultivation of Sea Island cotton. American farmers have already demonstrated, within the past year, that "Sea Island cotton will yield from one to two 500-pound bales of lint per acre, bringing from 20 to 26 cents per pound in Savannah, Georgia. This means a profit from one to two hundred dollars per acre in six months' time from planting."

No oranges in the world are finer or sweeter than those of Cuba, which, in that country, sell almost for a song. Exempt as the island is from the occasional frosts of Florida, they can be easily and successfully grown. When three or four year budded trees are set out, the groves will yield a profitable return in the third year, "and at from five to ten years will produce $500 worth of fruit to the acre. Orange groves at maturity in Cuba are valued at $5,000 per acre, or at three times the price of Florida groves." While waiting for the groves to bear, pineapples (of exceptional quality and sweetness), cotton, tobacco, or vegetables may be grown to advantage between the rows.

Vegetables of all kinds thrive in Cuba, and garden-truck farming in the vicinity of Havana and the principal Cuban cities is quite a profitable industry. The Cuban potato, when placed in competition with the Bermuda, will bring quite as high a price in the New York market. If smaller, it is very mealy and remarkably firm, suffering scarcely any deterioration, even when kept for a year.

It is hard to know where to stop when describing the natural advantages and resources of the Pearl of the Antilles. In the eastern and southern portions there are vast forests of cocoanut palms, almost sufficient to supply the needs of the world. Among fifty varieties of hard woods, susceptible of high finish, there is one species, majague, destined to command a higher price than mahogany as soon as known to the markets of the outside world.

No land is more favored than Cuba with deep and well-protected harbors, accessible to all the great arteries of international traffic. Havana, with 250,000 inhabitants, is a progressive commercial and manufacturing metropolis, and justly called, from its geographical position, the "Key to the Gulf of Mexico." Cienfuegos (30,000 souls), sometimes called the "Pearl of the South," is already an important commercial emporium, and will attain a commanding position when the Panama Canal shall have been completed and opened, as it has a splendid and sheltered harbor on the Caribbean Sea. Santiago (45,000 souls) with its background of lofty mountains rich in iron and other minerals, is destined in time to become a second Pittsburg. The Bay of Nipe, on the north coast, is one of the finest in the world, and, with a branch line connecting it with the Cuban Central Railway, it will become an important outlet for the exportation of cattle, horses, and live stock from the unexcelled grazing grounds of the center and east of Cuba.

Rendered fertile by the copious rains of summer; never unbearable even in the warmest season of the year, with an unrivaled balmy winter climate from December until May, and remarkably free from poisonous reptiles and pests, Cuba is fast becoming more and more popular as a residence for Americans, whether engaged in business or as tourists. In winter, to the invalid, it offers peculiar attractions, as its beautiful scenery and wondrous caves are extremely enchanting, while, at almost every turn, there can be found natural baths and waters of the highest medicinal value.

The future of Cuba is brilliant and assured, as she is well started on the difficult path of orderly and constitutional government. Her population is of excellent material, the great majority being of the best white stock of France and Spain, the French element having emigrated to Cuba from the neighboring island of Hayti, at the time of the slave insurrections early in the last century. The black population, constituting only one-fifth of the million and a half inhabitants, if generally ignorant, is industrious and possesses a native refinement. Cuba is fortunately free from the taint of Indian blood, so that, unlike some of the other Latin-American republics, she is strongly opposed to revolutions, and inclines toward industry, education, enlightenment, and the development of her best faculties.

* Specially prepared for the SCIENTIFIC AMERICAN SUPPLEMENT.

ELECTROLYTIC REFINING OF LEAD.

MR. ANSON G. BETTS contributes a long illustrated article in the current number of Electrochemical Industry, in which he gives full details concerning his lead-refining process, which is among the most interesting recent achievements in electrometallurgy. The solution of the problem found by Mr. Betts is probably the first one enabling the electrolytic process to enter into successful commercial competition with the older metallurgical methods, and the fact that the electrolytic process furnishes lead completely free of bismuth appears to be the main argument in favor of its success. An incidental advantage, which, however, is equally important, is the diminution of the danger of lead-poisoning to which the workmen are exposed. The novel feature of the process is the electrolyte, which is a solution of lead-fluosilicate, containing an excess of fluosilicic acid. It is easily prepared from inexpensive materials; it may be made to contain a considerable amount of dissolved lead; it conducts the current well, is easily handled and stored, and is non-volatile and stable under electrolysis. Mr. Betts states that the electrolyte takes up no impurities, except possibly a small part of iron or zinc. On the basis of a content of 0.01 per cent of zinc and soluble iron in the anodes, and on the basis of 150 cubic feet of solution required for every ton of lead turned out per day by the refinery, Mr. Betts estimates that in one year the 150 cubic feet will have taken up 93 pounds of iron and zinc, or about 1 per cent. These impurities can accumulate to a much greater extent than this before they become objectionable. Mr. Betts also points out that the electrolyte may be easily purified in several ways. An interesting detail of importance is the simple method by which a dense, coherent, and solid cathodic deposit of lead is obtained. The lead "trees" produced under ordinary conditions are well known. When the Betts process was first operated with the pure fluosilicate solution containing an excess of fluosilicic acid the lead grew from the cathode toward the anode, and in order to avoid short-circuits it became necessary to periodically remove the cathode and roll down the lead. This difficulty was overcome by the addition of some gelatine or glue in small quantities to the electrolyte. With this addition to the solution a dense deposit of lead is obtained, its density being greater than can be produced by rolling the crystalline deposit unless great pressure is used. Commenting editorially on the Betts method, our contemporary expresses the hope that the success thus obtained in the electrolysis of lead, generally accepted as impracticable, may give some encouragement to the employment of similar methods in the treatment of some other metals. This hope appears justified, especially in view of the fact that in the Betts process it has been found to be possible to obviate the chief difficulty—spongy deposits—by inexpensive means.

THE FIRST ELECTRIC TRUNK RAILROAD IN GREAT BRITAIN.

By the English Correspondent of the SCIENTIFIC AMERICAN.

THE first run under actual working conditions of an electric train upon a trunk railroad in Great Britain was recently made upon the Lancashire & Yorkshire Railroad. It was a curious trip, strongly emphasizing the rapid advance in transit and the possibilities of future electric traction, for both the electric and steam systems of propulsion were in simultaneous operation upon the same track, and without interfering one with the other.

The section of this trunk railroad to be converted to electricity is that between Liverpool and Southport, which is a popular residential quarter for business men. Under steam conditions there are thirty-six trains per day in either direction running, making an aggregate mileage of 1,900. The time occupied in the journey is 25 minutes by express train, and 54 minutes by trains stopping at all intermediate stations. By electric traction it will be possible to accelerate the speed of the stopping trains to 37 minutes, a saving of 17 minutes upon the old system, owing to higher speed attainable between stations and less time occupied in slowing down and stopping, as well as restarting and attaining maximum speed again. Furthermore, owing to the more economical facilities of electricity, the number of trains will be increased to 65 in each direction, representing a total daily mileage of 3,200 without increased cost. The express trains will take 25 minutes as before for the journey.

On the first trip the journey of 18 miles was accomplished in 27 minutes, and would have been shorter had not the train been stopped by adverse signals.

The train comprised four coaches, a total weight of 140 tons, and a length over all of 248 feet 6 inches. The bogie cars are 10 feet wide, and they have straight sides. They form a continuous train, with a central gangway, and sliding doors are at either end of each car. Immediately inside, the seats are placed longitudinally, to facilitate ingress from the vestibules, but otherwise the cars are fitted with cross seats, having reversible backs. The first-class cars seat two passengers on each side of the passage, a total of sixty-six per car; and the third-class have three seats on one side and two on the other, or sixty-nine passengers. A normal train can therefore carry 270 persons. The first-class coaches are trailers, and the two thirds are equipped with two motor bogies, one at each end of the train. There are in all eight motors of 150 horse-power, so that each train is given 1,200 horse-power. The maximum speed attained on the run was 57½ miles per hour.

The total cost of the electrification of the track and the installation of the necessary power and trains was $1,700,000. Forty-seven miles of single track have been converted. The third-rail system has been adopted. The live rail is placed with its center 3 feet 11½ inches from the center line of the track and projecting 3 inches above the surface of the track rails. A fourth and insulated rail is also laid down outside the running track. Although this fourth rail is not essential, it has been laid down as a precautionary measure, so that the current may complete its circuit without interfering with telephone or signal wires. The motors receive the positive current from the live rail by collecting shoes.

The central generating station is situated at Formby. The three-phase alternating current is adopted. The plant consists of four engines of the horizontal cross-compound type, and a vertical cross-compound, developing an aggregate of 12,000 horse-power. They are designed for a steam pressure of 160 pounds per square inch, with an overload of 20 per cent. The current is generated at a pressure of 7,500 volts, but the working potential is only 600 volts, and is transformed by the rotaries from an alternating to a direct current. There are four sub-stations, to which the current is transmitted through high-tension cables.

ON THE MAGNETO-ELASTIC DETECTOR.

THE magnetic detector designed by Marconi, as is well known, was of great importance for the success of his experiments. The effect of electric waves on the hysteresis of iron was utilized for revealing, with an extraordinary sensitiveness, the presence of electric oscillations.

Now magnetic cyclic processes are quite analogous in their behavior to elastic cyclic processes, which may consist either of torsions or of tensions. Prof. A. Sella, as pointed out by C. Carpini in L'Elettricista, recently ascertained whether electric waves would also have an influence on elastic cyclic processes, as undergone by a wire. For this purpose, he used a bundle of annealed, varnished iron wires 1-3 millimeter in diameter, soldered to one another at both ends and placed vertically inside of a coil comprising two independent circuits. The ends of one of the circuits were connected to a small antenna and to the ground respectively, while the other circuit was in connection with a telephone. The tensional weight of the bundle of wires was provided with a horizontal index, moving on a graduated circle, so as to allow of the angle of torsion of the wire being readily determined. The apparatus used for generating electric waves was installed in a distant room, and consisted of a small sized Tesla transformer, the primary of which was fed from an induction coil having a Leyden jar placed in shunt. The terminals of the secondary winding of the coil were connected to a small antenna and to the earth respectively.

When the wire bundle was exposed to a torsion and the Tesla transformer set working, the characteristic noise, as produced in the telephone of the magnetic detector, was perfectly audible.

In order to investigate the phenomenon quantitatively, Sella used, instead of a telephone, an astatic needle magnetometer, the lower needle of which was placed opposite the upper end of the bundle. The deflections of the needle, as read by means of the telescope and scale, allowed of the magnetic moment of the bundle being readily altered.

Measurements were made as follows: After the wire had been exposed to a cyclic process by means of repeated torsions (between +180 deg. and —180 deg.), while the magnetometer circuit was being closed and re-opened, the bundle was turned a given angle, when a magnetometer reading was made. Immediately afterward the electric waves were allowed to work, and a second reading was taken. The bundle was next submitted to another cyclic process and the two readings repeated with another angle, and so on, until a fairly considerable series of angles between +180 deg. and —180 deg. had been gone through. It is interesting to note that the effect thus produced by the waves in the single portions of the cyclic process is independent of any previous alteration.

The effect of electric waves is shown to consist of the magnetization of the bundle being diminished. The sensitiveness, as in the case of the magnetic detector, seems to be the greater in the steeper portions of the cycle. Quite similar effects are ascertained if the wire bundle is submitted to a cyclic process through the action of tensile forces.

As shown by Prof. Angelo Banti, in a paper published in the Proceedings of the Lincei, nickel will also undergo modifications in its magnetic state, under the action of a torsion as well as of a tension; and the same effects as were observed in the case of iron, were accordingly produced by electric waves in a nickel wire.

The waves need not pass through the coil surrounding the bundle. The latter, in fact, may itself be traversed by the wave without the effects being altered in the least.

It would have been desirable to observe the phenomenon always in the manner above described. Its behavior, however, seems to be complicated. If the Tesla transformer operated by alternating currents be replaced by an electrostatic machine with condensers, and the spark be caused to jump between the inner armatures of the latter, while the outer armatures are connected to the antenna and to the earth respectively, a diminution in the magnetization is stated as long as the sparks are short. For longer and stronger sparks, however, either a diminution or an increase of magnetization is obtained when exchanging the earth with the antenna.

As, however, the direction of the phenomenon is of no importance, a similar modification could in any case be used for designing a detector, though the sensitiveness of such an instrument would not equal that of magnetic detectors.

CONTEMPORARY ELECTRICAL SCIENCE.*

INFLUENCE OF PRESSURE UPON RESISTANCE.—In 1899 S. Lussana announced that he had discovered an effect of pressure upon electrical resistance in the sense that the resistance of a metal diminishes with increasing pressure, but more and more slowly as the pressure increases. Also, that this diminution is not solely due to a squeezing together of the molecules, but also to a variation of the molecular velocity, and that the effect is greatest in pure metals as distinct from alloys. These results have since been confirmel by Lisell, who put the relation between the resistance at p atmospheres, and that at zero pressure into the formula:

$$x_p = x_0(1 + \gamma p + \delta p^2)$$

where the coefficient γ is always negative for pure metals and δ is positive. According to Lisell, γ would be —35.92 and δ 0.86 for silver. Lussana gives these figures as —31.2 and 0 respectively, whereas for lead he gives —197.4 and 47.6 respectively. The only point in which the two physicists seriously differ is that Lussana believes there is a permanent as well as a temporary effect. But such discrepancies may arise from the difficulty of accurately measuring the hydraulic pressure, and from the fact that γ diminishes with increasing temperature.—S. Lussana, Nuovo Cimento, May, 1903.

INFLUENCE OF ELECTRIC WAVES UPON A MERCURY JET.—A. Trowbridge and L. Amaduzzi have studied the effect produced by electric waves upon a jet of mercury falling into mercury through an electrolyte, the whole jet being immersed in the latter, and issuing from a capillary glass tube. They found that the waves produce a distinct effect, but that effect varies in an apparently arbitrary manner. Sometimes the jet is stopped, sometimes it flows more freely, and sometimes a spark is produced in the capillary tube capable of cracking it. The authors made a circuit by connecting the mercury jet with the mercury reservoir at the bottom of the electrolyte through an external circuit, in which they inserted a resistance, a capacity, an inductance and a telephone, together or separately. They directed the jet slantingly downward, so that its initial velocity could be judged by its curvature. The sound in the telephone altered considerably with the elements of the circuit, which represented, in fact, a Righi or Duddell oscillator reduced to its simplest form. The authors found that the effect depended upon the initial phase of the impinging wave, accelerating or retarding the jet accordingly as the impinging E. M. F. corresponded with that of the mercury-electrolyte couple or the reverse.—Trowbridge and Amaduzzi, Nuovo Cimento, May, 1903.

IONIZATION BY POINT DISCHARGES.—According to A. Righi, the process in the neighborhood of an electrified point discharging through air is this: Ions are shot out from the point in the direction of the electric lines of force. The tendency to proceed in a direction tangential to the lines of force is arrested by collisions with neutral molecules, and, on the whole, the ions practically trace out the lines of force. If a metallic plate of opposite charge is placed near the point, the lines of force, and, therefore, also the ions, converge upon the plate. But if the plate has perforations, a number of ions will escape into the zero field beyond. It is these escaped ions that the author has specially investigated. He substituted a brass net for the plate, and inclosed the point and the influence machine in a metallic box of which the brass net formed part. He proved the presence of escaped ions outside by means of an electrometer. He found that the current and the voltage so obtained had a maximum, not close to the net, but at some distance from it, amounting to 20 millimeters in the case of positive and 30 millimeters in the case of negative ions. The negative ions were the more numerous. He also obtained electric shadows of conductors by means of red lead and sulphur powder.—A. Righi, Nuovo Cimento, May, 1903.

THE CAUSE OF THE EARTH'S MAGNETISM.—W. Sutherland proposes a modification of his own theory of terrestrial magnetism. For the supposed cosmical separation of large charges of the electricities in the interior of the earth, he substitutes an inequality in the distribution of its atomic charges. Such an inequality must produce magnetism in any rotating body. Every ordinary molecule involves in its own existence that of at least one positive and one negative electron. The whole earth, then, contains two opposite enormous charges of electricity. These charges are so nearly equally distributed throughout the earth that they produce no external electrical effect; they help to hold the atoms together in chemical combination, and they cause the cohesion of the earth's material with the assistance of gravitation. If the two charges of electricity were distributed through the earth in absolute equality, their magnetic fields would exactly neutralize one another, and we should have no terrestrial magnetism. But the author shows that if the negative and the positive electricity in the earth are spread over concentric spheres whose radii differ by only the diameter of a single molecule, they can account for the earth's primary magnetic field. This separation of the two electricities would produce no external electric effect. It implies a minute tendency of each negative electron of a molecular doublet to turn further from the center of the earth than each positive electron does. Such a distribution is suggested by the greater attraction exerted by metals upon positive than upon negative electricity. On this theory, magnetism must be a property of all rotating bodies, though it is inappreciable unless the bodies are large enough. The effect of the sun's magnetic field on the earth is infinitesimal except in an indirect way. It remains to prove a general difference in the attraction of matter for the two kinds of electricity.—W. Sutherland, Terr. Magn., June, 1903.

IONIZATION BY POINT DISCHARGES.—A. Righi has studied a special case of point discharges in air, by means of which he produces electric "shadows." A charged point electrode is placed opposite a piece of brass wire gauze surrounded by a guard ring, and behind the wire gauze is placed an ebonite plate covered with tinfoil on the further side. A field having been established between the point and the tinfoil, the discharge is allowed to act for some time, after which the ebonite plate is removed and dusted with the well-known mixture of red lead and sulphur. With a negative charge of the point and a positive potential of about 800 volts at the tinfoil, a silhouette consisting of red squares is obtained in a few seconds, representing the meshes of the wire gauze through which the negative ions have penetrated. The best results are obtained if the tinfoil is charged by a spark from a Leyden jar. The dimensions of the shadow show an accurate motion of the ions along the electric lines of force. If a figure made of cardboard is introduced between the point and the wire gauze an enlarged silhouette of the object is obtained on the ebonite, owing to the divergence of the lines of force. Metallic powders may also be used for these experiments.—A. Righi, Phys. Zeitschr., September 15, 1903.

ELECTRIFICATION BY IONIZED GASES.—Five years ago John Zeleny showed that if a metal is surrounded by air partly ionized by means of X-rays, it assumes a negative charge, while the air itself becomes positive. Since then Villari has described a great variety of experiments, in which ionized air is blown past or through metallic wires, gauze, or tubes, and the charges on the metal vary in sign in an apparently arbitrary manner. Zeleny's experiments show that all the phenomena can be simply explained on the ground of the unequal size of the ions of opposite signs. Röntgenized air blown through tubes or rolls of metallic sheets, assumes a positive charge. The tube or roll acquires a positive or negative charge in accordance with the strength of the blast. The sign of the charges is reversed when moist carbonic acid is substituted for dry carbonic acid or for air, whether dry or moist. Villari's hypothesis that friction against the metal leads to a separation between the two classes of ions, one of which goes to the metal while the other remains in the gas, is inadequate to explain the whole of the phenomena. If Röntgenized air is blown through an ebonite tube having a static charge on its inner surface, that static charge is eventually carried by the ions to the nearest conductor of large capacity, even against the current of gas. There is no conversion of Röntgenized into ordinary air, as supposed by Villari.—J. Zeleny, Phys. Zeitsch., October 1, 1903.

ELECTRIC CONDUCTIVITY OF THE ATMOSPHERE.—The conductivity of the atmosphere contained in the hollow badly conducting shell comprised between the conducting earth and the conducting shell of the upper atmosphere is of great importance in meteorological work and in any efforts to utilize the store of electric energy contained in the atmosphere. H. Gerdien has devised a special method for rapidly determining the conductivity and the mobilities of the two classes of ions. For determining the mobility of, say, the positive ions, the number of positive ions per cubic centimeter must be determined by Ebert's method with two different voltages. Four observations have, therefore, to be taken to measure the number of ions and their velocities. From these observations four numbers are obtained from which the conductivity can be immediately calculated. The author used a tube 60 cm. long and 5 cm. wide, through which air was aspirated with a velocity of 410 cm. per second. Near the soil the velocity of the positive ions varied from 1.32 cm. to 1.4 cm. per second, and that of the negative ones from 1.52 cm. to 1.75 cm. per second. At a height of 7,000 feet the negative ions were found to have a velocity of 2.12 cm. per second.—H. Gerdien, Phys. Zeitschr., September 1, 1903.

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

AN AUTOMOBILE SLED.

SENATOR J. K. FLOOD, of Hart, Mich., has conceived the idea of mounting his automobile on runners, so that it can be used in winter time on snowy roads. As our illustration shows, the machine, when transformed for winter use, rests on two runners in front, whereby it is steered much in the same way as by the front wheels of an automobile. The rear runners are mounted on an axle attached closely to the under side of the body of the machine. The means of propelling the automobile are the two automobile wheels, carried on an axle below the runner axle. Springs are fastened to the runner axle at the top and at the wheel axle at the bottom. Such is the tension of these springs that the rear weight of the machine is carried on the wheels, so as to give them sufficient traction. The weight of the passengers compresses the springs so as to cause the runners to rest solidly on the snow. The springs take up any unevenness in the road. The rubber tires, partly inflated, adhere well both to snowy or icy roads. Fifty per cent of the power ordinarily required to drive the machine is used in propelling the automobile by its runners over snow. A brake acts on the rear wheel axle, just as it does on the automobile. Emergency brakes are provided for the rear runners.

AN AUTOMOBILE SLED.

ELECTRICITY VS. MULE POWER ON CANALS.*

By H. M. RISELEY.

IN view of the fact that the State of New York is about to expend over a hundred million dollars in enlarging the Erie Canal so as to permit the passage of 1,000-ton barges instead of the 250-ton boats now used, it is particularly timely and fortunate that an invention has recently been perfected which bids fair to successfully supersede the outgrown method of mule propulsion on canals by the more modern power of electricity.

In order to make these inland waterways efficiently helpful as arteries of commerce, and to make more active and up to date their competition with modern railways, it is unquestionably necessary that the slow and expensive mule method of propulsion should be abandoned; for in a few years it is more than likely that that method will be found to be as obsolete as the horse cars, of a short time ago, are in comparison with the electric street cars of to-day.

The electrical device in question is an invention of Mr. Stephen W. Wood, and consists of a motor, or "electric mule," closely resembling a "hogback" mine locomotive, and is 10 feet long by 2 feet wide and 30 inches high from the rail. It is ironclad to better protect it from the weather, but all the parts are accessible, as the mail can be quickly removed. In actual service the motors will be equipped with an electric headlight for night travel, and also with a cab for the protection of the motorman. At each end of the machine is a 40-horse-power street-car motor of narrow-gage type, and at the rear end is a mining locomotive or rheostatic controller, and a resistance box serving as a seat for the motorman.

For the tow ropes two large hooks project from each motor, and there is also a running board and guard handrail to enable the motorman to go around the machine without dismounting. Reaching up from the center of the top shell of the motor is a stout, short mine trolley pole, which can be pulled down so as to let another motor go by on the upper or lower track. A heavy arm extends downward from the body of the motor, and carries springs which pull upward two grooved wheels, so as to exert a gripping effect on the under rail. This tension spring can be loosened or tightened at will, and the arrangement serves to keep the track steady, besides affording additional adhesion.

The invention has been practically shown and demonstrated by the International Towing and Power Company, of New York, who are its promoters, on an experimental stretch of track situated opposite the factories of the General Electric Company, at Schenectady, N. Y. Several severe and successful tests were there made with four loaded canalboats on October 28 and November 6 last in the presence of Gov. Odell, State officials, members of the Canal Board, canal operators, engineers, electricians, and many others fully competent to judge of its practicability.

This experimental track is about 2,700 feet in length, with a sharp curve, and furnishes a good average section of the seven-foot prism. At intervals of 25 feet along the canal bank are erected short posts set in concrete, supporting an 18-inch continuous plate girder about 3 feet apart on each side of the post. The girder farthest away from the canal is raised above the inner one as in a tier of seats, so as to enable the motors to pass one another. The girders are cross-braced so as to stiffen the structure, and the edges of each on top and bottom are faced with a light 3-inch rail for a track. Over the two girder tracks extend a series of ordinary trolley brackets carried on poles set at the outer edge of the canal bank, and carrying one trolley wire so placed as to be readily accessible to a trolley pole reaching up from either track.

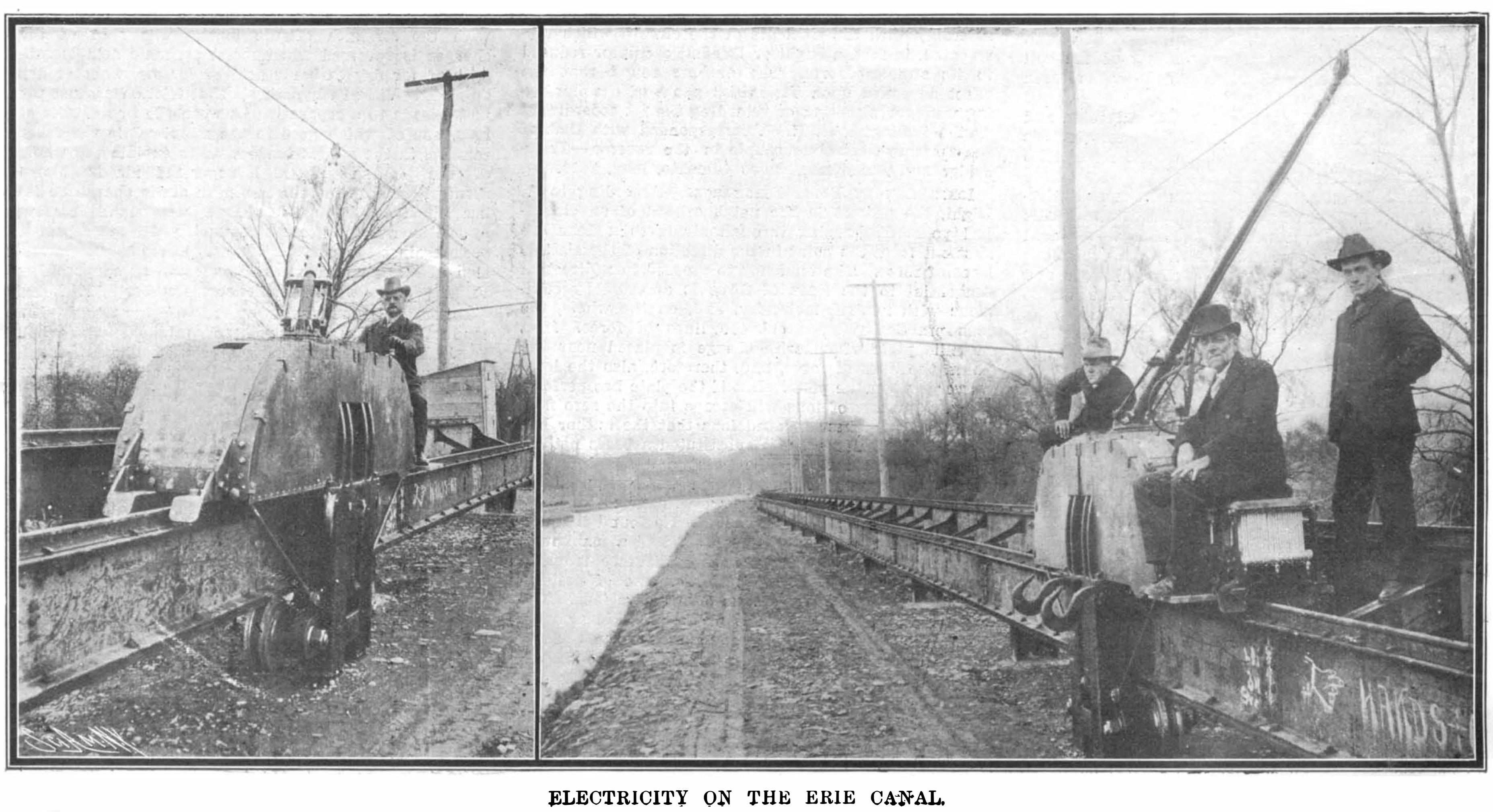
Several canals in Europe and a few in America have been experimentally equipped with electric tractors of one kind or another, but the devices have not as yet proved very successful. During the past few years several tests by various inventors were made on the Erie Canal, but were afterward abandoned for various reasons. Some few of the canalboats are now equipped with steam propellers, but this method of propulsion has not proved wholly successful on account of the expense, being about the same as mule power, and also on account of damage to the canal bank caused by the eddies of water.

Where the proper conditions exist, the cheapest of all transportation is by water; and when successfully equipped with electricity as a motive power, the canals of the country will forge again to the front as commercial necessities, and will then be in position to actively compete with the modern railroad, which has had such a phenomenal growth during the past century. The value of the inland waterways of this country cannot be even estimated. The vast expenditures both in energy and money which have been made by the people of several canal States of the Union have placed an obligation upon the people of the present generation to maintain them, and the national and State governments should take advantage of every practical plan which may tend to rehabilitate them and make them commercially useful.

The amount of power or current necessary for electric traction will of course depend upon the speed, the weight hauled, the depth of the canal, the condition of the track, and many other factors; but based upon the several tests which have already been made with this electrical system of Mr. Wood's, it has been estimated that where two or three boats are now hauled in a flotilla by mules at a speed of 1½ miles per hour, and at a cost of 1 9-20 mills per ton per mile, by electricity from three to six boats may be hauled in a flotilla at a speed of from 4 to 6 miles per hour and at a cost of only 19-100 mill per ton per mile; the cost decreasing in proportion as the tonnage of the canal is increased by means of the proposed enlargement and the use of 1,000-ton barges.

* Specially prepared for the SCIENTIFIC AMERICAN SUPPLEMENT.

Washing of Silk Stockings, Gloves, and Handkerchiefs of Light Color.—The best soap may change delicate tints. The following method is therefore preferable: First wash the silk tissue in warm milk. Prepare a light bran infusion, which is to be decanted, and after resting for a time, passed over the fabric. It is then rinsed in this water, almost cold. It is moved about in all directions, and afterward dried on a napkin.—La Nature.



ELECTRICITY ON THE ERIE CANAL.

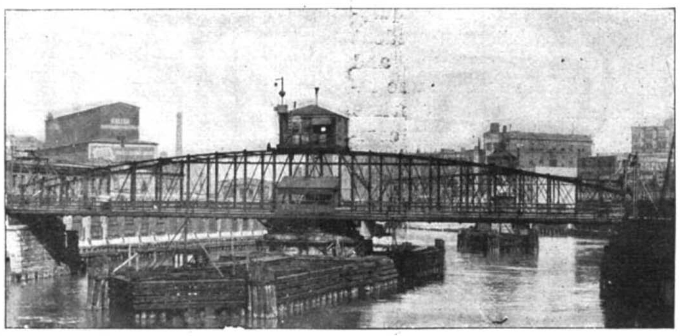
THE SCHERZER ROLLING-LIFT BRIDGE.*

WE present an illustration of the new Scherzer rolling-lift bridge across the Chicago River, at State Street, Chicago. Its total length is 250 feet, its clear span 162 feet, and its total width 64 feet. This structure forms the last of several bridges of the same type which have recently taken the place of swing bridges of the ordinary type over the Chicago River. The bridge, which is in two equal halves, is made up of two cantilever-like arms which are counterweighted at their inshore ends, and when in the lowered position meet and lock at the center of the span, and present all the rigidity and other desirable features of a single fixed span of similar dimensions. At the inshore ends the spans are provided with circular segments placed in the plane of the trusses which are adapted to roll upon heavy plate steel tracks. Each end is provided with its own rolling gear, by the operation of which the arms can be rolled back upon their segments into the vertical position shown in our engraving, thereby leaving the river entirely unobstructed for navigation.

This is the fourth bridge of this type to be erected across the Chicago River within the past few years, the other three having been built at Randolph Street, Canal Street, and Main Street, Chicago. These have proved so satisfactory that three additional bridges of the same type have been ordered by the Sanitary District of Chicago for Dearborn Street, Harrison Street, and 22d Street, to take the place of swing bridges. The rolling-lift bridge is receiving such wide application and is exciting such interest that a statement of the advantages which have brought it into favor will be of interest.

In the first place, as compared with the swing bridge, it does not encroach upon the channel space by necessitating a central pivot pier, but leaves the channel entirely open to navigation; nor does it encroach upon land or dock space, either in opening or closing, these advantages being due to the fact that its movement is in a vertical and not in a horizontal plane. A further advantage is that the rolling-lift bridge, when in the open position, acts as its own safeguard, and by extending vertically for the full width of the roadway or railroad tracks as the case may be, it precludes any possibility of railroad or vehicular traffic being precipitated through an "open draw." Moreover, the swing bridge and the bulkhead protection for the draw span are a positive danger to navigation, there being many instances of vessels being wrecked by collision with them.

There is a further advantage of great adaptability, since the roadway of a rolling-lift bridge can be placed nearer to the water than that of a swing bridge. As a matter of fact, all the truss work may be, and frequently is, placed above the roadway; and should it be necessary at any time to widen such a bridge, it could be done by adding new and independent sections, parallel with the existing structure. This, of course, would be impossible in the case of an ordinary swing bridge, because of interference. Considered from the structural standpoint, there is an advantage in the manner in which the weight of the bridge is carried. It is only by the exercise of the greatest care in design and construction that the turntable of a swing bridge can be made certain of easy and reliable operation. If there should be uneven wear in the rollers, or an uneven distribution of load on the roller path, or a lack of perfect level in the same, the swing span will be in constant trouble. In the case of the rolling-lift bridge, however, the two halves move with very little friction upon segments of large radius, running on smooth and straight tracks, that are easy and simple of construction. Then, moreover, the rolling-lift bridge is opened and closed in much less time than a swing bridge of like dimensions. Furthermore, in the case of tugs and smaller vessels, time is saved because they are able to pass through with only a partial opening of the bridge, whereas in the case of a swing span the opening must be complete, or practically complete, before it is safe for any size of craft to go through. Lastly, there is a decided advantage when the two types are judged on the score of artistic appearance. The rolling-lift type lends itself to the arched form, whereas the swing span in nearly every case necessitates a through truss in which the structural work is all of it above the roadway. Its appearance is always marred by the necessarily heavy pivot pier and the always unsightly protection piers which must be built on the up and down stream sides to safeguard the swing span against colliding vessels when it is in the open position.



THE OLD TYPE OF SWING BRIDGE.

*Specially prepared for the SCIENTIFIC AMERICAN SUPPLEMENT.

OIL SHELLS.

ONLY those who make a practice of going down to the sea in ships, to whom is given the opportunity to observe the vast watery expanse in all its moods, can fully appreciate the violence with which the bosom of the deep heaves after a storm, or the fury into which its mobile surface is lashed during the prevalence of such a forceful agitation of the air.

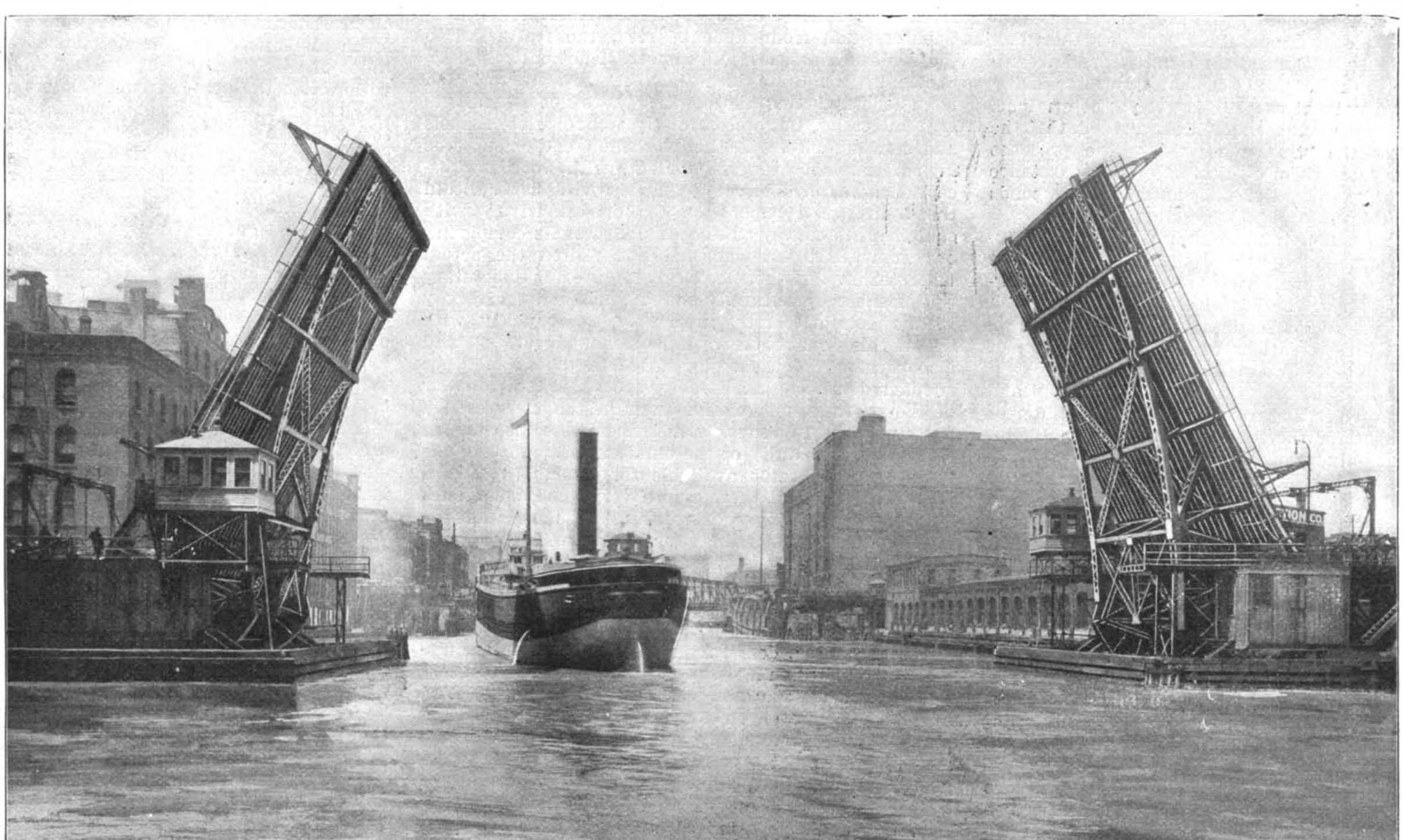
Primitive seafarers were more or less distressed by this phenomenon, and some one of the wiseacres of those early days discovered that oil, besides possessing other soothing qualities, was also a quietus for this ill. "Cast oil upon the troubled waters," was enjoined upon the boatmen of two thousand years ago, and has been handed down to us through the centuries. Whether at the then prevailing prices of animal and vegetable oils the expedient was extensively resorted to, history fails to relate. However, within the last quarter of a century, having an abundance of cheap mineral oil upon the market, the experiment has been frequently essayed, and its efficiency proven by those who have tested it.

The problem is no longer of the oil, but how to spread it effectively upon the surging waves, and at a sufficient distance from the ship to permit it to ride out the storm in comparative quiet or proceed in the direction of its destination.

To protect a disabled and storm-tossed vessel not under way is no difficult matter, for bags of oil trailed astern or pushed out from the waist or bow of the ship on spars will spread oil in the immediate vicinity of the threatened vessel, and provide an easy berth; but to afford similar protection to a ship willing and in a condition to proceed has been a subject of much thought, and developed a great amount of ingenuity.

Oil shells, that is, shells containing oil, which should distribute their contents upon the waves wherever they might happen to fall, could, by means of a cannon, be projected some distance in advance of a moving ship, but to assure the distribution called for invention. Shells with explosive heads, bearing a time fuse or a detonator that should ignite the charge when the shell struck the water, scattering the oil widely, were tried, not always with success. Again, the juxtaposition of oil and explosive is attended with the danger of a premature explosion; moreover, the time fuse does not always work. These frailties led to the invention of wooden shells without the explosive head, but provided with an easily ruptured *cloture*, which should upon contact with the wave resistance open and let out the soothing liquid. Such covers are made of some impermeable stuff, paper being the most suitable, which, to prevent the destructive influence of the oil, is coated with glue; the impact upon the water breaks the cover, and frees the confined oil.

To prevent accident while the shells are in storage, the paper seal is protected by a metal cover, which is removed just before firing. Another, but less effective, system is to close the cylinder with a heavy cover, secured to the end by a paste or gelatinous mass soluble in water, which is expected to soften and thus open the mouth and permit the exit of the oil. The time required for this dissolving process is its greatest drawback. Shells of this construction are further provided with a woven wire casing to strengthen them, and have their breech loaded or weighted, so that they float upright in the water, distributing their contents gradually and by means of the wave motion. For use at night a rocket or blue light is attached to the shell, the burning of which discloses the position of the fallen projectile. That perfection in this direction has not yet been achieved is witnessed by the continued issuance of patents for this purpose.



SCHERZER ROLLING-LIFT BRIDGE ACROSS CHICAGO RIVER AT STATE STREET, CHICAGO, ILL.

Total length, 250 feet; clear span, 162 feet; total width, 64 feet.

EXPLORING WEDDELL SEA.

A brief report about the Scottish Antarctic expedition, sent to Washington from Buenos Ayres, was printed recently. The document had come by mail, and there had been delay in making public the contents, perhaps because the tidings were not particularly startling. It thus appears that as long ago as January 12 the ship "Scotia" had arrived at the Argentine capital, and her captain had told something about her explorations to the southeast of the South Orkneys. It might be inferred from the non-committal character of the dispatch that her mission had ended. Such, however, is probably not the case. Letters received in Dundee a few weeks ago indicated that the "Scotia" would proceed to Buenos Ayres in December for coal and repairs to her machinery, and would then return to the South Orkneys, where a part of the scientific staff had remained. It was known, independently of these advices, that the head of the expedition, Mr. Bruce, wanted to continue his investigations for another year, and that his friends had raised money enough to make it possible for him to do so. Inasmuch as all of the "Scotia's" company were well at last accounts, it may be assumed that she will poke her way again to the eastward and southward before returning to Scotland.

Two expeditions have been operating for the last year or two in the vicinity of South America. The Swedish party, under Dr. Otto Nordenskjold, studied the region immediately to the eastward of Graham Land, their geographical researches supplementing those of the Belgian expedition of ten or twelve years ago. Mr. Bruce wanted to invade the ice pack still further to the eastward, following the route of Weddell. The latter was able to reach south latitude 74:15. Bruce barely crossed the seventieth parallel, just a year ago, when a severe cold spell drove him back. He then went into winter quarters in the South Orkneys, which are in about latitude 60:35. Whether he will make another push into Weddell Sea is doubtful, for the opportunity afforded by the summer of 1903-'04 in the Southern Hemisphere will probably be over before he can get there. Perhaps he will try it twelve months later.

Making a record of this kind, though, has formed only a part of his programme. Information about the depth of the seas which he explores, and the forms of life existing there, and the collection of meteorological data have also entered largely into his plans. Like the Germans and Swedes, the Scotch have been fairly successful. There is nothing sensational, but much which will prove useful, in the results thus far obtained. Another year's observations by Mr. Bruce will enlarge the harvest. When the British expedition, which was icebound near Mounts Erebus and Terror nearly two years ago, brings or sends back its reports of similar studies, a vast amount of material will be available for comparison.—N. Y. Tribune.

THE ORIGIN OF PEARLS.

The origin of the pearl has long been a mooted question. Apparently of much moment, it excites the investigation of laymen and scientist alike. Upon the most probable origin of real pearls Le Diamant contains a long disquisition, from which we give here some selected passages; and yet even from them it is not yet fully proven what conditions cause the formation of the pearl within the oyster shell.

The scientific investigations undertaken within the latest years seem to agree upon the presence within the shell of a foreign substance; but whether this exotic matter arises from a disease in the oyster itself, whether it be a grain of sand accidentally or artificially introduced or a natural parasite is not yet determined. However, this much has been definitely settled, that the mollusks cover the strange objects, whose presence would seem to cause them discomfort, with a substance absorbed by them, and which as it hardens corresponds to the mother-of-pearl.

Depending upon the circumstances whether these intruders fix themselves upon the shell or remain free and move about within it, are developed the irregular-shaped, flat pearls or the beautiful round ones, which are so highly prized for feminine adornment. Noticeable is it that these creations of the oyster partake of the mass and color of the mollusk itself.

Notwithstanding that the researches of Philippi and Küchmeister prove that a grain of sand or a splinter of shell is sufficient for the formation of a pearl, Dignet maintains that only an organic body can cause the origin and development of fine pearls, and contrariwise only pearls of little value or of absolute worthlessness can be built up around inorganic substances. Upon these premises rest the many recent attempts to favor the formation of pearls by artificial means. The parasites are keenly sought for, in order to introduce them in the neighborhood of the pearl banks, and thus force the oysters into the pearl-forming business. With such experiments Prof. Raphael Dubois now busies himself, and the King of Italy has placed at his disposal the banks of the Rocconipi, which form part of the royal possessions, for a thorough testing of the theory. That no brilliant results have as yet arisen from these essays is due to the various unfavorable conditions which surround the experiments. The natural motion of the water, the agitation of the mollusks in the sand, their pursuit by rapacious fish, especially the roach, which is inordinately fond of oysters, as well as the circumstance that the formation and development of a pearl require from six to eight years of time, all tend to make success more difficult. At best the yield is uncertain, and from published statistics we find great variance in the value of the harvest. Thus the value of the product of the Ceylon pearl fisheries for the year 1888 amounted to 1,810,625 francs, while in 1901 the amount exceeded the two million mark by 159,265 francs.

ENGINEERING NOTES.

The establishment of a central pumping station operated by gas power for serving high-pressure fire mains in congested city districts is a decided step in advance in municipal enterprises. Recent successful tests upon the completed system of the city of Philadelphia furnish the best evidence of the soundness of engineering judgment in selecting gas engines as the prime movers for this important service. The equipment of the Philadelphia system is without precedent in the history of large fire protection systems, and likewise marks a new era in the introduction of the internal combustion motor. The gas engine as a prime mover for this important service has two close competitors, the steam-driven pump and the electric motor-driven pump. The former has in its favor extensive development and wide usage; the latter, in the ease and convenience with which power may be applied to the pump. In the present instance electric power was first considered, but soon abandoned for the following reasons: Liability of accident to power house and supply line, due to short circuits and other causes; control of entire fire situation in the hands of independent corporations; obvious futility of constructing a special electric generating station. The use of steam power likewise presents important difficulties. According to a recent authoritative utterance, "it must be confessed that the cost of maintaining a steam plant ready for instant operation throughout the year is rather staggering to the municipal mind in a department where all is outgo and there is no income." This cost arises from the necessity of constantly maintaining full head of steam and banked fires, with attendant losses in many directions. The entire boiler equipment must, furthermore, be under steam, as any demand up to full capacity of the pumps is liable to occur at any moment. The selection of the gas engine as a motive power brings into prominence its unique characteristics for this intermittent service. Although extreme conservatism in the matter of fire risks is highly preferable to the reverse, considerable adverse criticism attended the substitution of gas for steam power. This criticism, however, finally culminated in the tacit admission that "there is no mechanical objection (to gas engines) if pumps and engines can be made reliable for such a serious purpose."—J. R. Bibbins, in Cassier's Magazine.

A paper was read by Dr. R. Mullineux Walmsley to the Institution of Electrical Engineers on "Transatlantic Engineering Schools and Engineering." He said that for some time there had been, in this country, a growing feeling of uneasiness that our methods of recruiting for both the higher and the lower ranks of engineering workers had not shown themselves sufficiently plastic in following the changes caused by the ever-increasing applications of science and scientific methods to the solution of the more complex problems with which engineers were called upon to deal, and also in following the social changes which had specially affected the supply of skilled artisans for the factory and workshop. Broadly speaking, the schools for higher engineering education in the United States and Canada might be divided into three classes: Those attached to universities which were not, either at all or to any great extent, supported by the State, but derived their funds from endowments, from private contributors, and from students' fees; those attached to the State universities, and almost, if not entirely, supported by the State in which they are situated and from federal funds; those which were not attached to any university, but were frankly technological schools and nothing else. If the workshop equipment was lavish, the laboratory equipment, with very few exceptions, was still more so, and it was difficult within the limits of a paper not dealing exclusively with equipment to convey an adequate idea of its complexity or extent to those who had not visited the actual laboratories. In the electrical engineering laboratory equipment they naturally found much more diversity in the details, partly because of the rapidity with which this branch of work had been developed, and also perhaps because being so recent the actual lines adopted depended much more upon the individuality of the professors in charge than in the more settled work referred to above. Differences were also due to the greater flexibility of the chief experiments and the variety of apparatus available for them. In all the laboratories visited there was a very good, sometimes a very lavish, supply of testing instruments of the most recent patterns in actual commercial use, and usually, also, good and well-known standard instruments for calibration work. With scarcely an exception the supply of commercial testing instruments, often of expensive types, was very lavish, and if there was sometimes a deficiency in the instrumental equipment it was with regard to the more delicate and less frequently used laboratory instruments. In most places, however, the provision for research work insured a more than adequate supply of these costly instruments and apparatus. It was fully recognized by many engaged therein that, whatever the other conditions might be, the success of any educational work depended very largely indeed upon the teachers, both senior and junior, intrusted with the instruction. On all hands it was agreed that for engineering the question was not quite so simple as for other subjects of education, and that, in the endeavor to staff the schools with the best men, the economic laws of supply and demand raised considerations more difficult to deal with in this particular form of education than in other forms. What were wanted were men who, in addition to these academical qualifications and the necessary enthusiasm for the work, had also had experience, and successful experience, as engineers. Not only would they settle the curricula, and teach the subjects included therein, but the whole question of the awarding of the honors and of the graduating diplomas was placed in their hands without restriction. The total amount contributed by the Federal government for education of university rank reached the large total of £1,133,600, while the individual States and the municipalities together contributed £1,011,900 for similar purposes. He asked them to contrast these figures with the government contribution to our universities and colleges, which, according to Sir Norman Lockyer, amounted at present to £150,000 a year.

ELECTRICAL NOTES.

In No. 2 of the Elektrotechnischer Anzeiger, E. Lenggenhager describes an electric railway traction system, which is being developed at the present moment by a Swiss Studiengesellschaft, appointed for the purpose of finding out an electric railway system suitable for that country, which on account of her dependency on the foreign coal market, evidently should endeavor to utilize her wealth in hydraulic power. Speeds, on the other hand, are limited there on account of the steep gradients, small curves, and numerous stoppages. The system in question uses steam locomotives heated by electricity. Electric heating, as is well known, will work with the highest possible efficiency, so that the total efficiency will mainly depend on the output of the mechanical part of the locomotive, being the steam engine proper. Any coal steam locomotive could readily be converted into an "electrothermical" locomotive by simply replacing the firebox and boiling tubes of the boiler by a number of parallel electric heating walls running throughout the boiler, and being composed of two copper or iron sheets. The author suggests using in this connection the well-known Prometheus heating elements. The consumption of current would depend on the consumption of steam; let the boiler be designed for accommodating 4,000 liters (1,056 gallons) of water, which are to be brought within three hours from 10 up to about 190 deg. C., corresponding with a steam pressure of 50 kilogrammes per square centimeter (710 pounds per square inch). In the case of an efficiency only as high as 90 per cent, the following data would be obtained: 4,000 liters of water would require, in order to be brought to the above temperature, $4,000 \times 180 = 720,000$ kg. cal.; 1 kg. cal. = 1.275 eff. watt hours, therefore 720,000 kg. cal. = about 900 eff. kilowatt hours, or, distributing this amount over three hours = about 300 kilowatts. A consumption of steam of 1,000 kg. (2,204 pounds) per hour would accordingly require a supply of current of about 225 kilowatts. As regards the advantages inherent in the electrothermic system, the resistance of the steam accumulator against current shocks should be mentioned. There is the further advantage of both direct and alternating currents being practicable in this connection, any desired combination being suitable. The mean efficiency of electrothermic locomotives, being about the same as that of an electromotive machine of the same size, would be about 60 per cent to 70 per cent, whereas the total efficiency of a railway system, on account of the more advantageous utilization of the load, would be higher for the former. Furthermore, the adoption of electrothermic service may take place gradually, being much easier than that of electromotive service, on account of the lower cost of the conversion and the ease with which the personnel may be trained for the new service. Finally, a possible conversion of an electrothermic into electromotive railway service could be readily made, should the electromotive service in future be so improved as to become superior to the electrothermic system.

As pointed out in a paper recently published in the French electrical papers, D. Tommasi had for some time past observed the striking fact that the negative plate of an accumulator, when exposed to the action of light, would be formed more rapidly than in the case of its being left in the dark. This reducing effect of light was observed in any case, quite independently of the composition of the active mass contained in the accumulator plate, the density of the sulphuric acid serving as electrolyte, and of the working temperature. In order to further ascertain the part incumbent on luminous energy with the formation of accumulators, Tommasi made the following experiment: Of the two accumulators of his own system, consisting of a glass vessel each, filled with acidulated water and containing three negative and two positive plates, the one, *A*, was exposed to the action of sun rays, while the other, *B*, was placed in a pasteboard box coated with tar and closed everywhere, so as to exclude any light rays. After having been mounted in series, the two accumulators were exposed to a charge of two to three amperes. Now, whereas in the course of the first thirty hours, no appreciable difference was noted, the negative plates exposed to light, after this time had passed, were found to assume a more strongly gray coloration, whence it was inferred that they were further advanced. This difference in coloration, due to the more or less great amount of reduced lead oxide, after first increasing, would become smaller, disappearing eventually as the negative plates were wholly reduced to spongy lead. From these experiments, which were repeated many times, the proposition is derived that the negative plates of a lead accumulator, all the remaining conditions being identical, are formed more rapidly

in the light than in the dark. This point being once established, the action of light on the positive plate was investigated by connecting two accumulators similar to those above described, so that the two external plates were positive. One of the accumulators, *A'*, was exposed to the action of light, while the other, *B'*, was left in the dark. Both cells were connected in series, and charged with 2 to 3 amperes, when, after about twenty hours, the positive plates left in the dark already showed a much darker coloration, being more strongly peroxidized than the positive plates exposed to the action of light. These differences in coloration showed a similar behavior to the one above mentioned, thus giving evidence of the fact that the positive plates of an accumulator, all else being identical, are formed more rapidly in the dark than in the light. There are, in addition, permanent differences in coloration, positive plates as formed in the dark being dark brown, and those formed in the light, reddish brown. This may be observed even after several consecutive charges, but finally all the positive plates assume the coloration of the plates formed in the dark. The same is true of the negative plates, which, when formed in the light, are lighter, whereas the capacity of the accumulator is about the same, no matter whether they are formed in the dark or in the light. A. G.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

American Building Wood in Havre.—The imports of wood into Havre for building purposes during 1902, although less than those of 1901, were larger than the average for the past four years. Of the imports of oak in 1902 (2,988 tons) 2,438 tons were received from the United States, 479 tons from Roumania, 43 tons from New Caledonia, 21 tons from Russia, and 7 tons from Germany. There were 5,879 tons of oak staves imported in 1902, of which 5,858 tons came from the United States. Of the walnut imported 344 tons were of American origin and 52 tons came from various other countries.

Of the other woods, under which is included pitch pine, 30,528 tons were received from Sweden, 20,284 tons from the United States, 14,565 tons from Russia, and the remainder from Norway, Madagascar, and Canada.

From the above it will be seen that Havre is a good market for the sale of American wood, but if our shippers would be more careful in filling their orders according to the requirements of the French trade the sales would be still greater.

In the following table are given the imports of building wood into Havre during the past four years:

Description.	1902.	1901.	1900.	1899.
	Tons.	Tons.	Tons.	Tons.
Oak, undressed, squared, or sawed, in various dimensions	2,988	3,681	6,743	3,893
Oak staves	5,879	10,154	6,953	6,727
Walnut, undressed, squared, or sawed	396	592	49	134
Other woods, undressed, squared, or sawed	69,511	73,897	66,031	64,137
Total	78,774	87,324	79,776	74,891

Suggestions to American Shippers.—For the benefit of American shippers of wood to France I give the following extracts from a letter I have received from Mr. Charles Humbert, one of the largest importers of wood in Havre, in answer to my request for suggestions as to how the trade relations between the United States and France might be increased:

"I would recommend that more uniformity and regularity be displayed in the execution of contracts, in the dates of delivery, in the quality of the merchandise; in short, scrupulously to observe the agreements made, a point to which insufficient attention is at present given. There appears to be a certain degree of indifference prevailing, which is not only prejudicial to business relations, but affects confidence on both sides.

"For example, an American exporter, finding it difficult to execute a contract made several months previously, will not hesitate to ship wood of an inferior quality, hoping, later on, to make an allowance to the importer or a reduction in the price. This allowance or reduction, even when accepted, is by no means satisfactory to the buyer, for he will not be receiving the quality of merchandise ordered. The American exporter is too much bent upon effecting sales, with solely his own interests in view. If he would also consider those of the buyer he will be more apt to develop his trade relations.

"I have transacted business with the United States for many years, giving special attention to lumber, or wood sawn as it is in the Baltic; but with the exception of several well-known houses, it is always with apprehension that I make a contract, for I fear that it will not be executed in conformity with the requirements. I can not lay too much stress on the point that if I buy first-quality lumber and second or third quality, worth less, is delivered to me, the situation is an embarrassing one; for even if a reduction is made, the difference in price does not compensate me for not getting what I ordered.

"I wish to mention two other points which appear to pass unobserved in the United States, and which prevent or interfere with the development of trade:

"First—For the French market, wood should be sawn in certain customary thicknesses, based on metric measurements—for instance, 27 millimeters (1.06 inches), 34 millimeters (1.34 inches), 41 millimeters (1.61 inches), and 54 millimeters (2.13 inches). The Americans persist in sawing their timber in inches—i. e., 1 inch, 1.25 inches, 1.5 inches, and 2 inches. These measurements are short of those required here, and it is frequently impossible to make use of wood sawn in such dimensions.

"The giving of strict attention to the wants of buyers is one of the strongest points of the Germans, who manifest a marked desire to observe all requirements, and their shipments are always accompanied by documents in proper order.

"Second—In regard to the care which ought to be taken of merchandise by shippers (a) in the transportation by rail from the sawmills to the ports, and (b) while the merchandise is at the port awaiting shipment. Special attention should be directed to these two points.

"In concluding this series of suggestions, based on long experience, I would also direct the attention of American exporters to the choice of the employes whose duty is to examine, either at the mills or at the port of shipment, lumber to be sent abroad, and upon whose certificates the sellers make out their invoices. I have frequently observed that the work of these inspectors has been very carelessly done, and that documents regarding the quality, quantity, and dimensions of the lumber have frequently been inaccurate."—A. M. Thackara, Consul at Havre, France.

American Apples and Cider in France.—In consequence of the poor apple crop of last year and of the poorer one of the present year, there has been a large increase in the importations into France of American dried apples, both for cider making and for cooking purposes. The imports of chopped apples for cider making in 1902 were 3,071 tons, against 1,568 tons in 1901 and 4,399 tons in 1900. Of apples for cooking purposes, evaporated apples, and apple rings the imports were, in 1902, 241 tons, as compared with 194 tons in 1901 and 402 tons in 1900. For the first eight months of 1903 the imports of chopped apples have been 6,000 tons, against 1,800 tons during the same period in 1902 and 1,300 tons in 1901. The imports of evaporated apples for the first eight months of 1903 were 480 tons, against 110 tons in 1902 and 134 tons in the same period of 1901. American evaporated apples have met with a ready sale this year. The failure of the French apple crop is likely to have a lasting effect upon this particular trade, as the American products have been widely distributed and have reached centers where they were hitherto unknown.

As mentioned above, the apple crop of 1903 proves to be even less than that of last year. Prices for green apples have already reached very high levels, and as the present wine crop of France will also be a poor one, causing the prices of wine to be greatly increased, it is not surprising that large quantities of chopped apples have already been contracted for in the United States, and there seems to be every indication that there will be a still greater trade in these products.

Our shippers should be careful to see that the chopped apples before being packed in the barrels are well dried, as complaints have been made of apples being damaged by moisture. On the whole, the quality of the American apples received at Havre has been good, and they have been satisfactory to the consumer.

It is to be regretted that greater efforts are not made to export fresh apples from the United States to France. The scarcity of fruit of all kinds in this country is so great this year that I feel assured there would be a good sale for such excellent apples as could be supplied from our Eastern States. The duty of 3 francs (58 cents) per 100 kilogrammes (220.46 pounds), when imported direct, should not be a serious hindrance to this trade, since the importation of green apples from other countries has taken place on a large scale.

The imports of fresh apples and pears for table use into France during 1902 were 10,158 tons, against 4,360 tons in 1901 and 5,536 tons in 1900. Of the above amounts a very insignificant portion is received at Havre from the United States. For the ocean journey the apples should be selected and well packed.

I am assured by the local dealers that at the present time there is also an outlet in France for American cider. If any of our cider manufacturers should be interested in finding a market in France for their products, I would be pleased to furnish them with the names of responsible houses in Havre with whom they could make connections or with details concerning prices, customs duties, etc.—A. M. Thackara, Consul at Havre, France, October, 1903.

Outlook for American Trade in Austria.—There seems to be no hostility on the part of the Austrian people to the introduction of American products of whatever character, if the opposition of the Agrarians to the importation of food stuffs be excepted. On the contrary, superiority or improvement of method is quickly acknowledged. This would appear to make an easy market here for American goods, and a practical knowledge of local conditions is necessary to correct such an impression. In reality, it is an extremely difficult market to compass with satisfactory results. Vienna and Prague are the natural commercial and wholesale centers for Austria and Bohemia. The other numerous cities are comparatively small and their shops designed only for local trade. The immense relative population of Bohemia lies in the dorfs, or small villages, which stretch along the watercourses in almost contiguous lines and in apparent disregard of transportation facilities. The shops in these villages, which supply daily necessities to the great bulk of the population, are insignificant affairs, buying in small quantities and to some extent from the traveling vans of town or city concerns. With wages of skilled workmen, as in the cut-glass trade, at a maximum of 70 cents a day, with girl and other female factory labor at from 20 to 40 cents, and with a peasantry that exists in the most primitive fashion, the purchasing capacity of the people, outside of the richer classes, of the cities and towns, is restricted, and to reach what market there is requires a practical campaign based upon knowledge of local conditions.

The few importers in the cities, dealing chiefly with the well-to-do, are somewhat autocratic; the retailers, conservative and skeptical regarding direct importation. American trade seems to have drifted largely, therefore, into the hands of a set of wholesale or clearing agents, chiefly at Hamburg, and excessive middlemen's profits, added to heavy interior freight rates and the perplexities of the Austrian tariff, stand between the American exporter and the Austrian consumer. The consequence is that the retail prices of American wares, staples, and what are here termed "table luxuries," are unaccountably high and out of the reach of all except the very wealthy. The American exporter who can get into connection with substantial retail houses, either directly or through his own continental agency, and who will conform in his dealings to local commercial usages, should reap a decided advantage. In spite of obstacles, however, American products are becoming more and more common, finding their way, by devious processes, even to the shelves of the smaller stores, and the pronounced German faculty of imitation is kept busy providing substitutes. Of 1,942 letters received and dispatched from this consulate during the year, as compared with 1,639 the previous year, the great majority related directly to the introduction or extension of American trade.

The low cost of labor is the great obstacle to the introduction of the heavier and costlier labor-saving machinery. When the saving in wage and increase of production would hardly meet interest account on increased investment, it is difficult to convince a manufacturer that it would benefit him to introduce modern machinery and throw out of employment the people who depend upon him for livelihood in their native dorfs and for whose welfare he has a genuine if somewhat selfish regard. Excepting for the introduction of a few Northrop looms, there appears to be no noticeable improvement of processes in the textile branches. It is the opinion of old observers that the supremacy of hand labor, water, and foot power will continue until gradual social development creates a higher standard of existence for the lower classes.—S. C. McFarland, Consul at Reichenberg, Austria.

Abyssinian Trade.—German and Austrian commercial bodies recommend the establishment of steamship lines to Djibouti for the purpose of cultivating commercial relations with Abyssinia, the trade of which is now controlled by the French and English. It is believed by the members of these bodies that Abyssinia promises a large field for European goods. United States Consul-General Skinner's mission to Abyssinia is much discussed by the German and Austrian press. This new advance move of the United States is watched with much solicitude by Europeans.—Simon W. Hannauer, Deputy Consul-General, Frankfort, Germany.

American Trade Interests in Tahiti.—Former United States Consul J. Lamb Doty has inaugurated an American company to handle the wholesale interests of the colony. The capital is $50,000. The merchants regard the enterprise in a favorable light, in view of the announcement that no established interests will be antagonized. Banking facilities will be afforded the community. The new company aims to save the commissions of middlemen to the local merchant; to stimulate trade by paying cash for produce to the merchant, and by branding and guaranteeing quality of goods, etc. There is a large field for the enterprise in this colony.—William F. Doty, Consul at Tahiti.

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TRADE NOTES AND RECIPES.

Preserving Liquid.—For zoological and vegetable preparations the alcohol may be replaced with the following cheaper and serviceable solution: Formaldehyde, 60; glycerine, 120; alcohol, 30; water, 1,000. The addition of glycerine is necessary only where it is desired to keep the articles soft.—Neueste Erfahrungen und Erfindungen.

Removal of Ink Spots.—To remove ink spots, the fabric having the spot is soaked, according to Graham Bott, in warm water, then it is squeezed out and spread out upon a clean piece of linen. Now apply a few drops of liquid ammonia of a specific gravity of 0.891 to the spot, and dab it next with a wad of wadding which has been saturated with dilute phosphoric acid. After repeating the process several times and drying the piece in the sun, the ink spot will have disappeared without leaving the slightest trace.—Pharmaceutisches Journal.

New Process for Coppering.—This is the Dessolle process for the galvanic application of copper. The special advantage claimed is that strong currents can be used, and a deposit obtained of a tenth of a millimeter in an hour and a half. After having cleaned with sand or in an acid bath the object to be coppered, a first coat is laid on in an ordinary electrolytic bath; then the object is placed in a final bath, in which the electrolyte is injected on the electrode, so as to remove all bubbles of gas or other impurities tending to attach themselves to the surface. The electrolyte employed is simply a solution of cupric sulphate in very dilute sulphuric acid. For the preliminary bath the double cyanide of potassium and copper is made use of.—Le Cosmos.

To Fill Engraved Letters on Metal Signs.—Letters engraved on metal may be filled in with a mixture of asphaltum, brown japan, and lampblack, the mixture being so made as to be a putty-like mass. The mass is well pressed down with a spatula. Any of the mass adhering to the plate about the edges of the letters is removed with turpentine, and when the cement is thoroughly dried the plate may be polished.

If white letters are desired make a putty of dry white lead, with equal parts of coach japan and rubbing varnish. Fill the letters nearly level with the surface, and when hard, apply a stout coat of flake white in japan thinned with turpentine. This will give a clean white finish that may be polished.

The white cement may of course be tinted to any desired shade, using coach colors ground in japan.—Drug. Circular.

Washing Liquid for Silver.—Various washing liquids may be used to do away with the polishing entirely or almost entirely. One of them is ordinary soap water. An efficacious preparation is obtained by mixing beechwood ashes, 2 parts; Venetian soap, 4-100 part; cooking salt, 2 parts; and rain water, 8 parts. Brush the silver with this lye, using a somewhat stiff brush. Latterly, a solution of crystallized potassium permanganate has been recommended. A grayish violet film which silverware acquires from perspiration can be readily removed by means of spirit of sal ammoniac. To remove spots from silver, the following process is recommended: Lay it for four hours in soapmakers' lye, then throw on fine powdered gypsum, moisten the latter with vinegar to cause it to adhere, dry near the fire, and wipe off. Next rub the spot with dry bran. This not only causes it to disappear, but gives extraordinary gloss to the silver.—Metallarbeiter.

Preparation of Rush Fibers for Paper.—The rush is cut in two. The part immersed, growing in water, is submitted to maceration and to prolonged boiling—longer boiling and with more concentrated solutions than the portion of the plant which grows in the air. The maceration is conducted in vats heated to about 45 deg. C. in water, which is renewed three times in eighteen hours. The mass is pressed, cut up in strips, and boiled in an emulsion formed of 3,000 liters of 2 or 3 per cent soda lye to which has been added 7.5 kilogrammes of lime, 100 liters of water, and 30 liters of petroleum. The fiber is softened by the emulsion, which at the same time dissolves the silica. The matter is washed, and then purified in a bath of water containing acetic acid (4 per 1,000). The long fibers serve for manufacturing paper, and the short fibers may be mixed with hair for the manufacture of felts.—Moniteur de la Papeterie Française.

Preparation and Preservation of Skins.—Many persons, especially hunters, are embarrassed in preparing the skins of animals for preservation. It should be done as follows: Dry the skin. For this purpose stretch it on a board with the hair below, taking care not to disturb the direction of the hair, and nail it at the edges. For preservation, spread on the fresh side a cold solution formed of a liter of boiling water, in which 30 grammes of kitchen salt and 60 grammes of alum have been dissolved. This is done by means of a brush, and repeated twice. When the skins are dry, spread them hair against hair. The dealers seek for skins thus prepared, where the hair has preserved its natural direction.

Another process for preserving the skins of beasts freshly slaughtered consists in pricking them on the flesh side with an awl or a large needle, after having stretched them on a wooden frame, and rubbing them with a wad of cloth soaked with a strong decoction of the ground dried sumach leaves used by curriers. The skins are afterward washed and put as quickly as possible in the shade to dry. The friction with the sumach is repeated two or three times, followed each time by washing with ordinary water.—Science, Arts, Nature.

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