his captors feasted in truly Indian style. But a few hundred miles away the Indians of San Francisco Bay rode on a raft or bundle of reeds! The conclusion follows irresistibly that a different aboriginal civilization existed from the Columbia River northward to Alaska than that on San Francisco Bay. From a careful examination of the archæological remains it seems quite certain that the lines connecting the middle type of civilization of the Puget Sound region with other American civilizations lay—one up the Columbia and across to the Ohio region, and the other by way of the Snake River, Great Salt Lake and the Pueblo region, and connecting with the Mexican country. But in each of these regions —in Ohio and Mexico—we find pottery in abundance, but none in the Puget Sound basin. This cannot be on account of lack of material, for the finest potters' clay exists in great beds throughout this region on the surface, and many potteries now work it. What is the conclusion, then? It is that the high civilization of the Northwest coast did not come either from the east or south!

This middle type of civilization on Puget Sound made splendidly carved war canoes; the finest basket work in America; featherwork like the Aztecs; metalics like those of Moqui; wove blankets equal to the Navajo; worshipped the sun like the Mexican, and made stone gods equal in carving to those of Central America; as carvers of wood they have no equals in America; they were artisans skilled in carving, weaving and painting; they built permanent homes of great posts and cedar boards, exactly like the Mongolian tribes of Asia—exactly like the Japanese; their beds were arranged on each side of the houses on platforms in the true Mongolian style; their language yet preserves the identical tongue spoken by the Apache and other southern Athapascan; many pure Aztec words linger north of Puget Sound—and yet they made no pottery!

No nation ever lost the art of pottery-making. The art never was known to the people of this northwest country; though they are cousins to the Algonquins and Aztecs and brothers to the Apaches, yet they had not the art possessed by these people of making vessels from clay. Not a trace of the potter's work can be found in the Columbia River or Puget Sound regions. Although these people are of kin, yet in this particular they are as distant as the poles. It follows that the Athapascans of Mexico learned the potter's trade after they left the early home of their kinsmen on Puget Sound; it also follows that the Apache and kindred tribes were migrants from the north, and it is true that the Algonquin was not a potter until after he reached the Mississippi valley.

It seems to me that one certain result follows from the known facts, viz.: That the Athapascan tribes of Mexico, and possibly the Aztecs, migrated to Mexico from the Puget Sound region—for if our Athapascans came to the north from Mexico and settled in the Puget Sound basin, why did they not bring that most characteristic manufacture, pottery, with them? I take it that the conclusion must be conceded that the migration was southward, and not by San Francisco Bay, either, but via Great Salt Lake to Mexico.

Humboldt, Prescott and other eminent authorities place Aztlan, the ancient Aztec hiving place, in the Puget Sound region, and certainly the absence of pottery here is a strong additional fact in support of their statements. If, now, it be conceded that the hiving place of the Aztecs, Apaches and other southern Athapascans was on Puget Sound, may it not also be granted that this is some further proof of the Asiatic origin of the same tribes?

DISPOSAL OF WASTE AT THE WORLD'S COLUMBIAN EXPOSITION.*

BY W. F. MORSE, NEW YORK.

When it was seen that the proposed World's Fair would occupy 600 acres of ground, have a resident population of thirty to forty thousand, and an average of one to three hundred thousand daily visitors, it was apparent that the sanitation of the grounds was a problem of some magnitude, and one that must be solved without the chance for an error, as after the opening there was no time for changes of plans.

For the drainage the Shone Hydro-Pneumatic System was chosen. This is an English apparatus, which receives, in tanks under the floors of the buildings, all the sewage from toilet rooms, and by compressed air automatically employed forces it into large tanks or reservoirs at one central station. The sewage is then precipitated by chemicals, the effluent run off into the lake, and the residuum pumped into presses which deliver it in solid cakes for disposal.

Besides this sewage sludge, the waste food products from restaurants and the refuse and litter of all sorts taken together would amount to a vast bulk of waste to be destroyed. There was no convenient place outside the grounds where this might be dumped, the lake was impracticable for the purpose; it must be burned, and this must be done on the grounds of the Exposition.

The Engle Sanitary Garbage Cremator was selected as the one which promised best results, and two large furnaces were built in the fall of '92. At the opening of the Fair the work of disposal of all garbage, sewage sludge, waste, refuse, manure and the bodies of animals was begun and has been carried on without cessation for six months. The results of this work give a better idea of the value of garbage cremation than any reports yet published.

The two furnaces used crude petroleum oil as fuel, atomized this by air, obtained the power from an electric motor, and with a pressure of twelve ounces of air and using six to seven gallons of oil per hour for each burner, obtained as high a degree of heat and did the same work which would be done by a steam burner using 120 lbs. pressure of steam and a much larger amount of fuel.

The sewage cake contained fifty-eight per cent of liquid, and of the remainder only eighteen per cent was combustible. The garbage contained water in large amounts, rising sometimes from sixty to eighty per cent. Because of the necessity of being always open for inspection, more men were employed than would usually be needed, thus adding extra expense.

There was at no time any discharge of odors, fumes or smoke from the chimney; the results of combustion (carbonic acid gas) were colorless and invisible, and being discharged fifty feet from the ground at a temperature of 1,000° were quickly dissipated.

The cost of labor and fuel was from sixty to seventy cents per ton, the sludge costing considerably more than the garbage. At other places where furnaces of this same type are employed, this cost has been brought down to eight to twelve cents per cubic yard, equivalent to twenty to thirty cents per ton.

The bodies of animals—four horses, two camels, cows, deer, elk, pigs, dogs, etc., were destroyed with ease and speed.

The Engle furnaces are constructed with two fires, the first or primary fire burning the garbage and waste by direct application of flame, the smoke, gases and fumes from this combustion being driven forward into a second

*Extract from paper read at World's Public Health Congress, Chicago, Oct. 10-14, 1893.

fire at the other end of the furnace. Combustion is assisted by hot air inlets and by combustion chambers, thus making it possible to consume the most offensive matter, to destroy or convert into gas the product of this combustion, and to do this with speed and economy at places near to houses and in the presence of large numbers of people. The garbage and sewage sludge resulting from the presence of twenty-seven and one-quarter million of persons has been destroyed in six months to the entire satisfaction of the Exposition authorities and under the observation and in the presence of thousands of persons. The furnace received the highest awards in medals.

BIRD NOTES.

BY MORRIS GIBBS, KALAMAZOO, MICH.

Rapacious birds and beasts retain their love of destroying, even after years of confinement, and it is a well-acknowledged fact that among those rapacious animals of a menagerie which are reared in confinement, we find the most ferocious and destructive examples, if they once escape and become aware of their power. As a fitting illustration of this principle of general acceptance, the following instance is offered:

A friend of mine took two half-grown young from a nest of the great horned owl, *Bubo virginianus* (Gmel.), five years ago last spring. These birds were always kept in confinement and were never in the presence of other birds or mammals which might have formed their food in the wild state.

Within a few months past the pair escaped from their pen, and instead of flying to the woods, they immediately sought out a hen-house at a neighbor's less than sixty rods distant, entered it and mangled and killed over a dozen chickens. The owner of the hennery appeared on the scene and caught the owls red-handed in the midst of the carnage.

This is certainly a much more destructive onslaught than is recorded from the visitations of wild owls in my experience.

In watching the gulls which follow the steamers on the sea or great lakes, the question has often occurred to me, Do these same birds follow the boat day after day, or do the birds of the day drop out and others take their place? I have repeatedly noticed individuals leave one steamer and follow another, oftentimes in a different course and sometimes directly opposite to the formerly selected route. Of course during the nesting season gulls or other birds cannot fly to any great distance, but in the summer, fall and winter months they certainly can and do follow ships for immense distances.

On a trip in a coasting steamer from New York to Jacksonville a few winters ago, I had a favorable opportunity to prove that a gull could follow a vessel for a great distance. Soon after passing Hatteras we noticed one of the gulls in the good-sized flock which followed the boat, to have an injured leg. The foot hung so that the passengers could readily identify the cripple.

When we reached Charleston harbor the crippled gull was still picking up scraps thrown overboard from the galley, but was soon lost to us in the fog which surrounded us for hours while we waited to cross the bar. The next morning, when the passengers went on deck, there was our gull which had met the vessel on coming from the harbor, whether by accident or design I cannot say. The cripple followed us up the St. Johns River, and was often remarked upon by the passengers who had come to know it. This bird, which was one of the larger gulls, but I cannot be positive in regard to the species, followed our steamer fully five hundred miles.

LETTERS TO THE EDITOR.

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

A MISTAKE IN TEACHING BOTANY.

Allowing for some measure of truth in the article under the above heading in your issue for Oct. 20, I still think that the writer is in error in several of his recommendations and in some of his criticisms.

Probably the system of teaching botany at present in vogue in many schools and colleges is far from perfect, but I very much doubt if the introduction of the changes proposed would effect any improvement. Some of them would, I am persuaded, be injurious.

The writer condemns the old plan of a spring term in botany spent on the study of the phanerogams and followed by the analysis of fifty to one hundred plants, and he suggests if no more time can be given to the study that the teacher should tell the names of the plants and save the time for more important work, adding that, as for analysis, experience shows that a large part of the work, when not done under the supervision of the teacher, is accomplished by ascertaining the common name and then going to the index. He afterwards suggests that those who have been confining the study to the phænogams should give half of the time to the cryptogams, and even adds that every one who studies botany at all should learn something about bacteria, smuts, moulds, mildews, etc., and that vegetable physiology should form an important part of the work of the first term.

I cannot infer with certainty from the article if the writer is a teacher or not, but after many years' experience in the work it appears to me that any attempt to cover the ground proposed must end in failure so far as real scientific education is concerned.

Consider for a moment the mental position of a class of beginners of any age and in any science, botany for example, utterly ignorant of scientific method and unversed in scientific work, and too often, if beyond childhood, mentally purblind from the pernicious habits of thought and work engendered by the book-instruction of which school work mainly consists. For such scholars the whole available time of a term is required to learn how to work, and the difficulty of studying even a phænogam is quite sufficient to engross their attention without entering on the intricate ground of cryptogamic botany. The organs of a plant, their parts, their names and functions, their description and the nomenclature, with other important but untechnical topics that can be incidentally introduced by the teacher, such as the elements of geographical distribution, economic botany, forestry, etc., are more than enough to fill the time while the scholar is wrestling with the elementary difficulties of the science. And the teacher of experience knows that a considerable time is necessary for the assimilation of even this minimum of knowledge, and that it is impossible to reduce this amount if any real mental discipline is desired, because the organic law of mind demands repetition, variation and attention before facts and their significance and words and their ideas can make a permanent impression on the memory and the intellect. Any other course can end only in a smattering, and in the past this method of procedure has too often brought so-called scientific teaching into disrepute.

Moreover any one accustomed to working in the higher departments knows how little can be accomplished in the