seen, and it has been the good fortune of Alexander Agassiz to succeed in hatching the eggs and raising the young until they showed at least the principal structural peculiarities of the adult. A short account of the chief facts in connection with this stage of the bony pike's history will appear in the forthcoming number of the *Proceedings* of the American Academy of Arts and Sciences; from an advance copy we cull the following details:— The spawning-ground selected for observation was the Black Lake, at Ogdensburgh, N.Y. Mr. Garman, who describes the scene, and Mr. Blodgett, who rendered most essential assistance, deserve the thanks of every naturalist. The eggs collected were carried by the hand in pails from Ogdensburgh to Cambridge, where their progress was watched by Prof. A. Agassiz.

The fish began to spawn about May 18. Little projections of granite stand out here and there into the lake. The frosts from time to time have broken off from these, small angular blocks, which lie piled together under the water at depths varying from two to fourteen inches. Into these shallows the female fish would come, each of them attended by two males. While very timid when in deep water, they seemed to be courageous to recklessness when they approached the shallows. On they would come in threes, when rising to the surface of the water, and thrusting their bill out of it they would open this widely, then take in air, and close it with a snap. In some few cases three or four males would be in attendance on one female, but much more often there would be but two, and these would swim resting on either side of the female fish, their bills reaching up toward the back of her head. At times the water would be lashed into all directions with their conjoined convulsive movements. The eggs when laid were excessively sticky; to whatever they happened to touch they stuck, and so tenaciously, that it was next to impossible to release them without tearing away a portion of their envelopes. It is remarkable that, as far as could be seen, there was, on and about the spawning ground, a complete absence of anything that might serve as food for the young fish.

Of the quantity of eggs brought to Cambridge, only thirty hatched, and not one of those artificially fecundated was hatched. In Prof. A. Agassiz' anxiety not to spoil this interesting experiment he did not venture to examine any of the fresh eggs; so that the history of their segmentation and very early development remains to be worked out. The envelope of the eggs is very opaque and of a yellowish green, like that of toads. Of the thirty hatched out by the end of May, twenty-eight were alive in the middle of July last. When first hatched the young fish possesses a gigantic yolk-bag, and the posterior part of the body presented nothing specially different from the general appearance of any ordinary bony (teleostean) fish of the same age; but the anterior part was most extraordinary: it looked like a huge mouth cavity, extending nearly to the gill opening, and crowned by a depression like a horse's hoof in outline, along the margin of which were a row of protuberances acting as suckers. The moment the young fish was hatched it attached itself to the sides of the vessel by means of these, and would hang immovable. The eye was not very advanced, the body was transparent, the gill covers were pressed against the sides of the body; the tail was slightly rounded, the embryonic fin is narrow, and there were no traces of embryonic fin rays; the olfactory lobes were greatly developed and elongated as in sharks and skates; the chorda was straight. On the third day the body became covered with minute black pigment cells, and then was noted the first traces of the pectoral fins, and the snout became more elongated; the great yolk-bag was greatly reduced in size. About the fifth day were seen traces of the caudal, dorsal, and anal fins. Gradually the snout became elongated, the suckers concentrated, and the disproportionate size of the sucking disc became reduced, so that when about three weeks old it became altogether more fish-like. The sucking disc was now reduced to a swelling at the top of the upper jaw, the yolk-bag had disappeared, the gill covers extended well up to the base of the pectorals—these latter were in constant motion, and the tail exhibited the same rapid vibratile movements. The young fish now begins to swim about, and is not so dependent upon its sucking disc, and at last this only remains as a fleshy globular termination on the snout. At this stage, too, the young have the peculiar habit of the adult fish of coming to the surface to swallow air. When they go through the process under water of expiring this air they open their jaws wide and spread their gill-cover, and swallow as if they were choking, making violent efforts, until a minute bubble of air has become liberated, when they become quiet again. Their growth is rapid. Within a month the teeth made their appearance, and some of the fin-rays on the fringe of the pectorals were to be seen.

Prof. A. Agassiz draws the following conclusions from these observations:—"That notwithstanding its similarity in certain stages of its growth to the sturgeon, notwithstanding its affinity with sharks by the formation of its pectorals from a lateral fold, as well as by the mode of growth of the gill openings and gill arches, the Lepidosteus is not at all so far removed as is generally supposed from the bony fishes." The memoir is illustrated by five plates containing some forty-five figures, and is only to be regarded as a preliminary account, but it is a preliminary account of such exactness, importance, and interest, that no apology is necessary for bringing it at once under the notice of our readers. This memoir was presented to the American Academy as recently as October 8 last. E. PERCEVAL WRIGHT

THE MUSIC OF COLOUR AND MOTION

At the Physical Society, on November 23, 1878, Prof. W. E. Ayrton, late of the Imperial Engineering College, Tokio, Japan, read a paper, written by himself and Prof. J. Perry, of the same college, on "The Music of Colour and of Visible Motion." The authors began by pointing out the well-known fact that emotion is excited by moving bodies, and they believed that, upon this basis, a new emotional art would be created which would receive a high development in the far distant future. All methods of exciting emotion could be cultivated; but of these, music, by reason of the facility with which its effects could be produced, had alone been highly perfected by the bulk of mankind. Sculpture and painting are not purely emotional arts, like music, inasmuch as they involve thought. It would take a long time and much culture for the eye to behold moving figures with similar emotional results to those of the ear on hearing sweet sounds; but time and culture only might be necessary. It might be due to their neglect of this emotional tendency that the Western nations felt little emotion at moving visual displays. For among the Eastern nations they had entertainments consisting of motions and dumb show, which, although incomprehensible and even ludicrous to the European, powerfully affected the feelings of a native audience. In Japan the authors had seen whole operas of "melodious motion" performed in the theatres, the emotions being expressed by movements of the body, affecting to the audience, which were quite strange to them. The accompanying orchestral music was, withal, displeasing to the authors, while, on the other hand, Western music is mostly displeasing to the Japanese.

The emotions produced by rapidly-moving masses, such as a train bowling up to a bridge, or by changing colours, as in sunsets, have been felt by all, and those excited when the moving bodies are very large do not seem to be producible by anything else in nature. Harmonic instruments have been constructed to exhibit the combination of two or more pairs of harmonic motions to the eye; for example, Blackburn's pendulum, Lissajous' forks, Wheatstone's kaleidophone, Yeates' vibrating prisms, Donkin's and Tisley's harmonographs, and Hopkins' electric diapason. Prof. Ayrton illustrated his remarks by exhibiting these instruments in action. The pendulum traced out the complex path of the combined motions by a jet of falling sand, the forks or prisms by a moving beam of light thrown on a screen, the kaleidophone by a bright bead, and the harmonograph by the involutions of an aniline pen. With none of these and such like instruments, however, is the production of mere emotion the end in view; and in some of them no change can be made in the periods of the pairs of harmonic or periodic motions combined without arresting the instrument, a proceeding which in music would be analogous to stopping the tune at the end of every chord. There is no provision either for changing the amplitude or phase, equivalent in music to an inability to render, at will, a note forte or piano, or rather as it is not only the strength of the entire note, but even the amplitude of the various component harmonics that these instruments cannot regulate, it would be as if in music there was the probability of a note marked in the score as piano for the flute being rendered by a loud blast from a trumpet. A successful instrument in the new kinematical art must at least visibly render changes in period, amplitude, and phase of the harmonic motions represented. Profs. Perry and Ayrton had designed an instrument, which is now in Japan, for effecting these required changes in a combination of harmonic motions given to a moving body, and which they claimed to be the first musical instrument of the visual art in question. They had not given it a name yet, because the nomenclature of the subject was uninvented. Photographs and diagrams of this instrument were exhibited to the meeting. It consists of a mechanical arrangement of sliders, pulleys, and cords, whereby two motions, one along a vertical, and the other along a horizontal line, and *each* consisting of the *sum* of a number of harmonic motions the *period*, *amplitude*, or *phase* of *any one* of which can be varied at will, are compounded in the resultant motion of a suspended pane of glass. A black circle painted on the pane is intended to represent the moving body as projected against a wall or screen behind. The sliders controlling the motion of the pane are actuated by a revolving barrel, the periphery of which is carved according to mathematical principles, so as to give the different harmonic motions to the sliders in one revolution. The motion is further regulated by shifting the sliders either parallel to the axis or at right angles to the radius of the revolving barrel; and by the angular velocity of the barrel. In this way the period, amplitude, and phase of the component motions of the glass either in a vertical or horizontal direction, may be changed at will, and almost immediately. Other kinds of periodic motions may be compounded in a similar way. Prof. Ayrton also suggested other forms of apparatus for this purpose. Numberless combinations of graceful motions producing emotional effects on the beholder can by its means be given to a visible body. It is the intention of the authors to construct an improved form of the apparatus, and to arrange for the blending of colour with the moving body to heighten the emotional influence; for example, they purpose having changing mosaics of different hues, thrown upon the screen for a background to the black spot. This can be done by means of an instrument similar to the chromotrope with its revolving sheets of parti-coloured glass. In conclusion Prof. Ayrton said that there might yet be invented many different ways of producing these spectacles, and there was no reason why a whole city full of people should not enjoy these displays projected upon the clouds overhead.

THE SWEDISH NORTH-EAST PASSAGE EXPEDITION

FROM letters despatched from the mouth of the Lena by Prof. Nordenskjöld on August 27, which have just been published in the Gothenburg *Handels Tidning*, we learn that the *Vega* accompanied by the *Lena* left Dickson Harbour, at the mouth of the Yenissej, on August 10, the weather being fine. On the 11th ice was seen, but it consisted almost exclusively of bay ice which did not obstruct navigation, which, however, was rendered difficult by a thick fog. The salinity of the water began gradually to increase and its temperature to fall. Organic life at the bottom grew richer at the same time, so that Dr. Stuxberg on the night between August 13 and 14, while the vessel lay anchored to a drift-ice floe, collected with the swab a large number of beautiful pure marine types; for example, large specimens of the remarkable crinoid, *Alecto eschrichtii*, numerous asterids (*Asterias linckii* and *panopla*), pycnogonids, &c. The dredgings near the land now too began to yield to Dr. Kjellman several large marine algæ. On the other hand the higher plant and animal life on land was still so poor that the coast here forms a complete desert in comparison with the rocky shores of Spitzbergen or West Novaya Zemlya. Auks, rotges, loons, and terns, which are met with on Spitzbergen in thousands upon thousands, are here almost completely absent. Gulls and *Lestris* which there fill the air with continual sound occur here only sparingly, each with two species, and it appears as if they quarrelled less with one another. Only the snow-bunting, six or seven species of waders, and a few varieties of geese are found on land in any great numbers. If we add a ptarmigan or two, a snowy owl, and a species of falcon, we have enumerated the whole bird fauna of the region, at least so far as the Swedish expedition have been able to ascertain it. Of warm-blooded animals in the neighbouring sea, only two walruses and some seals, *Phoca barbata* and *hispida*, were met with. There is probably great abundance of fish. Cosmic dust was sought for on the ice without success, but there was found upon it some yellow specks which, on examination, were found to be a coarse-grained sand, consisting exclusively of very beautifully-formed crystals up to two millimetres in diameter. The nature of these crystals was not ascertained, but it was evident that they are not formed of any ordinary terrestrial mineral, but possibly of some substance crystallised out of the sea-water during the severe cold of winter.

The *Vega* lay at anchor from August 14 to 18 in a harbour named Actinia Harbour, from the number of these animals brought up by the dredge from the sea-bottom. This harbour is situated in a sound between Taimyr Island and the mainland. The land was free of snow, and covered with a greyish-green turf formed of a close mixture of grasses, mosses, and lichens, forming a reindeer pasture much superior to that of the valleys in Spitzbergen which abound in reindeer. Only a few reindeer, however, were seen here, probably owing to the presence of wolves. The number of phanerogamous plants is exceedingly small; the moss and especially the lichen vegetation, on the other hand, abundant enough. Actinia Harbour is an excellent position for a meteorological station. The fog still continuing, the *Vega* and the *Lena* sailed again on the 18th, and reached Cape Chelyuskin on the 19th, anchoring in a little bay which indents the low promontory, dividing it into two parts. The western point was found to be situated in 77° 36′ 37″ N. L., and 103° 25½′ E. from Greenwich, and the eastern in 77° 41′ N. L., and 104° 1′ E. L. Inland the mountains appeared to rise by degrees to a height of 1,000 feet. These mountains, as well as the plains, were free of snow. Only here and there were to be seen large white patches of snow in hollows on the mountain sides or in some small depression on the plains. At the beach, however, the ice-foot still remained at most places.