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THE SPONGE FISHERY OF FLORIDA.*

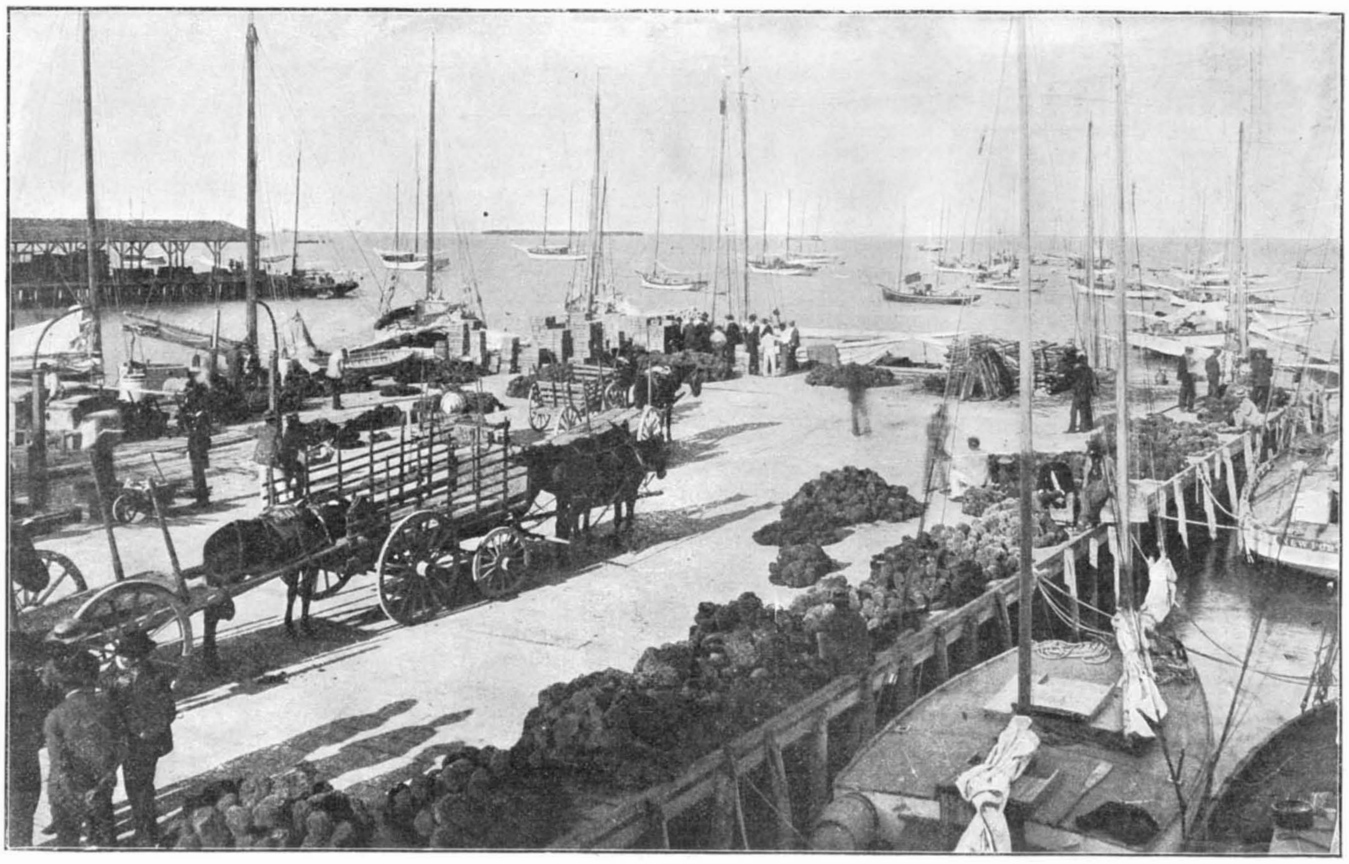
By JOHN N. COBB, Agent of the United States Fish Commission.

IN 1901 the writer was detailed to make an investigation of the commercial aspects of the fishery, and the following notes give complete data showing its condition in the calendar year 1900:

GROUNDS, VESSELS, METHODS OF THE FISHERY, ETC.†

There are two well-defined areas of the Florida coast in which sponging is prosecuted.

A chain of "keys," or islands, starts from the mainland at about Miami, on the east coast, and extends, in the shape of a horn, far into the Gulf of Mexico, the Dry Tortugas being the westernmost point of the horn. In the waters surrounding most of these keys, and also between the keys and the mainland as far as Cape Sable, sponges are found. This is called the "key



THE SPONGE AUCTION WHARF AT KEY WEST.

* Extracted from U. S. Fish Commission Report for 1902.

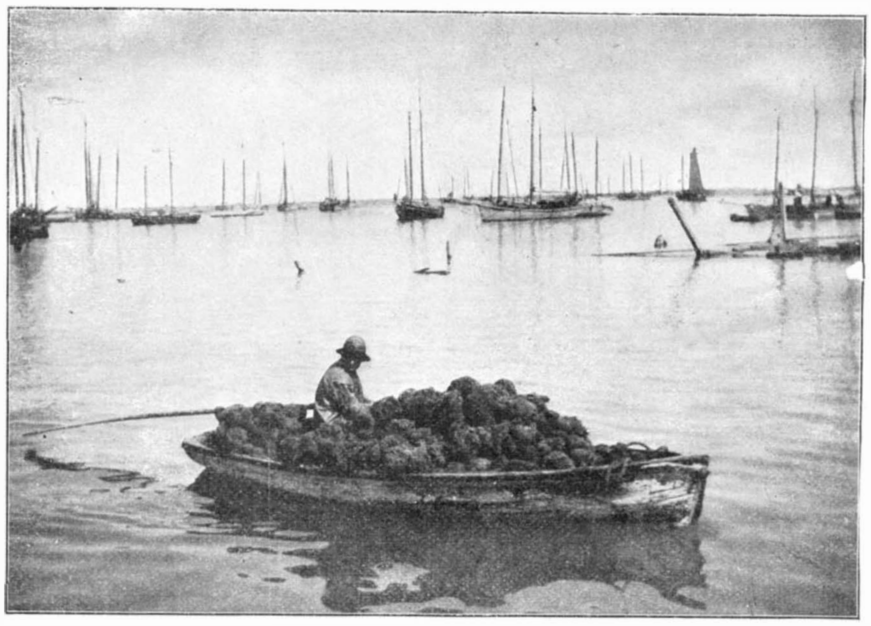
† No effort has been made to give these subjects in detail, as they have been covered in other reports, to which the reader is referred as follows:

The Fisheries and Fishery Industries of the United States. Tenth Census of the United States.

The Fish and Fisheries of the Coastal Waters of Florida. Rep. U. S. Fish Com. 1896, pp. 263-342.

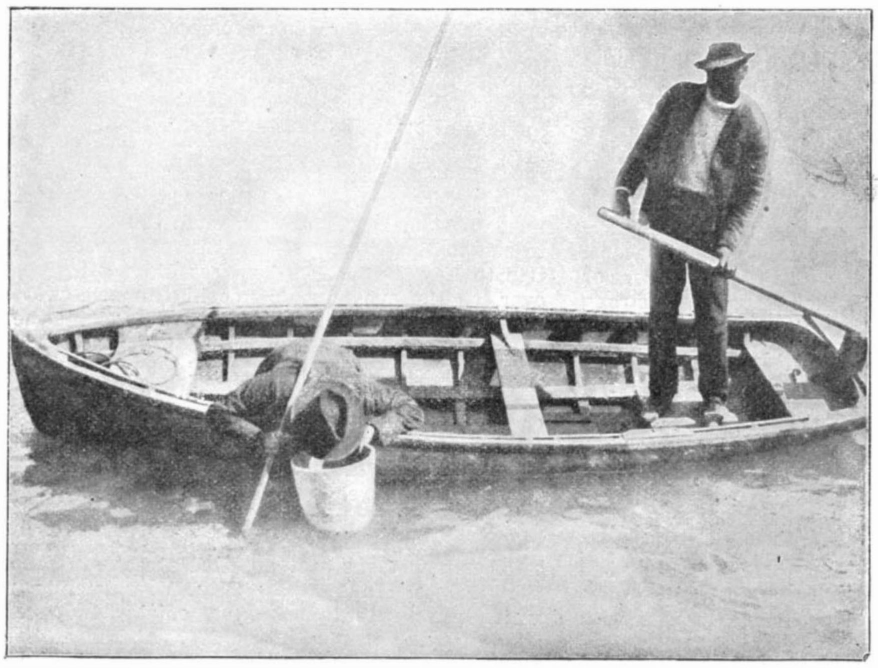
The Florida Commercial Sponges. By Hugh M. Smith. Bull. U. S. Fish Com. 1897, pp. 225-240. 19 pls.

Notes on the Florida Sponge Fishery in 1899. By Hugh M. Smith. Bull. U. S. Fish Com. 1899, pp. 149-151.



BRINGING SPONGES FROM THE VESSELS TO SPONGE WHARF AT KEY WEST.

A SPONGE AUCTION AT ANCLOTE.



SPONGERS AT WORK.

SPONGE YARD AT KEY WEST, SHOWING THE SPONGES DRYING.

THE SPONGE FISHERY OF FLORIDA.

grounds" and is worked exclusively by spongers from Key West and the few inhabitants of the many keys. The earliest sponging was on these grounds.

The "bay grounds," which are the most prolific, are on the west coast, in the Gulf of Mexico, and extend from Johns Pass, a few miles north of the entrance to Tampa Bay, to St. Mark's lighthouse, a distance of about 200 miles. Sponges are also found in the Gulf between Tampa Bay and Cape Sable, but not in sufficient quantities to justify making trips specially to this region.

The sponges taken from these grounds are classified as follows by the spongers and buyers: Sheepswool, yellow, grass, velvet or boat, and glove. A few other unimportant kinds, such as "wire," "hardhead," etc., are generally included with those mentioned.

Vessels of a schooner or sloop rig, ranging from 5 to 46 tons (averaging slightly over 11 tons), operate chiefly on the "bay grounds," while small sloops, usually of less than 5 tons burden, work mainly on the "key grounds." The larger vessels, which average about $1,168 in value, exclusive of outfit, carry from 5 to 13 men, while the smaller vessels, which average in value about $780, including outfit, carry crews of from 3 to 5 men.

The larger Key West vessels make three to four trips per year to the "bay grounds," and some of them make one or two trips to the "key grounds." Each "bay" trip occupies about two months, while the "key" trip is made in about a month. The Tarpon Springs and Apalachicola vessels average about five trips each year, each trip occupying about two months. None of these latter vessels visits the "key grounds."

The "bay" trips are usually arranged as follows:

The first trip begins about the first week of January, and ends from the 10th to the 20th of March, the spongers working from the mouths of Anclote River to St. Martins Reef, about 40 miles. Many of the vessels do not make this trip, as the weather is usually cold and windy.

The second trip begins about April 1 and ends from the 10th to the 20th of June. The grounds between Johns Pass and Cedar Key are visited during this trip.

The next trip begins about July 1 and ends from the middle of August to the 1st of September, and is also carried on between Johns Pass and Cedar Key. This is usually the best trip of the year.

The fourth trip is called the "hurricane trip," from the fact that it is prosecuted during the hurricane season, and lasts from the middle of August to about the 10th of October, the same grounds being visited as on the two previous trips.

The last trip usually begins the early part of November and ends December 20, the Rock Island grounds being visited.

A number of the vessels refit previous to the last trip, while others wait until the first two months of the year for this purpose.

The crews work on shares. The owner, or "outfitter," furnishes the food, fuel, boats, apparatus, etc., for the trip. While sponging in the "bay" each member of the crew is assessed 35 cents per trip for watchman's fee at the "kraals," and 50 cents per trip for wood. After deducting these two items from the gross proceeds of the trip, the vessel takes half of the remainder, and the other half is divided up equally among the crew. Besides his regular share with the crew, the captain gets 10 per cent of the vessel's share, and each "hooker" gets one-fourth of one share from the vessel's portion. Should the captain also be a "hooker," which is generally the case, he only gets his regular 10 per cent.

The same division of proceeds is followed on the "key" trips, except that there are no charges for watchmen and for wood. The men generally camp on the keys where wood and water are convenient, and as settlers are scarce in this region, the "kraals" do not have to be guarded.

The only apparatus used in this fishery is the sponge hook, a three-toothed curved hook attached to poles of varying lengths, according to the depth of water in which the sponger is working, and the sponge glass—a common water bucket with the bottom knocked out and a pane of window glass substituted. The latter is used for seeing below the surface when the water is disturbed by ripples.

A sponge "kraal," or pen, is generally about 10 feet square, built of wattled stakes, and is placed in shallow water in the shelter of some key or island. Each vessel usually owns one, and for better protection from thieves, a number of them are congregated at some convenient place and a watchman employed to guard them. For a number of years many of the "bay" spongers had their kraals at the north end of Anclote Key. As these were exposed to the full force of the wind when blowing from certain directions, considerable loss was sustained on several occasions by the storms washing the sponges out of the kraals and carrying them out to sea. Owing to this the kraals were removed in 1890 to Baileys Bluff, on the mainland about 2 miles north of the mouth of Anclote River. In 1890 certain of the spongers became dissatisfied and established kraals at Sawyers, about half a mile nearer the Anclote River. The latter are sometimes called the "cabbage kraals," from a large cabbage palm standing on the beach just opposite the kraals. At Baileys Bluff there are about 85 kraals, while at Sawyers there are about 40. A few kraals are also located at North Key, close to the town of Cedar Key. This was at one time a very important kraaling place.

Kraals were also located at Rock Island and near St. Mark's lighthouse at various times.

The key spongers build their kraals at various places, no effort being made to keep them together, as in the "bay." The spongers usually select a convenient key and make their camp on shore, and build their kraal in some sheltered cove close to the shore. They suffer very little from thieves, so do not require watchmen. Should the key have any inhabitants, these usually watch over the kraal.

When first brought to the surface, the sponges are black and slimy. As soon as a dingy has secured a load, it is sculled to the vessel, unless the latter is too far away, when she sails down to the boat, and the load is transferred to the deck of the vessel. They are then spread carefully over the deck in their natural upright position so as to allow the slimy matter, or "gurry," to run off easily. At first they have a strong ammoniacal smell, exceedingly disagreeable to those unaccustomed to it; but this is soon succeeded by a scent very similar to that of decaying seaweed. After several days' exposure on the deck, the sponges die and a good part of the "gurry" runs off. In the "bay" the vessels usually return to the kraals every Friday. The sponges are then transferred from the vessel to the kraal, where they are allowed to soak until the vessel returns from the next week's trip. Those brought in the previous week are then beaten out with a short heavy stick, which removes most of the slime and animal matter still remaining in them, while those to which the black scum still adheres are scraped with a knife. The sponges are then squeezed out quite thoroughly with the hands, after which they are removed to the shore and strung on pieces of coarse twine about 6 feet in length, in which shape they are ready for sale. All sponges are sold by auction.

SPONGES GATHERED IN FOREIGN WATERS.

In September, 1900, the schooner "Serafina C.," of Key West, made a trip to the Mosquito Coast of Nicaragua, and brought back about 1,016 pounds of sheepswool sponges and 44 pounds of velvet sponges. Most of these were taken in water shallow enough to permit of the sponges being secured by wading. No effort was made to gather other kinds, as they would not have sold for enough to pay for the collecting. The sheepswool and velvet sponges were of an inferior grade. On landing the sponges at Key West they were compelled to pay duty on them. Owing to the success of the "Serafina C.," several other vessels have since been working on these grounds. For some years past Key West vessels have made occasional visits to these grounds, the schooner "Sea Gull" having been wrecked while returning from such a trip in 1886.

Shortly after the close of the Spanish war one or two of the vessels visited Cuba and brought back a few sponges. These were not gathered by the crew, however, but were purchased from the natives. As they were of an inferior grade, and duty had to be paid upon them, no effort was made to continue the business.

SPONGE BUYING.

The buying of sponges gathered by the Florida fishermen has developed into a business of considerable magnitude and one quite distinct from that of the gathering of sponges.

When the sponges are landed by the fishermen, they have merely been roughly cleaned of the mud and dirt adhering to them, and it is necessary, before they can be placed on the market, to thoroughly clean them of the remaining dirt, see that no foreign substances are inside the sponge, and trim off the rough edges to give a symmetrical appearance. This work is done by the buyers, who have large warehouses at convenient places on the coast.

For many years Key West had almost a monopoly of this business, but in 1891 serious competition began at Tarpon Springs. Owing to the favorable situation of this latter place, the business here rapidly expanded until in 1900 it amounted to almost as much as at Key West. The Spanish-American war was a great help to Tarpon Springs, as the Key West vessel captains avoided going to Key West with their cargoes for fear of being captured by Spanish war vessels, and so were constrained to sell at Tarpon Springs. During 1899 and 1900 a few sponges were sold at Lemon City, on the east coast. Some of the "key" boats from the upper part of Biscayne Bay found it more convenient to sell to the one buyer there than to make the long trip to Key West. The business did not thrive, however, as the spongers do not like to sell at a place where there is but one buyer, as they claim the lack of competition keeps the price down. None was sold at Lemon City after the spring of 1900.

At Key West and Tarpon Springs all of the buyers, except two—one at each place—represent New York, Philadelphia, and St. Louis wholesale houses. The two independent buyers market their own catch. Each buyer has a warehouse where the sponges are dried, cleaned, and baled ready for market. Some of these buildings are elaborate and costly structures, and a number of persons are employed at each in preparing the product. In 1900 the Key West establishments, which were valued at $90,400, employed 67 persons, whose wages amounted to $25,978. At Tarpon Springs, in the same year, the sponge establishments were valued at $9,332, and gave employment to 57 persons,

VESSELS AND KRAALS AT BAILEYS BLUFF.

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whose combined wages amounted to $17,969. Property is much less valuable at Tarpon Springs than at Key West, which explains the great difference between the two places. The employes come under three classes, viz., "clippers," who clip the sponges and sort them; the "pressmen," who bale the sponges; and the draymen and common laborers. The "clippers" are paid about $1.50 per day, the "pressmen" about $2 per day, and the draymen and laborers about $1 per day. At Key West very few buyers own drays, preferring to hire them when needed.

Burlap, which costs about 10 cents per yard, delivered, and jute rope, with diameters of one-fourth and three-eighths inch, worth about 7½ cents delivered, are used in baling the sponges. Formerly sisal rope was employed, but as it was found that jute rope could be secured at a much lower price, and would answer the purpose, the latter is now used almost exclusively.

In baling, each kind is kept by itself. For the general trade sheepswool sponges are packed in 15, 30, and 50-pound bales. The medium-size sponges are placed in the 15 and 30-pound bales and the large ones in the 50-pound bales. The yellow sponges are packed in 30, 40, and 50-pound bales; the medium-size in the 30-pound bales, and the larger sizes in the 40 and 50-pound bales. The grass sponges are generally packed in 50-pound bales, while the velvet and glove sponges are packed in 30 and 50-pound bales. The above weights represent the net weight of the sponges in each bale. The burlap, rope, and twine usually add about 2 pounds to the net weight of each bale. Bales weighing differently from the above are also put up, but only for special orders. In baling the sponges, presses very much resembling cotton compresses are used. The screw is purchased, but the framework is erected and the screw adjusted at the warehouse.

The great evil in the sponge business at the present time is the loading of sponges. Sheepswool sponges are nearly all loaded, while occasionally lots of yellow and grass sponges are also adulterated in this way. The loading is done for the purpose of increasing the weight of the sponge. Rock salt, glucose, molasses, lead, gravel, sand, and stones are the substances generally used. Most of the warehouses have watertight bins in which glucose or molasses, sand, and rock salt are mixed together in water. According as more or less weight is desired, the quantity of certain of the ingredients is increased or decreased. The sponges are thoroughly soaked in this preparation and are then run through an ordinary clothes-wringer, or laid on an inclined rack and allowed to drain into the bin. Some years ago the loading of sponges was quite common, and became such an evil in the trade that an agreement was made by the dealers that loading would be abandoned. This agreement was lived up to until within the last two or three years, when certain dealers resumed the practice. As the loading enabled the buyers to pay more for their sponges and still not increase the price to their customers, the buyers who had not taken it up were compelled to do so in self-defense. Most buyers would gladly abandon the loading if the agreement was made unanimous.

No sponges are bleached at the warehouses in Florida, this part of the business being done at the wholesale houses or by the jobbers in the trade. Small sheepswool sponges are quite generally bleached, as it gives them a better color. The bleaching of the yellow sponge, and the consequent great improvement in its hitherto poor color, has made it more attractive, and the increase in its value during the past year has been quite remarkable. Owing to the prevailing high prices for sheepswool, it is supplanting the latter for many purposes. In bleaching, lime and acids are used. This bleaching undoubtedly injures the sponges, as it weakens the fiber and considerably shortens the period of its usefulness. The spongers bleach a few sheepswool. They are usually washed in soapy water and, after being covered with soap-suds, are hung up on poles on shore or on the masts of the boats. The action of the nightly dews and the sunlight in conjunction with the soap-suds bleaches them to a beautiful white or golden color in one or two weeks. This manner of bleaching preserves the fiber of the sponge intact, and it is as durable when bleached as before. These sponges are either given away by the spongers or sold to the merchants in Key West, who sell them to tourists.

THE CENTENARY OF KANT.

A HUNDRED years have now passed since the death of Kant. On February 12 the great philosopher died at Königsberg, in East Prussia, where he spent practically his whole life, a long, laborious, and ascetic one, in the single-minded and ardent service of science. That his teaching created a remarkable epoch in the history of thought, an epoch, indeed, to which we refer and by which we estimate, of necessity, all subsequent developments, will not be disputed, and so important a centenary has naturally claimed the attention of the whole cultivated world. Immanuel Kant is so much akin to some of our English writers, notably Locke and Hume. Was it not Hume who, in his own words, "roused hir from his dogmatic slumbers;" and, moreover, does he not himself tell us of his Scottish ancestors, who, in some respects, so much influenced him, that England may well join with Germany in paying a tribute of reverence to his memory? Kant literature is so voluminous already, and the story of his life, so far as he had a life apart from his work, has been so well told, that little remains to be said beyond a brief reference to his intellectual affinities and to the relationship of his critical philosophy to the existing world of physical science, to compare, in other words, the *a priori* and ideal with the naturalist and *a posteriori* results. An antithesis between these two halves of thought has ever been a prominent feature in our efforts after knowledge, though of late it has grown to be regarded as a convenience in classification rather than an absolute distinction. For many of us the policeman still acts as the representative of ethics, and we are seldom transcendental except in personal instincts. It is also incontestable that

"Until this paragon of spheres
By philosophic thought coheres,
The vast machine will be controlled
By love and hunger as of old."

But in rational development nothing pleads more urgently for reconciliation in the future than these two great currents of human activity, one of which owes so much to the genius of Kant and the other to the indefatigable energy of recent research.

So many and so varied workers have been animated by the spirit of Kant, conscious or unconscious of their debt, that there is a danger of overlooking the strength of his influence. Most can raise the flower now, all have got the seed, and even such dissimilar minds as Hegel, Schopenhauer, and von Hartmann are truly consequent on Kant. A whole army is the better equipped for the "celestial panoply" of that solitary epoch-maker, lifted above the merely objective events of his age to his *bestirnte Himmel* by a torrent of thought setting inward, centripetal, rather than centrifugal. So fine a mind, frailly supported by a delicate physique, yet disciplined to a rigorous austerity in matter and spirit, was surely destined to fame. The philosophic habit cannot be put on like a garment. It is all or nothing. To be influenced at all is to be responsive in every fiber; and with Kant the relation of the mind to its world was the San Graal of his quest—his religion. It was for him, too, its own reward, and almost the sole one, though in time he gained more of contemporary fame than comes to some of the great ones of the earth. For, as Spinosa says so deeply, "He who loves God truly must not look to be loved by Him in return."

It is interesting to note that the manner of Kant's intellectual development, as instanced in the chronological record of his work, is from the simpler to the more complex, from the physical to the psychical. It may be pointed out in this connection how solid was the foundation of empirical knowledge upon which he based his epistemology, and this is surely the *sichere Gang der Wissenschaft*. In this long period of apprenticeship we may trace the workings of that marvelous intuitive faculty which he employed in the more abstract realms. His treatises on physical subjects traverse a wide range. In "Thoughts on the True Estimate of *Vis Viva*" he shows the Cartesians and Leibnitzians to be fighting about different things. The dispute was due to incorrectness of definition as to the meaning of force, but it is only fair to say that Kant's views, unknown to him, had been anticipated. In another essay he affirms that the earth's rotation is slowly retarded by the action of the tides. But the "General History and Theory of the Heavens," of 1755, was a more ambitious work. He was then aged thirty-one, and at the height of his speculative power; extending the cosmographical conceptions of Newton to the whole phenomenal cosmos, he introduces for the first time the conceptions of the nebular theory. Though worked out more fully in its details by Laplace at a later date, this soul-stirring thought owes its essential origin to Kant, and may well be associated with his name rather than with that of the great Frenchman. This efflorescence of Kant's comprehensive outlook has been the greatest triumph of cosmography since the publication, some two hundred years earlier, of the "De Revolutionibus Orbium Cælestium." And in his later work Kant was another and no less influential Copernicus who showed how the planet feelings circle round the constructive and illuminating mind, where erstwhile that sun of reason had been held the satellite. He, too, divined that Nature, in its silent unplumbed depths of space and mind, holds more than earth and man.

The growth of the body of knowledge since the death of that old man in Königsberg may be held to show more of bulk than of differentiation. Yet when we look to the fact that he forged a weapon of research, ready to the hand of all, rather than spend his labor within the meshes of a system such as those woven by Comte and Spencer, we find cause for saying that Chronos does not always devour his own children. We are all thinkers, on our several planes, and the struggle for existence forces us to acute thinking at times, but we commonly fail to shut out the seeming discord between speculative ideals and experience. The pressure of that "unconscious" which according to von Hartmann molds our lives may seem the agent in advance of materialism, though the moral sphere is not yet wholly at its mercy. The universal practical acquiescence in the dogmas of conduct still silences theoretical doubt. In spite of the gigantic accumulation of scientific facts, no Œdipus has yet returned an answer more permanently satisfying than that which was given by Kant to the central question of the sphinx of life, as to the conditions of all and any knowledge and of the meaning of personal identity, which must always most strenuously exercise our highest faculties. If there has been any marked shifting of ground, it has been toward the region of personal experience, a return to the principle of *cogito, ergo sum*, a principle of more metaphysical treasure than Descartes himself discovered. The living and dynamic nature of the self has come to stand out in more striking relief. The self-realization of Hegel and the will of Schopenhauer, ideas so typical of the resolute individual character of western ethics, will illustrate one of the many lines along which Kant's impulse has acted. In nothing is he more emphatic than in urging the necessity of a critical inquiry into the foundations of knowledge before attempting to deal with the opposing dogmatisms of physics and metaphysics, and it is just the validity of his own *Kritik* which has made the later times so productive of reconstructions. The parts in our vast system of knowledge have at the same time become more and more related to an organic whole. More and more has the analogy of the living organism, with its parts in the whole and its whole in the parts, become descriptive of the body corporate of thought, and it may perhaps be said that it enters into our conceptions of the whole of being. Perhaps the full result of this idea in its religious aspect has not yet been realized. Certainly the living purpose of the abstract physical law has not yet been successfully formulated either by transcendentalist or materialist.—Alfred Earl, in Nature.

PRODUCTION OF GLASS SAND IN 1902.

PLENTY of sand mankind has always had, but the discovery of sand that would make glass it owes to a fortuitous circumstance, if that ancient encyclopædist, Pliny the elder, can be trusted. When those observant old Phœnicians of his story rested their cooking pots on blocks of natron and found that a shining, translucent substance, unknown to them, had been produced under the heat by the union of the alkali and the sand of the seashore, they probably did not realize that the quality of the sand had anything to do with this unexpected transformation. That it must have been sand rich in silica we now know. In all our country there were only ten States that produced in 1902 sand sufficiently siliceous for the manufacture of glass. These States are given in a report by A. T. Coons, on the "Production of Glass in 1902," published by the United States Geological Survey as an extract from the annual volume of Mineral Resources. They are Illinois, Indiana, Maryland, Massachusetts, Missouri, New Jersey, New York, Ohio, Pennsylvania, and West Virginia, and their total production of glass sand for 1902 was 943,135 short tons, valued at $807,797.

Small quantities of glass sand have also been quarried in Henry County, Tennessee; in Richland County, South Carolina; and near Lumber City, Montgomery County, Georgia. In Florida the natural deposits of sand, although very fine, contain, as decomposed coral, too much calcium oxide to be suitable for many kinds of glass. There are undeveloped deposits in other non-producing States, and some undeveloped deposits in States that are already producers.

The value given for the glass sand is the value of the sand free on board at the quarry or mine, and does not include freight or transportation. If that were included, it would raise the value considerably, as most of the sand mined must travel far before it reaches its final destination at the glass works. The values range from 50 cents to $2 a ton, according to the purity of the sand, the cheapness of labor, and the ease with which the sand can be obtained.

Pennsylvania leads the States in point of production, having 356,209 tons to her credit. The greater part of this was mined by the Pennsylvania Glass Sand Company, of Lewiston, although seven other companies are engaged in the same business in other parts of the State. The Pennsylvania sand occurs both as a sandstone, which needs to be quarried, crushed, and prepared for use, and as a rock that disintegrates quickly when exposed to the air and moisture.

Illinois, with an output of 215,012 tons, ranks second as a producer of glass sand. The product of this State is used in plate-glass works in the vicinity of Chicago and in Indiana, and is also shipped to flint glass works in the West. It is used in furnaces for steel molding and as sand for sawing and grinding stone at various quarries. The deposits in this State occur mostly as sand, which requires but little labor to make it fit for use. The sand that makes the best glass is, however, treated with water and steam, being thoroughly washed and dried before it is shipped.

Third on the list is Missouri, with a production of 134,587 tons. The deposits of glass sand in Missouri are among the important ones of the West. Sand from this State is also shipped to the East. The sand occurs as sandstone and is taken out with picks and then crushed.

Massachusetts produced only 8,923 tons of glass sand, less than any of the other States, but its product had a value of $17,846. The glass sand of Cheshire, Berkshire County, is especially valued for its use in the manufacture of the best flint glass. It is also employed for filtration purposes. It is found at a considerable distance under the ground and contains moisture. The grains adhere sufficiently to give the rock an appearance of solidity, but it is easily crushed. It is then carried by running water through a series of sieves, is spread out, and dried.

The glass sand quarried in New Jersey is highly refractory, and is used extensively in furnaces for steel molding.

The quality of glass depends chiefly on the quality of the sand used in its manufacture. The essential constituent of glass is silica, the only material that enters into all varieties of glass. The chief of the other constituents are the oxides of soda, lime, potash,

and lead. The oxides of zinc, tin, barium, and antimony are also occasionally employed. The oxides of manganese, gold, cobalt, tin, arsenic, copper, iron, and aluminium are found in glass as coloring matter, as impurities, or as material for the correction of impurities. Iron is the chief impurity, and often can be removed only by the use of magnets. Alumina and clay give a cloudy appearance. Freedom from color, absolute transparency, and exceeding brilliancy are the essential characteristics of the finest glass, such as flint, plate, and cut glass, and only the purest sand can be employed in its manufacture, as even slight impurities tend to destroy these effects. In some cases these impurities may be dispelled to a large extent by washing or by burning when there is much organic matter present. The metallic color may be removed by the use of chemicals.

The report contains tables in which analyses are given of the principal glass sands of the United States and analyses also of certain European sands.

ON PURSES; A PURSE; AND A PRIORY.

AMONG the many articles of personal and domestic utility, fit and wont to be the objects or more or less artistic decoration, which have been described by pen

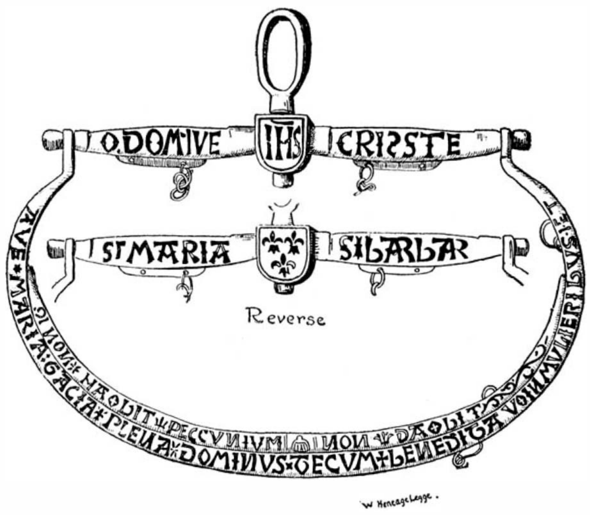


FIG. 1.—BRASS FRAMEWORK OF A PURSE FOUND IN MOAT OF BINHAM PRIORY.

or pencil, purses and pouches seem to have attracted little attention. Possibly this may be accounted for by the all-absorbing attraction of that commodity usually carried or contained in them, namely, money; a commodity, indeed, so desperately desired and sedulously sought that even souls are said to be bartered for it.

In the beginning of man's history the procurement of such necessaries of life as were not obtained by his individual effort, was effected by the exchange between purchaser and vendor of the actual articles themselves; and even into historic times such methods continued to be very commonly in operation. The Phœnician merchants who passed the Pillars of Hercules and sought the coasts of the Cassiterides, exchanged in bulk their corn and oil, their fabrics and their fruits, for the tin, copper, silver, and lead which the labor of the natives extracted from their mother earth.

Throughout the ancient world, cattle for corn and corn for cattle was the essence of commerce; and sheep and oxen passed in body in exchange for wheat and barley in bulk. The inconvenience of this could not but be felt even at an early period in the development of mankind; and, in consequence, the substitution of some portable article, which should be universally recognized as representative or symbolic of value, became necessary. So ancient, hereditary, and ingrained was the association of cattle with buying and selling, that portions of the hides of animals cut into disks, and stamped, appeared to be the fittest symbols of value. So, too, when portions of various metals of differing form and weight came to assume the same function, the word "pecunia," originally attached to cattle, came by the same association of ideas to be

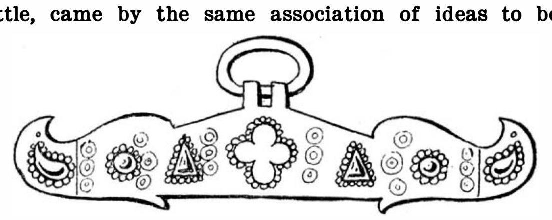


FIG. 2.—BRONZE TOP-BAR OF PURSE FOUND IN FRANCE IN 1856.

used for the coin, the symbol, *inter alia*, of sheep and oxen.*

At first, solid pieces of metal served as money; afterward these came to be perforated for convenience of carriage (as they are to-day in the Far East). A further devlopment in this direction was that of ring-money; such as has been found in British interments; though, as Cæsar tells us, at the time of the Roman invasion of this island, the natives used pieces of copper and iron, of assigned weight, for money. With the advance of society and the universal application of the niceties of science and art to almost everything of man's invention and use, money eventually evolved into that form, everywhere essentially the same, which has been known and used by civilization these two thousand years and more past.

The portability of money on a string being thus for ever doomed, other means for its carriage, and for its keeping or concealment, became necessary, and hence came into use little boxes of wood, ivory, or metal.

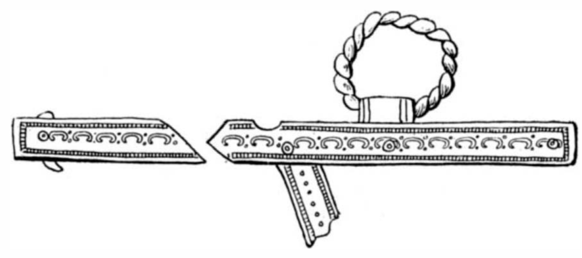


FIG. 3.—SILVER FRAMEWORK OF A PURSE FOUND IN A TOMB AT BRIGHTHAMPTON.

These must soon have been superseded by receptacles more in the nature of purses, as we know them, for Juvenal mentions money bags of soft leather; and Plutarch describes them as having been closed with strings. Such a bag, or purse, was called "Crumena" or "Sacculus." Suidas mentions purses of goat-skin; and at this period probably pigs' ears—preferably sows' from their size—were used for the same purpose; from which the well-known proverb arose. A more delicate receptacle was made from the whole skin of the soft-coated mole —a practice wnich is still in use in rural communities. The purses of the Saxons were called "Pûse;" their more permanent receptacle, "the money-box," was termed "Teage," and was placed under the care of the housewife. In the Norman period the purse was called "Aulmonière," eventually contracted into "Aulner" or "Alner." At a later date the Mediæval-French word "gipcière" or "gypciere" was used to designate more particularly the form of purse which, in the fourteenth and fifteenth centuries, was constructed of silk, velvet, leather, or canvas, according to the rank of the wearer, on a framework of metal. Brass was that most commonly employed, but silver was not unknown in this connection. The essential features of these frameworks were a top-bar, and a ring for suspension from a girdle, or for holding on the finger, the larger ones having in addition one and sometimes two semicircular hoops of the same metal, to which one border of the silk or leather covering was sewn. Occasionally a sub-bar moving on a central pivot was employed to carry one border of the bag part of the purse, by turning which the receptacle was opened or shut. The more costly of these purses were

FIG. 4.—PURSE-FRAME FOUND NEAR YARM.

embroidered in gold, silver, and colored silk thread. Chaucer, describing "the Franklin," says:

"A gipciere all of silk
Heng at his girdel, white as morwe milk;"

while elsewhere he speaks of a purse "tasselled with silk and pearled with latoun," i. e., studded with beads of "laten," an alloy much used in the Middle Ages, even for sacred utensils.

Remains of these brass-framed purses, pouches, or wallets have frequently been found. At first their nature was quite misunderstood; seventeenth and eighteenth century archæologists being very much puzzled by them. Some conjecture these top-bars (the parts most usually found) to be part of the Roman Vexillum; others that they were the beams of some balance of antiquity.

Though they are usually assigned, in the main part, as regards their origin, to the fourteenth and fifteenth centuries, those having a top-bar can claim a far higher antiquity, as the beautiful silver and gemmed relic unearthed on the Continent in 1856 will show, for the learned assigned it an origin as far back as the eighth century. This little work of art affords another instance of the affection of both Celtic and Teutonic races for the animal form adapted to decorative art, the termination of this top-bar evidently representing hawks' or eagles' heads with eyes of colored glass or gems.

The finest of all these frameworks of mediæval purses hitherto unearthed is one which has been for three generations in the possession of the writer's family. Found in the early part of the nineteenth century in the moat of Binham Priory, in Norfolk, by some favor of fickle Fortune or some peculiarity of position, it shows scarcely a trace of the touch of Time or accident. The metal is unrusted; the niello of the inlaid lettering absent from but a few letters; tne secondary semicircular flap, so usually wanting, entirely intact; and the twists of brass wire still present which once fastened the pouch to its framework. From the thickness of the brass wire it is evident the purse must have been of leather. The accompanying drawing will show the character of this mediæval wallet better than any description. There are, however, some points of peculiarity to which attention may be drawn with advantage; particularly to the Lombardic lettering, in, for instance, the peculiar and differing forms of the letter T in "St. Barbara" and "St. Maria," and in the curious double S in "Crisste." Every one of these peculiarities is to be seen in the top-bar of a similar purse in the British Museum, where the curious reader may see a collection of kindred relics in Case A in the Mediæval Room. So exactly are the peculiarities in these two top-bars resembled, that the brass of each must have been cast in one and the same mold.

About the same time in the last century a somewhat similar framework was discovered. It is of very inferior workmanship, the lettering in particular being ill designed and worse executed. It is noteworthy, however, in being almost the only one of these relics found in association with human bones; in this case probably the remains of the owner. It was disinterred

FIG. 5.—TOP-BAR OF MEDIÆVAL PURSE OR WALLET. (FIFTEENTH CENTURY.)

near Yarm, when the railway was in process of making. In addition to the bones and the brass, a few wooden beads were found, but no coins of any kind. These facts seem to indicate that the remains were those of the religious, with wallet and rosary; and readers with a romantic turn of mind may further conjecture that the body being found in a secluded, unconsecrated place, with no money near the purse or anywhere about the spot, points to the probability that some mendicant friar was murdered here for the sake of the coins his wallet may have contained. The shield on the beam of this purse had the device of two V's interlaced, one being reversed, which is often found on these frames, the meaning of which appears to be unknown. In addition to the Angelic Salutation which is so commonly engraved on these relics, this purse-frame has the words "Soli Deo honor et gloria" and "Creator celi et terre et in prpum."

Another of these relics was found at Selborne in 1811 in grounds the property of Gilbert White's family. Like the last described, it has the Angelic Salutation and the double V monogram.

Yet another, also illustrated, has the same monogram, but a different legend, which is, however, practically unintelligible. It appears highly probable that in many cases the lettering on these brass frames was executed by illiterate handicraftsmen, working possibly from copies badly written and partly illegible to those unacquainted with Latin and its usual abbreviations. These purses or wallets were the largest kind of portable receptacles for money; the larger ones, measuring 7 inches long and 5 inches deep, are those most commonly found. Smaller purses, ranging down to half those dimensions, are rarer, and generally consist of the top-bar only. Yet even they were intended to be carried at the side or waist, suspended by a band or strap, as the small one here illustrated manifestly evidences by its broad and deep flattened ring through

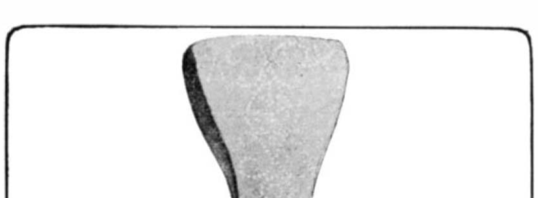


FIG. 6.—TOP-BAR OF SMALL PURSE (BRITISH MUSEUM).

which a belt no doubt was passed. These wallet-purses hardly survived the sixteenth century, a smaller style of lighter material and more slender frame supervening. Silk, linen, and fine canvas came into use for this purpose, embellishment with embroidery being added. Some purses were entirely without any metal framework, consisting of small bags, both elongated and square in shape; the mouth drawn together by strings. These are the forms the most usually decorated with designs in colored threads or silk. A beautiful specimen of an embroidered purse is to be seen in the British Museum, in the same case with the metal-

* "Pecunia dicta est a pecudibus eo quod primo fiebant de corio pecudum." (Sprott's Chronicle memb. 2.)

framed wallets. It is a square bag, less than four inches in depth and width, and is closed by long strings. Its groundwork of silver cloth is beautifully decorated with five embossed flowers, one central and four corner conventionally designed blooms with stems of gold thread. The colors are too faded to be described.

The place of discovery of the brass gipcière, now in my possession, was the moat of Binham Priory, in Norfolk. A certain amount of the history of this religious house has come down to us, although it occupied a somewhat subordinate position among kindred establishments, being but a "cell" of the greater St. Alban's. Whether, like that celebrated monastery, it was of Saxon foundation is not known; but some of its architecture dates from quite early Norman times. Its long nave was divided from its north and south aisles by an arcade of eight semicircular arches, above which was a triforium of smaller but similar openings, above which rose a clerestory of eighteen arches arranged in triplets, the central light of each being larger and higher than its two side openings. At some subsequent period, notably the Decorated, the church was extended westward, as a new Pointed bay in the nave arcade shows, with two similar openings in the triforium above, and three in the clerestory. These Norman arches in nave, triforium, and clerestory were enlivened with various moldings characteristic of the style, such as chevron, billet, and lozenge. At the east of the nave opened out, through high round-headed arches, the transepts. The early English west end was of very graceful proportions, though the doorway was small, completely eclipsed, as it were, by the great west window. The wall on each side of the door was relieved by a blank or blind arcade of two double arches, their heads filled with Pointed sexfoil, the spandrels with Pointed trefoil tracery. Above each outer arch of this arcade was a buttress-like projection, doubtless containing, inside, the stairway to the triforium ambulatory. The faces of these were paneled with two long round-trefoil-headed arches, the inner ones pierced with a narrow elongated light. The west window was of two main lights, each again divided into two. A large circle occupied the head of the main window; a smaller one each of the two lights. In its original state, with its tracery intact, this "wide window, westward"—as "Piers Ploughman" hath it—filled with "gay glittering glas, glowyng as the sunne," must have been a glorious sight. The foundation, endowment, and maintenance of a conventual establishment boasting so fine a church as this must have made some considerable demands upon the lands and finances of the faithful. It owed its origin to Peter de Valoniis, a Norman baron upon whom the Conqueror had bestowed various lands and manors in Norfolk. What special claims St. Alban had upon this baron does not appear, but it was as a cell to the monastery of that saint that Binham Priory was founded. Peter's charter of endowment reads as follows, somewhat abbreviated, and translated:

"Be it known to all men present and to come that I Peter de Valoniis and Albreda my wife with the consent of my sons William and Roger and with the advice of my nephew Walter and others my men and friends and with the assent and license and by brief of King Henry my lord and Queen Matilda do give and concede to God to St. Mary and to St. Alban the church of St. Mary of Binham and the whole manor with lands meadows woods and marsh and homage as fully as I have held that manor from the King reserving or retaining nothing to myself or my successors unless it be somewhat of divine recompense but I wish and grant that my heirs and successors may be the guardians and defenders of that church and vill I grant also to the said church two parts of my tithes in Dersingham and Ingulnesthorp of my demesne and two parts of the tithes of my knights who hold lands of me in Northfulch by their assent indeed and goodwill These are the manors the tithes of which I give to the aforesaid church Biburg which Ralph Facatus holds and Snaringa and Toftes which Richarde Spineto holds of the said Ralph and Testurtuna and Biburg and Wodedallinga and Saxselingham which Thurold holds Walsingham which Humphry holds Berneya which Walter Dapifer holds Babingleya which William de Rudham holds and Appletona which Turgisius holds and Patesleya which Roger holds. Be it known that my aforesaid knights when dead if they die in England are to be buried at Binham and their bodies honorably received by the monks." Then follows: "The donation and gift of this beneficent grant Peter de Valoniis and Albreda his wife and the men of his demesne and of St Mary and St Alban offered upon the altar of St Mary of Binham in the presence of Richard abbot of the church of St Albans who celebrated Mass there there being present Robert abbot of St Edmunds Richard abbot of St Benedict of Holme and Lambert prior of Acre." This charter was confirmed by King Henry I., and also by Roger, son of the founder; by Roger's son Peter de Valoniis, junior, who adds the information that he confirms the grant "for the safety of the soul of King William, who acquired England, and who gave the said manor to my grandfather." Yet another confirmation was that of a succeeding de Valoniis, Robert by name. A kingly gift of some considerable importance in days when trade was less fixed to one place or particular shops was the grant of a fair and market which the same monarch made to the Prior and convent. He also gave them "libra warenna," or rights of hunting, another valuable concession; for in the days when there was little or no keep for cattle during the winter such a grant was a matter of as much practical value as of pleasurable exercise and sport. All these gifts, grants, and charters were confirmed at various times by succeeding kings; by Richard I., Edward III., and Henry IV., the latter adding to his confirmation of market, fair, and free-warren the words "ac aliæ amplæ libertates." Smaller gifts were bestowed upon this Priory in great numbers; in the twelfth century Helewisa de Wendenal gave a mark of silver of her share of the Mill Steneheye, with the view and condition, however, that the monks "should celebrate her anniversary" and "provide a wax candle to burn before the altar of the Blessed Mary every day at Mass." A more

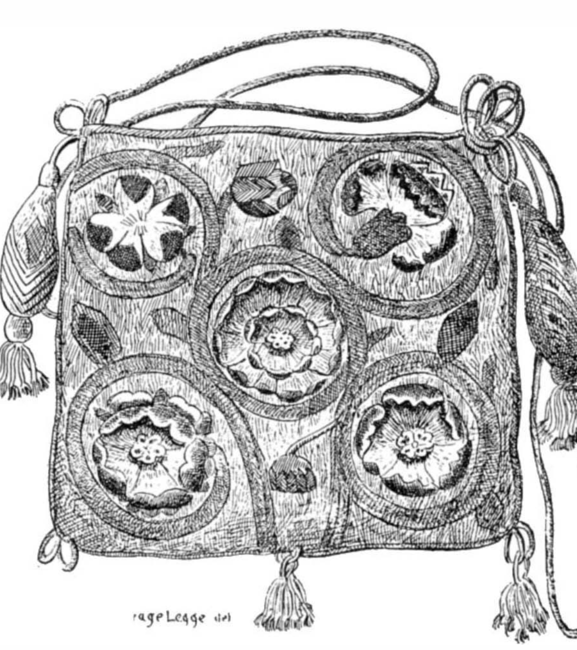


FIG. 7.—EMBROIDERED PURSE (BRITISH MUSEUM).

celebrated person, Earl Reginald de Warenne, gave "xxs from the Mill of Wichton." A certain Ralph de Candos gave three acres of land at Hindringham. Several citizens of Norwich gave houses and lands within that city; while another member of the house of Valoniis gave three plots of land in London to this favored Priory.

As might be expected, some of its many endowments were the gifts or legacies of clerical devotees. Thus in the beginning of the fourteenth century Galfridus de Gunthorp, chaplain, gave seven acres of land in Gunthorp "in pure and perpetual charity" to Robert de Waltham, prior of Binham. About a hundred years later, Simon Baret and others gave the manor of Pakenhamhill in Dersingham.

All these manorial endowments were of much greater value to their possessors in days of old than those unacquainted with mediæval methods of land tenure would imagine. The greater number of the tenants holding lands under the Prior and Convent, as well as the "landless" men of the manors, were bound to render a series of services to the lord, of such a nature that his lands were plowed and harrowed, his crops sown, reaped and ingathered; his sheep tended; his swine "pannaged" in the woodlands; his cattle herded in the pastures; his very errands run practically free of cost to himself, save in a few cases where the custom of the manor bound him to supply a small dole of bread and drink at midday to the worker; or, in addition, to allow him certain perquisites, such as, at

FIG. 8.—BINHAM PRIORY. WEST FRONT. 1790.

haymaking, as much grass as he could lift on his scythe on each mowing day. Then there were, too, the various customary rents paid in kind, such as with eggs at midsummer and hens at Christmas. The "Chartulary" of Binham, now in the British Museum Library, in addition to the various transcripts of its early charters, as quoted above, contains a "customary" of the various manorial rents and services, with names of lands and tenants; all of great interest, but too lengthy to be treated of in these pages.

Supplementary to private and lay donations and privileges, the powers ecclesiastical were not forgetful to favor this religious house with various liberties, immunities, and exemptions. More than one Pope—"servant of the servants of God"—showed it the light of his countenance. Celestinus, for instance, granted to the Prior and Convent exemption from excommunication at the hand of bishop or archbishop, as well as a more practical privilege of immunity from summons to Synods.

With all these lay endowments and Papal privileges, it is small wonder that this "cell" to a greater house came to regard itself as almost self-sufficient and semi-independent. Sir Richard Riche, agent in destruction to Thomas Cromwell, says of it: "I have fynes and other matters of record levyed by them and not namyng the Abbott of Saynt Albanys. Also contynually they make leasez under their own seale not namyng the Abbott."

On the other side of the picture of rich endowments and wide possessions, we find a few records—for we must imagine many only recorded in the chancellery of Heaven—of gifts and favors bestowed, in their turn, by the Prior and his monks, such as grants of land, manumissions of serfs. In the latter matter we might expect to find the Church foremost, and such may be the case, though I am not aware of any statistics favoring the view. Some, indeed, of the church's manumissions were qualified by some condition or clause in a manner indicating a certain reservation and want of whole-heartedness in the gift of freedom. Thus, in 1361, Islip, Archbishop of Canterbury, in freeing a certain serf on his manor of Framfield, in Sussex, "with his sequela," retained one unfortunate member of the family that he and his descendants for ever might remain as serfs upon the demesne. Let us hope that when in the reign of Henry VI. our Prior of Binham freed a certain John Warin, "villein of our manor," he made no such far-reaching reservation.

As regards their grants of land, an ancient deed (A. 3958 P.R.O.) affords an instance, whereby Peter, Prior of Binham, in the twelfth century granted land in Westleya to Gunora de Estferia for life or until she should take the veil.

The time was now approaching when Binham could not hope to escape the prevalent disestablishment and confiscation taking place throughout the land. The "Valor Ecclesiasticus" affords what we may readily believe to have been a comprehensive catalogue of the income and possessions of Binham Priory. A list of Norfolk manors and rectories paying tithes and pensions to the Prior and Convent includes Eggefelde, Westrudham, Parva Biburg, Magna Biburg, Ingaldesthorp, Walsingham Parva and Magna, Sandringham and the Priory of Westacre; some of these we learn for the first time to have been contributories to Binham. The value of the whole is summed under St. Alban's valuation in these words: "Prioratus de Binham in Comitatu Norffolc cella dicti monasteri in temporalibus et spiritualibus per annum clare valet 140 £ 5s. 4d. Decima inde 4 £ 6. 0½."

The greater part of all this was swept into the royal coffers or into those of the favorites of the hour. A certain amount remained, however, for religious purposes, some passing to the Cathedral of Norwich, such as the manor of Binham itself, together with Feldalyng and Hyndryngham. The agent of this confiscation was, as we have seen and quoted, Sir Richard Riche. The whole letter which he wrote to Thomas Cromwell on the subject is as follows:

"My lorde I entende to suppresse Bynham before my retarne, which pretendeth hittself to be a sell to Seynt Albonys, yf ye advertyze me to the contrarye. I have fynes and other matters of record levyed by them and not namyng the Abbott of Saynt Albanys. Also contynually they make leasez under their own seale not namyng the Abbott."

The last prior was John Albon; and with the mere mention of his name we now draw to a conclusion our account of the ancient Priory of Binham; the first account, I believe, to have been put together.—W. Heneage Legge, in the Reliquary and Illustrated Archeologist.

SOME NEW PHOTOGRAPHIC CHEMICALS.*

By DR. H. SCHWEITZER.

PHOTOCHEMISTRY has only recently been taken up by the German synthetic chemist, but the results already accomplished are most remarkable. Hitherto the aim has chiefly been the discovery of new developing substances, but lately other steps of the process for the production of photographic pictures have been scientifically investigated, which researches have resulted in the introduction of new chemicals that have greatly simplified the art and have attracted to it an ever-increasing number of devotees.

Speaking first of developers, it was not until 1882 that hydroquinone appeared as a competitor for the old reliable pyrogallic acid, $C_6H_3\left\{\begin{matrix}OH\ (1)\\ OH\ (2)\\ O\ \ \ (3)\end{matrix}\right.$ which was first recommended as a developer by Archer in 1851. Hydroquinone $C_6H_4\left\{\begin{matrix}OH\ (1)\\ OH\ (4)\end{matrix}\right.$ was found to possess excellent developing properties, and since a developer ready for use that would keep for weeks could be prepared with hydroquinone, it soon became very popular. As a matter of fact, the simple process of developing with hydroquinone, by virtue of its durability and cleanliness, created the great army of amateur photographers, development with pyro being so complicated and difficult that only professionals and people with a scientific bent of mind cared to go to the

* Read before the New York section of the American Chemical Society.

trouble of developing pictures, it being then more of a labor than a pleasant pastime.

The introduction of hydroquinone also paved the way for the synthesis of new developing substances. Whereas up to 1882 only iron oxalate and pyro were used as developers, the developing properties of hydroquinone and its chemical relationship to pyrogallic acid showed that there must be certain relations between chemical constitution and photo-chemical qualities.

Andresen was the first one to make use of such theoretical deliberations, and after having found that not only di-oxy derivatives of benzol and its homologous and analogous bodies, but also amido-oxy compounds possess developing properties, he proposed in 1889 the use of eikonogen as a developer. Eikonogen, the trade name for the acid sodium salt of amido-betanaphtholmonosulpho acid, on account of its fine properties and convenience of use soon became a great favorite of the already very large class of amateurs.

In 1890 there followed in quick succession the introduction of rodinal, a concentrated solution of para-amidophenol sodium, metol, the sulphuric acid salt of monomethylpara-amidometakresol

$$C_6H_3\left\{\begin{matrix} NHCH_3 & (1) \\ CH_3 & (2) \\ OH & (4) \end{matrix}\right. \qquad \frac{(H_2SO_4)}{2}$$

Amidol, orthoparadiamidophenol,

$$C_6H\left\{\begin{matrix} OH & (1) & \\ NH_2 & (2) & HCl. \\ NH_2 & (4) & HCl. \end{matrix}\right.$$

Glycin

$$C_6H_4\left\{\begin{matrix} OH & & & (1) \\ NH. & CH_2. & COOH & (4) \end{matrix}\right.$$

To be followed by adurol, a halogen derivative of hydroquinone, and by ortol, a combination of methylorthoamidophenol and hydroquinone; and diogen, the sodium salt of amidonaphtholdisulpho acid.

$$C_{10}H_4\left\{\begin{matrix} NH_2 & (1) \\ OH & (2) \\ SO_3Na & (3) \\ SO_3Na & (4) \end{matrix}\right.$$

In 1899 Eichengrün found a new method for the preparation of oxyalcohols of the aromatic series.

He allowed formaldehyde to react on salicylic aldehyde in the presence of concentrated muriatic acid, but instead of obtaining the expected methylenedisalicylic aldehyde, $CH_2\left\{\begin{matrix} C_6H_3\left\{\begin{matrix} OH \\ COH \end{matrix}\right. \\ C_6H_3\left\{\begin{matrix} COH \\ OH \end{matrix}\right. \end{matrix}\right.$ he obtained under intermediate formation of chlormethylic alcohol ($Cl.CH_2OH$) a body of the constitution,

$$C_6H_3\left\{\begin{matrix} OH \\ COH \\ CH_2\,Cl. \end{matrix}\right.$$

By heating this substance with water, chlorine is substituted by OH, and the body

$$C_6H_3\left\{\begin{matrix} OH \\ COH \\ CH_2\,OH \end{matrix}\right. \text{ is formed.}$$

In extending this reaction Eichengrün found that other oxy derivatives containing strong acid radicles in the nucleus such as carbonic acid and their esters, nitro and halogen derivatives of phenols could be substituted for the aldehyde of the first example; sulpho acids, however, could not be used in the reaction. Salicylic acid, for example, gave a product of the following constitution:

$$C_6H_3\left\{\begin{matrix} OH \\ COOH \\ CH_2.\ Cl. \end{matrix}\right.$$

And by treatment with water, $C_6H_3\left\{\begin{matrix} OH \\ COOH \\ CH_2OH \end{matrix}\right.$ para-oxy-methyl salicylic acid.

If the intermediary product is treated with phenols in the presence of a condensing agent, chlorine is substituted by the phenol radicle and by the use of beta-naphthol, the body,

$$C_6H_3\left\{\begin{matrix} CH \\ COOH \\ CH_2.\ C_{10}H_6.OH \end{matrix}\right.$$

is obtained, which is used in medicine under the name of epicarin, as a non-poisonous dermal antiseptic.

If instead of salicylic acid paranitrophenol is applied in the Eichengrün reaction, then

$$C_6H_3\left\{\begin{matrix} GH \\ CH_2\,Cl. \\ NO_2 \end{matrix}\right. \qquad C_6H_3\left\{\begin{matrix} OH \\ CH_2\,OH \\ NO_2 \end{matrix}\right.$$

is formed.

If this alcohol is reduced, then the amido compound,

$$C_6H_3\left\{\begin{matrix} OH \\ CH_2OH \\ NH_2 \end{matrix}\right. \text{ is obtained.}$$

The hydrochloric acid salt of this meta-amidoorthooxybenzyl alcohol is the new developer called edinol.

Eder divided the developing substances into two classes—the slow developers of the pyro type, to which belong pyro, hydroquinone and pyrocatechine; and the rapid developers of the eikonogen type, rodinal, amidol, and metol.

In considering the chemical constitution of these two classes we find that the pyro class contains only the acid hydroxyl groups, whereas the rapid developers contain amido and hydroxyl groups. The character of the pyro developer is therefore, so to say, acid, and that of the rapid developers more basic.

If we look at the composition of edinol we find that it is chemically between the two classes. It contains one OH group, and one NH_2 in the nucleus, and in addition to it an OH in the lateral CHOH group.

It is of a less acid character than the developers of the pyro class and of a less basic character than those of the rodinal class.

It is further distinguished from all the known developers by having the hydroxyl group in the lateral CH_2OH group. This chemical composition determines the developing properties of edinol. It stands between the two classes of known developers possessing at the same time properties peculiar to itself. Its main properties are, that on account of its great solubility it allows the preparation of concentrated stock solutions. Even with prolonged development it produces negatives entirely free from fog or stain. It does not stain the hands or finger nails, and is not poisonous. It is the best all-around developer, as it is equally good for over and under exposures, plates, films, bromide and gaslight papers. Although very rapid, bringing out the latent picture as quickly as any of the rapid developers, it is under absolute control so that faults of exposure can be easily remedied.

ACETONESULPHITE.

In conjunction with developing substances alkali salts of sulfurous acid, such as sodium sulphite, potassium metabisulphite, etc., are used, in order to protect the easily oxydizable developers against the influence of the oxygen of the air. On account of this action they are called preservatives. The requirements of the photographer have brought about the production of such salts which otherwise would perhaps never have become commercial articles.

Until after 1890 when Schering produced sodium bisulphite in solid form, real sodium bisulphite was unknown, since the liquid sold as bisulphite of soda, etc., was a very impure product which, according to Bothamley, contained only meta bisulphites. This he explained by the fact that the bisulphites in the presence of water cannot exist, but are converted into the meta bisulphites.

Neither Berthelot in 1883 nor Bothamley in 1890, in spite of numerous attempts, succeeded in preparing the pure bisulphite. The normal sodium sulphite with one molecule H_2O was always a commercial article, but the desiccated product was not introduced until after Vogel recommended its use in 1889 for photographic purposes. Again in 1891 potassium metabisulphite in the form of well-formed crystals was first brought into the market by an English firm.

These salts were exclusively used as preservatives until a new product was discovered. It is called acetonesulphite, and as the name indicates, is the condensation product of acetone and alkali bisulphite.

Acetone was recommended by Lumiere and Seyewitz in 1898 as a substitute for alkali in developers. Lumiere and Seyewitz further discovered that acetone, when used in connection with a developing agent, not only replaced the alkali but also possesses valuable properties of its own. It was found to prevent the formation of fog and stains and to exert a remarkable influence on the color of the silver deposits of negatives as well as of bromide of silver prints, and in consequence thereof developers containing acetone were soon in great favor with photographers.

When acetonesulphite was tested in photography by Eichengrün, he thought that it might replace the sulphites as a preservative, and also acetone as a substitute for alkali in developing solutions. In this connection it may be well to add that alkalis act as accelerators in developing solutions. By their use it is assumed that the phenols employed as developers are converted into the sodium or potassium salts of the free phenol, and that the amount of alkali necessary for this conversion would give the best results.

Eichengrün ascertained by his investigation that acetonesulphite possesses the developing properties of acetone and the preserving properties of the sulphites, without, however, acting as an alkali. But he found that it has still properties of its own mainly due to the fact that acetonesulphite acts as a weak acid, whereas sodium sulphite acts as a weak alkali. This peculiar property of even the purest sodium sulphite is due to the presence of sodium dithionate of the composition $Na_2S_2O_6$, to which is ascribed a decided alkaline reaction, whereas the acid reaction of acetonesulphite is due to the fact that the latter product is the acid sodium salt of a sulfo acid.

The acid reaction of acetonesulphite is proved by the fact that, if it is used as a preservative in connection with amidol, alkali must be added, whereas without acetonesulphite, sodium sulphite furnishes enough alkali for development.

Again, acetonesulphite can be used in such developing solutions where sodium sulphite on account of its alkali reaction could not be employed, for example in the iron oxalate developer, which it keeps extraordinarily clear. Furthermore, in fixing baths the addition of acetonesulphite to the hypo acts as if acid salts or acids were added to the hypo solution.

By his experiments Eichengrün succeeded in disproving the theory of Lumiere and Seyewitz for the action of acetone. He showed that in an acetone developer of the above kind the presence of hydroquinone sodium could not be established, but only of free hydroquinone, and acetonebisulphite could not be traced, but only unchanged sodium sulphite. If the above formula were correct, then the solution ought to contain acetone bisulphite and hydroquinone sodium. On shaking such a solution with ether, he could remove the whole amount of hydroquinone and acetone in the cold, while on evaporating the watery solution, a residue remained which contained not a trace of acetone, and therefore could not be acetonebisulphite.

If hydroquinone sodium and acetone bisulphite had been formed, then the ether could not contain any hydroquinone nor acetone. Again, in evaporating a second sample of the solution it was proved that the residue contained free hydroquinone soluble in ether, but not hydroquinone sodium, and on adding alkalis no acetone was generated, the latter having been already driven off during the heating, and it was therefore not present as acetone bisulphite.

Also by photographic means he proved the incorrectness of the above theory in so far as a developer in which the formation of hydroquinone sodium was completely excluded, namely one made by hydroquinone, acetone bisulphite and acetone developed even in the absence of sodium sulphite. Therefore acetone in itself must possess such basic properties which enable it to act as an alkali proper, a quality which, although surprising, yet is perhaps not quite inexplicable after the epoch-making investigation of Adolph von Bayer concerning the basicity of oxygen. This experiment seems also to disprove the theory that the addition of alkali is made for the purpose of converting the phenols employed as developers such as pyro, hydroquinone, etc., into the corresponding alkali salts and that only these act as developers whereas free phenols would not develop.

Eichengrün's experiments proved that acetone bisulphite could replace sodium sulphite in developing solutions. Further experiments showed that this body did not only replace sulphite, but also acid sulphites, such as potassium metabisulphite and sodium bisulphite, and possessed considerable advantages over these chemicals. The well-known drawbacks of these chemicals are: Sodium sulphite must be employed mostly in eight times the quantity of the employed developer, therefore its use for the preparation of concentrated stock solutions is excluded. Potassium metabisulphite cannot be used for all developer solutions—it cannot be used with acetone at all. On account of its strongly acid reaction it can be used with alkali carbonates only by employing a very great excess of the alkalis. Solutions of these two sulphites keep only for a short time, splitting off sulphurous acid and depositing crystals, thereby of course losing effect. On contact with air they are very quickly transformed into sulphates.

Acetone bisulphite, on the contrary, furnishes easily highly concentrated 50 per cent solutions which keep indefinitely, and therefore can be used for the preparation of highly concentrated stock solutions of developers, also for the preparation of developer solution ready for use by simply measuring the solution instead of weighing, which is especially troublesome in the dark-room. Acetonesulphite replaces the above sulphites in every formula, since it can be used with caustic alkali as well as with alkali carbonates. It can also be used with acetone. Acetonesulphite is generally employed in quantities one and one-half to two times that of the developer, which is about the fifth part of the ordinary quantity of sodium sulphite, and developers made with it possess the character of the Lumiere acetone developers, which are distinguished from other developers by the brownish color of the silver deposit, which makes them especially fit for lantern slides and transparencies.

A higher percentage of acetonesulphite, with which of course the percentage of alkalis must be increased, has a very peculiar influence on the color of the silver deposit, and in such a manner shades of deep black to velvet brown can be produced not only on plates but also on developing papers, even with such developers which, like pyro and hydroquinone, could not be used for bromide paper on account of their tendency to yield yellow prints.

The following developing solutions: Edinol 1, acetonesulphite 1, sodium sulphite 8, acetone 10 to 20, water 100; and edinol 1, acetonesulphite 5, sodium carbonate 15, water 100, are, according to Prof. Precht, the best formulæ for the development of bromide papers.

Acetonesulphite is also an excellent preservative for fixing baths, in which an addition of one-half of one per cent makes a further addition of sulphuric acid, citric acid and alum unnecessary. Acetonesulphite imparts to the fixing bath the desired faintly acid reaction and weakly tanning properties, and keeps them extraordinarily clear and colorless. On the other hand, contrary to the above acids, it does not harden the gelatine, and therefore makes a quick washing possible after fixing.

Acetonesulphite may also be used in the method discovered by Namias for the reduction of over-printed pictures on celloidin paper, bromide paper, or chlorbromide paper. For this purpose the prints are immersed in a dilute solution of permanganate of potassium which is acidulated by sulphuric acid. The prints are left in that solution until the desired reduction is brought about, and then they are treated with a solution of acetonesulphite. This is the only easily executed method known for saving over-exposed prints which does not stain the highlights of the picture.

It can be used for blackening after intensifying with mercury instead of ammonia which is generally used for this purpose. It recommends itself especially for this purpose on account of the concentration in which it may be used and on account of its being odorless.

In the development with oxalate of iron acetonesulphite is used as a preliminary bath. It replaces here advantageously hyposulphite, which frequently produces fog. It is especially valuable because it may be used in very small quantities, and it accelerates development extraordinarily. It also increases the intensity and produces strong and clear pictures.

But the most astonishing use of acetonesulphite is as a restrainer for rapid developers. Here it produces results which are surprising in the highest degree and which open up new photographic fields, namely, the development of extremely over-exposed plates, the pro-

vention of solarization, thereby permitting photography against the sun, and photography of pictures with the sun as an object.

This correction of over-exposure does not mean prolonged development. Acetonesulphite is therefore not a restrainer in the sense in which this word is used in contradistinction to accelerator. The chemical action of acetonesulphite in saving over-exposure is unique and has not been observed with any of the chemicals used in photography, and to describe its action a new word must be coined. The effect, however, is easily observed: The deep, black opaque deposits on over-exposed negatives are changed to a soft transparent brown, and the printing qualities become normal.

Whereas hitherto it was hardly possible to save over-exposed negatives, yet by employing acetonesulphite, we get good negatives with an over-exposure of 100 to 20,000 times normal. To develop such over-exposed pictures we proceed as follows: An ordinary developing solution containing about one-half of one per cent developer is used without the addition of potassium bromide, but with an addition of 1 per cent of acetonesulphite. For example, 1 drachm of edinol developer is diluted with 4 ounces of water and 1 gramme acetonesulphite or ½ drachm C C concentrated acetonesulphite solution is added. The picture appears only after some minutes, and development becomes so slow that the plate may be developed like a normal plate. The plate can be removed from the bath before any fog sets in and the clear negative may, if necessary, be intensified.

This new method of developing with acetonesulphite makes it possible to photograph such subjects which, on account of too great contrasts, could not be exposed long enough to get the details of the shadows; for example, subjects which are exposed to too much light in the studio, reproduction of pictures, portraits in strong light, dark interiors with windows, engines and apparatus with bright reflexes, landscapes with too much light, landscapes in sunlight, glaciers and marine pictures. A great many experiments have shown that negatives of almost the same quality are obtained under normal exposure of one second and under enormous over-exposure, for example, of 6,000 seconds. The new method also permits all kinds of exposures which would until now have suffered from solarization; it even admits photographs of the sun, and such with the sun in the picture, which was considered impossible up to now. The experience of the present day is that, if the sun shines directly into the lens the negative shows impenetrable fog, but with acetonesulphite it is now possible to get a perfectly clear negative without fog. The negative can be removed from the bath before the phenomenon of solarization becomes apparent. By these experiments solarization has been proved by Eichengrün not to be as was assumed up to now, the function of development. In this way landscapes were photographed in which the sun as well as the clouds highly illuminated by the sun appeared in the picture. The latter appear always with the sun at a height of 10 degrees, whereas at a greater height the disk of the sun shows solarization, but only the disk, whereas all details, down to the deep shadows, are brought out even when the sun was high in the sky and was furthermore reflected in the water.

From the above it appears that acetonesulphite is a new photochemical which is unequaled in versatility. It can be employed for developing, for fixing, for intensification, for reduction, as a preliminary bath for iron developers, for after treatment in clearing and for retardation. Above all, it possesses properties which open up a new branch of photography, namely the photography of very strong light contrast.

M. BLONDLOT'S N-RAY EXPERIMENTS.*

IN his experiments on the rapidity of propagation of the Röntgen rays, the French academician, M. R. Blondlot, discovered a new kind of rays, which he called N-rays, after the place Nancy, in which they were first observed.† These rays are said to be emitted by an Auer burner, or better still by a Nernst lamp of 200 watt power. Like the Röntgen rays, they are said to pass through aluminium with ease, but on the other hand to be absorbed by the slightest film of water, like the longer heat-waves. Although they are stated to be absorbed by cold platinum, they readily pierce red-hot platinum.

Blondlot has recently found that these N-rays are emitted by the wire of the Nernst lamp even after this has been extinguished for several hours, and that, moreover, flints which have been exposed to the sun's rays have a distinct effect in the sense of the N-rays.

In all these observations of Blondlot the action of the N-rays consists in general of a brightening of a source of light under these rays, or rather of a darkening when the rays are cut off by interposing either the hand or a lead screen between the source of light and the source of the N ys. The analyzing source of light may be a small spark, a bluish flame, a phosphorescent surface, a dark platinum plate at dull red heat, or the surface of a paper feebly illumined by a source of light. The dimensions of all these analyzing sources of light are very small (the illumined paper, for instance, being 2 x 16 mm., or 0.078 x 0.629 inch in size), and the observation is carried on in a dark room.

Although the change in brightness is said to be considerable, neither Blondlot (C. R., cxxxvii., 167, 1903), Rubens (Ebenda), nor others (Phys. Zeitsch., iv., 732 and 733, 1903) have hitherto succeeded in demonstrating objectively the corresponding transformation of energy. At the same time the phenomena observed subjectively by Blondlot could not be perceived by Rubens and others when repeating the latest experiments with slightly illuminated or phosphorescent surfaces.

* Translation of "Notes in Elucidation of the Most Recent Researches of M. R. Blondlot on the N-Rays." By O. Lummer. Read at the Sitting of the German Physical Society, November 27, 1903.

† R. Blondlot, "Sur de nouvelles actions produites par les rayons N; généralisation des phénomènes précédemment observés" (C. R., cxxxvii., 684, 1903). "Sur l'emmagasinement des rayons N par certains corps" (C. R., cxxxvii., 729, 1903).

Without wishing, for the present, to dispute the objective existence of these N-rays, I should like in what follows to bring forward the fact that a whole set of Blondlot's experiments may be almost exactly imitated in their effects *without employing any source of illumination whatever*, and that the changes in form, brightness, and color respectively of the analyzing luminous surface observed by Blondlot under a stream of rays, and the interception of a diaphragm (Abblendung) may be referred to processes taking place in the eye itself, and, in fact, to the *contest between the rods and cones of the retina when seeing in the dark.*

It has been known for some time that the layer of rods and cones in the retina is the structure which is sensitive to light whereby this form of energy, from without, is transformed into nerve-stimulation. While, however, experiments on sharpness of vision have led to the assumption that the power of vision is due to the agency of the cones alone, the almost identical anatomical structure of the rods admits of the conclusion that they also play their part in vision. But on the ground of more recent physiological researches on vision in dim light, and the influence of the visual purple contained in the rods on color perception, we have been enabled to distinguish, more and more clearly, the respective modes of action of these two elements of the retina and to ascribe to them their different functions. A. König* has already ascribed to the rods the colorless vision of the totally color blind in every degree of brightness, the non-perception of color in a very dim light of those otherwise able to perceive colors, and the perception of blue. J. v. Kries† went further, and disposed of the still existing difficulties and contradictions by putting forward the hypothesis that the cones form our color-perceiving "light apparatus" ("Hellapparat") and the rods our totally blind "dark apparatus" ("Dunkelapparat"). According to this theory of Kries the cones render vision possible in a very bright light, and their stimulation by light-waves arouses in the brain the perception of color, while the purple containing rods are totally color blind, and only come into action in a very dim light, and are endowed with the property of considerably increasing their sensitiveness in the dark. These properties of the rods are called by Kries "adaptability to the darkness" (Dunkeladaptation). Before the cones perceive colored light, the rods bring about in the brain the impression of colorless light.

We know from the anatomy of the eye‡ that the fovea centralis contains cones only and no rods, and that the rest of the retina has rods as well as cones, the former predominating toward the periphery, and it is also well known that the fovea centralis is the special point of vision when looking at an object and fixing our eyes upon it. *Hence it follows that in gazing at an object, i. e., direct vision (foveal), the rods are excluded, and it is only in indirect vision (peripheral) that they come into action.* Thus, then, in dim light these two elements enter into a sharp contest which, if the light is dim enough, results in favor of the color-blind rods, so that everything resolves itself into grays, i. e., colorless shades of light.

By the help of this theory one gets a natural explanation of phenomena hitherto unexplained, as, for example, Purkinje's phenomenon, the change of position of the "neutral point" in the spectrum as light decreases in the case of those who confound red with green, and the dependence of color identification on the absolute intensity of light. In my work "Grauglut und Rotglut" I was able to show§ that the remarkable "shadow-like" (gespensterhaft) appearance of the gray and red glow can be explained by attributing to the two light-perceiving elements the part assigned to them by v. Kries.

If in a dark room we observe the gradual rise in temperature of a body from that of the room up to glowing temperature, then, according to my view, the eye perceives two sudden changes or "leaps," first from dark to shadowy gray ("gray glow"), and later from gray glow to colored glow (red glow). In each case the "leap" arises from stepping over the threshold of stimulation of the optic nerve, but the efficient organs are not the same in the two cases; the gray glow corresponds to the threshold of stimulation of the rods, the red glow to the threshold of stimulation of the cones. *Accordingly we must conceive of the gray glow as a sensation of the retinal rods and of the red glow as the sensation of the retinal cones.*

The "shadow-like" character of the rod-division is not apparent until we observe a sufficiently small surface the retinal image of which does not exceed in area that of the spot of clearest vision, i. e., the fovea centralis, and the increase of brightness of which we follow in the dark from zero upward. For this purpose it is best to make use of a platinum plate

* "Über den menschlichen Sehpurpur und seine Bedeutung beim Sehen" (Sitzber. d. Berl. Akad. d. Wissensch., S. 577, 1894).

† "Über die Funktion der Netzhautstäbchen" (Zeitsch. f. Psych. u. Physiol. d. Sinnesorgane, ix., 81-123, 1894).

‡ R. Greef, "Die mikroskopische Anatomie des Sehnerven und der Netzhaut." Aus dem "Handbuch der Augenheilkunde" von Graefe u. Saemisch. 2 Aufl., I. Bd., V. Kap. (Berlin. 1901.)

§ O. Lummer, "Über Grauglut und Rotglut" (Wied. Ann., lxii., 14-29, 1897; Verh. Phys. Ges. Berlin, xvi., 121-127, 1897).

brought to a glow by means of electricity and limited by a diaphragm, the development of light thus being observed in the dark by a well-rested eye. When the platinum plate has reached a temperature of about 400 deg. C., at first only the rods of the eye searching in the dark are stimulated, and the perception of colorless light (gray glow) is aroused in the brain.

Being accustomed to gaze at what sends us light, we turn our eyes in the direction from which we believe the light rays come. As, however, the cones have not yet been stimulated, the fovea centralis sends no message of light to the brain; accordingly we cannot see the spot gazed at. Thereby we are confronted by the remarkable fact that we see something which we are not gazing at, while it becomes invisible when we wish to fix our eyes upon it. And as we can see nothing by direct vision, we involuntarily move our eyes away, whereby the rays again fall on extra-foveal retinal spots; we again receive the impresssion of light, and our search after the place from which the remarkable light comes begins over again. Thus there arises in us the impression of a light which darts to and fro, which is sometimes present, then again evades us, mocking us, like a will-o'-the-wisp. It is only when the brightness is of a sufficient intensity to stimulate the cones also and enable them to send a message of light to the brain that this unusual condition comes to an end, and then we see what we gaze at, just as we have been accustomed to do, and the thing seen no longer escapes the searching gaze.

In the case of glow this does not occur until the body has reached a temperature somewhat above 500 deg. C.; not until then are the cones stimulated, and we then perceive color as well as brightness, in other words, the "gray glow" is transformed into "red glow."

But at a still higher temperature (up to 700 deg. C. and above) the rods enter into vigorous competition with the cones, and the light red color seen in gazing at the platinum plate changes in indirect vision into a peculiar colorless white, the "rod white," while the brightness of the platinum plate increases.

In some of Blondlot's experiments one finds one's self in precisely the same position as in the observation of the "shadowy vision" just described. One perceives a very small slightly luminous surface, e. g., a dull red glowing platinum plate, in the dark and fixes one's gaze upon it. Before bringing one's undivided attention to bear on it, it is seen by the extra-foveal parts of the retina, because the eye involuntarily endeavors to gather as much light as possible, thus consequently both rods and cones take part in the vision. As soon, however, as the lead screen or the hand is interposed between the source of illumination and the luminous platinum surface, the observer, in order to see the change in it, will fix his gaze as directly as possible on the platinum plate, thereby excluding the rods. The necessary consequence will be that the platinum plate will appear reddish and less bright, and the rod-white of the peripheral parts of the retina be lost. But this fixing of the gaze requires time and effort. The darkening and the red coloring observed will also require a certain amount of time, and as soon as the hand or the screen is removed the eye will return as quickly as possible to extra-foveal observation, in which it receives more light. After the removal of the screen, therefore, the brightness of the platinum plate increases, and provided the brightness of the luminous surface under observation is very dim, there will be an immediate diminution in the distinctness of the outlines on darkening it while the gaze is fixed on it. In fact, there will eventually be a complete disappearance of the platinum plate provided the energy sinks below the threshold of stimulation of the cones and the surface is small enough.

As a proof that the phenomena here described (which were not only observed by myself subjectively, but were produced in my lecture before a large audience) resemble to an extraordinary degree the more recent observations described by Blondlot, I will quote, word for word, two sentences from his article of November 2, 1903 (C. R., cxxxvii., 685, 1903). After describing the order of procedure in the observation of a feebly illumined strip of paper, he goes on to say: "If one now intercepts the rays by interposing a lead plate or the hand, one sees the small rectangle of paper grow dark to its contour and lose its distinctness; the removal of the screen causes the brightness and the distinctness to reappear, the light diffused by the strip of paper being then increased by the action of the N-rays."*

In the case in which Blondlot observes the transparently luminous paper mirrored on a needle and then illumines the needle with the N-rays, he describes the process in the following words: "It was then easy to prove that the action of these rays strengthens the image, for if one succeeds in intercepting them, this image becomes dark and reddish. I have repeated this experiment with equal success by employing instead of the knitting-needle a plane bronze mirror."†

In this article it is also stated: "All these actions of the N-rays on light require an appreciable time for their production and disappearance";‡ this is on a

* "Si maintenant on intercepte les rayons en interposant une lame de plomb ou la main, on voit le petit rectangle de papier s'assombrir, et ses contours perdre leur netteté; l'éloignement de l'écran fait reparaitre l'éclat et la netteté; la lumière diffusée par la bande de papier est donc accrue par l'action des rayons N."

† "Il fut alors facile de constater que l'action de ces rayons renforce l'image, car si l'on vient à les intercepter, cette image s'assombrit et devient rougeatre. J'ai repete cette experience avec le meme succes en employant, au lieu de l'aiguille a tricoter, un miroir plan en bronze."

‡ "Toutes ces actions des rayons N sur la lumiere exigent un temps appreciable pour se produire et pour disparaitre."

parallel with the appearances of gray and red glow during vision in the dark. The experiments described in this article do not deal with the behavior of different substances under exposure to the N-rays. It is unnecessary to say that seeing in the dark can in no wise explain why some substances transmit the N-rays and others do not. But it may be asserted briefly that neither brightening, darkening, nor change in color will take place if during the experiment with the above mentioned source of light one gazes continuously at the analyzing luminous surface so that the image always falls on the fovea centralis and the cones alone come into action. As a matter of fact, Prof. Rubens, as he kindly informed me in answer to my question, took his observations in this way, and could perceive no brightening even when a very powerful Nernst lamp was employed. Moreover, this sustained gaze is always accompanied by great fatigue, for reasons already adduced, and especially so in observing a very feebly luminous surface of small area in a dark room. The sustained gaze at small bright objects, as is well known, is, in fact, the most effectual way of inducing hypnotic sleep.

But although one cannot imitate all M. Blondlot's experiments by purely subjective perceptual processes without employing some source of illumination, I have thought it advisable to direct attention to these more recent physiological discoveries, the more so as M. Blondlot pays no attention to them in any of his publications, and does not state with what visual apparatus one ought to observe, nor does he give warning of the illusions one may fall into in carrying out his experiments. But the foregoing statements will at least serve to remind all those who take the trouble to repeat M. Blondlot's experiments that in vision in the dark changes in brightness, form, and color may arise from a purely subjective source. These purely subjective changes, however, do not depend upon any optical illusion, but, like the "shadow-like" appearances of the "gray glow" and the "red glow," are brought into existence by the competition between the two elementary structures of the visual organ, and correspond to objective processes in the retina.

As soon as the phenomena observed by M. Blondlot shall have been incontestably proved by means of objective instruments of precision, these few remarks on the N-rays will be only of secondary importance.

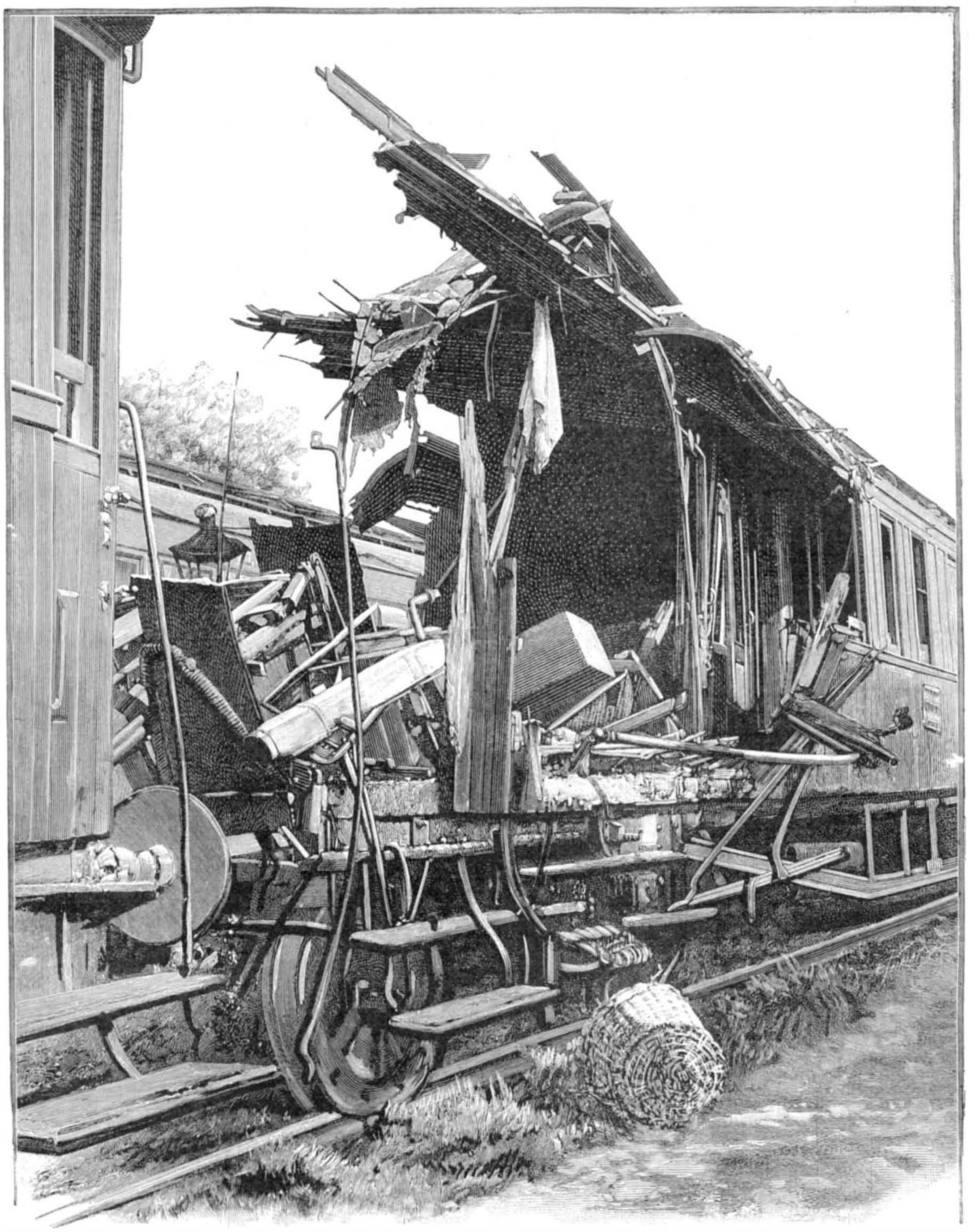
THE KOULELI-BOURGAS DISASTER.

THE Macedonian revolutionary committees have, as is well known, sworn to prevent, by all means, even the most atrocious, civilized Europe from interesting itself in the destiny of Macedonia, and nearly every week brings the news of some outrage due to their activity. One of the last was directed against one of the "conventional" trains that establish communication between Budapest and Constantinople. These trains are so called because they run daily, one in each direction, in pursuance of an agreement between the different states interested—Bulgaria, Roumania, Servia, Turkey, and Austria-Hungary. The train on its way to Constantinople was standing, at twenty minutes past eleven at night, at the Kouleli-Bourgas station, the point of junction, at about twenty-five miles from Adrianople, of the Dedeagatch-Salonic-Monastir-Uskub lines with that of Adrianople, when an explosion took place in the dining car.

It was exactly the hour at which the train should have been upon the bridge that crosses the Maritza at a short distance from the station. This bridge, the longest of all those upon the Eastern lines, is old and weak, and a new one is at present in course of construction to replace it. Had the explosion occurred at this place, the train would have been thrown off the track, and, most likely, through the giving way of the bridge, would have been precipitated into the river. The designs of the revolutionists were therefore partially defeated. Nevertheless, their attempt made a sufficient number of victims. Six persons were killed, among whom were the steward of the dining car of the sleeping car company, a child, a student, and two Turkish women. Eighteen other persons, three of whom were employes of the railroad, were injured.

The attempt had been carefully planned, as is proved by the time at which the explosion occurred. It appears to be established, on the other hand, that, in order to make this "example," the revolutionists had selected a car that contained Mussulmans solely. It is thought that a few members of the committees had secured seats in the train in order to carry out a plan prepared long in advance and that failed to have all its effect only in consequence of circumstances independent of their desire. It is believed, moreover, that an arrest has been made of one of them—an individual of suspicious behavior, who was found upon the spot immediately after the explosion. Half of the car in which the infernal-machine exploded was reduced to fragments. Nothing remained but a sorry mass of debris, wrenched iron plates, and scattered boards. The metallic frames that united the two parts of the vestibule had been violently separated, and the one connected with the wrecked car lay, with the debris of the body of the car, upon the frame of the latter. All the kitchen and table utensils were twisted, dented, and crushed by the violence of the explosion.

As for the dead, they were in a pitiful state. The steward of the dining car was found in the kitchen at the extremity of the car in which the explosion occurred. Nothing but the upper portion of the cadaver, starting from the pectoral muscles, was found. The rest of the body was gathered up in the state of ghastly morsels of flesh. One of the Turkish women was half decapitated. The baby, which was eighteen months old, was fearfully mutilated. The head of a thirteen-year-old child was detached from the shoulders. The cadaver of a young woman twenty-two years of age was intact externally, but the skull was fractured and the vertebral column broken.—Translated from L'Illustration for the SCIENTIFIC AMERICAN SUPPLEMENT.



THE KOULELI-BOURGAS DISASTER.—THE DYNAMITED DINING-CAR.

CALCIUM STEEL, THE NEW RIVAL OF CERAMIC PRODUCTS.

WE have already referred to a new product combined by M. A. Bonnot, which appears likely to receive various applications in modern construction, viz., calcium steel. We now return to this subject, in order to give some additional information.

This product is compact, plastic, and homogeneous; it is extremely hard, unchangeable under the action of atmospheric agents, not oxidizable, not attacked by acids, and a bad conductor of heat and electricity. Its density is 3.33; its resistance to rupture, about 2,500 kilos per square centimeter.

It can be filed, drilled, sawn, engraved, and polished, like metals; it can be enameled, painted, and decorated, like glass and ceramic products.

These qualities give it an incontestable advantage over similar ceramic products. It will, therefore, be employed in many industrial branches.

Calcium steel, thus named on account of its hardness and of the calcareous flux which enters into its composition, is formed of two bodies: Sandy feldspar (refractory product) and calcareous flux (melting product).

Mixed in definite proportions, these two bodies may be molded, cold, pressed like bricks and tiles, and heated afterward at the high temperature necessary for vitrification; or simply melted at the fusing point, and the liquefied matter run into molds, like iron, bronze, and other metals.

It is annealed, in order to impart malleability and to prevent cracks, which would be produced in contracting by too abrupt lowering of the temperature.

Calcium steel is white, but it may be colored as desired by the addition of clay, glass, slag, or metallic oxides to the raw materials which enter into its composition.

From the preceding it will be seen that there are two ways of producing calcium steel, viz., either by direct fusion or by firing after molding.

There is also a third method, which we shall only refer to briefly, as it is very troublesome. This is that employed for manufacturing glass-stone.

The first method of manufacture consists in mixing intimately feldspathic sand and hydraulic lime in crucibles, which, placed in suitably constructed furnaces, attain gradually the fusing point. The liquid product is run into molds of sand or other material and assumes all the forms desirable.

The molds are placed in special furnaces and reheated to a temperature below fusing and brought down gradually to the temperature of the surrounding air. Then the objects, after being cooled completely, are removed from the molds.

It is possible, by this method, to produce statues, ornaments, pipes, and other objects not requiring a great deal of strength. For such purposes the material is much superior to cast iron, and the articles are much less expensive.

By comparing, for instance, pipes 0.30 meter in diameter, made respectively of cast iron and of calcium steel, it will be found that 1,000 kilos of cast iron will furnish 10 meters of pipes, and 1,000 kilos of calcium steel will furnish 20 meters. The price of casting and molding a ton of the latter will be double that of the former; the fuel employed will also be double in quantity, on account of the reheating. Thus, because the length produced is twice as great for calcium steel as for cast iron, the cost of manufacture will be per linear meter the same in both cases, but it must be taken into consideration that the constituent materials are not as expensive as iron.

Its physical properties, its impermeability, its nonoxidability, its not being attacked by acids, its being a bad conductor of heat and electricity, render pipes of this material incontestably superior to pipes of cast iron, whether employed for conveying water, gas, acids, or other matters.

Another consideration is their light weight, which diminishes in an appreciable manner the cost of transportation and of placing the pipes.

In regard to statues and ornaments of all kinds formed of calcium steel, the inoxidability of this new

matter renders the objects unchangeable for an indefinite period, with no expense for keeping them in order.

The second method consists in mixing sand and hydraulic lime in suitable proportions, which, however, may be varied, according to the hardness desired. These materials are moistened and worked up in order to form a paste, more or less resistant, as the case may require. This paste is pressed cold, into molds, preferably of plaster, because plaster absorbs the moisture, so that the paste becomes solidified. It is left to dry in the open air, and the molded and hardened objects are then put in furnaces and heated to the temperature of vitrification. From this elevated point they are afterward brought down to the temperature of the surrounding air, in order to secure annealing. The elevation of the temperature and its lowering must be quite gradual.

It might seem at first sight that these objects, molded cold and becoming soft during vitrification, would lose their form. This does not occur.

Objects of a certain value may remain in the plaster molds, while for others, in order to preserve the shape, it is sufficient to cover them with a slight layer of refractory powder.

Comparison with Ceramic Products.—This method allows the manufacture of materials of construction, which can take the place of stone and ceramic products. Pavements, flagstones, the foundation of buildings, the various ornaments, the tiles which it is important to keep free from moisture and vegetation, can be advantageously manufactured of calcium steel. Here, as in the case of metals, it is from its physical properties superior to all similar products. Its resistance to crushing (1.800 kilos per square centimeter) renders it possible to place it wherever other materials of construction are employed.

If we wish to compare the cost of calcium steel with that of ceramic products, we shall, for want of the necessary data, be unable to be as explicit as in the case of iron. But an idea can be formed by considering that the paste of calcium steel is a cement; that it can be vitrified, molded, and pressed in the same way as ordinary cements; that, like the clay for bricks, it dries in the open air; and that it is reheated in the furnace like ceramic products. Perhaps it requires a little more fuel by reason of the high temperature requisite. The original materials are not costly, and the baking and preparatory work unavoidable for the clay of ceramic products, is not required. We should not be surprised if the cost of manufacturing calcium steel should prove to be less than that of ceramic products. Even if it should be more, the difference would be insignificant.—Translated from L'Echo des Mines et de la Metallurgie.

WATCH DIALS.

The dial of a watch is almost the watch itself. The movement, which seems as if it ought to be the most interesting part, since it actuates the hands, is not so, however. To the carrier of a watch, the dial is everything. It might almost be said that if the movement of a watch is its soul, the dial is its face. It gives it its character, its physiognomy. Its dial gives to one watch a vulgar, gross, and awkward appearance, while another will seem to have a *distingué*, refined, and elegant look. The constant motion of the hands gives the dial a semblance of life, and we evidently no longer find ourselves face to face with an inert object. Moreover, the origin of the French name for a watch, viz., *montre* (from *montrer*, "to show") comes especially from the dial. In fact, toward the end of the fifteenth century, the small weight-driven clocks that became portable, thanks to the invention of the mainspring, were called in France *montres d'horloges*, or watch-clocks. Owing to the doing away with the weights, they could then be placed upon a table or other piece of furniture. They could thus be more plainly seen, and the reading of their dial became easier. They therefore "showed" the time better than ever. Those that were really carried became, by abbreviation of the above-mentioned name, known as *montres*, or "watches."

While the part played by the dial in a watch is a preponderant one, it is often in table-clocks but secondary, and, in some even, its abolition would scarcely be perceived, so empty is its decorative rôle.

The bottoms of watches have been frequently richly decorated, nothing having been neglected to make the case one of the most beautiful ornaments for men and women. If the bottoms of watch cases are often more sumptuous than the dials, it is because, in all times, the artists who have conceived them have not been embarrassed in their artistic combinations by the placing of the hour-figures, which requires an inexorable arrangement. Dials, indeed, have been made with the hours placed in a square, oval, semicircle, etc., and the divisions of the dial have even been done away with by causing the hour to appear in a small aperture; but all that has constituted but a conceit of the moment.

The decorative evolutions of the dial are so much the more interesting to study in that there is here a double question of art and fashion, to which is added an industrial one, which is that of the dial-plate maker. In this study we shall make use of some original designs of the old master artist-engravers, either French or foreign, and of some reproductions of actual dials dating back to the seventeenth and eighteenth centuries, and presenting great artistic interest. Among the French masters, we find Jacques Hurtu, goldsmith-engraver (1614-1619), whose inlaid enamel work (Fig. 2, No. 1) with fine arabesques is skillfully elaborated. Jacquart, of Blois, his contemporary, designed some dials that are genuine little pictures. They are not surpassed in the least by the beautiful backs of the watch cases that were to accompany them. The decorative wealth of his dials will never be excelled (Fig. 2, No. 2). The designs of Vauquer, also of Blois, executed in the second half of the seventeenth century, are of exceeding delicacy. The flowers and scrolls that constitute their decoration are charming (Fig. 2, No. 3). All the designs of which we have spoken were designed to be engraved on copper. They were often made, also, in enamels of translucent color. Those of Vauquer served as patterns to engravers as well as to the dialplate artists, of whom we shall speak further along.

In the German and Dutch schools we shall find types none the less interesting. Theodore de Bry, a

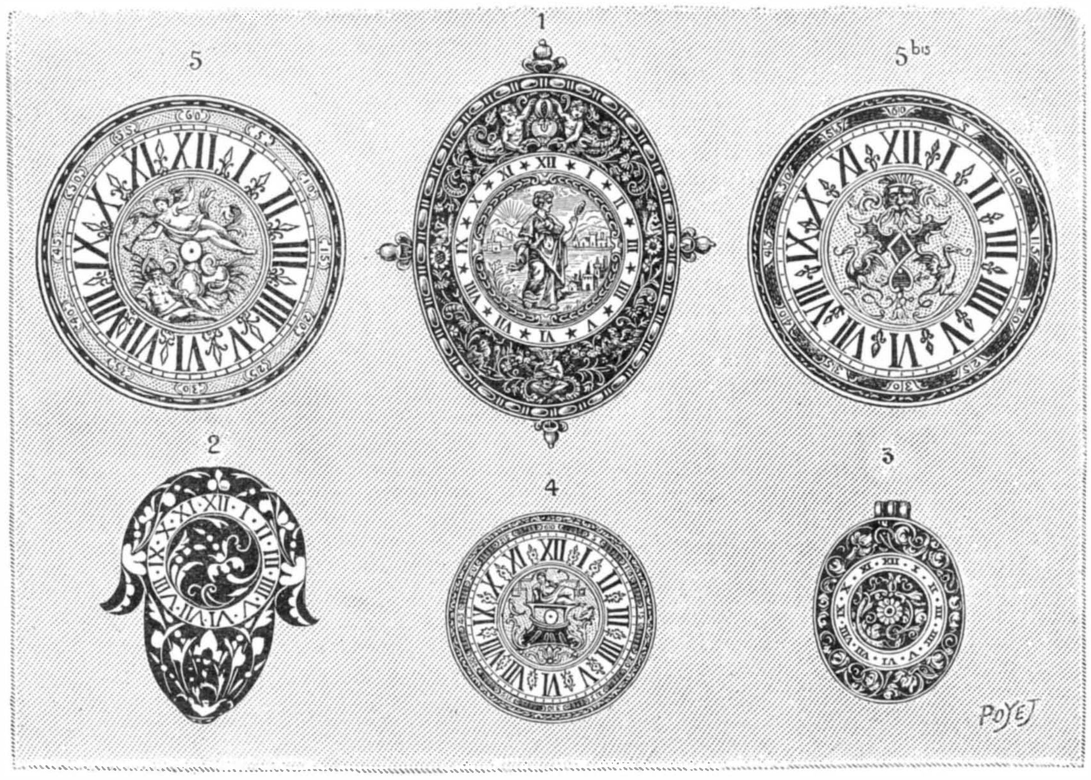


Fig. 1.—DIALS OF GERMAN AND DUTCH WATCHES OF THE XVI. AND XVII. CENTURIES.

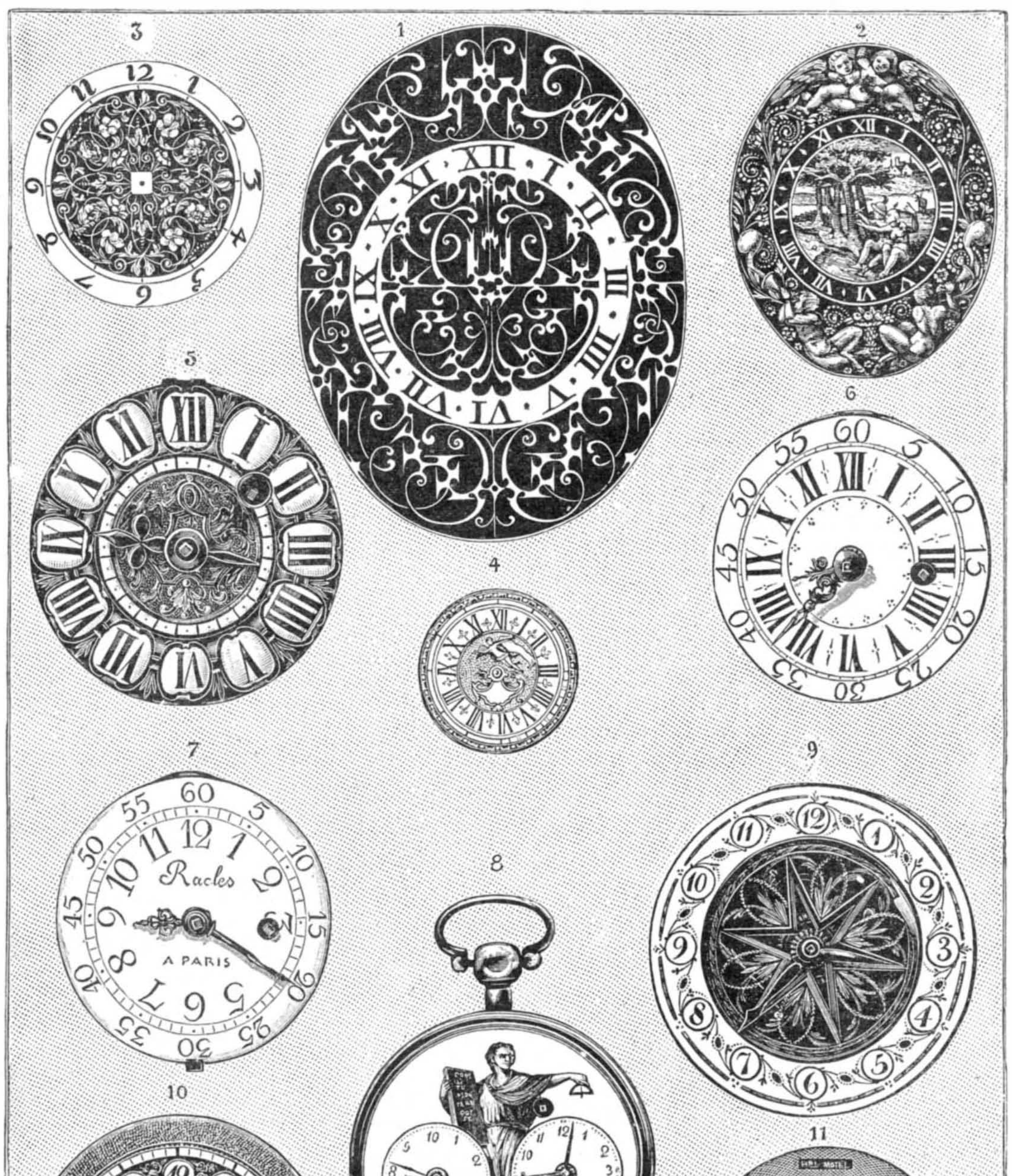


Fig. 2.—DIALS OF FRENCH WATCHES OF XVI. AND XIX. CENTURIES.

goldsmith, designer, and engraver, born at Liege in 1528, worked at Frankfort-on-the-Main, where he died in 1598. He had the reputation of being one of the finest masters of the German Renaissance. The dial with human figure that we reproduce (Fig. 1, No. 1), and the drawing of which he has left to us, rivals those of the best masters of the time. Mathias Beitler, an engraver, who worked at Onoltzbach, from 1582 to 1616, designed dials with human figures, but of gross aspect. Their want of sharpness prevents a reproduction of them. The productions of Von Hulsen, of Middelburg, executed at Stuttgart, between 1606 and 1617, somewhat resemble the inlaid enamel work of Hurtu, his contemporary (Fig. 1, No. 2).

One of the masters who did the most designing for the watch-making industry at this epoch was Michel Blondus (Michel le Blond), a goldsmith-engraver who was born at Frankfort-on-the-Main in 1590 and died in 1656. Although he was a German by birth, his name suggests that he was of French origin. As he always worked at Amsterdam, he is classed among the Dutch masters. His arabesque compositions (Fig. 1, No. 3) are remarkable. ..is dials include no human figures, as do certain watch case bottoms that he designed.

Weigel, a publishing engraver, of Nuremberg, who died in 1746, designed some dials of a new kind, and differing from the preceding in their execution, which, instead of engraving on copper, consisted of chasing in relief. The general effect of this is somewhat heavy, and the details are less delicate and not so well studied as in those engraved (Fig. 1, No. 4). The designs of Decker, who also was born at Nuremberg in 1677 and died in 1713, and who was a celebrated architect, offer the same spirit o. ornamentation (Fig. 1, Nos. 5 and 5 *bis*). Daniel Marot, of French origin, but who worked at Amsterdam in 1712, designed dials in the same style (Fig. 2, No. 4).

Starting from this epoch, foreigners no longer created anything new. In France, dials with chased centers usually had the hours depicted in black upon so many patches of white enamel (Fig. 2, No. 5). Concurrently with these latter appeared finally, in France, those in full enamel of a single piece. The hours were here painted upon small embossments of enamel, which replaced the patches (Fig. 2, No. 6). It was then also that the dials in enamel of a single piece were ornamented with enamel paintings. Their decoration was a reminiscence of the dials of the sixteenth century, as their center was provided with landscapes, flowers, fruits, and variou~ scenes, the whole painted instead of being engraved. Subsequently, the dial was especially the work of an enameler, and it is not until the beginning of the nineteenth century that we find gold and silver dials again.

Under Louis XIV. hardly any dials were made except those of full white enamel with the hours in black or red (Fig. 2, No. 7), some being enriched with fine stones set into the enamel between the hours. Their convex form, with the name of the maker plainly visible, gave them a rich aspect, although in keeping with the opulent decoration of the bottom. The tradition of the enameled dial with painting, dating from Louis XIV., is found again during the Revolution, but with complete decadence. Fig. 2, No. 8, shows one of these dials of this epoch belonging to the collection of M. Charles Roblot. The dial reproduced in Fig. 2, No. 9, is of the first empire. The painting of the enamel disk is delicate, and the center of engraved and open work gilded copper is of most careful workmanship. The wheels of the hands were seen through the ornaments of the center. It was at this epoch that were made the metal dials of which we have spoken; but then they were simply guilloched. This kind of dial was continued up to the middle of the nineteenth century (Fig. 2, No. 10). Under the Restoration, a return was made to the style of metal dials with an enamel ring for the figures (Fig. 2, No. 11), but they were far from equaling their predecessors, and are without interest. The forfeiture of the dial from the viewpoint of decoration is irrevocable. We have said that the dial gives the watch its physiognomy. We may state that for those of our day the thing is more striking than it was for those of the past.

The present dial, with its wan face and its scanty hands, gives the object as a whole an anæmic aspect. It is practical, it is true, and the hour is well shown, and that, it will be said, is the principal thing; but there would be no harm done in adding a little decoration. It is a pity that the word practical so often means common-place.—Translated from La Nature for the Scientific American Supplement.

AN ATTEMPT AT A CHEMICAL CONCEPTION OF UNIVERSAL ETHER.*

By Prof. D. I. Mendelejeff.

The ether is usually defined as an imponderable elastic fluid, permeating all bodies and all space. But it must have weight, or mass, if it is matter. Lord Kelvin has computed a minimal mass of 10^{-16} grammes per cubic meter. Ether cannot be a mixture of ordinary gases, for these do not penetrate all substances, and they act differently upon those they do penetrate, whereas ether is everywhere the same. Many learned men suggest or express belief in ether as the primordial matter of which atoms are formed, and in which they float just as stars and planets co-exist with unagglomerated cosmical dust. Some think that atoms are continually being formed and disintegrating, others that they were created once for all and that the ether is a residue or by-product of their formation. With the latter hypothesis, which rests on pure assumption, realists have nothing to do. The former involves the possibility—long accepted by the great mass of mankind—of creating new atoms and annihilating matter. Emmens has claimed that he can make gold from silver, Fittica that he can convert phosphorus into arsenic. Many such transformations were described half a century ago, but every one was based on errors due to inadvertence or prejudice.

If we had to do merely with the ether that fills the interplanetary space and conveys energy through it, we could confine our attention to the mass and neglect the chemical nature of the ether. But so negative and bloodless an ether becomes unsatisfactory when we descend from heaven to earth, for the ether must permeate all bodies.

This power of penetration may be regarded as the highest development of the power of diffusion, shown by many gases with respect to caoutchouc, and by hydrogen with respect to iron, palladium, and platinum. In the latter case the diffusion is due not only to the lightness and high velocity of hydrogen molecules, but also to a chemical action analogous to solution and the formation of alloys, in which the compounds formed are ether, indefinite or unstable and readily dissociated by elevation of temperature. But the power of ether to form true compounds must be absolutely nil; in permeating other substances the only change it can undergo is a certain condensation.

Ten years ago the existence of so inert a substance appeared improbable, but now we know five such, argon, helium, neon, krypton, and xenon, the gases discovered by Ramsay and his associates; which dissolve freely in water, but so far as is known, form no definite compounds with anything.

They afford an experimental basis for the conception of ether as a gas incapable of combination.

We need not, like Crookes, assume a fourth state of aggregation, and thus we avoid all mysticism. We have assumed nothing inconsistent with the current conception of ether.

In 1869, when I pointed out the periodic connection between the properties of the elements and their atomic weights, the existence of absolutely inert elements was not suspected. Therefore the system began with group I and series 1, or with hydrogen, the lightest known element, common to both, but I never thought that it *must* begin with hydrogen. My predictions of the existence and properties of unknown elements were confirmed by the discoveries of gallium, scandium, and germanium.

These predictions are examples of what mathematicians call interpolation. The prediction of ether, as a rare gas, is an example of extrapolation which I venture now to attempt, because I have little time to wait, and because the new theory that atoms are composed of much smaller electrons appears to me to have sprung from the want of a definite conception of the ether, an outrush of which will suffice to explain the apparent disintegration of atoms into electrons.

The periodic system may be illustrated by an example. If we arrange in two series those elements whose atomic weights lie between 7 and 35.5, thus: Li 7, Be 9, B 11, C 12, N 14, O 16, F 19, Na 23, Mg 24, Al 27, Si 28, P 31, S 32, Cl 35.5, we see that each closely resembles the one below or above it and that the affinity for oxygen increases regularly as we go from left to right, the highest oxides of the second series being

Na_2O, Mg_2O_2, Al_2O_3, Si_2O_4, P_2O_5, S_2O_6, Cl_2O_7.

Hence the vertical groups are designated by the Roman numerals I. to VII. But as the new gases form no compounds, they must be put in a zero group, and the atomic weight of each must fall between those of an element of group VII. of one series and an element of group I. of the following series. This *a priori* conclusion is fully confirmed by experiment as appears from the following table, which is extended to include group zero and series zero and two hypothetical elements, x and y.

The latter, y, must have the fundamental properties of the argon group. Its atomic weight—deduced from the variation in successive neighboring groups and series—is probably less than 0.4. This element is probably coronium, whose spectrum, resembling that of helium in simplicity, appears in the solar corona above the hydrogen spectrum millions of miles from the sun's center, a fact which indicates its small density and atomic weight. If it is monatomic, like the helium group, its density is half its atomic weight, or less than 0.2, and its molecular velocity more than 2¼ times that of hydrogen, so that it may escape from the earth's sphere of influence, though it cannot escape from the sun's, and so cannot be the all-pervading ether. It may aid us, however, to the conception of x, the lightest and most mobile of elements, which I believe to be the universal ether and for which I suggest the name "Newtonium."

I cannot conceive the other elements to be formed of this, and I see no simplification in a common origin of elements. Unity of a higher order is given by the conception of ether as the final link in the chain of elements.

The molecular velocity of a gas may be calculated from the kinetic theory. For hydrogen at 0 deg. C. it is 1,843 meters per second. For any gas at temperature t it is 1,843 $\sqrt{\frac{1+\alpha t}{d}}$ where d is density referred to hydrogen and α is the coefficient of expansion 0.00367.

For ether, assumed to be monatomic, this density would be half the atomic weight, or ½x. Most estimates of the temperature of space lie between —60 deg. C. and —100 deg. C.

Taking the mean, —80 deg. C., we have,

$$v = \frac{2,191}{\sqrt{x}}, \text{ or } x = \frac{4,800,000}{v^2}$$

where v is the molecular velocity in meters per second.

PERIODIC TABLE OF ELEMENTS.

Series.	Group 0.	Group I.	Group II.	Group III.	Group IV.	Group V.	Group VI.	Group VII.	Group VIII.
0	x								
1	y	H 1.008							
2	He 4	Li 7.03	Be 9.1	B 11	C 12	N 14 04	O 16	F 19	
3	Ne 19.9	Na 23.05	Mg 24.1	Al 27	Si 28.4	P 31	S 32.06	Cl 35,45	
4	Ar 38	K 39.1	Ca 40.1	Sc 44.1	Ti 48.1	V 51.4	Cr 52.1	Mn 55	Fe Co Ni (Cu) 55.9 59 59
5		Cu 63.6	Zr 65.4	Ga 70	Ge 72.3	As 75	Se 79	Br 79.9.	
6	Kr 81.8	Rb 85	Sr 87.6	Y 89	Zr 90.6	Nb 94	Mo 96	—	Ru Rh Pd (Ag) 101.7 103 106.5
7		Ag 107.9	Cd 112.4	In 114	Sn 119	Sb 120	Te 127	I 127	
8	Xe 128	Cs 132.9	Ba 137.4	La 139	Ce 140	—	—	—	— — — (—)
9		—	—	—	—	—	—	—	
10	—	—	—	Yb 173	—	Ta 183	W 184	—	Os Ir Pt (Au) 191 193 194.9
11		Au 197.2	Hg 200	Tl 204 1	Pb 206.9	Bi 208	—		
12	—	—	Rd 224	—	Th 232	—	U 239		

This velocity must be great enough to overcome the attraction of the heavenly bodies.

A projectile thrown with sufficient velocity will not return to the earth, the limiting velocity being that acquired in falling to earth from infinity, equal to

$$\sqrt{\frac{2m}{r}}$$

where r is the earth's radius and m the earth's mass in gravitation or astronomical measure, determined by the equation $g = \frac{m}{r^2}$. Hence $v = 11,190$ meters per second. The atomic weight corresponding to this molecular velocity is 0.038. Gases heavier than this would remain attached to the earth; lighter ones would escape.

To resist the sun's attraction the molecular velocity must be 608,300 meters per second, the atomic weight 0.000013. But ether atoms must be still lighter and swifter to escape the attraction of still larger suns. The masses of some binary stars have been computed from their rotations. The heaviest has 33 times the mass of the sun. There is spectroscopic and other evidence that their densities do not differ greatly from his. Hence, knowing the mass, we can calculate the radius and, therefore, the molecular velocity which would overcome the star's attraction. For a star 50 times heavier than the sun, it would be 608,300 × $\sqrt[3]{50}$ = 2,240,000 meters per second.

This is about 1-130 of the velocity of light, 300,000,000 meters per second, and we may assume the molecular velocity of ether to lie between these limits. The corresponding limits for its atomic weight are 0.00000096 and 0.000000000053.

In the present state of science it seems impossible to accept the latter value, which would suggest a return to the emission theory of light. I think that many phenomena may be explained by assuming that the x atoms have about a millionth of the mass of hydrogen atoms and a mean velocity of nearly two and a quarter millions of meters per second. While I was making these calculations, I received Prof. Dewar's Belfast address, in which he expresses the opinion that the highest strata of the atmosphere, the region of auroræ, is also the field of hydrogen and the argon gases! It is but a step from this to the assumption of a still lighter gas filling all space and giving a tangible reality to the conception of the ether. Without developing the theory further I turn to certain apparently irrelevant phenomena which have guided my speculations, led me to publish this essay, and induced others to revert to the emission theory or to adopt that of electrons, scarcely conceivable to me, without thereby clarifying our conception of the ether. I refer especially to radio-activity.

From the first my impression has been that here we have to do with a condition which is no more peculiar to uranium, thorium, and radium than magnetism is to iron, cobalt, and nickel.

These heaviest of all atoms (V 239, Th 232, Rd 224) may be regarded as suns possessing the highest development of that special attractive power which is intermediate between gravitation and chemism, and which is the cause of gas absorption, solution and the like. We must not assume that because ether, like argon, forms no stable compounds, it may not dissolves in or accumulate about great centers of attraction such as stars and suns, uranium and thorium atoms. Though

*Abstract for the Scientific American Supplement from a paper published in Prometheus.

such accumulation might involve a change in velocity, it would be a comet-like rather than a planet-like connection, and it would be most likely to occur with the heavy uranium and thorium (and radium) atoms. Such an ether swarm about the uranium atom would explain various phenomena. I believe that radioactivity indicates a material emanation and that the arrival and departure of ether atoms are accompanied by the disturbances which constitute waves of light. When a flask containing gelatinous zinc sulphide is connected by a tube with a flask of radio-active solution, the sulphide glows as long as the connection is maintained, but the phosphorescence gradually dies away when the connecting tube is closed, and may be renewed by reopening the stop-cock.

This experiment, which M. and Mme. Curie performed in my presence, becomes explicable if we assume that a tenuous ethereal gas enters and leaves the radio-active substance as comets enter and leave the solar system.

Transverse light waves may be provoked either by molecular motion of other bodies, as in incandescence, or by variation in the motion of ether atoms themselves, that is, by a disturbance of their mobile equilibrium. A possible cause of such disturbance is the great mass of the uranium atom, as the chief cause of the sun's luminosity is, in my opinion, its great mass and the accumulation of ether due to its attraction.

I think that light waves are far more complex than is generally believed, because of the great velocity of the ether atoms.

Dewar has observed that the phosphorescence of paraffin and other substances is greatly increased by cooling to —193 deg. C.

It appears to me that at very low temperatures there is a condensation or an increased absorption of ether in these substances and that the increased phosphorescence is due to motion of ether atoms.

This essay is merely a series of impressions, suggested, however, by actual phenomena. Probably others have had similar ideas but have not developed them. If there is any truth in my theory, it will be elaborated and confirmed; if it is wholly false, its refutation will warn others.

I have attempted to give the first approximate answer to the question: What is the chemical nature of universal ether? Or, rather, to bring the question before the parliament of science.

THE DISTILLATION OF PINE PRODUCTS.*

By THOMAS W. PRITCHARD.

THE process of destructive distillation is not a new one; the art has been carried on for perhaps a hundred years or more. But its practical application to the distillation of pine wood in the United States unquestionably dates from a plant built by James Stanley in 1872 at Wilmington, N. C. Owing to a lack of capital, this plant was not a success, and, in 1878, it became the property of the present owners of the Spiritine Chemical Company, who were undoubtedly the first to realize and prove the practicability of the enterprise. Their efforts were for many years confined exclusively to the preservation of wood and the products of distillation were put to no other use. After many years, the process of making turpentine direct from the wood was evolved, and this is to-day perhaps the most important product. To fully realize the possibilities of this feature, we must consider the following facts: Within the last twenty years the turpentine industry has moved from North Carolina, where it was at one time pre-eminent, to lower Florida and Mississippi, and at the present rate of manufacture it will be but a few years before all the available turpentine orchards will be worked out. I speak now of the manufacture of turpentine from the crude spirits to get which the trees are chipped or boxed, which primitive method not only saps the vitality of the tree but also destroys its usefulness for milling purposes and, if carried too far, kills the tree outright. The demand for turpentine to-day is greater than ever before, and the price is steadily advancing. This is urging the manufacturers to further efforts, and naturally hastening the end of the old *régime*. We must also consider the fact that the lumber industry is eating up the timber lands of the South in a marvelous manner, the writer knowing of one particular mill in Mississippi that cuts the timber from eight acres of land each day. We have the word of an authority on the subject, that the pine lands of the South will not supply the mills now in operation for more than ten years to come, to say nothing of the many new mills now building and to be built in that time. Brick, stone, and iron may in time come to supplant the use of lumber for building purposes, but nothing known to science or manufacture can take the place of turpentine. The old method of manufacture being an expensive one, and the field of operation being limited, let us consider the advantages that the process of destructive distillation possesses over it. In the first place, the wood distiller starts where the lumberman and old-time turpentine manufacturer have long since ceased their operations, for we use what they leave as useless—the fat, light wood stumps and refuse, called in local parlance "knots." The very field that has been deserted by the turpentine manufacturer using the old method of boxing the trees and collecting and stilling the crude spirits is the Mecca of the wood distiller, for it is there he gets his raw material in the greatest quantities and at the lowest price, the light wood being practically useless except to the distiller. The greatest cost is the labor of cutting and hauling to the plant; the supply of crude material is practically unlimited, and the field of operation covers the entire South. Another advantage in an indirect way is the removal of the stumps, thereby giving to agriculture many thousands of acres of valuable land now useless because of the cost of clearing. I shall now try, as nearly as possible, avoiding technicalities where practicable, to describe the process of destructive distillation as applied to the manufacture of turpentine and other pine products. Destructive distillation, as its name indicates, destroys; in other words, chemical changes take place and new matter is formed, possessing properties possibly entirely different from the crude material used. It is, in this case, driving out by intense heat all the volatile and liquid matter in the wood and condensing and collecting them after vaporization. The original form of the wood is destroyed and in its place are divers liquids and more or less pure carbon. There must of course be no combustion, else the valuable products would be destroyed. The process is carried on in huge steel shells or retorts, as they are called. These are set in brickwork or masonry, in very much the same way as a boiler, having a space beneath for fire. The retort must be built in such a manner that it can be hermetically sealed during distillation, as any ingress of air or escape of vapor must be avoided. The size of retort best adapted to the work is a much mooted question, but the most satisfactory size I have seen are those holding five cords of wood each, as they give a maximum of products at a minimum of labor and expense. They should have two doors, one at each end, and these doors must be so built as to make a gas-tight joint when closed and as a general thing some heat-resisting substance such as fireclay or asbestos is used as a packing around the doors during the running of a charge. From the top of the retort in the center a pipe connection is made and a copper pipe, of sufficient capacity to carry off the resultant vapors of distillation, leads to the condenser or worm, which is immersed in a tank of sufficient capacity. This tank is kept full of cold water during the running of a charge. At the lower opening of this coil or worm there is an ingenious arrangement called a gas trap. This is to save the gas during distillation, and this gas is quite an item. So much for the mechanical arrangements. The wood is placed in the retorts, being packed in as closely as possible; the doors are closed and hermetically sealed; fires are started in the furnaces beneath the retorts, and the pumps put to work pumping cold water into the condenser tank. In a few hours distillation commences. The liquids are driven from the wood by the intense heat, and as there is no ingress of air, and consequently no combustion, these liquids become vapors, and, rising to the top of the retort, seek the most available opening for escape. This is, of course, the pipe. Passing through this pipe, they strike the coil or worm, and as this is kept cool by the constant changing of the water in the tank, the vapors at once begin to condense in the order of their gravity; and, following the complete course of the coil, they run into collecting tanks in a liquid form. The gas, being naturally lighter than the other products, follows the top of the coil, and before reaching the outlet, is piped off, either to be used for illuminating purposes around the plant or as an adjunct to the furnaces under retorts or stills. The liquid products are pumped from the collecting tanks to the secondary still, where they are redistilled, and by fractional distillation are separated into the different oils and by-products according to weight and the purpose for which they are to be used. After the retorts have been allowed to cool, the doors are opened and the residuum, which is charcoal, is drawn. The retorts are then ready for another charge. The charcoal is used for firing the retorts and practically offsets the fuel expense. The products of the first distillation come over in the shape of a thin amber-colored oil, together with a quantity of dilute glacial acetic or pyroligneous acid. The oil and acid are separated by their difference in gravity. The oil, while at first light in color, soon assumes a darker hue and becomes thicker in consistency. This oil, after being pumped into a secondary still, undergoes a second distillation, and from this distillation wood spirit or turpentine and a light and heavy oil are evolved, leaving a residue of heavy consistency—in other words, tar. The spirit from the first distillation is not water-white in color, and a third distillation is necessary to reach this stage. I will now speak of the diversity of products, together with their uses, and will give, as an illustration of this, the products of the Spiritine Chemical Company, as they are, beyond question, the foremost manufacturers of pine products to-day, and have carried the art farther than any one else. We will take first the actual amount of products from one cord of wood, good, rich wood being used. The results, to the uninitiated, will seem almost impossible, but they are actual figures of what is being done every day. The yield from one cord of wood on an average is 18 gallons of spirits turpentine, 72 gallons of oil, and a like quantity of pyroligneous acid; in other words, about four barrels of products, almost equaling in bulk the cord of wood. In addition to this, the residue of charcoal equals about half the original bulk of the wood used. The uses of turpentine are too well known to mention. Suffice it to say they are increasing daily and the price was never so high nor the demand so great as now. This is perhaps the most valuable product of the distillation. We next have the oils, one light, the other heavy. The light oil is made into a wood preservative, and it is beyond question the best known wood preserver to-day. It contains a large percentage of creosote—about 50 per cent—and it is treated chemically to increase its fire test and give it greater penetrative properties. The fire test is so high, 235 deg., that from actual tests made untreated wood burned much more rapidly than that treated, and its penetration properties are so great that a railroad cross-tie immersed for fifty minutes was found on examination to be permeated with the oil from end to end. From this light oil there is also made a perfect substitute for linseed oil as used in painting, and in many cases a much better paint is made and at a much lower cost. It is also used in the manufacture of shingle stains of surpassing beauty. The heavy oil has its uses also, and is made into cable coating for wire rope transmission; pine rubber, which is used for insulating purposes; disinfectants of great value, and a number of other medicinal preparations. The tar, which is of a very high grade, being free from acid and water, has many uses, but as most of our readers are familiar with this product we shall not attempt to enumerate them. Perhaps the least valuable of the products and certainly the one of which the least use is made, is the pyroligneous acid. True, it is used for making iron liquor for dyeing purposes, acetate of lime, from which vinegar is made, sodium acetate, and other chemicals, and it is now being used to some extent for curing meat, giving to fresh meat in a few hours that delicious smoked flavor formerly attained only after days and weeks of treatment. Still the uses for this product have never been developed, and a wide field is presented in its application. As a matter of fact the entire industry is in its infancy, and each year sees new uses for the products and new methods of refining. Plants are springing up like mushrooms in the night, and more plants have been erected in the past two years than were built in the twenty years preceding. The business has passed the experimental stage and has assumed a solid and established footing among southern industries; not only this, but those embarking in the enterprise are beginning to realize that, while the profits are large, greater in fact than in any other legitimate enterprise of which the writer is conversant, still it is not a "get-rich-quick scheme," and sound business judgment, in combination with sufficient capital, is a necessary adjunct to success. We predict a great future for the industry, as great, if not a greater, prominence in manufacture as the cotton seed oil trade now enjoys, for the uses of pine products are just as necessary and far more varied.

* Specially prepared for the SCIENTIFIC AMERICAN SUPPLEMENT.

CONTEMPORARY ELECTRICAL SCIENCE.*

SELF-ELECTRIFICATION OF RADIUM.—Since radium gives out both positive and negative electrons, and since the positive electrons are easily intercepted, radium inclosed in an envelope impervious to the positive ions should become positively charged. If a radium preparation is inclosed in a thin glass tube closed at one end with a platinum electrode, it will give out a constant current due to the positive ions liberated by the radiation of the negative ones through the wall of the tube. W. Wien has measured this current and found it to be of the order 3×10^{-12} amperes. This figure enables us to arrive at an estimate of the masses radiated per second, since it gives a value for e per second, and the ratio e/m is known. The masses are: Negative electrons, 2.9×10^{-20} grammes per second; positive ions 4.6×10^{-17} grammes per second. These masses are quite beyond detection by weighing. Their energy, on the other hand, is considerable. Neglecting the change of apparent mass with the velocity, and assuming the velocities 2.5×10^{10} for the negative electrons and 1.65×10^{-9} for the positive ions, the kinetic energy developed by the negative electrons comes out as 8.7 ergs per second, and by the positive ions 60 ergs per second, from 4 milligrammes of radium preparation used in the experiments.—W. Wien, Phys. Zeitschr., September 1, 1903.

CONDENSATION NUCLEI FROM PLATINUM WIRE.—Gwilym Owen has studied the nature of the particles given off when platinum is heated. He finds that the production of nuclei depends not so much upon the length of time the wire is heated, as upon the maximum temperature attained. He tried the effect of placing the heated wire in an electric field, in order to find whether any difference was produced in the rate of expansion necessary to form a cloud. He found that the electric field makes no difference, and hence concludes that the nuclei produced by the heating of platinum wire in air or hydrogen are uncharged. What these nuclei actually are he does not venture to say. It is highly improbable that they are due to dirt on the wire. On one occasion a wire was kept red hot for 13 hours with a stream of filtered air flowing along it, and yet afterward fogs were got by heating it to a temperature below 200 deg., and expanding. Platinum wire disintegrates in air below 300 deg. at all events, but that the process is very slow is explained by the fact that the nuclei are of almost molecular dimensions.—G. Owen, Phil. Mag., September, 1903.

HALL EFFECT.—E. van Aubel gives further particulars of the large Hall effects observed in bismuth sulphides. In pure bismuth sulphide the Hall effect is twice as large as in pure bismuth. It may be em-

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

ployed for the measurement of strong magnetic fields. The Hall effect differs somewhat when the magnetic field is reversed in direction. This is no doubt due to the position of the axes of the majority of crystals forming the plate. The author cut a circular plate of bismuth sulphide and rotated it about its axis while keeping the position of the Hall effect electrodes constant. The difference between the two Hall effects obtained with upward and downward magnetic fields respectively varied from place to place and was reversed in sign at some points. To discover a possible effect of a surrounding magnetic medium, the author covered the plate with a thin coating of varnish and immersed it in cold water and subsequently in a strong solution of ferric chloride of the same temperature. No difference was observed in the Hall effect in the two cases.—E. van Aubel, Phys. Zeitschr., September 1, 1903.

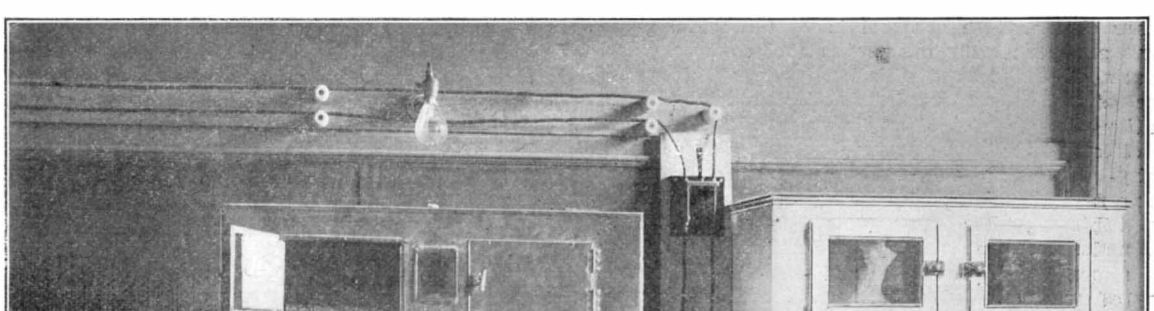
General Radio-activity of Metals.—J. S. McLennan and E. F. Burton have found that when a cylinder of any metal is inclosed within a second cylinder of the same material, insulated from it, and surrounded by air or other gases, it gradually acquires a negative charge, and after a short time reaches a state of equilibrium at a definite potential below that of the inclosing cylinder. The authors experimented with cylinders of aluminium, zinc, lead, tin and copper, and measured the potentials with a quadrant electrometer giving a deflection of 1,000 millimeters at a distance of 1 meter for 1 volt. The final potentials reached were — 179 millvolts in aluminium, — 160 in zinc, — 216 in lead, — 95 in tin, and — 73 in copper, these values closely corresponding to the Volta effects. Under the influence of Becquerel or X-rays, the same potentials were reached in a few seconds. The authors connect the facts specified with the discharge of positive corpuscles by a red-hot metal, and believe that every metal gives off more positive than negative electrons, thus acquiring a negative charge, which, owing to the ionization of the air, cannot exceed a certain value.—McLennan and Burton, Phil. Mag., September, 1903.

Electrolysis and the Solvent.—C. A. Lobry de Bruyn has endeavored to obtain quantitative data bearing upon the question as to whether the ions carry the solvent with them in electrolysis. The matter cannot, of course, be decided by using purely aqueous solutions, since the solvent would then be everywhere the same. But the author uses a mixed solvent consisting of water and methyl alcohol. Then, if one of the ions carried with it one of the solvents, this would be found out by the difference in the proportion of the two solvents at the cathode and anode. The electrolyte used was silver nitrate dissolved in 25, 35, and 64 per cent solutions of methyl alcohol, with electrodes of silver. The apparatus was that used for determining transference numbers of the ions. The result was distinctively negative. If the silver or nitrogen-oxide ion had carried with it one molecule of the solvent, then for every 4 grammes of silver an increase or decrease of 0.6 to 0.7 gramme of water or of about 1.2 grammes of alcohol at the anode or cathode would have taken place. This would have been plainly detected by the analysis, even though the amount had been largely diminished by diffusion.—C. A. Lobry de Bruyn, Proc. Roy. Acad. Sc., Amsterdam, August 27, 1903.

HOW TO BUILD AN ELECTRIC OVEN.*

By H. Schmidt.

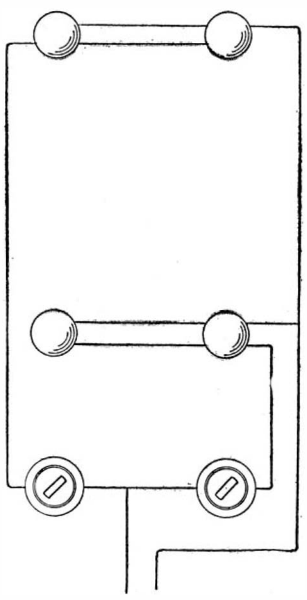
Of all the many useful applications of the electric current, there is not one which it so easily lends itself to as the production of heat. This is exemplified in the incandescent lamp, arc lamp, etc. To utilize this heat in an economical and easily transformed manner, is the object of all builders of electric heating devices.



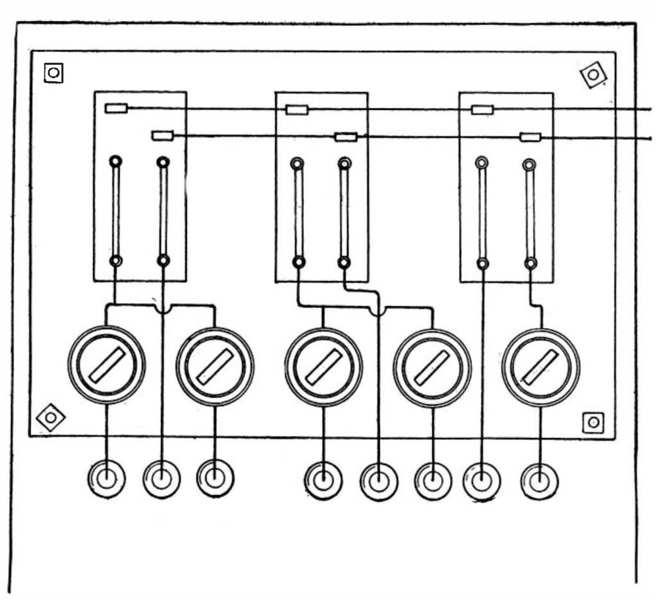
A HOME-MADE ELECTRICAL OVEN WITH WARMING CLOSET TO THE RIGHT.

The claims usually made as to economy are of necessity somewhat optimistic, but the money paid directly for the service of the current usually very imperfectly represents the value of the ultimate service rendered. The cleanliness, portability, freedom from radiation, and safety of devices surely count for something, and should be considered in counting the cost.

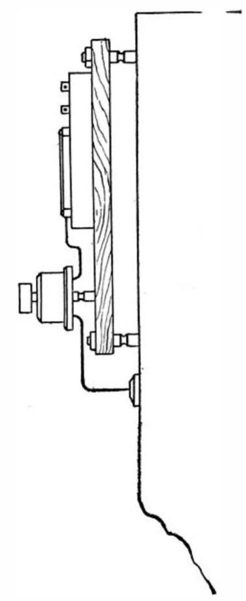
As this article treats essentially of an electric oven, I will confine my remarks to it. The electric oven, unlike any other, can be regulated so that the cook may know exactly what results will follow with a certain manipulation. The heat produced is always the same with the same setting of the switches. Cooks and domestic science teachers agree that all roasting and



WIRING OF WARMING CLOSET.

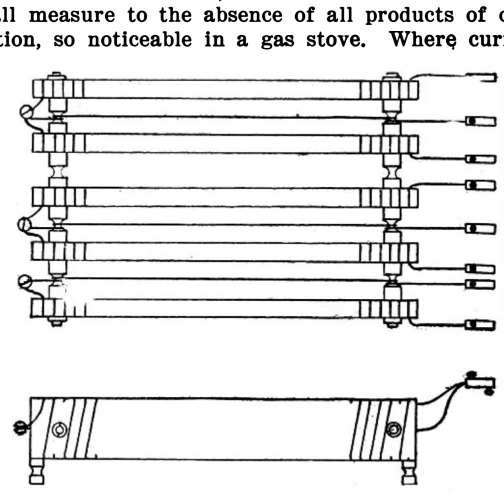


THE SWITCHES.



SIDE ELEVATION OF A SWITCH.

baking of meats can be done perfectly, and that in baking bread, pastry, etc., results are obtained far beyond all other methods of baking. This is probably due to the uniform heat and freedom from air currents. No oven can be made so air-tight as the electric one, and the air being in constant contact with and internally circulating over the heating coils, produces very remarkable results, which are attributable in no small measure to the absence of all products of combustion, so noticeable in a gas stove. Where current



HEATING COILS OF THE OVEN.

in same quantity is available, such as in isolated or private plants, the electric oven is the "thing."

Some time ago it fell to my lot to advise and plan for an electric oven which would fulfill certain conditions, in the domestic science department of a school. The heat to be obtained was to vary from 250 deg. to 700 deg. F., all processes going on within the stove to be perfectly visible, and the stove to have a capacity of thirty 6-ounce loaves of bread. The excessive cost of an oven made by electric heating concerns was prohibitive, and as a result of considerable experimentation, the following oven was designed and constructed, and has since "filled the want."

The accompanying photograph will give a general idea of its appearance. The left is a warming oven, of which I will say a few words later.

The outside dimensions are 36 inches wide, 18 inches deep, and 28 inches high. It is constructed of heavy planished iron on the outside. The inside is common sheet iron separated from the outside wall by a one-inch space all around filled in with asbestos. In the center of the top there is let in a heavy plate glass 4 x 18 inches, above which is mounted a 32-candle-power lamp, as shown. This in combination with the glass peep-holes in front of the oven render all interior parts of the oven visible. The shelves are of heavy iron screening.

The heating coils are of simple construction, and have the advantage that if burned out they can be replaced at a cost of a few cents. As shown by the diagram, there are five, made of 1-inch x 6-inch x 24-inch slate. In the top and bottom edges ¼-inch grooves, spaced ⅜ inch, are cut with a hack saw, making fifty-six grooves. In these are wound coils of No. 10 common iron stovepipe wire, making about 61 feet. This will permit a flow of about 33 amperes under a pressure of 110 volts when the current is first turned on; but on account of the high temperature coefficient of electrical conductivity of iron, the resistance increases very rapidly, so that at the expiration of about half a minute the current drops to about 15 amperes. This makes the wire barely red hot; after the slate gets hot the current is still further decreased, so that normally each coil consumes about 12 to 13 amperes. These figures will vary slightly, due to the differences in gage and quality of the commercial wire.

The wire should not be red hot, as oxidation sets up very rapidly at this temperature, and speedy deterioration results.

At the ends of the slate 5-16-inch holes were drilled, through which passed a ¼-inch iron rod threaded at each end. "No. 5 standard" porcelain knobs were used as spacers. This makes it easy to handle the coils, and introduce them as a whole through the large bottom door of the oven. Wound around the knobs between the coils are short lengths of bare No. 6 copper wire. These are looped at the left-hand end, and a ¼ inch by ⅜ inch stove bolt with washers is passed through this, and the ends of the iron wire secured under the washers. For removal purposes the ends of the wires are provided with screw connectors, which are attached to the ends of wires to the switches. The coils are raised 1½ inches from the floor of oven by means of porcelain knobs.

About 9 inches above the bottom of the oven, on the right-hand side, eight ⅝-inch holes were made, through which 1¼-inch x ⅝-inch porcelain bushings were passed, luted in place by means of asbestos cement. These are for the purpose of passing the wires from the switches into the stove, and then making connections with the coil wires. As copper conducts the heat readily, the wires on the switchboard must be bare, and the switches must be mounted about an inch above the wooden base, by means of porcelain knobs. Details and connections are shown in the diagram. Switches are single-pole indicating "Hart" snap switches. The cutouts are 30-ampere "Noark" fuse-blocks. A No. 4 wire should be used to connect stove with electric mains.

When bread and cake are to be baked, three coils usually furnish enough heat, for pastry four, and for high heat five. The slates retain their heat for a long time, and furnish enough heat to complete the processes in hand if turned off 15 to 20 minutes before completion.

The warming closet on the right in photograph is used for raising bread, etc. It is 36 inches wide, 18 inches deep, and 32 inches high. It is made of wood, lined with asbestos paper; the front is removable. In the middle and near the bottom are two frames 4 inches deep and fitting the inside of the closet. They are covered on the top with a heavy wire screening covered with asbestos, leaving a 2-inch space all around for circulation. To either end of frames electric light receptacles are fastened carrying 16-candle-power lamps. By means of switches, any two or all of them may be lit, producing a temperature of 180 deg. F. in ten minutes. Almost any temperature may be maintained, from 75 deg. to 180 deg. F.

Both of these ovens have worked admirably, and the

* Specially prepared for the Scientific American Supplement.

dimensions given herein will suffice for almost any size oven, provided the proportions of spaces heated and energy consumed are kept.

COMBINED CONDENSER AND OIL ELIMINATOR FOR STEAM AUTOMOBILES.

THE accompanying photograph and diagram show the general appearance and construction of a condenser that can be fitted to any steam automobile. The condenser is attached by means of suitable lugs and brackets to some convenient place on the front of the machine. The exhaust pipe of the engine is connected to the opening, *A*, in the center rear face of the condenser. An overflow pipe, *B*, comes down behind the condenser as shown. The water from the condensed steam accumulates in the steam trap, *K*, after passing through the quarter-inch pipe leading from the bottom header of the condenser into it. The object of the

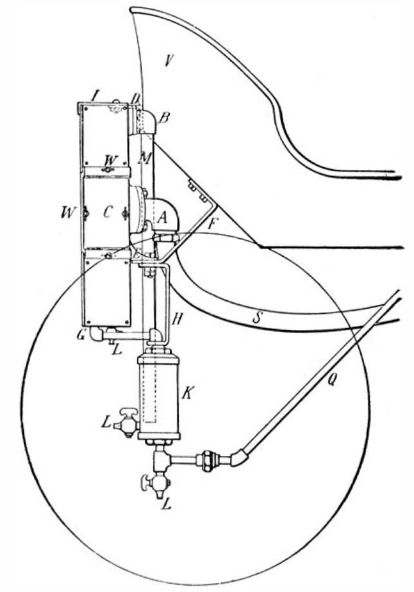
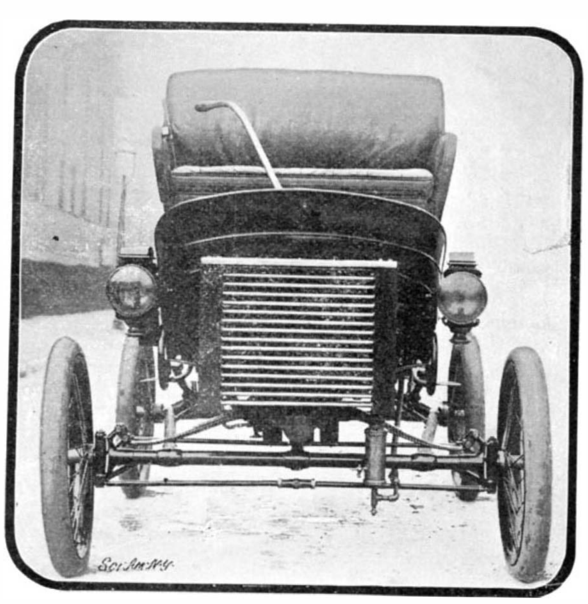


DIAGRAM OF CONDENSER AND OIL ELIMINATOR.

steam trap is to automatically send back the water into the tank without the use of the pump. For this purpose a ¼-inch pipe leads from the bottom of the trap up into the top of the water tank.

The oil eliminator is in the condenser and is packed after removing the main plate, *C*, in the following manner: In the chamber in which the exhaust steam enters first place the screen and then clean cotton waste or excelsior. Replace the gasket and plate and screw the nuts up tight. The cotton waste or excelsior must be replaced with fresh packing when it no longer absorbs oil. If the oil eliminator is packed in too tight, it will create a back pressure on the engine. Care should be taken to avoid this. When the engine is first started, exhaust steam will blow out through the overflow, *B*; but as the machine gains speed and the air strikes the condenser, this exhaust steam will stop discharging and will condense, while the condensation will be periodically discharged by the trap into the water tank.



THE BRANCH CONDENSER ON A TOLEDO STEAM CAR.

These condensers can be used with any boiler, whether of the flash, water-tube, or fire-tube type. As they are now made, radiating flanges are placed on every other tube. They are manufactured by the National Oil Burner and Equipment Company, of St. Louis, Mo.

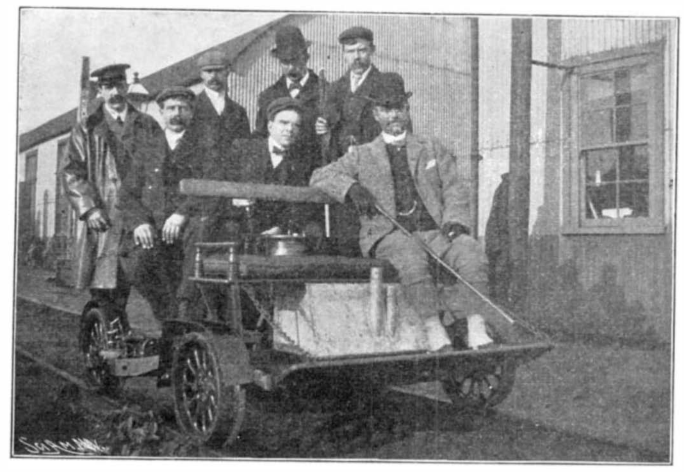
American Fruit in Germany.—The present year has witnessed a great increase in the imports of American apples into Germany. For the first eight months of 1903 the imports were 3,696 metric tons of 2,204 pounds each, against 214 tons and 543 tons during the same months in 1902 and 1901. Of American dried fruits, baked and simply preserved, the German imports for the same period were 25,251 tons, against 11,981 and 12,060 tons, respectively, in 1902 and 1901.—Richard Guenther, Consul-General, Frankfort, Germany.

GASOLINE INSPECTION CARS FOR RAILWAYS.

By the London Correspondent of the SCIENTIFIC AMERICAN.

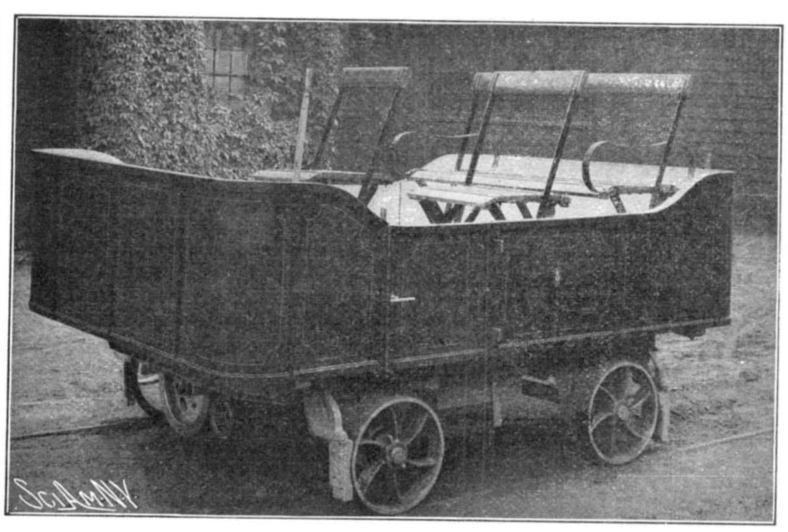
Two new forms of inspection cars have recently made their appearance in London, the one the invention of Mr. Robert W. A. Brewer, and the other the invention of Mr. Frederick R. Simms, whose motor war-car, described in these columns not so long ago, readers will doubtless remember.

Mr. Brewer's car is distinguished by the simplicity of its construction. No springs are employed; the axles run in brasses bolted on the frame of the car. The cylinders are outside of the frame. All valves are vertical and are mechanically operated. The lever which controls the timing of the ignition spark also supply to the engine, which valve requires setting only once. The strength of the mixture can be appreciably altered by the admission of air to the carbureter. The water circulation is by thermo-siphon, a tank of considerable capacity being located under the front seat. Owing to the very slow speed of the engine, very little heat is given up to the jacket-water. The ignition is of the single-circuit, low-tension, moving-contact type. Twelve dry cells supply the current. The induction coil is under one of the seats.



A NEW GASOLINE RAILWAY-INSPECTION CAR.

Since there are no vibrators, no adjustment is required. The moving contacts work in lava insulators, and are screwed down in mica washers. Mr. Brewer finds a break of about 3-32 of an inch gives the best results. The cam-shaft is worked by a bicycle-chain, from the back axle. The cams are loose on the shaft, a tongue-piece being so arranged that the engine will work equally well in either direction, since it is driven by a fixed key on the shaft.

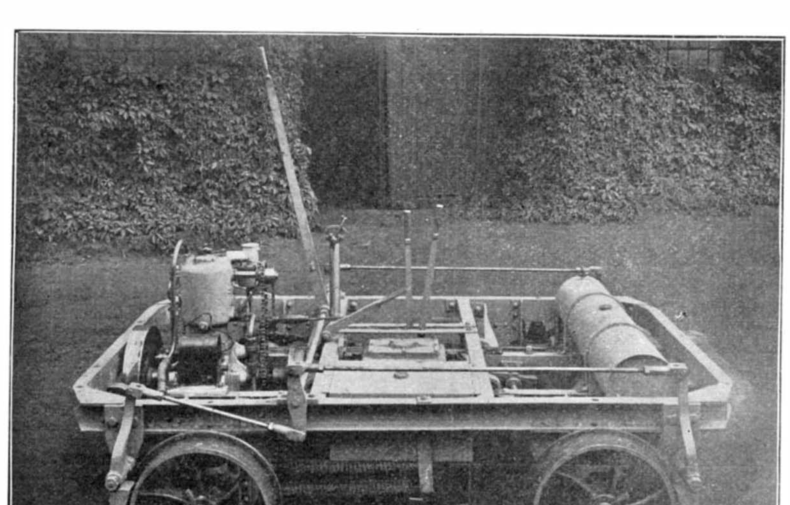


SIMMS INSPECTION CAR IN TIME OF PEACE.

holds open the exhaust-valve when in the "off" position, so that, when running down grade, there is no compression, the ignition current being, of course, then cut off. The carbureter is located below the gasoline tank (the capacity of which is two gallons). The quantity for each charge is regulated by a needle-valve, the lever of which works over a graduated scale on the tank. Storage arrangements are provided for additional quantities of gasoline. The car, however, is said to run nearly one hundred miles on two gallons. The engine is of slow speed, making about 500 revolutions per minute, the wheels being twenty inches in diameter. This small consumption can be accounted for by the fact that there is no gearing, the speed of the engine being proportional to that of the car. The vapor-pipe branches on reaching the car-frame, one branch running to each engine. A check-valve is provided on the cylinder side for the regulation of the air

Mr. Simms' car may be used both in war and in peace. In time of peace it may serve for the inspection of the permanent way, for sending dispatches, as well as for piloting ordinary trains. In time of war, the car is intended for the protection of railway lines and for the maintenance of continuous communication. The machine is not intended to dispense with armored trains; on the contrary, its purpose is to assist these in their operations, by doing independent scouting work.

These railway war machines, being armor-plated and carrying a one-pounder Maxim gun, as well as a small machine-gun, are intended to be employed in larger numbers than the armored trains. Each machine forms, so to speak, a little self-contained fort ready



CHASSIS OF THE SIMMS INSPECTION CAR.

to start at a moment's notice, and capable of attaining a speed of some thirty miles an hour.

Each of the war-machines is to be manned by one officer and two or three men. It is thought that a railway line extending over five hundred miles could easily and efficiently be held by twenty-five of these machines, or one hundred officers and men. Each car will cover twenty miles of the line. Fifty cars could, therefore, cover one thousand miles of line. By frequent inspection or continuous scouting, it would be almost impossible to injure any portion of the line.

The car itself is constructed throughout of channel steel and can withstand severe shocks and strains when running at a high speed. The car-frame is further supported by spiral springs in ordinary horn-plate boxes. The axles are of great strength and are made of Bessemer steel. All the wheels run on roller bearings. The car is propelled by a 7-horse-power Simms water-cooled motor fitted with a Simms-Bosh magneto-electric ignition and timing gear, which, independently of the speed-changing gear, allows the car to be run at any speed up to its maximum.

The motor can be run on gasoline or kerosene. It is cooled by water, circulated by a pump. Four gallons of water suffice for a journey of eight hours. The lubrication is automatically effected. The weight of the motor inclusive of the magneto machine, timing gear, float-feed and vaporizer, but exclusive of flywheels, is 82 pounds. The engine is coupled to a three-speed gear of the Panhard type, contained in an aluminium dust-proof and oil-tight box, by means of a Champion friction-clutch. The power is transmitted to the driving wheels by means of a counter-shaft, extending through the gear-box, carrying a pinion connected by a stout Brampton chain to the sprocket wheel keyed to the driving axle. The three-speed gear, which runs in an oil-bath, also contains a reversing gear, by which the direction of the car may be reversed at the like speeds. All the machinery is underneath the foot-boards, so as to render the space above available for the men and stores. The motor, gear, and car are all operated by one man, there being only two levers to attend to, besides the brake levers (foot and hand). Three powerful brakes are provided for, capable of bringing the vehicle to a dead stop within five yards, when traveling at full speed. The speeds are 8, 16, and 24 miles an hour, capable of being accelerated to 30 miles per hour. The normal speed of the engine is 1,200 revolutions per minute, which may be reduced to as low as 250, or increased to 2,000 by means of the timing gear, thus enabling independent control of the speed of the car.

HOW MUCH OF THE HEAT GOES UP THE CHIMNEY?

It is generally understood that the best results are to be gotten out of a boiler plant by making as little furnace gas as possible per pound of coal and sending that gas to the chimney as cool as possible. Not every engineer has a definite idea, however, of the effect of more or less unnecessary air in the gases, and few could tell off-hand how much the diminution of the final temperature of the gases 50 deg. would affect the efficiency.

The accompanying table gives the percentage of the heat generated which goes off in the gases at various flue temperatures and with different amounts of excess air so as to make from 15 to 25 pounds of flue gas per pound of coal. The combustion is assumed to be perfect, the fuel to have 14,500 British thermal units per pound of combustible, and the temperature of the fuel and air coming to the furnace to be 70 deg. Fahr. No allowance has been made for moisture in the coal, which is evaporated in the furnace and goes off as steam, carrying the latent heat required to evaporate it, as well as that due to its rise in temperature, but this affects the percentages given only about 0.076 of 1 per cent for each per cent of moisture. If, for example, the weight of the moisture in the fuel were 2 per cent of that of the combustible, the values in the table should be increased $2 \times 0.076 = 0.152$, making the heat rejected to the chimney with 20 pounds of gas per pound of coal at 100 deg., 10.62 per cent instead of 10.47.

If all the heat with the exception of that rejected

PERCENTAGE OF HEAT UNITS VOIDED TO THE CHIMNEY WITH FUEL OF 14,500 B. T. U. PER POUND OF COMBUSTIBLE, SPECIFIC HEAT OF GASES .23, TEMPERATURE OF FIREROOM, 70 DEGREES.

Pounds of Chimney Gas per Pound of Combustible.	Flue Gas Temperatures.							
	250	300	350	400	450	500	550	600
15	4.28	5.47	6.66	7.85	9.04	10.23	11.42	12.61
16	4.57	5.84	7.11	8.38	9.64	10.91	12.18	13.45
17	4.85	6.20	7.55	8.90	10.25	11.60	12.94	14.29
18	5.14	6.57	7.99	9.42	10.85	12.28	13.70	15.13
19	5.42	6.93	8.44	9.95	11.45	12.96	14.47	15.97
20	5.71	7.3	8.88	10.47	12.06	13.64	15.23	16.81
21	6.00	7.66	9.33	10.99	12.66	14.32	15.99	17.65
22	6.28	8.03	9.77	11.52	13.26	15.00	16.75	18.50
23	6.57	8.39	10.22	12.04	13.86	15.69	17.51	19.34
24	6.85	8.76	10.66	12.56	14.47	16.37	18.27	20.18
25	7.14	9.12	11.10	13.09	15.07	17.05	19.03	21.02

to the chimney were applied to the making of steam, the efficiency of the plant would be 100 per cent, less the percentage given in the table. Heat is, however, lost from the system in other ways, as by radiation, ash pit losses, etc. The difference between the efficiency actually attained plus the values given in the table and 100 is a measure of the sum of these losses. —Power.

ENGINEERING NOTES.

Mr. K. C. Bales, in the course of the discussion on his paper dealing with the subject of emery wheels, read at a recent meeting of the Institute of Marine Engineers, stated that the general average speed for emery wheels was 5,000 feet per minute, but the speeds varied from as low as 3,500 feet to as high as 6,500 feet per minute; it depended on the nature of the work they had to grind. With regard to the flanges for holding the wheels, he recommended that they should be half the diameter of the wheel, and that the flange be concave, so that it merely touched the wheel on its periphery. He believed in having between the wheel and the flange not only the blotting paper pad that was usually attached, but also an India rubber washer, so that the flange got right hold of the wheel. He had never had any interference from the home office in regard to emery wheels; he had with other machines, much to his regret, for they practically nullified the advantages of the machine. He would certainly recommend guards for wheels.

A difficult piece of telegraph and telephone construction work has recently been completed in the Belgian Congo Settlements, says the London Electrical Engineer. The line is 750 miles long, the first section undertaken being that from Boma to Matadi, a distance of 18 miles. This length took no less than eight months to construct. White labor was precluded by the climate, and the majority of the work was carried out by natives under the direction of Europeans. The work was complicated by several difficult streams which had to be crossed. The crossing at Underhill was effected by means of two steel pylons, 50 feet high and 2,620 feet apart, and placed respectively 237 feet and 206 feet above the high-water level. The construction of the line from Léopoldville to Equateur was also very difficult. Surveys were particularly dangerous, and the zone unhealthy. Advantage was taken as far as possible of the forest trees in fixing the supports for the line. The crossing of the Kasai River was probably the most difficult piece of work, as it was necessary to keep the stream clear for the steamer traffic. Advantage was taken of a rocky island in the river, and the crossing was made in two spans, one of 1,472 feet and the other of 2,198 feet, the supports being three iron pylons. Much trouble was experienced in getting the four conductors in place, but this was eventually accomplished with the aid of a steam tug. The maintenance of the line is expected to give considerable difficulty, for although the posts are either of iron or living trees, and, therefore, proof against the attacks of white ants, elephants abound, and storms occasion great interference by throwing down trees across the line. Atmospheric discharges are also troublesome. Birds make their nests on the wire, wasps nest in the insulators, and spiders cover the poles with webs, collecting a litter of leaves and twigs. The line is used for both telephone and telegraph service and the stations are protected by local garrisons.

The first of the big Westinghouse engines, four of which will supply a greater portion of the power for the Louisiana Purchase Exposition, has just been operated under load for the first time. Steam for the big machine was supplied by the most easterly battery of the Westinghouse boiler plant. The engine is of 2,000-kilowatt capacity, about 3,000 horse power. The engine has been running for some days without carrying a load, in order to test the bearings, to tighten the bolts, and to adjust the governor. The load carried on this test was an artificial test load. The engine will do no real work for some time, when a test of unit sections of the buildings will be made. All the work done at present is attended to by the Washington University power plant, an equipment of three Ide engines, directly connected with General Electric generators, each of 90-kilowatt capacity. These engines light the engine houses, the hospital, and attend to the patrol lighting of the grounds. The current for operating the two big electric cranes in the Machinery building is produced by the exciter engine of the Westinghouse plant. The engine just thrown into service is one of the 16,000-kilowatt plant, which will furnish the current for lighting and power during the Exposition. This plant is made up as follows: Four Westinghouse engines coupled to Westinghouse generators, 8,000 kilowatts; Allis-Chalmers engine coupled to Bullock generator, 3,500 kilowatts; Hamilton-Corliss engine coupled to National generator, 1,500 kilowatts; Rateau-Turban engine coupled to Bullock generator, 1,500 kilowatts; General Electric engine coupled to Turbo generator, 2,000 kilowatts; giving a total capacity of 16,000 kilowatts. The current for arc lighting will be supplied by three sets, aggregating 2,300 kilowatts, and including the following: Delauney-Belleville engine coupled to a generator of the Electric Lighting Society, 1,100 kilowatts; Alsatian Society of Mechanical Construction, supplying engine and generator, 700 kilowatts; the Bradley Company, of Pittsburg, supplying engine and generator, 500 kilowatts; a total of 2,300 kilowatts. In addition to these plants a 4,400-kilowatt plant, made up of five sets, including the machinery of the Murray Iron Works, at Burlington, Ia., Lane & Bodley, of Cincinnati, O., and a giant waterwheel supplied by the Abner-Doble Company, of San Francisco, Cal. The foundations for most of these machines are already in place. Two big cranes are ready for their installation. Some installation work has been done on all of the Westinghouse, while the big bedplate and some of the upper parts of the Allis-Chalmers engine, the largest on earth, are already in place.

ELECTRICAL NOTES.

Davy was the first who thoroughly investigated the discharge of electricity in air and exhausted gases. After stating that "Boyle's vacuum" is a conductor of electricity, whereas the "Torricelli vacuum" is non-conductive, he concludes that ponderable matter is necessary to the propagation of electricity, this conclusion being borne out by the further researches of other experimenters.

Schuster and Hemslech while examining the electric spark both spectroscopically and by photographing it on a rotating film, have stated that on the current first passing, the spark is nothing else than a "line of fire," and on being examined through the spectroscope it will show the bands of air. Afterward the electrodes will give off metallic vapors, forming a glow that surrounds the "line of fire." Under special conditions, these vapors will eventually fill all the space between the electrodes, when only the line of the corresponding metal will be observed through the spectroscope. Similar differences were observed in the behavior of the spark photograph. In fact, the "line of fire" is on movable films always represented by a straight line connecting the poles, whereas the image of the glow is composed of a series of strokes running away from the pole at an angle variable with the speed of rotation of the film. It may hence be inferred that the incandescent metallic vapor to which the glow is to be ascribed performs a translatory movement, the speed of which would be about 1¼ miles per minute.

Mr. J. Semenov (Journal de Physique, February, 1904) causes electric sparks to jump between two gas flames or a flame and a metallic electrode, or else between two metallic electrodes separated by a small gas flame. By this arrangement the glow is eliminated, so as to enable the spark proper to be examined separately. In fact, the metallic vapors constituting the glow are blown away by the gas stream of the flame. The image of the spark is projected by means of a convergent lens on the vertical slit of a direct-vision spectroscope, the axis of which is perpendicular to the plane of the spark gap.

Semenov's experiments go to show that electric currents in gases are a molecular phenomenon; this would be in accord with Prof. Bouty's researches on the dielectric cohesion of gases, which is also a *molecular* property.

Such currents are attended by the dissociation and projection of matter, the paths of which are in each point of the spark orientated in a plane perpendicular to the line of current. On account of the projection of matter taking place round the spark, a vacuum must be produced along the spark, the atmospheric pressure throwing into this vacuum the air and metallic vapor surrounding the electrode; this is obviously one of the causes of the transport of matter taking place from one pole to the other.

In a paper published in L'Electricien of January 16, D. Tommasi states that the important part incumbent on the nature of the electrodes in galvanic cells, made up of two liquids exerting a mutual chemical action, had been observed and described by himself as far back as 1882 in a memoir then read before the French Academy of Sciences. In the paper alluded to, it was pointed out that the E. M. F. of the same cell would show different figures according as the positive electrode is constituted either by an inattackable metal or by carbon.

As the chemical reaction produced within a cell comprising for instance a mixture of chromic and sulphuric acids is always the same, no matter what is the nature of the positive electrode, the author has tried to determine approximately by means of electrolysis the amount of galvanic energy (electromotive force) transmissible to the circuit, according as the positive electrode of this cell is either of platinum carbon or spongeous platinum, the following results being arrived at:

1. In the case of a positive carbon electrode, the above cell will produce an amount of galvanic energy transmissible to the circuit only as high as 1.4 volts, corresponding to 65.5 cal.

2. This amount is increased up to 85 cal. (1.8 volts) in the case of the platinum being replaced by carbon or spongeous platinum.

From the above it is inferred that the transformation of thermo-chemical energy is more complete with positive carbon electrodes than in the case of the positive electrode being of platinum. Furthermore, the thermo-chemical energy generated by the soluble electrode (e. g. zinc) will be converted into galvanic energy by the inattackable body (carbon or platinum) constituting the positive electrode, this transformation being either total or partial, according to the nature and the physical state of the positive electrode. It would seem possible also that the carbon plays the part of a real converter, analogous to induction coils, being capable of converting quantity current into tension current. The increase in the E. M. F. subsequent on the substitution of carbon for platinum would accordingly be due to an increase in capacity.

A still more striking fact is observed in the cell magnesium platinum and diluted sulphuric acid. In fact, this cell should according to the thermical data give rise to the decomposition of water, and still the author finds that such decomposition does not take place. If, however, a cylinder of graphite or retort charcoal be substituted instead of platinum, the electrolysis will readily occur.

The author purposes continuing his investigations, with a view to finding out the true rôle played by the positive electrode.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

How Canadian Fruit is Exported.—The Hamilton consulate is in the heart of Canada's great fruit-growing district, and hence an important shipping point. The Niagara district is about 50 miles in length and averages 10 miles in width, though at some points within a distance of about 20 miles from this city eastward the finest fruit lands are not more than 2 miles in width. There is nothing in the fruit line that can be raised in this climate but what is grown in profusion—apples, pears, cherries, peaches, plums, grapes, and berries of all varieties. Apples, however, pay the best, for rarely is there a failure in the crop, and there is always a foreign demand for the surplus.

This year the apple crop is good and nets the grower $2 per barrel of 3 bushels, though fancy fruit, weighing 7 ounces and more, packed in bushel boxes, brings as high as $1 per box. Fancy apples for the British market are examined, and all having any blemish are thrown out. Each apple is wrapped in tissue paper, as the orange growers of California pack their fruit, and then carefully laid in a row in the box, so that in the handling of the packages the fruit will not be bruised.

Mr. Linus Wolverton, living near Grimsby, has a large fruit farm, 50 acres of which are devoted to apple culture. He has made a special study of fruit raising, having been for years secretary of the Ontario Fruit Growers' Association, and is editor of a magazine principally devoted to fruit culture. From him I have gained information that may be profitable to the fruit growers of the United States. He has found that it pays to be careful in the packing of fruit for the foreign markets, as there is always a good demand for it, and at prices much higher than can be realized at home. Apples wrapped in tissue paper and packed in bushel boxes will always pay a better profit to the shipper than those packed in the ordinary way in barrels. Some consignments that Mr. Wolverton shipped to English markets in boxes returned him as high as $1.50 per bushel after all expenses were paid.

Apples and pears are the most profitable fruits to raise for export. Plums and peaches are more uncertain, as, while they would pay well if landed in good order, only the hardier varieties will stand shipment.

The Canadian steamship owners have fitted their vessels with cold-storage rooms and ventilating fans in order to secure the export trade in fruit, the government giving them assistance at the outset. Fall apples and pears are generally shipped in cold storage, but the winter fruits can be safely transported in the holds of vessels fitted up with fans. It has been demonstrated that the principal cause of the rotting of fruit shipped in the ordinary way is the foul air that gathers in the holds of the steamers. The fans obviate this by keeping a constant circulation of pure air and a cooler temperature. Choice apples and pears packed in boxes are shipped in cold storage, while the same fruit in barrels is shipped in the holds purified by ventilating fans. The difference in freight charges is considerable. Occasionally a shipment in cold storage or in the part ventilated by fans arrives at its destination in bad order because of neglect to keep the temperature uniform. The fruit is usually packed before it is thoroughly ripened, and the temperature should be from 40 deg. to 50 deg.—never higher—to keep it in good condition. It takes about twelve days for a shipment of fruit from Hamilton to reach Liverpool. Of pears the Bartlett is the best for export trade. This year shipments in half-bushel boxes have netted the shipper as high as $1.50 per box. Grapes can only be shipped in cold storage, and if carefully packed can be profitably exported.—James M. Shepard, Consul at Hamilton, Canada.

Swiss-American Trade.—Exports to the United States.—Five countries sold more goods to the Swiss in 1902 than the United States—Germany, France, Italy, Austria (frontier countries), and Russia. The grain and petroleum of the latter country enabled her to supplant the United States as the fifth furnisher of goods to this republic. But as a market for Swiss goods our far-off country holds the astonishing rank of fourth among the nations of the world. In 1901, only Germany, Great Britain, and France bought more Swiss products than the United States, and of these France only leads us by a nominal figure. The value of the exports to those countries and to Italy and Austria in 1902 was as follows:

Germany	$38,980,000
Great Britain	35,990,000
France	21,610,000
United States	21,030,000
Italy	10,840,000
Austria	9,070,000

Thus, Switzerland sends goods across thousands of miles of land and sea to the United States to twice the value of what she sends to either of her great neighbors, Italy and Austria. In fact, she sells $1,000,000 worth more to us than to Austria and Italy together. This is an achievement of which Switzerland may well be proud, if all the circumstances, internal and external, are taken into account. And it may be doubted whether there is another land, great or little, that can furnish such a proof of its economic vigor and intelligence and of its advanced industrial development.

Imports From the United States.—The total imports from the United States in 1902 amounted to $11,880,000, being only $60,000 more than in 1901. Only a few years ago the imports and exports balanced each other; but in 1902 we bought nearly twice as much from as we sold to Switzerland. The difference, however, has been caused rather by an increase of our purchases than by any decrease of our sales.

Of our leading articles of export to Switzerland, Kansas wheat—in great demand last year—was largely supplanted by a fine quality of grain from Russia and Roumania, offered at a lower price; but toward the end of the year there was an advance in the price of wheat, irrespective of its origin, the home crop having proved deficient in quality.

On account of the sharp advance in price from the beginning to the end of the year, lard—another of our great articles of export to Switzerland—fell off 25 per cent as compared with the previous year. Since 1899 the importations of lard have, in fact, decreased one-half. As a substitute, butter, both natural and artificial, has been introduced from Italy and Styria, but not in sufficient quantities to supply the whole deficit. Accordingly, it is assumed that there has been a diminished consumption of this important article among a large part of the population.

The importation of petroleum, on the other hand, shows a steady increase since 1899, reaching 21,042,000 gallons in 1902, though the price for the American article had considerably advanced. Eighty per cent of this import is of American origin; and this proportion continues even with the higher price demanded and obtained on account of its superior quality, as compared with the lower-grade Austrian and Roumanian products which are its chief rivals in this market.

The total import of tobacco in 1902 into Switzerland rose to a point never before reached—over 15,000,000 pounds. As compared with the previous year there was a decrease of about 4 per cent in the importation from the United States, while Greece, Turkey, Algeria, Central America, the Argentine Republic, and China came much more prominently forward as sources of supply.—George Gifford, Consul at Basel, Switzerland.

American Products in Ireland.—American Products in Belfast.—I have been unable to get an itemized statement of the articles received at this port (Belfast) from the United States. This is due to the fact that most of the imports from the United States are received at Liverpool, Glasgow, Southampton, and other ports, and transshipped to this port by cross-channel steamers; but among the line of American manufactured goods it may be mentioned that agricultural implements of all kinds are in the lead in the markets here. Many other productions from the United States have a solid footing in the trade in this city, among which may be mentioned American steel, iron, and all kinds of labor-saving machinery, wire nails, sewing machines, lawn mowers, and a great variety of smaller manufactured articles. The tobacco used by the manufacturers is principally of American growth, being mostly Virginia and Western leaf, and is used in the manufacture of cigarettes. Boots and shoes of American make, both for women and men, are preferred to all other makes. American flour supplies the market here and is far in excess of the importation of any other country. All kinds of canned goods from the United States find a large and increasing sale. In all the avenues of trade productions from the United States are to be found.

How to Increase American Trade in Ireland.—I receive many inquiries from correspondents in the United States asking me what is the best method for extending the sale of their manufactures in this market. My reply to all such inquiries is that the goods should always be sold strictly on their merit, using the same care that is given to the extension of the sale of manufactures in the home market, a personal representative or agent being the best method to adopt. Catalogues and price lists receive but slight attention from business men.—William W. Touvelle, Consul at Belfast, Ireland.

American Manufactures in British Columbia.—The principal openings in this district for United States products are in connection with the mines and smelters. A number of new smelters are going up in the boundary, Lardeau, and other districts, and many mines in the same districts will put in valuable machinery at an early date. A couple of railroads are also to be built throughout the Kootenai section in the immediate future. At Poplar Creek, the new mining camp, there will be an opening for mining machinery (also for stamp mills and concentrator machinery) any day now. There is a better feeling in trade matters through this country, and travelers for firms on both sides of the line say they are securing heavier orders than they have for years past. I would suggest that our exporters send good agents into this country, and I think they will find it will pay them to do so. There is a good market here for mining, stamp-mill, concentrating, and smelting machinery, provisions of all kinds, fabrics, typewriters, furniture, safes, cables, tramways, steel, iron, and hardware of all kinds, lumber-mill machinery of all classes, clothes, boots, shoes, etc.—George A. Ohren, Consular Agent, Rossland, Canada.

Dredging Machinery Wanted at Nantes, France.—During the present year bids will be asked by the French government at Nantes for about $450,000 worth of dredging machinery to be used in deepening the channel of the River Loire between Nantes and St. Nazaire. The government engineer at Nantes, whose department is charged with the supervision and possibly the execution of the work, says that it has not yet been finally decided as to whether bids for furnishing this machinery will be received from foreigners, but he thinks they will. In that event it is believed here that Holland manufacturers will get the contracts, as dredging machines made in that country are already in use in France and are giving satisfaction. If the proposed letting should interest any United States manufacturers of dredging machines, and the manufacturers will communicate with this consulate, I will try to secure and furnish the specifications in time for them to bid. The proposed channel will have a depth of from 18 to 48 feet, on a sandy bottom.—Benjamin Ridgely, Consul, Nantes, France.

Railroad-Building Bids in Mexico.—Under date of October 26, United States Consul W. W. Canada, of Veracruz, Mexico, sends the following translation of an article from the Mexican Herald, city of Mexico, of October 23, 1903:

"Bids are invited for the construction of the first section of the railroad which is to start from San Juan Bautisa, Tabasco, Mexico, or from a point on the left bank of the Rio Gonzales, touching at the towns of Nacajuca, Jalpa, and Cunduacan, and terminating at a point on the bank of the Rio Seco. Parties or companies able to give sufficient guaranty and wishing to obtain the contract for the construction of this first section of railroad can obtain all necessary information from the secretary of the board of directors, No. 21, Cinco de Mayo Street, San Juan Bautisa, Tabasco, Mexico. It is understood that the road is to be narrow gage, 914 millimeters (3 feet) between the rails, and from 20 to 25 kilometers (13 to 16 miles) in length. It is to be operated by steam."

French Complaints as to American Fish Cans.—American canned salmon and lobsters, canned meats, California canned fruits, etc., are, of course, staples of the grocery trade in France, but there might be a much larger sale, particularly for canned lobsters and salmon, if those products were energetically pushed by traveling salesmen. In this connection the attention of American canners is called to the fact that complaints are frequently heard here of the inferior and unsuitable cans in which our salmon and lobsters are packed. It is said that these cans are made from tin plate containing too much lead, and that, in consequence, their contents are poorly preserved. Often it is said the taste of the lobsters is affected and, in some instances, quite spoiled. I know nothing personally as to the merits of these complaints, and only call attention to them for the benefit of our canneries.—Benjamin H. Ridgely, Consul, Nantes, France.

American Trade in Wurttemberg.—Statistics as to imports into Wurttemberg are not collected. The large importing houses in Berlin and Hamburg have direct trade relations with the United States and distribute, in great part, the imports from that country throughout the German empire. It would undoubtedly be advantageous to our exporters if they would establish the system of thoroughly canvassing this country with skilled commercial travelers conversant with not only the language, but also the trade conditions here; a system long since adopted by the German manufacturers in foreign markets, and which has, perhaps, as much as any other factor contributed to their commercial success.—Edward H. Ozmun, Consul, Stuttgart, Germany.

American Provisions in Bogota.—I have received a number of inquiries lately as to American hams, flour, petroleum, preserves, pickles, butter, etc., particularly from Mr. Leopoldo Molina, who is desirous of starting a large wholesale and retail grocery, and wants catalogues, prices, and general information on these and other similar articles. I am informed that he has a good standing and is fully able to conduct such a business on a large scale, and under ordinary circumstances this place would certainly support it.—Alban G. Snyder, Consul-General, Bogota, Colombia.

Catalogues Wanted.—Under date of Niuchwang, China, November 27, 1903, received at the Department of Commerce and Labor on January 20, 1904, United States Consul H. B. Miller reports that the resident engineer in chief of the Chinese Eastern Railway, Imenpo, Manchuria, desires catalogues of flour-mill, brewery, and tar-making machinery, which should be addressed to H. B. Miller, United States Consul, Niuchwang, China.

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

TRADE NOTES AND RECIPES.

Lacquer for Lithographic Use.—Dissolve 15 kilogrammes of red lithol R or G in paste of 17 per cent, in 150 liters of hot water. Boil for two minutes, shaking with 2.5 kilogrammes of barium chloride. Dissolve in 25 liters of water. Add to the mixture 100 kilogrammes of aluminium hydrate of about 4 per cent. Cool, filter, and dry.—Science, Arts, Nature.

Lacquer of Sulphate of Baryta for Oil Painting.—Dilute 100 kilogrammes of sulphate of baryta with 600 liters of water containing in solution 60 kilogrammes of red lithol R or G in paste of 17 per cent. Boil the mixture for several minutes in a solution of 10 kilogrammes of barium chloride in 100 liters of water. After cooling, filter and dry.—Science, Arts, Nature.

Production of Cheap Hair Oil.—1. Sesame oil or sunflower oil, 1 kilogramme; lavender oil, 15 grammes; bergamot oil, 10 grammes, and geranium oil, 5 grammes.

2. Sesame oil or sunflower oil, 1 kilogramme; lavender oil, 12 grammes; lemon oil, 20 grammes; rosemary oil, 5 grammes, and geranium oil, 2 grammes.—Drogen Zeitung.

Liquid Flower Manure.—Liquid flower manure for potted plants is prepared as follows: Dissolve and filter—

Ammonium chloride	2 parts
Sodium phosphate	4 parts
Sodium nitrate	3 parts
Water	80 parts

For use thin with rain water—25 drops to 1 liter.

Laundry Blue.—When a blue color is used in the laundry on white clothes the intent is to neutralize the yellow tints present in the white and so to make a more pleasing impression upon the eye.

Different kinds of blue coloring matter are used for this purpose but most of the laundry blues of the market are probably solutions of the "soluble" blue of commerce, a variety of Prussian blue.

Anilin blues can be used for the same purpose, but they must be blues for cotton.—Drug. Circ.

Enamel of All Colors Having Diamond Reflections.—On the piece to be enameled apply oil varnish or white lead, and add a powder giving brilliant reflections, diamantine, brilliantine, or argentine. Dry in the stove. Apply a new coat of varnish. Apply the powder again, and finally heat in the oven. Afterward, apply several layers of varnish; dry each layer in the oven. Apply pumice-stone in powder or tripoli, and finally apply a layer of Swedish varnish, drying in the oven. This enamel does not crack. It adheres perfectly, and is advantageous for the pieces of cycles and other mobiles.—La Nature.

Soldering Powder for Steel.—When steel is to be soldered on steel, or iron on steel, it is necessary to remove every trace of oxide of iron between the surfaces in contact. The following receipts are published by L'Industrie des Cycles et Automobiles: Melt in an earthen vessel: Borax, 3 parts; colophony, 2 parts; pulverized glass, 3 parts; steel filings, 2 parts; carbonate of potash, 1 part; hard soap, powdered, 1 part. Flow the melted mass on a cold plate of sheet iron, and after cooling break up the pieces and pulverize them. This powder is thrown on the surfaces a few minutes before the pieces to be soldered are brought together. The borax and glass contained in the composition dissolve, and consequently liquefy all of the impurities, which, if they were shut up between the pieces soldered, might form scales, at times dangerous, or interfering with the resistance of the piece.

Lacquers for Colored Paper.—1. With Base of Baryta.—Dissolve 30 kilogrammes of red lithol R or G in paste of 17 per cent, in 300 liters of hot water. Add an emulsion obtained by mixing 10 kilogrammes of sulphate of alumina in 100 liters of water and 5 kilogrammes of calcined soda dissolved in 50 liters of water. Precipitate with a solution of 17.5 kilogrammes of barium chloride in 125 liters of water. Cool and filter.

2. With Base of Lime.—Dissolve 30 kilogrammes red lithol R or G in paste of 17 per cent, in 300 liters of hot water. Boil for a few minutes with an emulsion prepared by mixing 10 kilogrammes sulphate of alumina with 100 liters of water and 2.5 kilogrammes of slaked lime in 100 liters of water. Filter after cooling.—Science, Arts, Nature.

To Polish Watch Cases.—Take two glasses with large openings, preferably two so-called preserving jars with ground glass covers. Into one of the glass vessels pour 1 part of spirit of sal-ammoniac and 3 parts water, adding a little ordinary barrel-soap and stirring everything well. The other glass fill one-half with alcohol. Now lay the case to be cleaned, with springs and all, into the first-named liquid and allow to remain therein for about 10 to 20 seconds. Later on, after protracted use, this time may be extended to several minutes. Now take it out, quickly brush it off all over with water and soap and lay for a moment into the alcohol in the second vessel. After drying off with a clean cloth heat over a soldering flame for quick drying and the case will now look almost as clean and neat as a new one. The only thing that may occur is that a polished metal dome may become tarnished, but this will only happen if either the mixture is too strong or the case remains in it too long, both of which can be easily avoided with a little practice. Shake before using.—Metallarbeiter.

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