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## THE EXPOSITION AS AN EDUCATIONAL FORCE.

A great modern World's Exposition, like that of St. Louis, is intended first and last as a condensed exhibit, in concrete form, of the accumulated knowledge and practical achievements of the civilized world. The endeavor is made to gather this material together in such orderly arrangement and within such practicable limits of space, that the individual may turn to any part of it, and secure the information which he is seeking, with as much certainty as when he takes down an encyclopedia from his library shelves. To attempt the collection and arrangement of such an encyclopedia is a stupendous task in itself, and the writer ventures to assert, after many weeks careful study of the St. Louis Fair, that never, considering the magnitude of the undertaking, has so much material been gathered in one place and classified on an orderly and carefully considered plan, with such signal success as this. We have already spoken in terms of praise of the splendid architectural achievements of the Fair; and in the present connection, when dealing with its educational aspects, acknowledgment is due of the excellent manner in which the Director of Exhibits has brought to bear his experience in classification, gained in other great exhibitions of this character.

To anyone who watches critically the crowds that wander through the plazas and broad aisles of the exhibition palaces, what time they are not taking in the sights and sounds of that great highway of amusement, the "Pike," it would seem, at first sight, that the great bulk of the World's Fair visitors are drawn hither by the mere desire for amusement; but on a more careful study of the multitudes, and after taking note of the general run of comment and conversation, the conviction grows that the majority of the American people—there seem to be few foreigners at present within the Fair grounds—have come to St. Louis primarily to be instructed. The most positive proof of this is found in the crowded attendance at the various exhibitions of highly technical and scientific apparatus and phenomena, that are given in several different places throughout the grounds. Moreover, it is a significant fact that it is the more difficult and intricate exhibits, those that require intelligent thought and consideration if they are to be understood, that seem to present the strongest attraction to the sightseers. This is as it should be; and it may surely be taken as evidence that the main object for which the Fair has been conceived and carried out, namely, that of acting as a powerful educational force, is being abundantly fulfilled.

Undoubtedly these great expositions exercise upon the average citizen a broadening influence, which in a certain degree gives him a touch of that cosmopolitan breadth of view, which is commonly supposed to come only by actual travel. This would not be possible were the Fair conceived upon a smaller scale, and its exhibits spread out with a less lavish hand. A three-ring circus or a Wild West show may afford the untraveled citizen a glimpse of the outside world: but it takes a two-million dollar Philippine government exhibit, or the splendid gathering of distinct tribes under the Anthropological Department, to say nothing of the costly representation of foreign life and habits shown in private exhibitions—it takes the aggregate effect of all these to give to the visitor to a World's Fair that sense of having been actually in touch with the great outside world which is being realized by millions of visitors to the present Exposition.

The same broadening educational influence must be making itself strongly felt upon those who are making an earnest study of the carefully-arranged exhibits in the various exhibition palaces. There is a sense in which the inhabitants of a country so vast as our own, because of the lack of any means of direct comparison of themselves and their surroundings with some outside standard, may grow to a certain self-sufficiency, for which a study of the elaborate exhibits of other nations, and a knowledge of how greatly they exceed us in certain lines of achievement, will prove to be an admirable antidote.

Furthermore, an aggregation of such fine architectural and landscape effects as is presented at such an Exposition as this, must exert a lasting artistic impression, unconscious perhaps to the subject of it, but none the less real. It instills in the thousands and millions that throng the grounds new and lofty impressions of the grand and the beautiful. To many of the visitors these impressions will be capable of subsequent expression, and will no doubt show themselves in the improvement of public structures, in a more intelligent appreciation of what can be done in improving the artistic effects of buildings whether for the home, the city, the state, or the nation. This educative effect will make itself felt at many a city council where the inspection of competitive plans for municipal or other buildings come to be passed upon. We do not say that the World's Fair will make an art critic or a connoisseur of every citizen that visits it; but it will most certainly carry forward that national education, in domestic and municipal art and architecture, which owes its birth in this country largely to the great Exposition held at Chicago eleven years ago.

## OSMON, A NEW COMBUSTIBLE FROM PEAT.

A new form of combustible, known as "osmon," has been lately produced in Europe from raw peat. Of the 90 per cent water which the peat contains, from 20 to 25 per cent is eliminated by an electric process. A direct current is passed through the mass of the peat, contained in a suitable tank. Under the action of the current, the water collects at the negative pole and flows out by openings in the side of the vessel. In carrying out the process, the inventors use from 10 to 12 kilowatt-hours per cubic yard of raw material. The process lasts about an hour and a half. The electrically-treated peat is then dried in the ordinary way and reduced to small pieces in a crusher. It is delivered to the trade in the form of balls or briquettes. The heating power of the new product is considerable. No trace of sulphur is found, and it does not smoke or leave much cinder.

## M. CURIE'S EXPERIMENTS WITH RADIUM EMANATIONS.

In a paper recently read before the Académie des Sciences, M. Curie brings out some of the physiological effects of radium. The emanation given off by radium causes the death of the smaller animals, when breathed by them. He used an apparatus in which the animal is placed in a confined space and is made to breathe air which is charged with the emanation. A large jar is filled to one-third with pumice-stone soaked with potash. Above this is a support which confines the animal (a guinea-pig) in the upper part of the jar. Oxygen is introduced into the jar to keep up the animal's respiration, while the carbon dioxide which he gives off is absorbed by the potash. The radium emanation is sent into the jar by another tube at the beginning of the experiment. At the end of a certain time, varying from one hour to several hours, the respiration of the animal becomes short and abrupt; he rolls himself up in a ball with his hair standing on end. Then he falls into a profound torpor and his body becomes cold. Before the animal finally succumbs, his respiration has fallen as low as six per minute. The effects of ozone are eliminated in this case, as it is transformed to oxygen by the potash.

An examination of the animal showed an intense pulmonary congestion. The composition of the blood was modified, especially as regards the white corpuscles, and their number is diminished. The tissues of the animal are found to be radio-active. When the body of the guinea-pig is placed on a photographic plate wrapped in black paper, it gives an image in which the hairs are very clearly defined. All the different tissues have a photographic action. The hair shows the greatest effect, and the skin but little. The heart, liver, and brain possess this property, and especially the lungs. This action may be due to two causes, according to M. Curie; either the induced radio-activity of the tissues or the presence of the emanation dissolved in the humors of the body. In the above experiments he shows that radium has a toxic action not only when applied to the exterior of the body, as he already observed, but when it is introduced into the interior of the body by respiration.

## TROPICAL SPECIALTIES FOR PORTO RICO.

Tropical Porto Rico is to be revolutionized. American influences there may not always have been for the best, but the process of adaptation is steadily progressing. When this is completed there will be a new future for Porto Rico. The prosperity of the island must always rest in its agriculture; but this must be brought up to date, and made to yield its quota of the world's goods that are in special demand.

Under the scientific directions of the Department of Agriculture it is proposed to make Porto Rico an island of specialties—specialties in tropical commercial fruits. Sugar, tobacco, and a few other staple products will not be abandoned; but the island's salvation appears to lie in other directions. It needs more variety of industries—more materials out of which to weave a solid, substantial prosperity.

The soil, climate, and other conditions are all there, and even the products, in some instances, but there have been lacking the brains and the ability to adapt nature to the demands of the day. For some time now government experts have been studying the botany of the island, and incidentally experimenting with some of the native and imported plants of commercial value. The opening of the new prosperity of Porto Rico will begin with the cultivation of these plants according to the most recent scientific methods. Many of them are indigenous to the island, but either through lack of proper culture, or ignorance of their commercial value, they have been of little real use to the natives. Others are to be imported from the Orient and transplanted to the island for cultivation. They are eminently adapted to the soil and climate of Porto Rico, and hence there is little doubt, in the minds of the scientists having the matter in charge, about their success.

One of these new plants to be transplanted from southern China or British India is the litchi tree (*Litchi chinensis*), which is eminently adapted to a climate and soil such as furnished in Porto Rico. Specimens of these trees have been brought to this country and experimented with in the Washington greenhouses, and plantations of them are expected to be planted in Porto Rico by the government experts within the next year. A litchi orchard once started should prove a source of income for the owner for a lifetime. The fresh fruit has a delicious flavor, and dried the fruits resemble raisins in appearance. A few of these dried fruits are imported from the Orient every year, and they sell as high as fifty cents a quart. In the Far East, however, they are eaten chiefly in their fresh, acid condition. Enormous quantities are consumed, and they are considered by natives and visiting foreigners in southern China, British India, and the Malay Peninsula as most excellent fruits. The cultivation of plantations of these fruit trees in Porto Rico should open a market here for their products, and in a short time the industry should prove a most paying and satisfying one.

The sapodilla tree is one that visitors to Florida see at times, but it has never been raised on a commercial scale in that State. The sapodillas are fruits that are greatly enjoyed in tropical countries, and there is a growing demand for them in our northern markets as they are better appreciated. The question of raising these in Porto Rico on a large commercial scale is not a doubtful or visionary one. It is believed that there is a great future for the trees when they are raised in sufficient quantities to make it worth while to introduce the fruits in our cities. These fruits could be brought by steamers direct to this country, and if properly refrigerated in transportation they would offer a tempting fruit to the millions of consumers in the United States. In Porto Rico there is no frost to endanger the life and production of the trees, and a plantation should continue to produce for upward of twenty years. When too old to yield a good crop, the trees furnish a most excellent and costly, close-grained wood that sells for nearly as much as the cost of starting and cultivating the grove for the first few years.

The tree which produces the cashew nut of commerce is a tropical growth that can be raised in Porto Rico on a large scale, and it is estimated that plantations of this tree alone should add many millions of dollars to the island's income within the next half century if its cultivation is wisely and faithfully attended to. The cashew nut is of superior flavor, and of great value in candy making. Its flavor is delicious, and the oil expressed from it is considered for many purposes superior to almond oil. The few cashew nuts brought from the West Indies to this country are readily absorbed, but their imports have been so small, and the prices so high, that they have never received the popular attention they deserve.

From the juice of the cashew tree many commercial products are made, such as mucilage, chewing gum, and various lotions and anæsthetics. The use of the products of the tree is so varied that it would require a good deal of descriptive text to explain them. The wood of the trees is excellent for commercial purposes, and has a close, compact, unyielding grain. Plantations of these trees should represent an agricultural specialty proof against nearly every kind of local disaster, except possibly hurricanes.

A tree known as *Cedrela odorata*, but commonly spoken of in tropical countries where it grows as ylang-ylang, thrives wonderfully well in Porto Rico. It is known in that island as the West Indian cedar, and its wood is more compact and beautiful than the best Central American mahogany. From different parts of Porto Rico this tree has been foolishly cut down and wastefully used for cabinet work and house-building. The flowers of this tree are beautiful and fragrant. From them is extracted a commercial product almost equal to the famous attar of roses. This attar of ylang-ylang is what makes the trees most valuable. It sells as high as five dollars per

pound. Ylang-ylang oil has been held almost as an exclusive monopoly by France and Germany; but a steady cultivation of the trees in Porto Rico should lead to a change. The oil is extracted by simple processes, and without the use of chemicals, and from seventy-five pounds of the flowers a pound of oil is usually produced. In Europe the oil of ylang-ylang is used as the basic essence of the best perfumes as much as the famous attar of roses.

GEORGE E. WALSH.

## THE INFLUENCE OF MILKING UPON THE QUANTITY AND QUALITY OF MILK.

M. Lepoutre, agricultural engineer and assistant to M. Roquet, professor of zootechny and animal physiology at the Agricultural Institute of Belgium, has just made a series of interesting and careful experiments at the laboratory of zootechny and hygiene of the said institute for the purpose of determining the influence exerted by milking upon the quantity of milk, upon its composition, and particulary upon the proportion of its fatty materials.

Although our knowledge as to the influence exerted by the nervous system upon the physiological tissues is very meager, the experimenter started from the innervation (nervous stimulation) of the glands in general (to the greater or less excitation of which corresponds a more or less abundant secretion), in order to try to bring about an artificial excitation of the mammary innervation for the purpose of improving the lacteal secretion.

Broadly considered, the operation of milking is a rational massage that has the effect of drawing from the udder a quantity of milk much greater than that which is contained at the outset. It is admitted that the udder of a good cow may, before the operation, contain 3 quarts of milk already formed, while, if the animal is well treated, the udder may yield from 10 to 15 parts. It follows, besides, from the experiments of M. Lepoutre, that milking exerts a great influence upon the proportion of the fatty materials contained in the fluid. This influence is due, according to the experimenter, to the peripheric excitation of the nerves of secretion, which in their turn, by reflex action, bring about a greater excitation of the glandular cells. If we consider the general case of milking from two teats at once, as usual, we find that the effect produced is not the same during the entire period of the milking. The milk extracted from the first two teats is generally richer in fat than that of the two milked in the last place, and this richness will be greater if we simultaneously milk the two teats of one side, than if we simultaneously milk one teat of one side and one of the other, and then the two remaining ones—in other words, if we do the milking diagonally instead of laterally. The phenomenon is singular, if not obscure. It seems, however, explainable by the fact that in diagonal milking the excitation extends to all of the nerves of the gland, while in lateral milking it extends only to the side on which the operation is performed, and is consequently stronger. At all events, the influence of milking upon the proportion of fat is shown by the following experiment of M. Lepoutre. The same cow was milked several times and simultaneously by two different persons, who at each operation changed sides. The milk of each side was collected separately. One of the persons performed the operation by exerting a simple alternating pressure upon the teat, while the other performed a downward massage at the same time. The milk collected by the latter person was always markedly richer in fatty matter than that collected by the former. The difference was considerable, since in the first case there was 55 per cent of the total yield, and in the second 45 per cent. The method of milking has therefore a great influence upon the quality of the milk, and this influence is not explainable unless we grant that it bears some relation to the excitation produced.

On the other hand, the milk obtained at the beginning of the operation is not so rich as that obtained at the end. Up to the present, this fact has been explained by the statement that a prolonged operation ends by detaching from the lactiferous vessels the particles of butter adhering to the walls. M. Lepoutre is not of this opinion, and remarks that the operation is performed more vigorously at the end than at the beginning. The excitation must therefore be stronger, and the reflex action be greater upon the mammalary tissues, thus causing a lactiferous secretion richer in fat.

The experiments of Prof. Roquet's assistant tend to condemn all milking machines, especially those based upon the use of a centrifugal pump. Up to the present it has been thought that the superiority of hand milking is shown only by the quantity of milk obtained; but now it is necessary to add the superiority from the viewpoint of richness in fatty matters.

Although these facts would show machines to be useless which, it was thought, would some day solve the problem of mechanical milking, it is probable that more highly improved ones will eventually take their place. The principles upon which these new apparatus will be based will be those of the mechanical and intensive production of nervous excitation at present effected, unconsciously as it were, by manual treatment. It is not unlikely even, and it is the logical consequence of what has just been said, that the milking machine of the future, based upon such principles, will be able to perform the operation of milking better and obtain a greater quantity of milk, richer in fatty matters, in a more uniform and more scientific manner.

## PHOSPHORESCENT CRYSTALLIZATION OF ARSENIOUS ACID.

BY A. C. MAURY.

In the crystallization of arsenious acid there is frequently displayed one of the most beautiful and interesting phenomena of physics, the emission of light by a crystal at the moment of its formation. The experiment is one of the most impressive in laboratory or lecture room, yet it is rarely attempted, owing to uncertainty of success. It was accordingly proposed in a previous article of the SCIENTIFIC AMERICAN, entitled "Light in Crystals," that a brief description should be given of the writer's method of preparing the phosphorescent solution.

Fresh samples of arsenious acid were dissolved in hydrochloric acid, the lumps being first ground to powder, and then boiled with the hydrochloric acid in a test-tube or small flask. Success is dependent mainly on the solution's being of the right strength, and the best results are obtained when 3.81 grammes of arsenious acid are dissolved in 4 cubic centimeters of hydrochloric acid at 18 per cent to 18.5 per cent. The liquid must be boiled till clear and free from undissolved material, but solution should be effected as rapidly as possible, since long boiling alters the strength of the hydrochloric acid. The most highly phosphorescent solutions are those made in five minutes. This point is found to be of less importance when a return-flow condenser is used, though even then solutions made rapidly are the most successful. The condenser is convenient, but the open tube or flask serves equally well, if the exact amount of arsenious acid is placed in it and quickly dissolved. A favorable condition is indicated by the bubbles' breaking tardily, as though the fluid were slightly viscous. A drop taken out on a glass rod and placed on a cold glass surface should at once form a white ring round the edge, and in a few seconds should turn all to white crystals. If the whole drop turns instantly to a white mass, the solution is too highly supersaturated, and the crystals will be thrown down before cooling and without apparent phosphorescence.

When ready, the solution is placed in a hot sand bath, and set aside in a perfectly dark closet, where it may cool slowly without being jarred by passing footsteps.

When still warm but no longer hot, it begins to show occasional sparks, which resemble the soft flashes of the phosphorescent light seen sometimes in the wake of a vessel on summer evenings. Frequently two or three crystals form at once, and their light is then prettily reflected against the glass. When the flask is shaken hard the illumination is very beautiful, resembling a fine display of the light at sea. The phosphorescence is visible on repeated shaking, the solution being allowed intervals of rest; or if the flask be left undisturbed, the tiny crystals form spontaneously, and sparks continue until or even after the liquid is quite cold. Crystals which dry on the sides of the flask are phosphorescent when scratched with a glass rod.

The slight sound said by some observers to be emitted by the crystals in forming has not been noticed.

Bandrowski in his experiments (American Journal of Science, January, 1896, p. 51) found the most favorable strength of the hydrochloric acid to be 16.5 per cent to 18 per cent, which is somewhat lower than that given above. In the experiments made by the writer, solutions at 18 per cent and 18.6 per cent were alone successful; those at 17.4 per cent, 19 per cent, and 19.7 per cent showed only a few faint sparks on hard shaking.

The difference in Bandrowski's results is doubtless due to the fact that with the lower percentage of hydrochloric acid he used a smaller amount of arsenious acid, viz., 15 grammes in 150 cubic centimeters of the dilute acid, for altering the strength of the hydrochloric acid alters the solubility of the arsenious acid; and as phosphorescence in all probability depends on the readiness of the crystals to separate from the fluid, it is likely that various corresponding proportions may meet the required conditions.

It is likewise owing to alteration in solubility that long boiling impairs the liquid. Loss by boiling alters the strength of the hydrochloric acid, and increases the solubility of the arsenious acid. Thus when the return-flow condenser is used, it is not found possible to dissolve more than 4 grammes of arsenious acid in 4 cubic centimeters of hydrochloric acid at 18 to 18.5 per cent; but when the liquid is allowed to boil away in the open tube while being kept replenished with fresh hydrochloric acid, as much as 6 grammes of arsenious acid are dissolved. In the latter case nearly half the liquid boils away and must be renewed. That boiling had no immediate effect on phosphorescence is shown by the fact that the first successful experiment is made by boiling a solution of unknown strength for a number of hours, when a beautiful display is seen.

In the above experiments the transparent or vitreous form of arsenious acid was used, some very fine samples from their laboratories in Germany having been kindly presented to the writer by Messrs. Merck & Co. It will be remembered that arsenious acid assumes this form when it has been freshly sublimed at a high temperature, after which it passes slowly into the white, opaque, crystalline form, in which it is commonly found. Becquerel, in La Lumière, stated that the transparent form alone gives phosphorescent crystals; but Bandrowski later found both varieties to be phosphorescent. Trials were made in the present experiments, selecting the opaque portions of the specimens, and phosphorescence was obtained, though the transparent portions gave perhaps the finer results. The fact that both kinds phosphoresce is of interest, because the theory was formerly advanced that phosphorescence is due to the change from the transparent form, which is amorphous, to the opaque, which is crystalline. The explanation must therefore be sought elsewhere, in connection with similar phenomena shown in other cases of simple crystallization.

## SCIENCE NOTES.

The Carnegie Institution at Washington has received from Prof. Pumpelly a preliminary report of the investigations which he is making under the auspices of the Institution on the ancient site of Anau, near Aschabad, in Russian Turkestan. He reports gratifying success, the expedition having explored over 136 feet of successive culture strata, containing at least four almost uninterrupted culture stages, extending apparently for thousands of years through the neolithic and bronze into the beginning of the iron age, and having correlated the stages of culture with important events in the physiographic history and with the introduction of irrigation.—N. Y. Evening Post.

A series of interesting experiments with a new war kite for utilization with a newly-discovered system of wireless telegraphy were recently carried out with great secrecy before Kaiser Wilhelm. The inventor is a German-American professor, at present residing at Havre. The operations were carried out about a mile from the shore. No spectators whatever, beyond the naval officials and the Emperor and his suite, were allowed to witness the experiments. Seven kites were flown on copper wires to a height of from 10,000 to 12,000 feet. The experiments were partly made from the Kaiser's dispatch boat "Sleipner," traveling at the rate of thirty knots an hour, and several languages were employed. The feature of the invention is the possibility of transmission over the greatest distances without affecting any other wireless telegraphy station. The form of the kites used is that of two cubes side by side, similar to the Cody box kites.

From the bark of trees and shrubs the Japanese make scores of papers, which are far ahead of ours. The walls of the Japanese houses are wooden frames covered with thin paper, which keeps out the wind but lets in the light, and when one compares these paper-walled "doll houses" with the gloomy bamboo cabins of the inhabitants of the island of Java or the small-windowed huts of our forefathers, one realizes that, without glass and in a rainy climate, these ingenious people have solved in a remarkable way the problem of lighting their dwellings and, at least in a measure, of keeping out the cold. Their oiled papers are astonishingly cheap and durable. As a cover for his load of tea when a rainstorm overtakes him, the Japanese farmer spreads over it a tough, pliable cover of oiled paper, which is almost as impervious as tarpaulin and as light as gossamer. He has doubtless carried this cover for years, neatly packed away somewhere about his cart. The "rikisha" coolies in the large cities wear rain mantles of this oiled paper, which cost less than 18 cents and last for a year or more with constant use. An oiled tissue paper, which is as tough as writing paper, can be had at the stationer's for wrapping up delicate articles. Grain and meal sacks are almost always made of bark paper in Japan, for it is not easily penetrated by weevils and other insects. But perhaps the most remarkable of all the papers which find a common use in the Japanese household are the leather papers of which the tobacco pouches and pipe cases are made. They are almost as tough as French kid, so translucent that one can nearly see through them, and as pliable and soft as calfskin. The material of which they are made is as thick as cardboard, but as flexible as kid.—David G. Fairchild in the National Geographic Magazine.