separate exposures is shown in the right hand of the cut.

The proof is not, of course, a complete one. To make it such would involve an exceedingly difficult piece of photographic work, as from one hundred exposures per second upward would have to be effected. Enough has been shown to prove that a great deal of separation does take place, and that the electrodes are continually driven apart. The position of the Bonta patent in the light of the Bell claims is interesting, as it claims to utilize the disclaimed pulsatory current, thus dividing the field of telephony between itself and the Bell patent. It is not saying too much to assert that its theory is as good as that of the Bell specification.

EDWARD SYLVESTER MORSE.

BY MARCUS BENJAMIN.

The names of two men stand out pre-eminent in the history of the United States as having inspired the study of science. The elder Silliman made possible the wonderful strides achieved in the physical sciences, while the impetus given to the natural sciences received its greatest impulse from Louis Agassiz.

Among those who came to follow the lectures of the latter at Cambridge was Edward S. Morse, the retiring president of the American Association for the Advancement of Science, who has attained a high rank among that group of naturalists who sought knowledge from the most distinguished of modern scientists.

Professor Morse is of New England ancestry, and was born in Portland, Me., on June 18, 1838. His early education was acquired at schools in the city, and later he attended the Academy in Bethel, Me., but like many others, the beauties of nature were more attractive to him than the study of Latin or Greek.

At the age of thirteen he began systematically to collect minerals and shells. Indeed, the latter were probably the starting point of those valuable researches in biology which he has since contributed to science.

Yielding to his fondness for natural science, he entered the Lawrence Scientific School of Harvard, in 1859, devoting special attention to the subjects taught by Louis Agassiz, likewise attending the lecture of Jeffries Wyman in comparative anatomy and archæology, with whom he also visited and explored the mound heaps of a prehistoric people situated in New England. He also followed the lectures on chemistry by Josiah P. Cooke, and those on literature by James Russell Lowell.

His early fondness for shells had not been without profit, for from the knowledge now acquired he presented his first paper, on a "Description of New Species of Helix" (Helix asteriscus),* to the Boston Society of Natural History in 1857. This he followed with a second description† of another species (Helix milium), two years later.

During the years 1859–62 he was assistant to Professor Agassiz, and at that time began his special study of the brachiopods, which, although of a low animal type, have a range in time, geographical distribution, and depth of water more extensive than any other class of marine bivalves. He published in 1862 his first contribution to the literature of that subject, entitled "The Haemal and Neural Regions of Brachipoda."‡ This subject he continued to study for many years and with indefatigable industry, going deeply into the question of their structure and affinities. By the help of embryological analysis, he has thrown new and important light upon their systematic position in the scheme of invertebrate life. They had long been classed as belonging to the mollusks, but after careful researches involving dredgings all along the Atlantic coast, Professor Morse announced his belief in their annelidan nature, placing them among the worms.

Charles Darwin and other eminent naturalists encouraged him in his work, and although he was the first to accumulate evidence for the demonstration of his belief, he was anticipated in its announcement by Japetus Steenstrup, the Danish naturalist.

His most comprehensive paper on this subject is "On the Systematic Position of the Brachipoda," § published in 1873, and dedicated to Professor Steenstrup. It covers the entire group and embraces the results of other studies made by him and contributed elsewhere.

Previous to this however he had been busy with other work, and in 1864 he contributed to the Portland Society of Natural History, "Observations on the Terrestrial Pulmonifera of Maine, including a catalogue of all the species of terrestrial and fluviatile mollusca known to inhabit the State." This pamphlet of some sixty pages includes upward of one hundred illustrations drawn by himself, and nearly all of his papers contain sketches of his own making.

* Proc. Bost. Soc. Nat. His., vol. vi., p. 1.
† Proc. Bost. Soc. Nat. His., vol. vii., p. 1.
‡ Proc. Bost. Soc. Nat. His., vol. ix.
§ Proc. Bost. Soc. Nat. His., vol. xv.

Before this time he held the office of mechanical draughtsman in the locomotive works at Portland, and later he was engaged in Boston, preparing illustrations on blocks for wood engravers. In this manner he acquired the habit of sketching with striking rapidity and minute exactness, and he possesses, moreover, the additional power of being able to draw equally well with either hand. This accomplishment has been of inestimable value in his scientific work.

In 1866 he removed to Salem, Mass., and with Alpheus S. Packard, Alpheus Hyatt, and Frederick W. Putnam, founded the *American Naturalist*, one of the most prominent scientific monthlies in the United States.

His biological work was not neglected, and from 1862 till 1871 he published some twenty memoirs.

In 1871 he became professor of comparative anatomy and zoology in Bowdoin College, Brunswick, Me., and for three years remained in possession of that chair. In addition to his collegiate duties, he found time to prepare two papers on the Terebratulina, which he contributed to the Proceedings of the Boston Society of Natural History.*

Continuing his researches in this direction, he determined, in 1877, to visit Japan for the purpose of dredging along the coasts of the islands of that empire, in search of Brachipods, upon which he was still at work.

His studies soon attracted the attention of the Japanese government, and he was invited to accept the chair of zoology in the Imperial University of Tokio, then recently established. After thoroughly organizing this department and laying the foundations for the splendid collections which have since been made in this field in the imperial museum, he resigned his post in 1879, to resume his labors at home.

RETIRING PRESIDENT OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

During his stay in Japan, he established a zoological station in the bay of Yeddo for the purpose of training Japanese assistants in the work, and he obtained a large number of specimens for exchange with American societies.

In the winter of 1877–78, he came back to this country for the purpose of fulfilling certain lecture engagements, and while in Boston he communicated to the Society of Natural History some points new to science concerning the habits of Japanese lingula, † a form of life of particular interest to all naturalists on account of its persistence from the most ancient geological periods to the present time.

He returned to Japan in April, 1878, and again visited that country in 1882, when, after an extensive tour throughout the empire, he proceeded to China and thence home by way of Singapore, Java, and Europe, thus circling the globe.

During his sojourn in Japan, he was led to the study of the prehistoric remains, by his observance of some ancient shell heaps at Omori, not far from Tokio. These he soon examined and found to be similar to those described by Jeffries Wyman, along the shores of New England and in Florida, and those on the Baltic coast in Denmark, made known by Japetus Steenstrup. His researches subsequently embraced critical examinations of a similar nature at Otaru, and Hakodate in Yezo, and Higo.* From all of these localities large collections were made, which now are deposited in the Archæological Museum of the University of Tokio.

* "On the Early Stages of Terebratulina septentrionalis," vol. ii., p. 29, and "Embryology of Terebratulina," Vol. ii., p. 249.
† "On Japanese Lingula and Shell Mounds," *Amer. Jour. Sci.*, February, 1878.

The nature of these finds gave evidence that the pottery found in the mounds was identical with that found in similar deposits in Brazil, thus indicating the common origin of the art. Moreover, in a communication to the Biological Society of the Tokio Dai Gaku,† he showed that this prehistoric people were cannibals, and in their residence of Japan preceded the Ainos, a hairy people, now of the northern islands, who were dispossessed by the present Japanese race, which has lived there over 2,000 years.

Incidentally, these researches led to a comparative examination of Japanese pottery, and from a few pieces his collection has grown to include specimens of all kinds, from the commonest sorts up to the most precious varieties. It is considered the "largest, most valuable, and completest collection of Japanese pottery in the world," and is worth not less than $100,000. The main portion of it is contained in a gallery some eighteen by thirty feet, built expressly for its accommodation, and connected with Professor Morse's residence in Salem.

He is now engaged in making a study of Japanese keramic art from an ethnological standpoint.

In 1881 he became the director of the Peabody Academy of Sciences, an office which he has since held, except during his visit to Japan in 1882.

His work in connection with this institution has been a most valuable one. By his advice important features have been introduced, notably the conspectus of the animal kingdom, for the specimens are so arranged that the series returns to the starting point, the sponges and other of the lowest forms of life confronting the apex of the organic world where the higher mammalia belong.

Professor Morse, as a lecturer, is exceedingly popular with his audiences, talking directly to them like one who has some information that he wishes to impart, and therefore puts his statements in such language that all can understand him.

He has also shown considerable mechanical skill, for besides inventing several plays for children, of which the game of battle is the most popular, he devised a museum bracket shelf that has become a standard feature in many of the largest museums and libraries in the country.

Professor Morse found that dark curtains hung before windows through which the sun shone freely soon became quite warm and induced an upward current of heated air. This led to his apparatus for the utilization of the sun's rays in heating and ventilating apartments, and has been in successful operation at his own residence in Salem, at the Boston Athenæum, and elsewhere.

Another ingenious device was the placing of a sheet iron jacket around a stove, and a pipe from without bringing a constant supply of fresh air to the intervening space, out of which it comes into the room thoroughly heated, so that the apartment is wholly free from the close atmosphere which makes stoves so objectionable.

His latest invention is a pamphlet jacket, consisting of a broad band which, by means of a tape and hook attached, secures a set of pamphlets in a compact bundle that may be easily undone, and attached to the band is a card on which to inscribe the contents.

His separate papers exceed fifty in number, and several of his more important scientific memoirs have been translated into French, Italian, German, and Russian. In addition to these he has contributed largely to newspapers, and to children's magazines such as the *Youth's Companion*, *Wide Awake*, and others, but in book form his publications are: "First Book in Zoology" (New York, 1875), illustrated by its author, and is a favorite text book for schools, both in the United States and England. It has also been translated into German and Japanese. His "Japanese Homes and their Surroundings" (Boston, 1885), likewise illustrated by himself, is an octavo volume of 400 pages, which, according to an eminent authority, "is the first book that has been written about Japan since Siebold."

In 1871, Professor Morse received the honorary degree of Ph.D. from Bowdoin College, and like all scientific men, he is a member of societies. He early joined the Boston Society of Natural History, and is a corresponding member of the Biological So-

* See "Memoirs of the Science Department of the University of Tokio, Japan." Part I. "Shell Mounds of Omori." (Tokio, 1879.) The composition and press work of these memoirs were done in a Japanese office, where the employes were unable to speak English.
† Tokio *Times*, January 18, 1879.

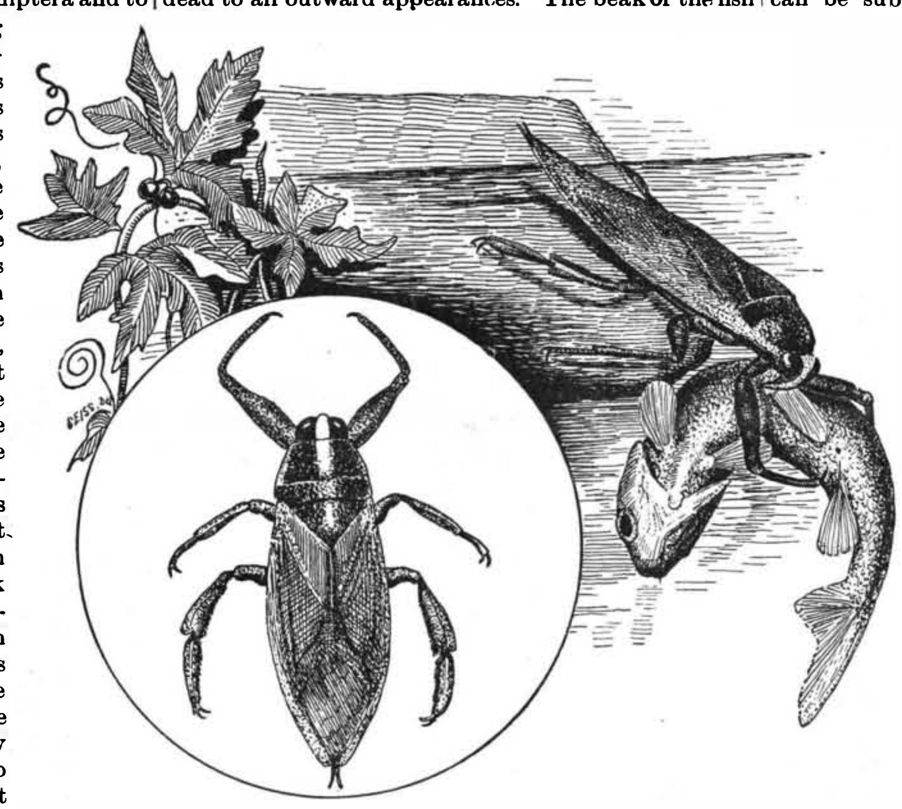
ciety of Washington, of the Philadelphia Academy of Natural Sciences, and of the New York Academy of Sciences. In 1868, he was elected a fellow of the American Academy of Arts and Sciences, and in 1876 received his election into the National Academy of Sciences.

Professor Morse became a member of the American Association for the Advancement of Science at the meeting held in 1869, at Salem, and was advanced to the grade of fellow in 1874, having meanwhile filled the office of general secretary at the Dubuque meeting. In 1875, he was elected vice-president of the section on Natural History, and delivered at Buffalo his address on "What American Zoologists have done for Evolution," in which he reviewed the brilliant work accomplished by American naturalists toward substantiating the doctrine of natural selection. In 1884, he was again called to preside over one of the sections, this time that of anthropology, and chose as the subject of his address "Man in the Tertiaries," pointing out the possibility of the existence of human life at that remote period of the world's history.

At the meeting held in Ann Arbor, in 1885, he was elected president of the entire association, and acted in that capacity at the Buffalo meeting held last year. He will call the association to order at Columbia College, on Wednesday, the 10th instant, and after resigning the chair to Samuel P. Langley, will terminate his official relations by the delivery of his retiring address, on Wednesday evening.

THE FISH KILLER.

BY C. FEW SEISS.



THE FISH KILLER (BENACUS HALDEMANUM).—⅔ Natural Size.

The fish killer belongs to the order Hemiptera and to the family Belostomidæ. The following remarks refer to the *Belostoma haldemanum* of Leidy, now placed in the genus *Benacus* by some authors. It measures from three to three and one-half inches in length. Its general color is dull brown, with a yellowish-white band between the eyes, extending upon the thorax, where it becomes less marked. The eyes are large and black. The body beneath is longitudinally marked with dark brown and dull yellow bands. The fore legs are powerful, without a groove in the femur, and each terminates in a single claw. It is with these raptorial legs that they seize their prey. The remaining four legs are each armed with two hooked claws. The posterior pair of legs are broad and flattened, fringed with hair, and are used as paddles or oars to propel the insect through the water. It is furnished with strong wings; and can fly well. Its beak is armed with a cutting or boring apparatus at its tip, by means of which it can easily penetrate the tissues of the animals upon which it feeds. It possesses large salivary glands, which doubtless secrete a poisonous saliva, for I have repeatedly noticed that a small animal ceases to struggle and is apparently dead almost instantly after the beak has entered its body. It feeds entirely by suction through the beak upon the blood and fluids of its prey. A peculiarity of these bugs is that they breathe through their tails, or draw in the air through the tip of the abdomen. They are generally found during the day on the under side of floating bark, dead wood, or other *debris*, completely submerged with the exception of the two little tails or setæ and the tip of the abdomen, which are kept above the surface of the water. Sometimes a large amount of air is drawn in and held in the form of flattened bubbles between the wings and body, which fit closely together, and I presume they use this air for breathing purposes when they remain beneath the water for any length of time. In the aquarium I have never noticed them to remain under water for over thirty minutes at a time.

They seem to prefer the quiet water of brooks and ponds, where small fishes and tadpoles are abundant. When food becomes scarce and the water low, they migrate during the night to other bodies of water. They generally capture their prey at twilight or in the night; at least, such has proved the case when in captivity.

I am confident that to be pierced by the beak of a fish killer would cause a painful wound. At a time when one of them was about to crawl out of the aquarium I brushed it back with my finger, which it instantly seized with its fore legs, no doubt mistaking it for something to eat; and although I pushed it off immediately, and am quite certain its beak did not touch my finger, yet I experienced a tingling sensation in the finger, followed by a semi-numbness which lasted for five or six hours. The scratch of its claws alone must have produced this, yet I could observe no marks whatever.

The following notes on the habits of the fish killer I take from my journal:

May 22, 1887.—Placed a large diving beetle (*Dytiscus*) in an aquarium containing a *Benacus haldemanum*. I observed that when I dropped the beetle in and it began swimming about, the fish killer crept under a large stone, as if to hide. An hour later, when I looked into the aquarium, *Benacus* was on the top of the stone, beneath the water, with the unfortunate *Dytiscus* firmly held in his raptorial fore legs, and his beak thrust deeply in the body of the beetle, between thorax and abdomen, on the under side. Of course, the beetle was limp and dead. In two hours or more, after he had sucked all the blood and fluids from the beetle, he discarded the remains. I found that the thorax and abdomen of the beetle were held together by merely a few shreds. The connecting tissue of the suture must have been separated by numerous punctures of the powerful beak, or softened by the saliva, which is copiously exuded.

June 1.—Two gold fishes were added to the aquarium containing the fish killer. One fish measured exactly 3½ inches in length, and the other nearly 4. On the same evening, about 7 o'clock, the *Benacus* darted at and seized the smaller of the fishes, but it struggled and dashed the bug off in an instant. On June 2 another fish killer was put in the aquarium.

Saturday, June 4.—At 7:10 P.M. I visited the aquarium and found both of the fish killers resting quietly on the under side of a floating block, with nothing but their breathing tubes above the surface of the water. At 7:30 I again took a look at the aquarium. Something startling had happened. The larger *Benacus*, the one first captured, was still clinging to the under surface of the block, but in the deadly clasp of his fore legs he tightly held one of the gold fishes. There was no motion discernible in any part of the fish, it was dead to all outward appearances. The beak of the fish killer was inserted in the fish near the base of the anal fin, and *Benacus* was sucking in a vigorous and contented manner. At 12:15 P.M., the fish killer was still clasping the fish, which had now become as limp as a rag, the head hanging over until it touched the tail. The beak of the fish killer was inserted near the gills of the fish, and the belly had been pierced and probed for blood and fluids at about every eighth of an inch from the vent to beneath the gills. In the morning the dead gold fish was floating on the water. It was much collapsed, and somewhat discolored along the abdomen. The fish killers were still on the floating block.

Arctic Cold.

A person who has never been in the polar regions can probably have no idea of what cold really is; but by reading the terrible experiences of arctic travelers in that icy region some notion can be formed of the extreme cold that prevails there. When we have the temperature down to zero out of doors we think it bitterly cold, and if our houses were not so warm as, at least, 60 degrees above zero, we should begin to talk of freezing to death. Think, then, of living where the thermometer goes down to 35 degrees *below* zero in the house in spite of the stove. Of course, in such a case the fur garments are piled on until a man looks like a great bundle of skins. Dr. Moss, of the English polar expedition of 1875 and 1876, among other odd things, tells of the effect of cold on a wax candle which he burned there. The temperature was 35 degrees below zero, and the doctor must have been considerably discouraged when, upon looking at his candle, he discovered that the flame had all it could do to keep warm. It was so cold that the flame could not melt all the wax of the candle, but was forced to eat its way down the candle, leaving a sort of skeleton of the candle standing. There was heat enough, however, to melt oddly shaped holes in the thin walls of wax, and the result was a beautiful lace-like cylinder of white, with a tongue of yellow flame burning inside it and sending out into the darkness many streaks of light. This is not only a curious effect of extreme cold, but it shows how difficult it must be to find anything like warmth in a place where even fire itself almost gets cold. The wonder is that any man can have the courage to willingly return to such a bitter region after having once got safely away from it, and yet the truth is that the spirit of adventure is so strong in some men that it is the very hardship and danger which attract them.

The Cellerier-Parkes Photographic Process.

The brief interest that was raised some short time since by the announcement—founded on misapprehension—that a process had been invented of securing natural colors by photography has died away, and the real foundation upon which so fanciful a claim was reared appears to have sunk out of sight, and to be replaced by the very practical Cellerier Parkes process, which has already established its claim to be regarded as a highly ingenious and successful application of some of the later developments of photography. It is based upon the carbon process, which, though old of itself, has been lately perfected so far that permanent sun pictures can be produced with rapidity and certainty. Told very briefly, the carbon process consists in the exposure behind a negative of a sensitized gelatine film containing finely divided carbon, or other suitable pigment, and mounted on paper from which it can be subsequently stripped on immersion in warm water. The bichromate of potash or other sensitizing medium renders the gelatine more or less insoluble, according to the energy of the light falling upon it, and which is of course regulated by the negative. After exposure the film is laid upon glass and is placed in warm water, when the paper backing comes away, the superfluous and soluble gelatine is washed out, and the definite picture, with all its light and shades determined by the thickness of the pigmented gelatine film, is left behind. When dry, this film is so thin that irregularities on its surface are inappreciable. The film is afterward stripped from the glass and mounted on a suitable permanent support of paper. So far this is an old and well known process, and the Cellerier-Parkes development commences with the treatment of the permanent paper support, which previous to being attached to the picture is held in contact with it temporarily, while it is still attached to the glass. The operator, for whom great skill is not necessary, is able to see the picture through the paper by transmitted light, and covers it with flat washes of suitable colors, but of a stronger tone than would be desirable for the finished work. This paper is then detached, the carbon film is stripped from the glass, and the face, which was in contact with the latter, is carefully laid to register with the colored washes on the paper. The film and paper are then brought into intimate contact, subjected to a steaming process, and by this means they are thoroughly cemented. The colors laid on the permanent support are then seen through the carbon film, much softened and subdued, all the lights and shadows being produced by the pigmented carbon. *Engineering* says the art of producing colored photographs can scarcely be carried much further than by the very simple means of which we have indicated the outlines, and which are equally adapted for landscape work and for portraits, as a visit to the Cellerier-Parkes studios in Pall Mall or the Poultry will show. The process appears, in fact, to be another step in popular art education, which has made such prodigious strides of late years.

Pigeon Weather Reporters.

Mr. O'Donnell, of the U. S. Signal Service, has gone to Key West, Fla., for the purpose of establishing communication, by means of homing pigeons, between that point and the West India islands, for the benefit of the signal service. Mr. O'Donnell will commence his experiment with about fifty young birds. When properly trained, he will give the birds to captains of vessels, who will take them out to sea and liberate them. At first he will take them out four or five miles, gradually increasing the distance until the West Indies are reached. It will enable the signal service, if the birds can be successfully trained, to give quicker and more definite and reliable information in regard to the prevalence and character of storms, and the condition of the weather on the several islands. It is calculated a pigeon will make the trip between Nassau and Key West, about sixty miles, in one hour and a half.