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

hundred and twenty hours or thereabouts that form the available allowance in a single term, even after the attainment of a fair knowledge of phænogamic botany. To acquire the necessary skill in the use of the compound microscope will alone consume no small part of the time, and without this nothing of value can be done among the cryptogams.

Again, to tell a class the name of a plant instead of teaching them how to discover it for themselves is to rob the study of much of its special value in training the faculties of observation. This part of the work compels a close and repeated examination of the plant and renders the parts and their names thoroughly familiar as no other method can do it. And speaking from a long experience, I cannot believe that the art can be acquired by less practice than that afforded by the analysis of the fifty or more specimens usually required, unless, as is sometimes, and as should be always done, the description of the plants is made a part of the work. And this description should consist not merely of the filling up of the forms usually supplied, whereby the exercise is robbed of much of its value, but by requiring the whole from the scholar, thereby training him in recollecting what to look for without suggestions or leading questions. No practice in elementary botany is so useful as this.

Of course a part of every class, especially if it is large, will shirk the labor when they are out of the class-room. But shirking in the way suggested can easily be prevented by giving a plant which has no English name and in general by testing a scholar's progress by the work done in the class-room from day to day.

I need not do more than allude to the difficulty, I may say the impossibility, of supplying elementary classes with microscopes of sufficient power for the purpose advocated in the paper here referred to, without which the study must degenerate into a mere absorption of what the teacher tells. This would be little more than a waste of time and a degradation of science to the level of a mere memory study.

On yet one other point I must disagree with this author. There was, some years ago, a disposition to begin the study of a science at the bottom and work upward, and this in spite of strong remonstrances from many teachers of great ability and experience. Even a man like Huxley fell into this error, as may be seen in the early editions of his "Biology." But a few years' test showed the many disadvantages of this method, and the opposite, or older plan has been readopted. Whatever may be urged from the standpoint of theory, practice is unanimous on the other side. Steady advance from the known to the unknown is easier than a plunge into the mysteries of cryptogamic botany with its abstruse terminology and its minute, often almost invisible structure. For every one who might be attracted by the delicacy and difficulty of the subject a thousand would be disgusted and disheartened and would forsake the study forever.

The author's illustration from geology is unfortunate because in teaching this subject the best plan is to begin neither with the superficial nor the deep rocks. This savors of book geology. The proper plan is to begin with whatever rocks happen to lie within the range of the student's investigation. Here again we work from the known to the unknown.

The object of the teacher in every study should be to stimulate to farther advance, and this cannot, I think, be accomplished except by beginning with the easy and the obvious, and by assigning tasks well within the strength of the student. If a fair acquaintance with the structure of the phænogams and the methods of phænogamic botany can be attained in the first term devoted to the study, the time will have been well spent, and neither the teacher nor the average scholar can reasonably expect much more.

E. W. CLAYPOLE.

Akron, Ohio.

CORAL REEF FORMATION.

IN *Science* for Oct. 20, p. 214, I observe that Professor Perkins gives a succinct account of the history of the theories of coral reef formation. Darwin and Dana have, of course, their proper place in connection with the *"subsidence theory."* Agassiz is justly mentioned as declaring that there was no subsidence in the case of the Florida reefs. Guppy and Semper are very properly mentioned along with Murray in connection with the new views; but my name is not mentioned in that connection. Let me, then, quote from a paper of mine read before the A. A. A. S., Aug., 1856, and published in the Proceedings and also in the *Am Jour.*, Jan., 1857: "On sloping shores with mud bottom, such as we have supposed always existed at the point of Florida, a fringing reef cannot possibly be formed, for the water is rendered turbid by the chafing of waves on the mud bottom; but at some distance (in this case ten to twenty miles), where the depth of sixty to seventy feet is attained, and where the bottom is unaffected by waves, the conditions favorable for coral growth would be found. Here, therefore, would be formed a *barrier reef*, limited on one side by the muddiness and on the other by the depth of the water."

This is positively the first attempt to explain barrier reefs without resorting to subsidence. Captain Guppy worked out the same explanation independently long afterward, but on becoming acquainted with my paper promptly acknowledged the anticipation of his views. I quote from a communication by him to *Nature* (Vol. 35, p. 77, 1886): "When I arrived at the above conclusions I was not aware that substantially the same explanation had been advanced thirty years before by Prof. Joseph Le Conte in the instance of the reefs of Florida. * * * * The circumstance that barrier reefs are frequently situated at or near the border of submarine plateaus receives a ready explanation in the view *first advanced* by Professor Le Conte."

When I wrote my paper I did not dream of generalizing my conclusions or of invalidating Darwin's theory except as applied to Florida. The subsidence theory was to me then, as it is now, the most probable general theory for the Pacific reefs. I am little disposed to make reclamations. Except on the score of history, it matters little who first brings forward an idea. My paper is now thirty-seven years old. In the midst of all these discussions of new views I have been silent. My paper, therefore, has almost dropped out of the memory of the younger generation of naturalists. This is my only excuse for bringing it up now.

JOSEPH LE CONTE.

Berkeley, Cal., Nov. 10.

BOOK-REVIEWS.

Tables for the Determination of the Rock-forming Minerals. By F. LOEWINSON-LESSING. Translated by J. W. Gregory. New York and London, Macmillan & Co. 55p., 8vo., $1.25.

THE literature of micropetrology has of late received an interesting addition in the shape of a translation by J. W. Gregory of F. Loewinson-Lessing's tables for the determination of rock-forming minerals. Unlike the *Hülfstabellen zur Mikroskopischen Mineralbestimmung* of Rosenbusch, or the *Tableaux des Mineraux des Roches* of Michel, Levy and Lacroix, the work is something more than a bare list of the rock-forming minerals with their optical properties, but has for its avowed purpose an attempt to apply to micropetrology the system "so long applied in