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

AN AMERICAN FLOATING EXPOSITION.

In the year 1901 an officer of the Department of Commerce and Labor suggested that for the furtherance of our export trade it would be an excellent idea to equip a large steamer as a floating exposition of American products, and dispatch it on a tour of the principal ports of the world. At its first mention the idea is a decidedly attractive one, and it receives no small measure of indorsement in the fact that it has already been successfully tried by Great Britain and, we believe, by Germany also; while we understand that as part of the comprehensive scheme for the extension of her foreign trade, which Japan has now under serious consideration, that country has planned the fitting out of a similar vessel. We are pleased to note that a strong company which has been formed in New York has advised the Department of Commerce and Labor that they have decided to adopt the suggestion originally made in the Geographic Magazine in 1901. It is proposed to equip a steamer of about 8,000 tons for the special purpose of the expedition, and fit up the various decks with exposition booths of much the same character as those to be seen in any of our great industrial exhibitions, with the one important exception, however, that only exhibits of a thoroughly serious character will be accepted, all exhibits of a trivial or purely speculative and doubtful character being refused. The steamer, in addition to devoting three decks to exhibits, will have living accommodations for about 200 representatives of exhibitors. A route has been laid out which will include a visit to practically every port of importance in the world, and will involve a journey of about 60,000 miles, the trip around the world being made in about fifteen months' time.

The plan is to allow each person who subscribes for forty square feet of space or more, to display his goods and send on the steamer a representative, whose duty it will be to see that the exhibit is properly arranged at each port, to meet the merchants and dealers invited to inspect the exhibits, explain the utility and advantages of the goods, quote prices delivered in the country of consumption, and ascertain what the markets of the country demand, the conditions of competition, and everything affecting the extension of our export trade in each particular locality. The representative will also appoint local agents at the various ports of call. In connection with the visit of the floating exhibition, extensive missionary work will be carried on at each port of call previous to its arrival. By means of circulars printed in the various languages, to be distributed hundreds of miles back in the interior, it is hoped to arouse widespread interest, and nothing will be left undone that judicious newspaper discussion and legitimate advertising can accomplish to prepare the ground for the work of the expedition. The expense of the trip is to be borne entirely by the sale of space on the vessel, of which about 20,000 square feet will be available. Attention is called to the fact that the enterprise is not designed with a view to any profitable return in money to the promoters, but is intended to be a dignified, broad-minded plan to further the cause of America's export trade.

We consider that this ambitious scheme is one of that class whose work is creative, and whose success depends almost entirely upon the thoroughness with which its well-laid plans are followed out. If none but the very best of American products are carried; if the greatest care is exercised to select competent representatives, who should be possessed of at least a fair knowledge of the language of the principal countries to be visited, and if the preliminary missionary work is judiciously and comprehensively carried out, this exposition should prove to be a most powerful factor in the extension of our export trade.

SANITATION OF THE PANAMA CANAL ZONE.

That the two prevailing diseases that render life unhealthy at the Isthmus of Panama can be successfully controlled by the use of simple precautions and remedies, is the opinion of Col. W. C. Gorgas, U. S. A., who is the Chief Sanitary Officer of the Isthmian Canal zone. In a brief but comprehensive and lucid article, to be found in the last annual report of the Smithsonian Institution, this officer describes the sanitary conditions at the Isthmus, and shows the cause and cure of the two great scourges of that country, yellow fever and malaria.

Briefly stated, the sanitary problem is to protect the fifteen thousand men that are likely, before many months, to be employed on the canal, from these two diseases. Yellow fever is conveyed from man to man only by the female Stegomyia, who has previously bitten some human being suffering from yellow fever. Therefore, yellow fever cannot originate in a place where there are no infected Stegomyia, until a yellow fever patient has been introduced and has infected the local pest; or until the mosquito, infected at some distant point, has been introduced. Practically, the introduction of a yellow fever patient is the only method by which the locality can be infected.

At present yellow fever is endemic nowhere on the Canal Zone except in the city of Panama, and the immediate object of the sanitary measures is to get rid of the infected Stegomyia at present in the city. This can be accomplished with great certainty by establishing a system whereby the health authorities are certain to be informed of every case of yellow fever, and then fumigating the house in which this case occurred, so as to destroy all the mosquitoes within its borders. The same thing must be done with all contiguous houses. It has been found by experience that this kills all the infected mosquitoes at that particular focus. By doing the same thing at every other focus as yellow fever occurs, all the foci in the community are gradually destroyed, and when the last focus has been got rid of, yellow fever is at an end. A more expeditious method is to systematically fumigate every house in the town.

The Stegomyia is a house mosquito, and being cleanly in her habits seeks principally the clean rain-water barrels and water containers, and never travels far from her birthplace. Therefore, as an additional sanitary safeguard, every receptacle for water should be so screened that mosquitoes cannot have access to it. The safest precaution is to pipe the water supply in from a distance, so that the people will not need to keep a supply of water in vessels. As a further preventive of standing water, yards must be thoroughly cleaned, sewers must be put in, so as to discourage the throwing of waste water into the yards, streets should be paved and swept, and garbage collected so as to decrease to the minimum all trash that is capable, in any way, of retaining fresh water. These precautions are exactly those which the government carried out at Havana, with results so flattering that yellow fever has been wiped out of that once famous, or rather infamous, center of the scourge. When Panama has thus been freed from yellow fever, as it most certainly will be, no more cases can occur until a yellow fever patient is introduced from some infected point without. This will be absolutely prevented by a proper system of quarantine.

An even more important problem than that presented by yellow fever is the control of malaria throughout the Canal Zone. The ten thousand natives of the district are distributed in about twenty small villages along the route of the canal, and these people are very generally affected with malaria. A recent microscopic examination of the blood of these people, taken at random at various points along the line, shows that out of several hundred cases, fifty per cent contained mosquito parasites in the blood. Four times out of five, if the female Anopheles bites a native she becomes infected, and when she bites one of our nearby laborers, he in turn becomes infected. Hence, if our laboring force is not to be completely used up, as was that of the French government, preventive sanitary measures must be taken.

There are two ways of approaching this problem; either by doing away with the infected human being, or by doing away with the mosquito. Since it is out of the question to do away with the infected natives, the remedy must be sought in the extinction of the mosquito. If some substance could be introduced into the circulation of the infected man and kill the parasite, and at the same time not be injurious to the man, the desired object would be effected, and in quinine has been discovered the suitable poison. This vegetable substance is harmless to man and fatal to the malarial parasite. Most of the effective tropical sanitarians, the Germans and the Italians conspicuously, have achieved a great success by inducing as large a proportion of the population as possible to take regularly small quantities of quinine, and they have succeeded, without adopting any other measures, in doing away with malaria in the several localities.

The disease may also be successfully attacked from the side of the mosquito, and the Anopheles may be as effectively exterminated as the Stegomyia by covering up water containers, clearing up the yards, preserving the surface of the road so there will be no puddles, instituting a regular system in all towns for the collection of garbage, and by the use of oil. Since the malaria problem along the route of the Panama Canal is, because of local conditions, more serious than in any place where the above-mentioned methods have been tried, the government intends to make sure the work of extermination by applying both systems, and it is confidently expected that, by the time the work is in full swing, our laborers will be completely protected from the two great tropical diseases.

COLLOIDS, SUSPENSIONS, AND RELATED PHENOMENA.

Van't Hoff's "Laws of Chemical Equilibrium in Rarefied Gases and Solutions," published some twenty years ago in the transactions of the Swedish Academy, might have escaped general attention had they not found an advocate in Ostwald. In this famous essay it is shown that dissolved substances behave like gases, but the argument is not easy to follow even now, when the facts have become familiar. It will be recalled, also, that Van't Hoff's laws, apparently, did not apply to acids, alkalies, and salts, that is to say, to the substances called electrolytes, which, when dissolved, conduct the electric current and are decomposed by it. These apparent exceptions, however, were soon explained and the great riddle of solution answered by Arrhenius. Recent work in theoretical chemistry has been largely devoted to the development of the Van't Hoff-Arrhenius theory, which is now firmly established.

We know more than a hundred thousand definite organic or carbon compounds, and a great many inorganic ones, all of which have fixed melting or boiling points. Many of them are also characterized by definite crystalline form. Very few of these definite and sharply-characterized compounds are found in living organisms and consequently they contribute little to the comprehension of vital processes.

Most of the substances which occur in animal and vegetable organisms do not crystallize or possess fixed melting and boiling points, and Van't Hoff's theory does not apply to them. A solution of albumen, for example, exerts an osmotic pressure so small that the mass of the albumen molecule computed from this pressure by the formula used for crystallizable compounds is too large (15,000) to be generally accepted. There is no reason why the albumen molecule should not be very large, but it seems wrong in principle to apply the usual formula for calculating molecular weight to such a substance, which does not form a solution in the ordinary sense of the word.

There are, also, inorganic bodies which have very large molecules, if we may judge from their inability to pass through porous membranes. If a solution of salt or sugar is put into a bag of parchment paper or a sausage skin free from grease, and suspended in a vessel of water, the salt or sugar gradually diffuses through the envelope, but many apparently dissolved substances, including silica as well as albumen and gelatine, do not diffuse under these conditions. These facts were discovered in 1830 by Graham, who gave the name crystalloids to the diffusible substances, most of which crystallize, and the name colloids to the non-diffusible substances, most of which do not crystallize. Van't Hoff's theory of solution applies to crystalloids, but not to colloids. The study of colloids, which may fairly be called the foundation of knowledge of the vital process, has been reserved for the twentieth century, and great progress has already been made.

Silica, alumina, ferric and zinc oxides, arsenic and antimony sulphides, are some of the many inorganic colloids. Of especial interest, partly for practical reasons, are the colloidal metals. Within the last ten years silver, gold, platinum, bismuth, and other metals have been brought into "colloidal" solution by various methods. In Carey Lea's process, solutions of metallic salts are decomposed under special conditions; in Bredig's the metal is pulverized by the electric arc under water; in Paal and Mueller's the metal is held in suspension by dissolved substances. Under the most powerful microscope the dark brown, red, and green liquids thus produced appear as homogeneous solutions, the metallic particles being invisible, but the ultramicroscope of Siedentopf and Zsigmondy, which distinguishes objects as small as four millionths of a millimeter (1-6,000,000 inch) in breadth, resolves these and other inorganic colloidal solutions into separate particles and thus confirms Graham's view of their nature.

In principle, indeed, every solution, even of a salt, is a suspension. De Bruyn and Von Calcar have crystallized salt from solution by centrifugal separation, and De Bruyn and Wolff have shown that solutions of sugar, like turbid liquids, disperse and polarize light.

True suspensions, formed by filtering the coarser particles from a mixture of starch and water, or by pouring alcoholic solutions of resins into water, behave like inorganic colloids. Both are subject to "cataphoresis," that is, they are moved by an electric cur-

rent. Most of the inorganic colloids move toward the positive electrode, and Biltz has discovered that colloids of opposite polarities precipitate each other.

Like the true suspensions, again, most inorganic colloids are precipitated by salts. Salts of trivalent metals (alum, ferric sulphate) are eight times as effective as salts of bivalent metals (barium chloride, copper sulphate), and fifty times as effective as salts of univalent metals (common salt, potassium iodide). The clarifying property of iron and aluminium salts has long been known and utilized. The Mississippi, Nile, and other rivers carry in suspension immense quantities of solid matter which the salt sea water precipitates at their mouths as bars and deltas. Schloessing suggests that the humus layer of the soil would be quickly washed away by rain but for the decomposition of organic matter with the formation of carbonic acid, which, like other acids, possesses great clarifying or precipitating power.

The gelatine-silver emulsion with which photographic plates are coated is comparatively insensitive until it has been "ripened" by prolonged heating, which agglomerates the very fine particles of silver salt into larger ones. In my opinion the process would be greatly accelerated by the addition of a salt of a bivalent or trivalent metal.

Most organic colloids differ from inorganic colloids and suspensions in remaining unaffected by salts of univalent metals—at least, by the mere traces, often not to be detected chemically, that suffice to precipitate suspensions. Some are not affected even by salts of bivalent metals. Organic colloids also present a different appearance under the ultramicroscope, an albuminous solution showing a mass of connected particles, which separate, diminish, and finally vanish only after fermentation or copious dilution. This agrees with the theory advanced by Quincke, thirty years ago, that organic colloids form a sort of network, like a sponge or a mass of foam, and consist of dilute solutions imprisoned by walls formed of concentrated solutions. Buetschli has extended this theory to protoplasm and applied it to the explanation of vital processes.

Neisser and Friedmann, as well as the writer, have shown that bacteria in suspension behave like organic colloids, being precipitated only by such salts as precipitate albumen and unaffected by common salt, barium chloride, etc. The bacterium was found to have an albuminous envelope which protected it from precipitation, and certain inorganic colloids which behave like organic ones were found to be similarly protected —for example, Paal's "bismuthose."

The albuminous envelope of the bacterium is susceptible of a curious modification. Serum from an animal infected with typhus bacilli precipitates typhus but no other bacilli, and similar laws hold for cholera and dysentery. This phenomenon, known as "agglutination," forms the basis of Vidal's diagnostic test for typhus. Now, Bordet has discovered that this agglutination and precipitation occur only in saline solutions, showing that the effect of the serum has been to make the bacilli more closely resemble inorganic particles in suspension. In a similar way, serum from a rabbit previously inoculated with bovine serum forms a precipitate with bovine, but with no other serum. A similar specific "precipitin" reaction exists for each warm-blooded species, but the precipitation occurs only in saline solutions.

We see, therefore, that the precipitation of colloids and suspensions by salts, a phenomenon whose importance has only lately been appreciated, plays a prominent part in the formation of the earth's surface and the life process of the organic cell.

"THE SCIENTIFIC AMERICAN BOY."

Every typical American boy is pretty much of a "Yankee genius," no matter what part of our great country he hails from. He can always be depended upon to provide his own diversions, even out of the most limited resources. This is an excellent trait, and should be developed to the fullest extent because of its bearing on the future career of the boy. "The Scientific American Boy," by A. Russell Bond, has been written for the purpose of stimulating this resourcefulness in boys. Genius is not a subject that can be taught, but is rather a faculty that must be developed. "The Scientific American Boy" is, therefore, not a book of instruction, but is rather a story of the doings of a club of boys, written in such a manner as to awaken the interest of the readers and induce them to emulate their example. The scene of the narrative is an island on the Delaware River, where the club spends several vacations in camp. Under the leadership of "Bill," who is the "Scientific American Boy," and with the occasional assistance of Bill's Uncle Ed, who takes a great interest in the boys, the club proceeds to develop the resources of the island, providing for their needs out of the materials at hand, and building the greatest variety of useful devices and contrivances for their own amusement and diversion. All the acts of the club are chronicled in detail, complete working drawings being given in every case, so that they can, if desired, be exactly reproduced by any American boy of average intelligence. The subjects covered are quite varied. The boy campers' needs are supplied by directions for making tents, straw huts, log cabins, caves, and the like, and a chapter is devoted to camping outfits. Complete instructions are given for making half a dozen different kinds of skate sails, and a large number of snow shoes and skis, besides sledges, toboggans, ice boats, and scooters. Among the miscellaneous subjects may be mentioned scows, canoes, land yachts, and the like. A number of subjects may be classed under the head of Engineering. These are surveying, bridge building, heliographing, wigwagging, how to build a gravity railroad, a windmill, and a waterwheel. Considerable space is devoted to bridge building, simple directions being given for making six different types of bridges, including a simple cantilever bridge. The latter is illustrated with photographs showing a full-sized cantilever bridge of 12-foot span, which was actually built by four young boys, according to the instructions given. The volume is handsomely bound, and contains 320 pages, well illustrated with 320 drawings and 18 half-tone page plates.

SOME CURIOUS USES OF AMERICAN WOODS.

BY L. LODIAN.

The giant sequoias of California, thousands of years old, have been preserved to this day because of their enormously thick bark. From time to time, in the course of ages, forest fires have swept through the big-tree lands, destroying everything, yet only scorching for a couple of inches' depth or so the almost fireproof bark. The flames having carbonized that much of the bark, could not penetrate farther; for the carbonized portion formed an absolutely fireproof covering for the remainder of the interior bark.

In the felling of the giant redwoods for timber, tons upon tons of the foot-thick bark would accumulate as a result of the cutting up of the giants. It was often found seriously in the way, interfering with the removal of the logs; otherwise, it would have been allowed to remain on the ground until it rotted. So there was nothing to do but burn the unsightly heaps.

But one day many years ago, a shrewd Connecticut Yankee named Atkinson, a woodturner by trade, began to think about this waste a bit, during his prolonged residence in his new home on the Pacific slope. True, the bark was too soft to make wooden nutmegs out of it, but it might do for something else. So he thought and thought; and in the course of time had produced a whole variety of useful articles from the hitherto wasted bark; dubbed it "atkinsos," or vegetable asbestos, and made an honest living for years therefrom. The industry spread; and now redwood-bark articles are—in fact, always have been—common property for anybody to make in the West or East. Almost all Pacific State homes have examples in their rooms of the useful articles made from this bark, of which there are two kinds, soft and hard.

Some of these redwood-bark articles are pin cushions, pen wipers, table mats (for receiving hot plates), flatiron mats (to prevent scorching), bathroom non-absorbent mats, fishing floats, temporary corks, life-buoy filling, "cork" jackets, cold-storage insulation, house sheathing, heat insulation (will burn under great heat if attacked both sides, but is about six times a more efficient heat-insulator than woven asbestos). Also coin mats, moisture-proof match safes, bicycle handles, silk-hat brushes, chair-seat mats, sound-deadening insulation, mattress fillings, cork-carpet substitute, and a variety of other uses.

The bark is entirely odorless, of a rich brown color, and is singularly non-absorbent. A piece kept under water for a month will absorb no more moisture than a piece of cork. It has a short, brittle fiber—cork has no fiber whatever—and is consequently not so liable to brittly snap as is the *Quercus suber*. It lacks, however, the elasticity and local toughness of cork, and is slightly heavier in its specific gravity, but is much more easily worked in manufacturing into articles.

Curious Natural Brushes.—These are produced from one of the palmetto species on our southern coasts. The "bristles" of the brush and the solid wood portion thereof are all one. No "coming out" complaint with those bristles!

The brushes are made in two ways. The extreme root of the tree is a mass of fibers. These are cut off close up to the trunk, which is sawn off about an inch up, and the slab is cut up into simple brushes for the bath, toilet, hair, etc. Another couple of inches will be sawn off the trunk, well soaked, and the pithy wood jagged out from between the fibers by a crude kind of steel or jagged comb. Once the pith is thoroughly dried and hard, it will stand immersion in hot bath waters without softening.

These curious natural-made brushes are only locally known, and are occasionally sold to tourists. They are unknown to commerce in the American brush trade. No attempt has ever been made to establish any industry in them. Yet they are possibly the longest-lived brushes extant. A bath brush used for half a dozen years looked, true, as if it had had plenty of use, but was good enough for another half dozen years.

The fibers and wood are of a bright sandy hue, and, if kept clean, almost preserve throughout their agreeably slight odor, reminding one of dried corn leaves.

SCIENCE NOTES.

The sweet wines generally produced in this country are those in which none, or only a part, of the sugar in the grape has through fermentation been converted into alcohol, the fermentation being prevented or checked at any desired stage by the addition of grape brandy. This adding of alcohol to stop fermentation is called "fortifying." Of the sweet wines, ports and angelicas are the two kinds most largely produced and consumed in this country.

The symbiotic relationship of fungus and root to *Mycorhiza* offers a fine opportunity for careful investigation. The studies which have already been made serve only to put the reader in a state of hopeless confusion. The universal phenomenon of irritability as manifested by tropic phenomena has been a fruitful field of investigation. The general methods of irritable response have been determined; and the best work of such investigators as Haberlandt, Noll, Czapek, Newcombe, MacDougal and others has more recently been directed to the deeper problems relating to the internal mechanism of response and to the exact methods of transmission of the stimulus, as well as to the immediate changes in the cells affected.

The U. S. Biological Survey is engaged in mapping the natural life zones and crop belts of the country for the primary purpose of aiding the farmer to decide what crops are likely to prove a commercial success in his locality. The work is done by studying the geographic distribution of native animals and plants in all parts of the country, and plotting the results on maps showing the distribution of each species. In order to obtain the necessary data the status of the various species must be determined by office study and their ranges laboriously worked out in the field. The progress already made is gratifying, and a large number of maps are now approaching completion. The individual-species maps serve as the basis of a composite map showing the natural transcontinental belts and their more important subdivisions.

The development of viscous flow is largely on the experimental side, particularly for solids, where Weber (1835), Kohlrausch (1863, *et seq.*) and others have worked out the main laws. Stokes (1845) deduced the full equations for liquids. Poiseiulle's law (1847), the motion of small solids in viscous liquids, of vibrating plates and other important special cases, has yielded to treatment. The coefficients of viscosity defined by Poisson (1831), Maxwell (1868), Hagenbach (1860), O. E. Meyer (1863), are exhaustively investigated for gases and for liquids. Maxwell (1877) has given the most suggestive and Boltzmann (1876) the most carefully formulated theory for solids, but the investigation of absolute data has but begun. The difficulty of reconciling viscous flow with Lagrange's dynamics seems first to have been adjusted by Navier.

The overcrowding of the medical profession in Germany is a matter of grave concern. There are now in the empire 29,200 physicians, which doubles the number found in 1876. In other words, there is one physician in Germany for every 1,700 inhabitants. In the city of Berlin 46 per cent of all the physicians have an income of less than $700, and five per cent of the whole number do not have a sufficient income to return it for taxation. On the other hand, in the legal profession in Germany 80 per cent of the lawyers have an income exceeding $2,000. It is estimated that the preparation of a man for the duties of a physician in Germany costs about $6,000, and thus it is seen that the income is often less than 10 per cent of the fixed charge on the capital invested. This leaves practically nothing for the reward of his own personal services, nor for wear and tear.

Within the last decade there has been an enormous increase in our manufacturing interests, so that it is not surprising to find that the output from the factory now constitutes 65 per cent of our annual production of wealth. A study of the figures presented to us in the annual reports of the Department of Agriculture and other branches of the government dealing with agricultural development alone, without reference to statistical matters shows that coincident with the development of factories in a community there has been a corresponding increase in the value of farms and farm lands, as well as of the products of the farm. The great era of manufacturing upon which this country is now entering is bound to have a beneficial effect upon agriculture, for aside from the great possibilities of other industries, it is clear that as factories continue to increase in number and enlarge their output, agriculture must necessarily grow to meet these conditions.