SCIENCE

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RICE CULTURE IN JAPAN, MEXICO, AND THE UNITED STATES FROM THE HYGIENIC POINT OF VIEW.[1]

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ONE of the most important problems to be solved by the Japanese medical profession is the application of a rational and efficient hygiene to the culture of rice. This culture lies, so to speak, at the very foundation of Japanese life. When the rice crop is abundant Japan is well fed, healthy, and content; when it fails, Japan droops and starves. Japan almost lives on rice, and, consequently, a considerable part of its population in employed in the culture of rice. This large fraction of the people, at least, is exposed to all the dangers which arise from a careless, imprudent, or slovenly system of cultivation, and the dangers, as every one knows, are very great, and, as every one knows, also, little is done in Japan to obviate them.

Rice culture is a watery business. Almost the whole population of Japan forms around its island a fringe, fifteen miles deep, leaving the interior a comparative desert. This fringe is exceedingly populous. From one town to the other you find scattered along the roads innumerable houses, so that it is impossible for a stranger to say where one village begins and the other ends; they dovetail into one another, as it were. In the interior the rare population is concerned with silk, lacquer, pottery, etc.; but in this fringe there is scarcely anything but rice culture. The sea washes, penetrates, at times partly covers by its tides, the coast-land, and furnishes the constant dampness necessary for the growth of rice. The sea takes away multitudinous parcels of the rice coast by forming swamps; and sometimes seems to be intent on compensation by giving something of its own; thus, for instance, a portion of the city of Tokio, now inhabited by 120,000 people, and which 200 years ago was under water, may be considered as a gift of the ocean.

The traveller in Japan is forcibly reminded of the cities of Egypt, perched upon their elevated seats during the overflow of their grand river. Here the inundation is an artificial one; the waters of the innumerable swamps formed, either by the sea or by the rivers, have been directed into the rice fields all around the villages, and the latter appear like islands. Even when the time of the flooding is ended, shallow marshes remain everywhere, for the drainage is imperfect, to say the least. The stork, the king of the swamps, is the national bird of Japan, semi-sacred, and, in olden times, Mikados and Tycoons alone were allowed to eat of it.

We must also, in an article on rice culture in Japan, take into account the exuberant canal system of that country. The traffic of the country is almost all on the canals, which join one river to the other, and form a network of filthy water over the whole extent of the densely populated zone. I said of filthy water, for it contains all the surface drainage of the large cities. Garbage[2] is continually, or rather systematically, thrown into the deep, elaborately built, stone gutters in which there is a perpetual flow of water, so that even a regular eel fishery goes on in them. These gutters do the work of our scavengers, without any cost to the city; they carry the city filth into the canals, and from the canals not only to the sea but also into the rice fields. A river is nowhere allowed to pass without paying toll in the form of public service; it enters into the sea only after it has washed the cities which it met in its course. On its surface it carries still more filth, if possible, than in its waters, for the contents of all the public closets, in the streets and in the houses, are daily carted to some boats and brought to the rice fields, to serve as manure. There, at the rice field, the liquid manure is preserved in tanks until the proper time has come for using it, after the drainage of the plantation, when the farmer feeds the growing plant by pouring over its roots with a dipper. The solid part is applied to the soil before the planting.

From all this it appears that the culture of rice in Japan is naturally a thorn in the side of the medical profession.

The first evil resulting from this occupation in Japan is impaludism, which is exceedingly frequent in all the rice plains until the monsoons of the spring and the autumn sweep away most of the paludic emanations.

Typhoid fever and its complications, together with other pernicious types, and the diseases caused by the distoma are due to the infection of drinking water by their deleterious system of manuring and draining.

It has occurred to several leprologists that there may be a connection between lepra and impaludism. It is a fact that the more malarious the situation of a sea-coast the greater is the number of lepers there. Moreover, it may be considered as a significant fact, that the first outbreak of leprosy is, in a large number of cases, in China as well as in Japan, preceded by one or several attacks of paludic fevers. It has even been suggested that the origin of leprosy might be in the malarious mud through which the rice laborers are continually wading. So much for Japan.

The situation in Mexico, a country allied with Japan in many ways, in climate, in constitution of inhabitants, irrigation system, etc., is aptly described by Dr. Nazario Lomas, member of the Board of Health of the State of Morelos, Director of the General Hospital, Cuernavaca (Morelos), Mexico. His paper on the subject was read in Kansas City (United States) before the American Public Health Association, Oct., 1891. I give here the essential part of it: "During the last five years the cultivation of rice by irrigation has become one of the chief elements of the prosperity of this State (Morelos, Mexico). In course of these five years we have seen the plantations increasing rapidly, while a corresponding deterioration was observed in the salubrity of neighboring towns. And how could it be otherwise, seeing that the rice swamps are exposed to a mean temperature of 33 degrees centigrade in summer and 28 degrees in winter?

"I think I need not here enter into any details about the cultivation of rice; in a general way, quite sufficient for my purpose, every one is acquainted with this subject. Let me only remind the reader that there are two systems of cultivation: dry (on hills), and by irrigation. The latter has two sub-divisions, irrigation by current and irrigation by flooding.

[1] Communicated to the Sei-I-Kwai, or Society for the Advancement of Medical Science in Japan.

[2] However it must not be forgotten that garbage in Japan is of a more simple and less lurid kind than ours; it consists chiefly of the refuse of fish and vegetable diet; no meat bones, no stale bread or other characteristics of our own garbage.

"The sytem of irrigation by flood, which, happily, we do not know as yet in the State of Morelos, but which is likely enough to be introduced by and by, as the rice culture progresses, is the worst of all. It is this system especially that is meant when competent authorities denounce the cultivation of rice as homicidal, declare its history to be one of blood, and contend that every sixteen hectolitres of rice are bought at the price of one man's life. This form of irrigation is said by experienced men to combine in the most effective manner all the evils of the very worst of sweet-water swamps.

"The rice cultivated under the current system, now generally adopted in this State, is irrigated from February to September by means of currents, renewed according to the necessities of the plant, but generally continuous. Now as perfect slopes are rare, the drainage is rarely, if ever, complete, so that every field of any considerable extent presents hollows ready to receive swamps. Moreover, the want of canals and drains, or their imperfection, is cause that at the points of entrance and exit the irrigation water diffuses itself in lagoons. But supposing even this system to be carried out in the most perfect manner, without any flaw, there remains still the evaporation, on an immense surface, from a soil exceedingly rich in organic matter. The harvest begins in September. It leaves on the ground, more or less damp and swampy, a large quantity of vegetable detritus, whose decomposition fills the air with most pernicious, because ever renewed, poison.

"As to the dry system, which is used on hill-sides, I am not practically acquainted with it. Of course it is not as unhealthy as the two others, but then it is less productive.

"Now, if once we have created in our midst this class of artificial morasses, with a large superficial extension, we find safely established among us the paludic fevers and all classes of gastro-intestinal affections. These are always endemic in the districts where rice is cultivated.

"Each progress of the rice culture is followed by a correspondent advantage gained by the fever. More than fifty per cent of the field-hands are attacked by it. It appears under all its forms, but mostly under those of daily intermittent, tertiary, and continuous fever; in the first two cases it is accompanied almost at the onset with swelling and hardness of the spleen, and very frequently of the liver. It is to be observed that the continuous or remittent fevers do not at once appear as such, they are usually preceded by two or three attacks of daily intermittent fever, whose duration gradually increases until the disease becomes continuous or remittent. Notwithstanding its paludic nature, this fever is not amenable to any form of quinine. Neuralgia, especially in the form of trigeminus, urticaria, and purple spots, is very frequent. Pneumonia becomes here an epidemic, and is cured, or very favorably influenced, by the use of salts of quinine: this observation is continually made in the battalions which come from the south. The day-laborers who come down from the central table-land and the Valley of Mexico are almost invariably affected with cachexia on their arrival.

"I think this is the place to give a few details concerning the physical geography of the State of Morelos. It forms an inclined plane from north to south. Its highest parts are 2,000 metres, and the lowest 500 to 650 metres above the level of the sea. The prevailing winds by day are from south to north, by night from north to south.

"There is an abundance of water, both from springs and rivers; the former is sweet, the latter sweet and salt.

"The course of the waters is naturally opposed to the formation of lagoons or swamps, and the climate must have been very healthy in former times.

"It is in the lower part of the State that the rice is cultivated. It grows there in company with the sugar-cane, another cause of paludism.

"The hygienic measures which the State Board of Health submitted to the approbation of the government, through my initiative, are as follows: —

"1. The cultivation of rice by the flooding system is, in no case, to be allowed, even as a trial.

"2. No new rice plantation shall be established, without a license from the government, for the granting of which, the Board of Health is to be consulted, the State engineer to be a member of such Board. The Board will appoint a committee to study the subject, composed of one of its members residing in Cuernavaca, a physician from the rice districts, who may be a corresponding member of the Board, and of the State engineer.

"3. If the ground, in which it is proposed to cultivate rice, is situated to the south or north of any village or town, and distant therefrom less than 3,000 metres, the petition shall be at once rejected, unless, in the opinion of the health experts, not less than three in number, the three being unanimous, an intervening hill, or forest, or other such natural feature, removes the danger.

"4. Any rice-planter who shall commence his harvest with the ground in a soaked condition, if such condition is due to bad management or carelessness, the waters not having been removed in due season, shall be liable to a fine of not less than $50, the amount to be fixed in consultation with the governor, and to be deposited with the funds of the State.

"5. The cultivation shall be suspended on any plantation, in which, in the opinion of the engineer of the Board, the irrigation waters form swamps or lagoons, either at the entrance or at the outlet. Once these defects removed, the permission to cultivate may be renewed.

"6. Any person may denounce before the Board, or its correspondents in the district, any defects in the irrigation or cultivation, which may cause the formation of swamps.

"7. Whenever the rice is beaten down by strong winds, hail-storms, etc., it must at once be cut, and especially if it is in the water.

"8. The laborers employed in the rice culture will begin work after sunrise, and will leave the fields before sunset.

"9. The overseers will, under no circumstances, allow the wives of the laborers to bring them their meals or visit them in the fields. This prohibition applies with still better reason to children.

"10. The owners and administrators of rice plantations, who have the well-being of their laborers at heart, may apply to the State Board of Health and obtain from it a pamphlet setting forth the rules to be observed for the prevention and cure of paludic fever."

There is a large rice culture in the United States also. How large is shown by the following numbers, which I have obtained from the U. S. Department of Agriculture. In 1879 the census data for the crop were as follows: —

	Pounds.
South Carolina	52,077,515
Georgia	25,369,687
Louisiana	23,188,311
All other States	9,495,860
Total	110,131,373

Estimates by State Commissioners of Agriculture are available for recent years for South Carolina and Louisiana. The figures of production for the last three years at hand are: —

	South Carolina.	Louisiana.
1888	67,752,374	51,414,909
1889	93,143,508	63,330,897
1890	68,091,944	

The production for Louisiana for 1890 is given at about 1,000,000 barrels of rough rice.

The largest cultivator of rice in the United States is probably Col. John Screven of Savannah, Ga. It is to the kind ness of this gentleman that I am indebted for the following information, relating to the rice culture in Georgia and the Carolinas (I leave Louisiana entirely out because the situation there is complicated by the presence of the sugar-cane culture).

"There are only two systems: tide-water, and inland or back-water culture. In the latter system, the water is derived from swamp or still-water reservoirs, formed by banking in the water of swamps and so retaining it convenient for the irrigation of adjacent fields. The culture of such fields is practically the same as in tide-water culture, the water being applied and removed at pleasure, provided the reservoirs or back-waters are sufficiently supplied, as may not be the case in seasons of drought. In the former, or tide-water system, a want of water-supply can scarcely occur, certainly not at the periods of spring tides, on which the system of irrigation is commonly based.

"The tidal lands lie in the deltas of the rivers and in their natural state are subject to overflow, certainly in the spring-tides, and being extremely level may be covered by 'great tides'[1] to a depth to hide summits. As these lands contract and settle under drainage and cultivation, this advantage is increased after they are taken in.

"They are embanked sufficiently to keep out the highest tides, and water gates, called "trunks," are laid, so as to admit or discharge the water, as the tides rise or fall. At these gates the drainage fall is from four to five feet in the Savannah River, where the mean tide-fall is about six and a half feet. The average drainage of the fields, however, will not exceed three and a half feet. To make the drainage as complete as possible, main ditches, say six feet wide by four feet deep, are dug around the fields, which are again subdivided by minor ditches, 2 feet wide by three feet deep, called quarter drains, cut parallel about seventy-five feet apart. This ditch system is not all-important for irrigation. It combines greater value in the rapid and thorough drainage it affords; for rice is an amphibious plant, and while irrigation is very necessary to its successful growth, good drainage, the more rapid the better, is equally necessary, for reasons which need not be stated here, as we have to consider only its hygienic value."

I had addressed to Col. Screven a number of questions relating to this subject. I give them here with the answers I received.

1. Which is the least dangerous of the different systems of irrigation? Answer. The tide-water system, because the water is not taken from stagnant reservoirs, and may be oftener changed.

2. What is the system of manuring generally adopted, are human excrements used? Answer. Commercial fertilizers are more commonly used — human excrements *never*.

[1] This is the almanac term for the high spring tides raised by the union of new or full and perigee moon — not storm-tides.

3. What means are used to prevent the contamination of drinking water? Answer. Water from wells, sometimes artesian, is used, very commonly water drawn directly from the river, which, by the more careful, is cleared by settling, or is filtered.

4. What seasons are most unwholesome for the cultivators? Answer. The summer and ante-frost autumnal months, commencing with July and the harvest flow, and especially after that flow is removed, say, from August 15, when it is cast off for the harvest, and the water-growth, animal, and vegetal exposed to the sun and decay.

5. Do the hands live in the immediate neighborhood of the plantations or, perhaps, on higher ground? Answer. Either, as convenience dictates, or on the plantation itself. Very often higher grounds are more unwholesome than the level of the rice-fields. Settlements close to the river-shore, where the tides move the atmosphere, and the winds are least impeded, are often the most healthy. High grounds overlooking rice-fields, and not well-shielded from them by vegetation, are considered most unwholesome. It should be stated that the cultivators (laborers) in the rice-fields are negroes, who are constitutionally less liable to fevers than whites. Ordinarily, the white residents of rice-fields abandon them from May 1 until frost the following autumn.

6. What system is used to dry the ground? Answer. The drainage method already described. The rice-fields are never pondy or muddy when properly drained. During the dry stages, they admit the plow, harrow, toothed roller, drill, or any other appropriate agricultural implement, and are sometimes even dusty, when stirred.

7. What is done to prevent the formation of swamps or lagoons? Answer. Effective drainage.

8. Is anything done to prevent infection from the rotting crops which have been beaten down by storms? Answer. When drainage is effective, serious infection is not likely to occur from crops beaten down by storms.

9. Are laborers permitted to work in the rice-fields before sunrise and after sunset? Answer. The most dangerous time to laborers is in the harvest, when the hot suns raise noxious effluvia in the fields from decaying water vegetation and animalculæ. At such times the laborers (negroes) seek their work in the early morning before sunrise, so as to complete their tasks before afternoon, when the sun is most oppressive. They fear the sun more than malaria.

10. What means are taken to obviate malarial and typhoid fevers? Answer. None specially; incidentally such drainage as is necessary to successful rice culture Drainage and good health are as interdependent as drainage and good husbandry. *As for typhoid fever, it is unknown in the rice-fields, even among whites.* Filth diseases are rare. If by "malarial fevers" is meant fevers other than those from paludal (marsh) causes, I venture to assert that in the rice-fields, and on the southern Atlantic coast generally, there is marked absence of them, and where fevers prevail from paludal (marsh) causes (bilious fevers?) typhoid fever will not originate. It is a notable fact, that typhoid fever was unknown in the city of Savannah before 1861.

In conclusion, I will in a few words give such advice to Japanese sanitarians as is clearly suggested by the preceding facts. 1. First of all, there is one thing that must be done if the culture is not to remain what it is now, a public calamity; the immunditæ must be kept out of the water. I should advocate the use of artificial manures, — bone phosphates and American fertilizers. Thus the general infection of drinking water with typhoid, cholera, and other germs, would cease.

2. It would be worth while, perhaps, if a trial was made to obtain negro labor for the rice plantations. The negro is proof against malarious influences in a considerable measure. Might not colored laborers be imported from Georgia and the Carolinas?

CURRENT NOTES ON ANTHROPOLOGY. — XI.

[Edited by D. G. Brinton, M.D., LL.D.]

Canadian Archæology.

UNDER the efficient superintendence of Mr. David Boyle, curator, the archæological collection of the Canadian Institute, Toronto, has grown to be the largest in existence, illustrating the prehistoric condition of man in the province of Ontario. His excellent reports, which have appeared annually since 1887, describe with great accuracy and sufficient fullness the yearly accessions to the collection of antiquities.

Objects which can properly be called palæolithic have not yet been found in Canada. This is the opinion of Mr. Boyle as expressed in his last report. Of course, forms simulating those of the old stone age occur, but this is not conclusive. Stone is the principal material, and in its shaping and dressing the Canadian Indians were not behind their neighbors to the south. The collection also contains many specimens of their pottery. It is well burned, ornamented with designs in scroll and line, and some of the vases are "almost classic in outline." The pipes, both stone and clay, are a prominent feature in the reports, and evidently were the objects of solicitous workmanship. Copper specimens are by no means unusual, some being knives, others spear-heads, with planges and sockets, others ornaments, as beads, bracelets, etc. Examples in bone, shell, and horn are also figured. About a hundred of the crania unearthed have been examined. They indicate a people with moderately dolichocephalic skulls, averaging a cranial index of 74.5.

It is to be hoped that the government of the Dominion will continue to lend assistance to this creditable effort to illustrate the archæology of Ontario.

The Question of the Basques.

As some readers of *Science* have manifested an interest in the Basques, they will doubtless be pleased to learn that at the next meeting of the French Association for the Advancement of Science, to be held at Pau, from the 15th to the 22d of September next, the Anthropological Section intends to devote most of its energies to settling "La Question Basque." According to an announcement of the President of the Section, Dr. Magitot, the question is to be attacked on all four sides: first, the history and origin of the Euskarian people; next, their anthropological characters; third, their language; and finally, their traditions and folk-lore. From such an onset as this we may hope for some positive results.

Not much can be expected from a study of the language. There is probably no other living idiom which has had its vocabulary so completely foreignized as the Basque. At the Congrés Scientifique International des Catholiques last year, the Comte de Charency, who is a good authority on the tongue, stated that at least nine-tenths of its words were borrowed from the Latin and Romance languages, and then proceeded to point out that a considerable percentage of the remainder were Celtic, Greek, or Germanic in origin. There is almost nothing left of the original Euskarian but its grammar; and this, it may be added in passing, shows no relationship to that of either Ural-Altaic or American tongues, in spite of various statements to the contrary.

On Left-Handedness.

Why are most people right-handed? Why are a few left-handed? These are questions which have puzzled all physiologists who have attempted their solution. The various theories put forward are compactly presented by Sir Daniel Wilson in his recent work, "The Right Hand: Left-Handedness" (London, 1891). His final conclusion is that left-handedness is due to "an exceptional development of the right hemisphere of the brain." But it must be acknowledged that his evidence, consisting of a single autopsy, is far from sufficient.

Sir Daniel calls attention to the fact that the forms of some ancient stone implements prove that palæolithic man was sometimes left-handed, and distinctly was not ambidextrous, as some have maintained. He does not refer to De Mortillet's tables in the Bull. Soc. D'Anthopologie, 1890, which show that at that time in France the men averaged more than twice as many left-handed individuals as at present; and at certain localities, as at Chassey, on the upper Rhone, the left-handed were in the large majority.

In Sir Daniel's generally very thorough volume there are but few references to this phenomenon in the lower animals, and no mention of its occurrence in snails. It may, indeed, sound like a "bull," to talk of animals as left-handed who have no hands, but the physiological phenomenon is plainly present. It is shown in the direction in which they construct the spiral of their shell. With the ordinary vine snail this is from left to right; but once in about 3,000 times it is from right to left. They are then known as *sinistrorsa*. In the genus *Partula* far more frequent examples occur, and indeed species have been named from this peculiarity. Whatever its cause, in mollusk and in man the same law is operative.

The Mentone Cave-Burials.

Near Mentone, but on the Italian side of the frontier, there are several caves in the cretaceous sea-cliffs, whose contents have long attracted the lively attention of archæologists. Unluckily, they have been worked over so much that the original stratification is no longer apparent; but throughout the mass, flint chips and rude bone implements have been abundantly found, of such a character that they have been unanimously referred to palæolithic man, to that period of his existence in western Europe which De Mortillet has called Solutreen.

Thus far, all is harmony; but in this deposit, at various depths, skeletons have been unearthed, and a lively discussion ensued as to whether these should be considered also of palæolithic time, or of later date. This debate has been renewed by fresh discoveries of such remains in February last, a good description of which, by Mr. A Vaughan Jennings, appears in *Natural Science* for June. They are said to be of unusual size, relics of men from six and a half to seven feet tall; but it is well known how easily one is deceived in measuring skeletons. With them were worked ornaments of bone and shell, necklaces, and finely-chipped arrowheads. These indications point conclusively to the fact of deliberate interment at a period when mortuary ceremonies were definite and solemn rites, and unquestionably, therefore, to neolithic times. In spite of the depth at which they were found, perhaps twenty-five feet below the modern level of the cave floor, they must be accepted as endorsing De Mortillet's rejection of the human remains as palæolithic.

Ethnology as Philosophy.

Among the most thoughtful writers on the meaning and mission of ethnology must be named Dr. A. H. Post of

Bremen. He is the author of several important works, and an essay of his, on "Ethnological Jurisprudence," was translated and published last year in the *Monist*, at Chicago.

In a recent number of the *Globus* he publishes some "Ethnological Reflections," which are intended to set forth the true position of ethnology with reference to other sciences. He defines ethnology as "the natural history of social life," and he believes that the time will come when all the so-called "social sciences" will be taught as its branches. He points out with force that this will bring about a revolution in all traditional methods of education, for there is a fundamental and irreconcilable antagonism between the two methods. Natural science denies absolutely the free will of man, the validity of *a priori* reasoning on any subject, the possibility of a "categorical imperative" in ethics, the abstract truth of any doctrine of religion or morals, the supremacy of any individual. All is an endless and unavoidable chain of cause and effect.

It appears to me that such a view of ethnology is true so far as it relates to the growth of societies under natural surroundings. The social unit is cribbed and confined by iron laws, and its development is in a measure subject to these; but in a measure only. It is even less true of the individual. For to deny free-will to man not only leads at once into logical contradictions of the grossest kind, but is contrary to the soundest maxims of inductive philosophy. As John Stuart Mill, whom no one will accuse of prejudice, pointed out, we are certain of nothing so surely as of our own feelings, and of these the strongest is that of our own individuality, and of it as a free agent.

Dr. Post has here committed the same error as another distinguished ethnologist, lately mentioned in these columns (*Science*, June 3), that of seeking to make ethnology synthetic, when its study should be objective and analytic. Where it leads him, his article curiously shows. On one page he says that to the ethnologist no social condition is good or bad, but merely present as a subject for study; and on the very next page he falls to bewailing the egotistic strife in modern society as threatening the ruin of the social edifice!

NOTES AND NEWS.

THE next meeting the American Association for the Advancement of Science, to be held in Rochester, N.Y., Aug. 17–24, will be of unusual interest and importance, especially to the members of the Section of Biology. At this meeting will be considered the place of meeting for 1893, and consequently the attitude of the association toward the Columbian Exposition. But even of greater importance to biologists will be the consideration and probably the decision of the question of the division of the section into two, — one for the botanists, and one for the zoologists. It is hoped, also, that there will come up for discussion the report of the American Branch of the International Committee on Biological Nomenclature. This report has nothing to do with the naming of species, but will consider the terminology to be employed in anatomy, embryology, etc. In view of the matters of general interest to the whole association, and those of vital interest to Section F, it is expected that there will be a large attendance of botanists and zoologists and a long list of papers to be presented before the present section of biology.

— Bulletin No. 23 of the West Virginia Agricultural Experiment Station, entitled "Illustrated Descriptive List of Weeds," contains a considerable amount of information in a condensed form. It is written by Dr. C. F. Millspaugh, botanist of the station. Illustrations of all the important families, as well as of a number of species, enable one unfamiliar with the weeds to recognize them. Short descriptions are given of each, with mention of any special medicinal value they may possess as household remedies. Some two hundred species are mentioned. One might reasonably question the justice of considering the locust (*Robinia pseudacacia*), the honey locust (*Gleditschia triacanthos*), or the wild hydrangea (*Hydrangea arborescens*) as weeds. The list would naturally not be the same for all States, but it is a little surprising not to find *Potentilla norvegica* mentioned. In southwestern Ohio, and doubtless other localities, whole fields have been overrun by this plant, and it is much worse in this respect than *P. canadensis*, which is mentioned in the Bulletin. A number of typographical errors show carelessness in proof-reading.

— At a meeting of the Paris Geographical Society on May 20, according to *The Scottish Geographical Magazine*, M. Venukoff gave a sketch of the surveys executed in Russia during the year 1891. After referring to the exploration of the Black Sea continued by MM. Spindler, Andrussof, and Wrangell, of which an account was given on page 154 of this volume, he turned to the geodetic and topographical work executed in the Crimea, which has been the means of ascertaining that the Roman Kosh (5,601 feet high) is the culminating point of the mountains of the peninsula, and not the Tchatyr Dagh (5,002 feet), as has hitherto been supposed. The phenomena of terrestrial magnetism and the local attractions of the mountains of the Crimea have also received attention. Among the geodetic works produced is a large map of the triangulation between Kishineff and Astrakhan, along the parallel of 47° 30′ N. This arc extends over nineteen degrees of longitude. It is remarkable that this triangulation, though quite independent, agrees exactly with that of the 52d parallel in regard to the anomalies observed in the length of different degrees of longitude (see vol. vii., p. 494). Between the same meridians the differences of the lengths of degrees of longitude, as measured geodetically and calculated astronomically, have always the same sign.

— For several years the chemical division of the U. S. Department of Agriculture, under H. W. Wiley, has been giving considerable attention to the subject of adulterants, and in part seventh of bulletin No. 13 is reported a series of investigations made on the adulterations of tea, coffee, and cocoa preparations. The conclusion reached is that teas are not now adulterated to so great an extent as formerly, and that the adulterants used are, as a rule, not such as may be considered prejudicial to health. In the case of coffee the use of adulterants seems to be on the increase. Of the samples of ground coffee examined, 90 per cent were found to be adulterated in some way, some of them containing no coffee whatever. Chicory is largely used as an adulterant of coffee, as well as wheat, rye, corn, peas, acorns, molasses, etc. Not only is ground coffee adulterated, but numerous imitations of unground coffee are on the market, a few imitating green coffee, but the larger number intended to be mixed with roasted coffees. The following description of some of them is taken from the bulletin: "8,951. Coffee pellets, molded, but not in the form of coffee beans. When mixed with ground coffee would escape the notice of the purchaser, also probably in mixture with whole coffee. Composition; wheat flour and bran, rye also probably present. Manufactured by the Clark Coffee Company, office 156 State Street, Boston; factory, Roxbury, Mass. Price, 6 cents per pound, or 5½ cents in 10-barrel lots. The manufacturers claim that an addition of 33 per cent of these 'pellets' to genuine coffee will make 'an equal drink to the straight goods.' The manufacturers, after making extravagant claims for their product, state, with evident intention to further a fraud, that 'it is uniform in color, and can be furnished with any desired color of roast.' 8,955. Imitation coffee beans. Composed of wheat flour, light roast. Manufactured by the Swedish Coffee Company, New York. 8,956. Similar to 8,955, and of the same manufacture. Composition; wheat flour and probably saw-dust. Dark roast; two kinds of berries. 8,957. Imitation coffee beans. Composition; wheat flour. Manufactured by L. H. Hall, 1,017 Chestnut Street, Philadelphia, Pa." Another method of sophisticating coffee is to treat it for the manufacture of coffee extract, after which the grains are roasted a second time, with the addition of a little sugar to cover the berries with a deceptive glazing.

SCIENCE:

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MODERN BOTANY.[1]

BY CHARLES R. BARNES, PROFESSOR OF BOTANY IN THE UNIVERSITY OF WISCONSIN.

I VENTURE to say that the ideas conjured up by the words "botany" and "botanists" in the minds of those of you whose school days ceased anywhere from fifteen to twenty years ago, or perhaps even at a later date, will be one which is very widely different from the ideas that those words ought to bring up. To most people the word "botany" recalls something which chiefly means the collecting of flowering plants in the spring; pulling flowers to pieces in an endeavor, too often a vain endeavor, to find out a long, hard name for the plant; an endeavor which is often vain unless they have acquired the very useful trick of looking in the index for the common name. The word "botanist" brings to mind a sort of harmless crank who spends most of his time in wandering about fields and woods and poking into swamps and bringing home arms full or boxes full of plants; perchance drying them and preserving them. Yet these two ideas are so extremely foreign to the subject of botany as it is thought of to-day, that I venture to present to you some hints of what modern botany is, and particularly what modern botany is on its economic side. The study that I have indicated as being the common one is the study of a part only of botany; one to be sure which is not without its value; but it is only the most elementary part of the subject. It was very natural that when people began, in the revival of learning, and at the close of the middle ages, to study plants, they should first turn their attention to the plants which were nearest at hand, and to those plants which attracted their attention most readily on account of their size. So we find that the early studies of plants are almost exclusively an attempt to describe and classify; at first simply to describe the plants which one found about him; later to ascertain what the relations of these plants to each other were. From that day until the present this study and classification of the higher plants has been almost the only subject to which any very great attention has been given. In our own country the people who came to it, if they had had any training at all in botany, had been impressed with the importance of the same ideas. They had come to a new country. It was their first duty to make known to those abroad who were studying plants, what the flora of this country was; and, from the year 1750 on, collections of great number and often of considerable value went across the water.

From 1750 to late in the present century little attention was given to any other department of botany; and it is only within the last ten or fifteen years that descriptive botany has had any competitors for favor. In Germany, however, the matter is widely different; it has been a much longer time since systematic botany, the study of plants as far as their classification is concerned, was the only topic which attracted attention. The reason of this is perfectly evident. People exhausted the subject to a certain degree in that country, and they then naturally turned their attention to some other phase of plant study. Germany and France stand far in advance of this country to-day in the investigations which their botanists have pursued, solely because of the longer time during which they have been at work, and the greater amount of time which each investigator is able to give to his own special subject.

But students nowadays are not expected to collect flowers and find out their names and then congratulate themselves that they have studied botany. They are put to work with the microscope to see the very minutest arrangement of the complicated machinery of plants. They are set to work with the pencil to delineate these arrangements; to record their observation in a way which appeals at once to the eye, without the intervention of words; and, in spite of the repeated assertion that they cannot draw, they are told to do the very thing which they cannot do until they have learned how to do it. They are asked to equip themselves with chemical and physical knowledge, in order that they may be able to study this machinery in action; and when they have attained a sufficient knowledge of other sciences, then, and then only, can they expect to unravel some of the mysteries of plant life, in many ways the least mysterious of organic things.

Now, what is the object and purpose of such training as this? First, it is to develop skill of eye, hand, and brain. It is to bring to them something of those qualities to which the essayist of the evening alluded. It is to enable them to see in the material things around them something more than bits of matter. It is to enable them to gain that breadth of comprehension and grasp of intellect which it is desirable that every educated man should attain. I hope, therefore, that the members of this society will use their utmost endeavor to have this sort of vital and vitalizing study commenced in the schools below the college and university; in what we may call the primary schools as contrasted with the secondary ones. Most of the high schools in the State to-day, I am sorry to say, are studying this subject in the same way in which it was studied twenty-five years ago, and they are doing this work partly because they have had no pull from higher schools to lift them to a higher level, and partly because they know no better way.

On its economic side this sort of training has its chief value, and it is that, I take it, in which the members of this society are mainly interested. Let me select a few topics from the very great number at my disposal in order to illustrate to you, if I can, just what the economic bearing of this

[1] An address delivered before the State Agricultural Society of Wisconsin, Feb. 1, 1892; stenographically reported and published by permission of the secretary in advance of the volume of Proceedings for the year.

science is; just what we may expect from it; just what we have a right to demand from it.

Take the single topic of the culture of plants. In how far has that been exhausted? How much do we really know about the reasonableness of our modes of cultivation? How much do we know about the effect of other modes of cultivation than those which have been in vogue for fifty, or one hundred, or hundreds of years? One suggestion in this direction may suffice as an illustration. If any man should sow Indian corn in the same way that he sows wheat, with the expectation of obtaining any crop of grain from it, we should almost consider him an idiot. And yet I wonder whether it is very much less idiotic to sow wheat in the way that we do, with the expectation of attaining the best results possible from this as a grain crop. I do not say that we do not get a crop, often a good crop. A magnificent one, as compared with what we have ever had, has been raised in the past year; but who knows whether the cultivation of wheat in something the same way in which Indian corn is cultivated, that is, by giving it a much greater range for obtaining its nourishment, and better advantages of light and air, would not increase the yield by a very large percentage? Indeed, there have been some experiments, on not a very small scale, which would seem to indicate that there are possibilities in this direction which we have not yet even attempted to ascertain.

You hear a great deal from our own university experiment station about the food of animals; and Professor Henry is constantly experimenting to ascertain just what are the best foods to produce a given result with a given animal. He has endeavored to ascertain something of the effect of different rations upon the bones, upon the muscles, upon the fat of various animals. Why should we not have some experiments carried on in regard to the food of plants? Does anybody know what the effect of a given ration of food for a plant will be? So far as I can recollect, experiments on what we may designate as feeding plants, have been carried on to a very limited extent. We have endeavored to ascertain particularly where plants obtain their nitrogen; and for the last twenty-five years, almost, this question has been one under experiment and under discussion. I suppose that many of you know something of the prolonged experiment which has been carried on at Rothamstead; and perhaps some of you know of the recent experiments of Hellriegel and Wilfarth, and Frank, men who are endeavoring to find out whether plants, when kept in very vigorous condition, can obtain nitrogen from the air, or whether it is absolutely necessary to get it from compounds in the soil. Here is a problem which has been attacked in the way these other questions ought to be attacked, and in the very way in which we may expect a solution of these thousands of other problems in regard to feeding plants. The most recent experiments in regard to this source of nitrogen for plants make it quite possible that when plants are in a very vigorous and thrifty condition they are then able to fix the free nitrogen of the air; and that when they are not at their highest notch of vigor, they are then able to get their supply of nitrogen only from nitrogenous compounds in the soil. On this very point we have some recent experiments that perhaps would interest you; and, bear in mind, I am only mentioning these as illustrative. I am trying to show the necessity for such a preparation in botanical study as will enable the men who are most deeply and profoundly interested in this very study to carry on some of those experiments that it seems so highly desirable to carry on.

Only a few months ago a paper was published by two of the men who have been experimenting longest on this matter of nitrogen assimilation; and they give some hints in regard to the harvesting of those plants which produce large quantities of nitrogenous material that may turn out to be of very great money value. It has been found that the contents of leaves of clover, so far as nitrogen was concerned, was very much greater at the close of the day, or near the close of the day, than it was in the morning or during the forenoon. That is, during the day, especially on bright and sunny days, the plants were able to manufacture large quantities of these materials. Now one of the main things for which our clover crop is grown is the large amount of nitrogenous materials which it contains as compared with other fodders. It is quite plain that if these results are correct, the harvesting of such a crop as this near the close of the day is going to give us a fodder whose money value is decidedly greater than that of one harvested early in the day, before the plant has been able to manufacture these substances; for in the course of the night the large majority of them are utilized for the plant's own growth, and are converted into other forms of material which are less valuable as animal food.

But I cannot dwell upon that topic. Let me give you a hint from another field. Perhaps if I should ask any of you what is the purpose of the shade-trees along the streets of our cities and villages the answer would be quite unanimous that these trees were for shade and beauty; and yet these trees are not used for that purpose. At least nobody, I think, would imagine that that was their use, if he passed along the streets of our own city. He would think that the main purpose of the best elms was to furnish adequate stays for some electric pole or to support the telephone wires which pass through them. He would suppose, if he saw the city force making a street, that the chief purpose of the roots of the trees was to be grubbed out of the way for the first curbstone or sidewalk that the city wished to put along that way. If one saw people trimming their shade-trees, he would think that the main advantage of these was to afford an object lesson as to how badly work could be done, and how much injury could be inflicted upon an unoffending plant, apparently with the intention of affording it early relief from its sufferings by death. Our treatment of shade-trees in the streets of cities and villages is one of the crying shames of this day. Watch the "trimming" of street trees. Ignorant laborers half chop and half break off the limb of a tree, and leave the rough end exposed to wind and weather instead of caring for the wound properly. We seem to think we have no more duties towards that particular tree except to ged rid of a branch that may be a little bit in our way. We do the very thing which will subject that tree to the greatest danger. We offer the very best chance for the attack of parasitic animals and plants on that tree; as though our main purpose was to destroy it, instead of our alleged intent, to trim it in order to maintain and augment its beauty.

This naturally suggests the management of forests. *Management* of forests? We hardly know of such a thing in this country. We do not manage our forests. We simply cut them down, and then are glad that the cutters can move on to some other acre and cut it down in the same way. We have made almost no provision in this country for maintaining our supply of timber. People may say what they please about the inexhaustibility of our forest resources. Those of you who have given the subject any attention know that it is utter folly to say that our forest resources are inexhaustible, or that they are not being exhausted at a most extrava-

gant rate. Now men trained in the knowledge of how plants live and grow and behave have some basis on which they can suggest ways of managing forests which will not only yield all the timber that is needed at the present time, but which will enable these forests to continue to yield such supplies for an indefinite period of years. Forest management is not unknown in other countries. We simply have trained no men in this country to have any idea what forest management means.

And then we have the immense subject of diseases of plants, and that is a study which seems to have attracted the greatest attention at the present day. The division of vegetable pathology at the Department of Agriculture at Washington is receiving a vast deal more attention than the division of forestry, and yet I doubt very much whether its money value to the people is any greater. The money value of the study of *both* these subjects to the American people, and *particularly to the farmers of the country*, is almost beyond calculation. We hardly realize what this money value is. We are so used to losing a certain percentage of our farm crops by diseases that we really pay no attention to it. If our animals, our flocks and herds, should be decimated as often as the crops are, we should hear such a hue and cry as would bring immediate attention on all hands to it. I suppose there is no one of you, who has given the subject a moment's thought, but will agree with me that the loss from rust on the wheat crop for the present year, stated in the very lowest possible terms, could not fall below one per cent. How much money does that mean on six hundred odd million bushels of wheat? It means several million more than has been laid out in the study of plants in all the centuries. It means a great many hundreds of thousands of dollars more than we shall lay out the next century for the study of plants; and yet we are learning and can learn how not only to check but how absolutely to prevent such diseases as this. I do not say that this particular one can be absolutely checked at the present time, but we know ways in which it can be reduced to a minimum, even at present. The same thing might be said in regard to such diseases as those of the smut in corn and oats. Very careful estimates of certain years have shown us that as much as ten per cent sometimes of an oat crop is damaged by that one disease alone. That might mean a good many millions of dollars on that one crop. So that a study of these plant diseases is by no means either fruitless or valueless.

But you say, "Why not let anybody who is concerned with these matters study them?" Chiefly because it is not possible for any man who does not know something of the life history of the parasite which causes a disease to go about checking or curing it. He may guess at some remedy, and he may, by a lucky guess, hit upon the right remedy. He may think of some process that possibly will turn out the right one, but he is not nearly so apt to think about the right process or to hit upon the right experiment as the man who has been properly trained for this kind of work. That sort of training means *time* to study, and *time* to work, and *money support* while the work is being carried on.

I might dwell at very much greater length on these various topics; but enough has been said, I hope, to give you some idea of what modern botany is and what the modern botanist is. It will at least give you a truer idea than you would have if you considered him *merely* as the man who goes out and gathers some plants, useful as this may be, or the man who tears apart some flowers to find out what the names of the flowers are. Rather, I would have you think of the botanists of the country as those men who are studying means of discovering, checking, and curing the plant diseases; men who are studying how plants grow, and how they may be helped in their growth and not harmed. They are men who are studying what is the rational basis for our modes of culture; and it is to these men the agriculturist must turn, with the hope that their experiments will lead him in the future, as they have in the past, to more rational modes of cultivation, and to better knowledge of the organisms, the very intricate organisms in spite of their simplicity, with which he has constantly to deal.

NOTES ON A DESTRUCTIVE FOREST TREE SCOLYTID.

BY ANDREW D. HOPKINS.

THE family of beetles known as Scolytidæ contains in this country, so far as known, something over 160 species. They are small, cylindrical, brown or black beetles. The largest one of the family, *Dendroctonus terebrans*, is thirty-two hundredths of an inch long, while the smallest, *Cripturgus atomus*, is but four hundredths of an inch long. With a few exceptions, beetles belonging to this family breed in the bark of wood of different forest and fruit trees. Each species usually has a preference for certain kinds of trees. Those feeding on the bark are called bark beetles, while those entering the wood are termed timber beetles. The bark beetles breed in and feed upon the inner bark of trees or logs, and when fully developed emerge through the bark, leaving it pierced with small round holes. The timber beetles enter directly through the bark, making their "pin-hole" tunnels in all directions through the wood; their eggs are deposited in these tunnels, and when the young are fully developed they emerge from the original entrance made by the parent beetle.

It has been claimed that Scolytids never attack healthy, living trees. We acknowledge that as a rule the different species of this family have a preference for unhealthy trees or those which have been broken by storm or felled by the axe, but in this *Dendroctonus frontalis* we certainly have an exception to the rule. From the abundant evidence I have obtained during extended and careful investigation, I am convinced that the death of large and small, vigorous trees of five species of pine and of the black spruce was caused primarily by the attack of this insect; in fact, this species seems to have a preference for the green bark on the living pine and spruce which they invade.

As Entomologist of this Station, I have conducted some investigations regarding the ravages of this beetle, and, since May 2 of this year, have travelled about 340 miles through some of the principal regions of the State, where the pine and spruce are most common. The species of pine observed were the White Pine (*Pinus alba*), the Yellow Pine (*P. echinata*), the Pitch Pine (*P. rigida*), the Table Mountain Pine (*P. pungens*), and the common Scrub Pine (*P. inops*). The Black Spruce (*Picea Mariana*) is also a common and valuable tree on some 500,000 acres of the higher mountains and table-lands of this State.

Trees varying from five inches in diameter to the largest, finest specimens of the five species of pine mentioned, and of the Black Spruce, were found dying in different sections from a cause which it was my duty to investigate. A large number of the dead, dying, and green trees were felled and examined. Every part of the trees from the roots near the surface to the terminal twigs and leaves was carefully

searched for possible causes of their unhealthy condition. The trees in the best condition to examine were those on which the leaves were yet green, but from their general appearance indicated that they had been attacked by the characteristic trouble which was shown in a few yellow leaves at the tops. The roots of such trees were found in a perfectly healthy condition for some distance beneath the surface; the bark on the trunks from a distance of from five to fifteen feet from the base was green, full of sap, and apparently healthy; the leaves were almost free from insect attack and disease, in no case was there sufficient attack of this nature to indicate even a slight injury; the bark, however, at a point about two-thirds up from the base of the tree, was found in every case to be infested by *Dendroctonus frontalis* in sufficient numbers to kill all the bark for some distance above that point, and in this bark fully-developed beetles and pupæ were found on May 5, thus indicating that the eggs must have been deposited in the bark the previous summer or fall. All of the characteristic dead and dying Pine and Spruce trees examined showed abundant evidence that they had been invaded while yet green by this bark beetle.

It would seem that the turpentine escaping into the burrows made by the beetles in the green bark would render the conditions unfavorable for the progress of their work. They have, however, the power of removing it from their burrows, and they manipulate the sticky resinous substance with seemingly as much ease and in a like manner as the crawfish does the clay it piles up around its burrow. Often a half teaspoonful of the turpentine will be found massed about the entrance to the burrows made by the beetle. They push the turpentine out through a hole kept open in the pitchy, adhesive mass. I have observed them backing out from the entrance, shoving behind them a quantity of the turpentine, and at the same time they would be completely enveloped in it.

Trees invaded by these beetles the previous fall may remain green until spring when they are usually attacked by the large *Dendroctonus terebrans*, *Hylurgops glabratus*, and *Tomicus calligraphus*, the two former at the base of the tree, the latter in the green bark above. They are in turn followed by numerous other species of bark and timber beetles until the invaded trees may be, as I have found, the hosts of at least twenty-five species of scolytids coming like reinforcements to the aid of *D. frontalis* to make doubly sure the death of the invaded trees. Later on, these scolytids are followed by insects belonging to other families until a dead or dying tree may be the host of hundreds of species and millions of examples, breeding in and feeding upon every part of the tree from the base to the terminal twigs, rendering it worthless for lumber within a year after it dies.

Thus it will be seen that *Dendroctonus frontalis* may be the primary cause of not only the death of the trees but of their rapid decay.

West Va. Agricultural Experiment Station, Morgantown, West Va., July 20.

LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

Auroral Display.

ON Saturday evening, July 16, there was visible, from this locality, in the northern heavens, the most brilliant auroral display which I have witnessed since the year 1859. Besides the usual exhibition of streamers of various hues, dancing along the northern arch like great hanging curtains, there was one most unique feature which I never saw or heard of before. A little after 10 o'clock, when the great brilliance of red and pink streams seemed to be dying out, and the northern heavens assuming a pale uniform hue, there appeared directly overhead a well-defined, nebulous arch, spanning the entire vault of heaven from east to west. At first a companion suggested that it was the Milky Way; but a few seconds' observation detected the Milky Way, running nearly at right angles with the arch — the two resembling each other somewhat in width and general appearance, except that the arch was more clearly defined and uniform in shape and outline than the other. In about fifteen minutes it began to fade away and disappear, the eastern portion disappearing first. In a short time there was only a bright strip near the western horizon, which much resembled the tail of a comet; but it, too, soon disappeared, and there were then no traces of the arch to be seen.

However, in a few minutes it began to reappear, and soon shone out bright and clear as before, — the arch being five to six degrees in width, — the eastern extremity at the horizon being a little south of east, and the other extremity being a little north of west, as if the whole had been drawn by a radius of a circle whose centre was a little east of the north pole. In ten or fifteen minutes this arch also disappeared as before.

Between the arch and the upper extremities of the gay streamers in the north there were several degrees of space lighted up by stars, and without any apparent connection between them. The band or arch seemed wider at the zenith than on either horizon — probably the effect of the greater distance of the horizon points from the position of the observer. The night air was quite cool, and I retired before midnight; and I have not learned whether or not the arch again reappeared. T. A. BEREMAN.

Mount Pleasant, Ia., July 20.

Magnetic Storm, Aurora, and Sun-Spots.

A MAGNETIC storm raged here from 10.30 A.M to 4.30 P.M., central time, on Saturday, July 16, 1892. An electro-magnetic wave reached the general telegraph office of the C. B. & Q. R. R. at 10.30 A.M., making it difficult to operate, especially with the quadruplex. The duration of the electric disturbance was six hours; but the impulses came with varying intensity. The energy always appeared as a wave, beat, or oscillation; and when fully developed in the wires, seemed to set up a counter electro-motive force in opposition to the batteries. The fact that electro-magnetic energy traverses space in the form of waves, coincides with the now classical experiments of Hertz, who projected these waves not only through space, but brick walls. Perhaps a law like this will be discovered — *All modes of energy alternate.*

It is doubtful if a constant pressure exists in nature. In some instances, telegrams have been sent by means of nature's electricity — without batteries. This is merely a prophecy of that time coming when men will appropriate electricity when they want it, as they do light and heat.

An aurora appeared at 9.40 P.M., and consisted of many pearl-colored columns, at times tinged with red, occupying more than 100° in azimuth, and all converging near Polaris.

At 9.45 an apparition unusual in auroral displays was seen. This was a streamer of nearly white light, that, starting in a sharp point almost on the horizon, in the north-west, shot with great velocity north of Arcturus, passed over Corona Borealis, which constellation it equalled in diameter, crossed Hercules and Cerberus, and, passing over Altair, descended almost to Mars in the south-east, terminating also in a fine point.

This majestic sword moved bodily 10° to the south, and, after shivering and pulsating throughout its length three times, vanished, after existing fourteen minutes. The whole aurora lasted forty minutes. On July 9, a large cluster of spots, with two smaller groups and one larger isolated spot, were seen on the sun. All the larger spots had bridges, and on the 12th and 13th the tongues across the large one began to curve, which curvature rapidly increased on the 14th and 15th. On the 16th, these jets were arranged nearly in a circle, or had assumed

the twisting, rotary, or cyclonic form. One of the tongues was brighter than the solar surface, and seemed to be the most brilliant at from 9.30 to 10.30 A.M., at which time the electric wave disturbed the telegraphs. Whether the solar turbulence causes terrestrial magnetic upheavals is a question that future physicists must decide.

A sun-spot maximum is drawing near, and already there are lively electro-magnetic times. EDGAR L. LARKIN.

Knox College Observatory, July 19.

The Crinoid Heterocrinus Subcrassus.

TWO or three years since, I concluded to find out, if I could, the character of the termination of the column of the crinoid Heterocrinus subcrassus. Having a lower silurian slab with about one hundred specimens of the calyx, with a great profusion of the columns diverging in every direction, I selected a column attached to its calyx, and followed it by uncovering, until I was rewarded by discovering the column diverging into well-defined roots; length of column from calyx 12½ inches, about 1¼ inches under the surface.

At that time I believed that the genus Glyptocrinus were floaters, and devoid of bases, or roots.

About eighteen months ago something caused me to doubt that idea, and I commenced the investigation of the terminations of their columns, and now, after a great deal of work, and after many discouragements, I have been able to so far develop roots on the terminations of the columns of Glyptocrinus neali, Glypt. dyeri, and Glypt. baeri, that I have a specimen of each species, showing the calyx, column, and roots intact, on the slab, one slab of Glypt. baeri having on its surface several specimens of that character.

One character of the specimens surprised me,—the diversity of the length of the columns between calyx and roots in the specimens just mentioned, the column of Glypt. neali, from two to four or five inches; Glypt baeri, from one-half an inch to six or eight; Glypt dyeri, from one to four or five inches between calyx and roots.

I have also found a specimen of Heterocrinus simplex, showing calyx, column, and inverted saucer-like base, attached to another column. DR. D. T. D. DYCHE.

Lebanon, O.

Professor Parker's Further Studies on the Apteryx

IN No. 435 of *Science* the writer invited attention to the very valuable contributions to our knowledge of the morphology of Apteryx that had been made by Professor T. J. Parker, F.R.S., of the Otago Museum (New Zealand). Those investigations have been continued on more extensive material, and the London Royal Society have just published in their Transactions (1892) the results, in a paper entitled "Additional Observation on the Development of Apteryx" (11 pages; two col. lith. plates, of 19 figs.). Professor Parker has kindly sent me a copy of this work, and I desire to say, in the present connection, in continuation of what already has been noted by me in my former review, that more advanced embryos of the bird under investigation (stage F[1]) show "the pollex is unusually large, and the fore-limb has the characters of the wing of a typical bird." Better figures are given than in the first paper, showing structures of the brain and skull, and also that one "specimen exhibits an unusual mode of termination of the notochord." In other figures (stage G') the final form of the chondrocranium, before the appearance of cartilage bones, is shown, and, what is a very interesting fact, "that in *A. oweni* there is always a solid coracoid region to the shoulder-girdle, while in *A. australis*, as far back as stage F', there is a coracoid fenestra and a ligamentous procoracoid." Finally, it is worthy of note that "in addition to the elements described in the corpus an intermedium may be present" As I have already said, the working out of these anatomical characters, in such an important form as Apteryx, will most certainly prove to be of the highest importance and use to the general comparative anatomist the world over. There could be no safer hand to accomplish it for us than that of the distinguished biologist of the Otago Museum. R. W. SHUFELDT.

Takoma, D.C., July 24.

A Satellite of the Moon

I HAVE seen accounts of an attempt to discover whether the moon has a satellite, and the accounts that have reached me seem to show one serious fault in the procedure. While I am not thoroughly conversant with all the points involved, it does seem to me, that, in taking a photograph of the region in which such a satellite would be found if it exists, the apparatus should be arranged with reference to stellar motion, and leave the moon out of question. Of course, the moon would be blurred, but we are not concerned about that. The fixed stars would appear plainly on the plate, while any one that had a motion different from theirs, especially a rapid motion such as a satellite of the moon must have, would appear blurred on the plate; in which case only the blurred stars, if such occurred, need be examined with any hope of finding a satellite of the moon. C. P. MAXWELL.

Dublin, Tex., July 20.

Auroral Display.

ON Saturday night, July 16, 1892, I was returning to my home in Rockville, Indiana, from Clinton, Indiana, sixteen miles south-west. Mr. Harry McIntosh, a young man of this place who had been helping me make a survey near Clinton, was riding with me in my buggy. We amused ourselves looking at a most beautiful sunset as we rode over the Lafayette and Terre Haute road, along the foot of the high hills east of the Wabash River.

When we turned eastward, over the hills toward Rockville, it began to grow dark, and most of the clouds that showed up so beautiful at sunset began to vanish, till only a few streaks of stratus clouds remained. As we were descending the west hill at Iron Creek, five miles south-west of Rockville, we saw in front of us what we supposed was the new electric light at Rockville, thrown upward and reflected from a cloud or mist. As we were ascending the hill on the east side of the creek and near its summit, we saw in our front the reflection of a great light from behind us. It was so noticeable as to cause us both to turn about on our buggy seat and look backward. There, at a bearing S. 60° W. (that is the bearing of the road, with which the light was in alinement), we saw a great white light radiating from a point at the horizon where it was brightest, right, left, and upward to a height of 10° to 15°, weakening in brilliancy as it radiated and terminated in a dark band or segment of rainbow shape, some 10° wide. The light seemed to radiate from a point a half-radius above the centre of the circle which the black segment would indicate. Above the dark segment another segment or band of light, not so bright as the one at the horizon, formed a rainbow, or arch, some 10° to 15° wide. Above that second band of light was a light haze, or mist, through which the stars could be easily distinguished. Some 10° up in that mist, and directly over the centre of the light at the horizon, was a light about as large as a man would appear to be if suspended from a balloon a thousand feet distant. It was about four times as long vertically as wide horizontally. Young McIntosh saw it first and called my attention to it, as I was watching the bright light at the horizon. When I first caught sight of it, it had the appearance of the head of a comet, only it was long vertically. When young McIntosh first saw it, it seemed to be a blaze such as a large meteor appears to carry at its front. We halted and watched it about ten minutes, during which time it (the small light) slowly faded till only its locality could barely be noticed, then suddenly loomed bright almost to a white blaze, then slowly faded as before. It would loom up in five seconds, and consume five minutes in fading away. It kept the same position all the time, for we watched its position with relation to the stars to see if it moved. At this second appearance I decided to commit the general appearance to memory so I could sketch it afterward This little light loomed up and faded four times when the big light under it faded also and made it dark there.

I am not sure we saw this light the first time it appeared, but think we did. The small light above looked as the moon does when shining through a thin cloud, except as to the oblong shape vertically.

When the first or south-western light faded nearly out, a light

at the horizon in the south loomed up, but not so bright as the first, nor had it any of the upper characteristics of the first, nor did it last over five minutes. When this second light faded a third loomed up in the north, quite as bright at the horizon as the first, but it was obscured or cut off from our view by a stratus cloud. This cloud was about 10° above the horizon, at its under side (which, by the way, was its most northern limit). This limit, I judge from my frequent observation of clouds, was fully twenty-five miles north of us. We could see the light through one hole in the cloud near its bottom (or distant) side, and also through several thin places, but could not determine its upper shape. This third light (counting the southwestern light as the first) lasted about five minutes, when a fourth light loomed up in the north-west, and, very bright at the horizon, reached upward about 15°, lasted a few minutes, and faded out as did the others. Then one appeared in the north-east, in the direction of Rockville; but we were so near the town we were sure it was the new electric light (we had been gone a week), but on entering the town found the old gasoline lamps still doing service.

On the first appearance of these lights at the horizon, I thought I saw a flash of light, not as a blaze, but as if a mirror had been turned so as to flash the light into my face, then away so quick I could not be certain what I saw. Young McIntosh thought he saw the same flashes of light when the great lights first made their appearance.

I saw this same electrical storm (if that is what it is) in the summer of 1884, from the town of Clinton, Indiana, and in July, I think. It had all the features I have given of this, except the one in the south-west with its three lights and dark segment, herein described. The Clinton display was watched by apparently the whole population of the place, and was described by the Clinton *Argus* at the time. I reported it to the U. S. Signal Office at the time, as I was then making voluntary observations for that office.

The small light I have described as seen in the south-west, in the first light last Saturday night, is a new feature, so far as I know or can learn from my authorities. These lights occurred from about half past nine to half past ten o'clock at night.

I wish to hear from others who may have seen these lights, by letter or paper containing published account of them.

Rockville, Ind., July 17. JOHN T. CAMPBELL.

BOOK-REVIEWS.

Geological Survey of New Jersey. Annual Report of the State Geologist for the year 1891. Trenton, 1892. Maps and plates.

To this report Professor R. D. Salisbury contributes a paper called "A preliminary paper on drift or Pleistocene formations of New Jersey." The title is somewhat misleading, inasmuch as there are few statements in it concerning the New Jersey formations. It embraces mainly an account of the nature of the drift, the formation and movements of glacial ice, the work effected by ice, and a summary of the development, movements, and work accomplished by the ice-sheet of North America. New Jersey is incidentally mentioned, and the only new contribution made is the statement concerning the discovery of the remains of a once extensive drift-deposit south of the terminal moraine. It is concluded that this was deposited by an ice-sheet previous to the formation of the great moraine; and that "the interval which elapsed between the first and the last glacial formations of New Jersey was several times as long as that which has elapsed since the last." Assistant Geologist C. W. Coman contributes an interesting paper on the oak and pine lands of southern New Jersey. The topographical survey showed that in 1888 there were only 430,730 acres of cleared land in the southern counties, against 1,326,000 acres of forest. The proportion has not been greatly altered since. Both uplands and swamps are heavily covered with timber, much of which is valuable for various purposes. "From a little distance a cedar swamp presents the appearance of a solid mass of dark green, while even when in the midst of it the eye can penetrate but a few yards among the thickly clustering, smooth, gray trunks. The gum and maple swamps are scarcely less dense, and are even more difficult to penetrate, because of the abundance of underbrush, amid which the poison sumac, *Rhus venenata*, is sure to be encountered by the unwary. The trees are often very large, exceeding 100 feet in height. The demand for white cedar for shingles, siding, planking for boats, and such other purposes as require great durability under exposure to the weather, far exceeds the supply." Much of the uncleared land is well adapted for fruit raising and "truck" gardening, and there is still room for a large addition to the permanent population of the State.

Mr. C. C. Vermeule, the consulting engineer and topographer of the survey, gives a comprehensive review of the water supply and water power of the State, with tables of rain-fall and evaporation, and accounts of the guaging of numerous rivers. A table is also given of all the water powers, with mention of the owner, kind of mill, fall, and horse-power. It is the intention to publish the full report on water power in the State as Volume III. of the final report some time during the present year. Finally, notes are given by other hands on artesian wells, on the Passaic River drainage and the active iron mines in the State. The information given cannot fail to be of value to the inhabitants of the commonwealth. JOSEPH F. JAMES.

Nature Readers — Seaside and Wayside, No. 4. By JULIA MCNAIR WRIGHT. Boston, D. C. Heath & Co. 1892. 8°. 361 p. 70 cents.

This volume is one of a series of reading-books written, the author tells us, "to direct the minds of our youth in their first studies to the pleasant ways of Natural Science." The earlier numbers of the series were devoted to lessons on the habits of animals and plants, but the present volume deals with a much wider range of subjects. The book begins with a lesson on the origin and structure of the globe and passes on to the consideration of the geological epochs and of the animals and plants that characterize them. It is, in fact, a collection of brief essays on important topics in astronomy, geology, palæontology, and zoology. The diversity of topics would seem calculated to cause confusion in the mind of a child; but this is, perhaps, an evil inseparable from the modern system of education.

Though the facts are presented in a somewhat too fanciful dress, the information is for the most part accurate, and the author has taken great pains to point out that there are exceptions to many of the general statements. She has included, so far as possible, the results of the latest investigations.

A few noticeable errors should be corrected. For example, the pig is made to figure as a typical odd-toed ungulate (p. 349). On page 300 the sperm whale is mentioned as the "Greenland sperm whale," which is, of course, misleading, as this animal is only very rarely found in Arctic waters. In another place (p. 148) the author refers to the squirrels and rats as being the first mammals to appear on the globe, a statement which no palæontologist would accept. We notice again (p. 320) that the vampire bats are described as "very large bats given to blood-sucking." This is quite erroneous, as the true vampires, *Desmodus* and *Diphylla*, are small bats, remarkable chiefly in the modification of their teeth and digestive organs.

The influence of English text-books is apparent in different parts of the volume. The common mole, for example, is described under the name of the European genus *Talpa;* although as the book is presumably intended for American children, it would have been better to mention *Scalops* or *Scapanus*, to which genera the commonest American moles belong. We can hardly find fault with our author in this instance, however, seeing that no general treatise on American mammals has been published for nearly half a century.

In the illustrations, with which the book is well supplied, artistic effect has been aimed at rather than strict accuracy; a number of them are entirely fanciful and represent only creatures of the imagination. They could be replaced to advantage, in our opinion, by figures of some of the real wonders of animate nature.

In spite of these defects the book is a good representative of its class, and the lessons will doubtless be read by children with interest and profit. F. W. T.

A Text-Book of Physiology. By M. FOSTER, M.D. Sixth Edition, Revised. Part IV. (comprising the remainder of Book III., The Senses and Some Special Muscular Mechanisms, and Book IV., The Tissues and Mechanisms of Reproduction). New York, Macmillan & Co. 1891.

WITHOUT doubt Foster's "Text-Book of Physiology" must be accorded the foremost place among the works upon this subject, which have been published in the English language. It embodies the results of the most recent researches in this department of biological science, and is not only comprehensive, up to date, and accurate, but is admirably arranged and most convenient as an encyclopædic work of reference upon all that relates to the subject.

A large portion of the present volume is devoted to the senses, including sight, auditory sensations, olfactory sensations, gustatory sensations, cutaneous sensations, the muscular sense, and tactile perceptions and judgments. Each of these subjects is treated in a masterly manner, the anatomical elements concerned in each special sense being minutely described, and the facts and theories relating to the perception of various sensations being fully detailed.

Chapter VII., "On Some Special Muscular Mechanisms," contains three sections: one devoted to the voice, one to speech, and one to walking.

Book IV., which concludes the volume and the work, gives a very satisfactory account of "the tissues and mechanisms of reproduction."

Diphtheria, Its Natural History and Prevention. By R. THORNE THORNE, Assistant Medical Officer to Her Majesty's Local Government Board. London and New York, Macmillan & Co. 1891.

THIS is a valuable résumé of what is known at the present day with reference to the etiology and prevention of diphtheria. The volume abounds in interesting details relating to the prevalence of the disease in England and Wales, and gives numerous facts showing the not infrequent transmission of the disease by contaminated milk and its probable transmission by cats, which have been proved to be subject to the disease as a result of experimental inoculations in the trachea with bits of diphtheritic membrane, or cultures of the Klebs-Löffler diphtheria bacillus.

According to Thorne Thorne there has been a progressive increase in the mortality from diphtheria in England and Wales during the past twenty years, and this progressive increase has coincided in time with steady improvement in regard to such sanitary circumstances as water-supply, sewerage, and drainage; and also with a continuous diminution in the death-rate from the group of zymotic diseases and from typhoid fever.

The diphtheria mortality remains, as heretofore, greater in the sparsely-peopled districts, but there is a marked increase in its prevalence in large towns and cities.

Publications Received at Editor's Office.

BENOTIRE, CAPT, CHARLES. Life Histories of American Birds. Washington, Government. 4°. Paper. 413 p. Ill.

CHADWICK, FRENCH E. Temperament, Disease and Health. New York, G. P. Putnam's Sons. 8°. 85 p. 75 cts.

DALL, WILLIAM H. Instructions for Collecting Mollusks. Washington, Government. 8°. Paper. 56 p.

MOOREHEAD, WARREN K. Primitive Man in Ohio. New York, G. P. Putnam's Sons. 8°. 262 p. $3.

PHILOSOPHICAL SOCIETY OF WASHINGTON. Bulletin 1888-91. Washington, The Society. 8°. 652 p.

RIDGWAY, ROBERT. The Humming Birds. Washington, Government 8°. Paper. 381 p.

RILEY, C. F. Directions for Collecting and Preserving Insects. Washington, Government. 8°. paper. 147 p.

UNIVERSITY OF MINNESOTA. Quarterly Bulletin. Vol. I., No. 1. 4°. Paper. 32 p.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

Taxidermist going out of business has quantity of finely-mounted specimens of North American birds, mammals and reptiles and skins of birds for sale, including a full local collection of bird skins, showing some great variations of species; also quantity of skulls with horns of deer and mountain sheep, and mounted heads of same. Will give good exchange for Hawk Eye camera with outfit. Apply quickly to J. R. Thurston, 265 Yonge St., Toronto, Canada.

For exchange.—A fine thirteen-keyed flute in leather covered case, for a photograph camera suitable for making lantern slides. Flute cost $27, and is nearly new. U. O. COX, Mankato, Minn.

To exchange; Experiment Station bulletins and reports for bulletins and reports not in my file. I will send list of what I have for exchange. P. H. ROLFS, Lake City, Florida.

Finished specimens of all colors of Vermont marble for fine fossils or crystals. Will be given only for valuable specimens because of the cost of polishing. GEO. W. PERRY, State Geologist, Rutland, Vt.

For exchange.—Three copies of "American State Papers Bearing on Sunday Legislation," 1891, $2.50, new and unused, for "The Sabbath," by Harmon Kingsbury, 1840; "The Sabbath," by A. A. Phelps, 1842; "History of the Institution of the Sabbath Day, Its Uses and Abuses," by W. L. Fisher, 1859; "Humorous Phases of the Law," by Irving Browne; or other works amounting to value of books exchanged, on the question of governmental legislation in reference to religion, personal liberty, etc. I particularly want "American State Papers," and buy other books on the subject. WILLIAM ADDISON BLAKELY, Chicago, Ill.

For Sale or Exchange for books a complete private chemical laboratory outfit. Includes large Becker balance (200g. to 1-10mg.), platinum dishes and crucibles, agate motors, glass-blowing apparatus, etc. For sale in part or whole. Also complete file of *Silliman's Journal*, 1862-1885 (62-71 bound); Smithsonian Reports, 1854-1883; U. S. Coast Survey, 1854-1869. Full particulars to enquirers. F. GARDINER, JR., Pomfret, Conn.

Wanted, in exchange for the following works, any standard works on Surgery and on Diseases of Children: Wilson's "American Ornithology," 3 vols.; Coues' "Birds of the Northwest" and "Birds of the Colorado Valley," 2 vols.; Minot's "Land and Game Birds of New England;" Samuels' "Our Northern and Eastern Birds;" all the Reports on the Birds of the Pacific R. R. Survey, bound in 2 vols., morocco; and a complete set of the Reports of the Arkansas Geological Survey. Please give editions and dates in corresponding. R. ELLSWORTH CALL, High School, Des Moines, Iowa.

To exchange Wright's "Ice Age in North America" and [illegible], "Elements of Geology" (Copyright 1882) for "Darwinism," by A. R. Wallace, "Origin of Species," by Darwin, "Descent of Man," by Darwin, "Man's Place in Nature," Huxley, "Mental Evolution in Animals," by Romanes, "Pre-Adamites," by Winchell. No books wanted except latest editions, and books in good condition. C. S. Brown, Jr., Vanderbilt University, Nashville, Tenn.

Wants.

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

A JOHNS HOPKINS graduate (1892) desires a position as instructor in mathematics and physics. Address A. B. TURNER, Johns Hopkins University, Baltimore, Md.

WANTED.—A collection of postage stamps; one made previous to 1870 preferred. Also old and curious stamps on original letters, and old entire U. S. stamped envelopes. Will pay cash or give in exchange first-class fossils, including fine crinoids. WM. F. E. GURLEY, Danville, Ill.

WANTED.—To purchase laboratory outfit; balances, evaporating dishes, burettes, etc., wanted immediately for cash. C. E. SPEIRS, 23 Murray street, New York. P. O. Box 1741.

WANTED.—The services of a wide-awake young man, as correspondent, in a large manufacturing optical business; one preferred who has a thorough knowledge of microscopy and some knowledge of photography. Address by letter, stating age and references. Optical, care of Science, 874 Broadway, New York.

WANTED.—We want any and all of the following, providing we can trade other books and magazines or buy them cheap for cash: Academy, London, vol. 1 to 28, 35, Jan. and Feb., '89; Age of Steel, vol. 1 to 66; American Antiquarian, vol. 1, 2; American Architect, vol. 1 to 6, 9; American Art Review, vol. 3; American Field, vol. 1 to 21; American Geologist, vol. 1 to 6; American Machinist, vol. 1 to 4; Art Amateur, vol. 1 to 7, Oct., '4; Art Interchange, vol. 1 to 9; Art Union, vol. 1 to 4, Jan., '44, July, '45; Bibliotheca Sacra, vol. 1 to 46; Godey's Lady's Book, vol. 1 to 20; New Englander, vol. 11; Zoologist, Series 1 and 1, Series 3 vol. 1 to 14; Allen Armendale (a novel). Raymer's "Old Book" Store, 243 4th Ave. S., Minneapolis, Minn.

WANTED.—By a young man, a Swarthmore College junior, a position as principal of a public high school in one of the Gulf States, or as instructor in botany, physiology, and geology in an academy or normal school. Address B., care of Librarian, Swarthmore College, Penn.

WANTED.—To act as correspondent for one or two daily or weekly papers. Have worked on paper for about two years. Would like a position on editorial staff of humorous paper. Address GEO. C. MASON, 14 Elm St., Hartford, Conn.

TRANSLATOR wanted to read German architectural works at sight (no writing). One familiar with technical terms desired. Address "A.," Box 149, New York Post Office.

Spraying Crops; Why, When, and How. By CLARENCE M. WEED. Illustrated. New York, Rural Publishing Company. 110p.

The author of this little book, formerly connected with the Ohio Agricultural Experiment Station, is now at the New Hampshire Station in the capacity of Entomologist. He has given in a condensed form an account of many insect and fungous foes of various fruits, trees, and vegetables. The information in regard to the former is much fuller than in regard to the latter, which is naturally to be expected from an entomologist. Quite full histories are given of the codling moth, the curculio, the canker worm, and the tent catterpillar. The only fungous disease treated with any degree of fulness is downy mildew or brown rot of grapes. The formulæ for the principal fungicides and insecticides are given, together with instructions how to combine the two. The few pages devoted to spraying are scarcely adequate to give a beginner an idea of what to do or how to go to work to do it; and in this respect the book is incomplete. Among the plants whose insect and fungous enemies are discussed we find the apple, peach, pear, plum, cherry, strawberry, currant, gooseberry, grape, raspberry, rose, potato, cabbage, and others. Some of the worst fungous diseases are not mentioned, such as oat and wheat smut, apple rust, peach yellows, pear and apple blight, etc. It cannot, however, be expected that in so small a book everything could be mentioned and described. It is, too, not improbable, that as these diseases cannot be prevented by spraying, that they are omitted intentionally. On the whole the book is one which will prove useful to the general fruit grower. JOSEPH F. JAMES.

D. C. HEATH & Co. have in press, and will soon issue "Elements of Plane and Spherical Trigonometry" and "A Treatise on Plane and Spherical Trigonometry," by Edward A. Bowser, Professor of Mathematics and Engineering in Rutgers College. The former is a brief course in the elements of trigonometry, particular attention being given to the numerical solution of plane and spherical triangles. It is prepared especially for high schools and academies. The latter is for more advanced work and covers the entire course in higher institutions. The books abound in numerous and practical examples, the aim being to make the subject as interesting and attractive as possible to the student.

QUERY.

Can any reader of *Science* cite a case of lightning stroke in which the dissipation of a small conductor (one-sixteenth of an inch in diameter, say,) has failed to protect between two horizontal planes passing through its upper and lower ends respectively? Plenty of cases have been found which show that when the conductor is dissipated the building is not injured to the extent explained (for many of these see volumes of Philosophical Transactions at the time when lightning was attracting the attention of the Royal Society), but not an exception is yet known, although this query has been published far and wide among electricians.

First inserted June 19. No response to date.

TO THE READERS OF SCIENCE.

PUBLISHER'S ANNOUNCEMENT.

Titles of Some Articles Published in *Science* since Jan. 1, 1892.

Aboriginal North American Tea.
Actinism.
Agriculture, Experimental, Status of.
Amenhotep, King, the tomb of.
Anatomy, The Teaching of, to Advanced Medical Students.
Anthropology, Current Notes on.
Architectural Exhibition in Brooklyn.
Arsenical Poisoning from Domestic Fabrics.
Artesian Wells in Iowa.
Astronomical Notes.
Bacteria, Some Uses of.
Botanical Laboratory, A.
Brain, A Few Characteristics of the Avian.
Bythoscopidæ and Cereopidæ.
Canada, Royal Society of.
Celts, The Question of the.
Chalicotherium, The Ancestry of.
Chemical Laboratory of the Case School of Applied Science.
Children, Growth of.
Collection of Objects Used in Worship.
Cornell, The Change at.
Deaf, Higher Education of the.
Diphtheria, Tox-Albumin.
Electrical Engineer, The Technical Education of.
Eskimo Throwing Sticks.
Etymology of two Iroquoian Compound Stems.
Eye-Habits.
Eyes, Relations of the Motor Muscles of, to Certain Facial Expressions.
Family Traits, Persistency of.
Fishes, The Distribution of.
Fossils, Notice of New Gigantic.
Four-fold Space, Possibility of a Realization of.
Gems, Artificial, Detection of.
Glacial Phenomena in Northeastern New York.
Grasses, Homoptera Injurious to.
Great Lakes, Origin of the Basins of.
"Healing, Divine."
Hemipterous Mouth, Structure of the.
Hofmann, August Wilhelm von.
Hypnotism among the Lower Animals.
Hypnotism, Traumatic.
Indian occupation of New York.
Infant's Movements.
Influenza, Latest Details Concerning the Germs of.
Insects in Popular Dread in New Mexico.
Inventions in Foreign Countries, How to Protect.
Inventors and Manufacturers, the American Association of.
Iowa Academy of Sciences.
Jargon, The Chinook.
Jassidæ; Notes on Local.
Keller, Helen.
Klamath Nation, Linguistics.
Laboratory Training, Aims of.
Lewis H. Carvill, Work on the Glacial Phenomena.
Lightning, The New Method of Protecting Buildings from.
Lissajou's Curves, Simple Apparatus for the Production of.
Maize Plant, Observations on the Growth and Chemical Composition of.
Maya Codices, a Key to the Mystery of.
Medicine, Preparation for the Study of.
Mineral Discoveries, Some Recent, in the State of Washington.
Museums, The Support of.
Palenque Tablet, a Brief Study of.
Patent Office Building, The.
Physa Heterostropha Lay, Notes on the Fertility of.
Pocket Gopher, Attempted Extermination of.
Polariscopes, Direct Reflecting.
Psychological Laboratory in the University of Toronto.
Psychological Training, The Need of.
Psylla, the Pear-Tree.
Rain-Making.
Rivers, Evolution of the Loup, in Nebraska.
Scientific Alliance, The.
Sistrurus and Crotalophorus.
Star Photography, Notes on.
Star, The New, in Auriga.
Storage of Storm-Waters on the Great Plains.
Teaching of Science.
Tiger, A New Sabre-Toothed, from Kansas.
Timber Trees of West Virginia.
Tracheæ of Insects, Structure of.
Vein-Formation, Valuable Experiments in.
Weeds as Fertilizing Material.
Will, a Recent Analysis of.
Wind-Storms and Trees.
Wines, The Sophisticated French.
Zoology in the Public Schools of Washington, D. C.

Some of the Contributors to *Science* Since Jan. 1, 1892.

Aaron, Eugene M., Philadelphia, Pa.
Allen, Harrison, Philadelphia, Pa.
Baldwin, J. Mark, University of Toronto, Canada.
Barnes, Charles Reid, Madison, Wis.
Baur, G., Clark University, Worcester, Mass.
Beal, W. J., Agricultural College, Mich.
Beals, A. H., Milledgeville, Ga.
Beauchamp, W. M., Baldwinsville, N.Y.
Boas, Franz, Clark University, Worcester, Mass.
Bolley, H. L., Fargo, No. Dak.
Bostwich, Arthur E., Montclair, N.J.
Bradley, Milton, Springfield, Mass.
Brinton, D. G., Philadelphia, Pa.
Call, E. Ellsworth, Des Moines, Ia.
Chandler, H., Buffalo, N.Y.
Comstock, Theo. B., Tucson, Arizona.
Conn, H. W., Middletown, Conn.
Cragin, F. W., Colorado Springs, Col.
Davis, W. M., Harvard College, Cambridge, Mass.
Dimmock, George, Canobie Lake, N.H.
Farrington, E. H., Agricultural Station, Champaign, Ill.
Ferree, Barr, New York City.
Flexner, Simon, Johns Hopkins University, Baltimore, Md.
Foshay, P. Max, Rochester, N.Y.
Gallaudet, E. M., Kendall Green, Washington, D.C.
Garman, S., Museum of Comp. Zool., Cambridge, Mass.
Golden, Katherine E., Agricultural College, Lafayette, Ind.
Hale, Edwin M., Chicago, Ill.
Hale, George S., Boston, Mass.
Hale, Horatio, Clinton, Ontario, Canada.
Hall, T. Proctor, Clark University, Worcester, Mass.
Halsted, Byron D., Rutgers College, New Brunswick, N.J.
Haworth, Erasmus, Oskaloosa, Iowa.
Hay, O. P., Irvington, Ind.
Haynes, Henry W., Boston Mass.
Hazen, H. A., Weather Bureau, Washington, D.C.
Hewitt, J. N. B., Bureau of Ethnology, Washington, D.C.
Hicks, L. E., Lincoln, Neb.
Hill, E. J., Chicago, Ill.
Hill, Geo. A., Naval Observatory, Washington, D.C.
Hitchcock, Romyn, Washington, D.C.
Holmes, E. L. Chicago, Ill.
Hotchkiss, Jed., Staunton, Va.
Howe, Jas. Lewis, Louisville, Ky.
Hubbard, Gardiner G., Washington, D.C.
Jackson, Dugald C., Madison, Wisconsin
James, Joseph F., Agricultural Dept., Washington, D.C.
Johnson, Roger B., Miami University, Oxford, O.
Kellerman, Mrs. W. A., Columbus, O.
Kellicott, D. S., State University, Columbus, O.
Kellogg, D. S., Plattsburgh, N. Y.
Lintner, J. A., Albany, N. Y.
Loeb, Morris, New York City.
Mabery, Charles F., Cleveland, Ohio.
Macloskie, G., Princeton, N.J.
McCarthy, Gerald, Agricultural Station, Raleigh, N.C.
MacDonald, Arthur, Washington, D.C.
Marshall, D. T., Metuchen, N.J.
Mason, O. T., Smithsonian Institution, Washington, D.C.
Millspaugh, Charles F., Morgantown, W. Va.
Nichols, C. F., Boston, Mass.
Nuttall, George H. F., Johns Hopkins University, Baltimore, Md.
Oliver, J. E., Cornell University, Ithaca, N.Y.
Osborn, Henry F., Columbia College, New York City.
Osborn, Herbert, Agricultural College, Ames, Iowa.
Pammel, L. H., Agricultural Station, Ames, Iowa.
Pillsbury, J. H., Smith College, Northampton, Mass.
Poteat, W. L., Wake Forest, N. C.
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