changeable with them. In this view inertia is a law of energy and not a property of matter.

The following table gives a synoptical view of the various forms of energy and the names they have. Where there are no names an interrogation point is placed to indicate the lack. To the writer it appears as if each specific form of energy should have a specific name, but he is aware of the difficulty of finding suitable names and getting them adopted. If this want is felt by others then a committee of suitable persons might be appointed by the American Association for the Advancement of Science, who might consider and recommend appropriate names as did the British Association for Electrical Science some years ago.

TABLE OF FORMS OF ENERGY.

1. *Mechanical or Molar Motion.*

	Form.	*Name.*
$E = \frac{mv^2}{2}$	Rectilinear	?
	Rotary	?
	Vibratory	Sound.
	Curvilinear	?
	Spiral	?
	Vortical	?

2. *Atomic and Molecular.*

	Form.	*Name.*
$E' = \varepsilon \frac{mv^2}{2}$	Rectilinear	Free path.
	Rotatory	Electricity.
	Vibratory	Heat.
	Curvilinear	?
	Spiral	?
	Vortical	?

3. *Atomic and Molecular.*

	Form.	*Name.*
$E' - E = \varepsilon$	?	Specific heat.
	?	Latent heat.
	?	Specific Induc. Capac.

4. *In Ether.*

	Form.		*Name.*
$E = ?$	Rectilinear		?
	Vibratory	Pulsatory	Chemism.
		Undulatory	Radient Energy.
			Pseudo { Light. Heat. Actinism.
	Rotatory, Curvilinear,	Circularly and Elliptically	Polarized Light.
	Spiral		Magnetism.
	Vortical		Matter.

THE SPANISH MACKEREL AND ITS ARTIFICIAL PROPAGATION.

By Chas. W. Smiley.

This fish, *Cybium Maculatum*, is in general appearance very like the common mackerel. It is larger, however, averaging seventeen to twenty inches in length. When first described it did not exist in our waters, but was abundant in the Gulf of Mexico and the Caribbean Sea. Its first appearance was about 1850. It then began to be taken as a food fish. It began to be caught in the Chesapeake about 1870. About 1872 or 1873 it appeared in Narragansett Bay, when three or four hundred were taken at one haul of the seine, but the fish did not subsequently reappear.

The Chesapeake Bay has been annually visited by large schools for several years, where it is known as the "Bay mackerel." None were known to have been marketed there prior to 1870, but in 1879 1,300,000 of this fish were sold, and the season of 1880 is expected to yield 2,000,000. They were taken in pound nets and gill-nets. At Cherrystone, Md., there are fourteen pounds, which average a catch of 500 to a day. As many as 4,000 per day have been taken in a single pound on the eastern shore of the Chesapeake, while 2,500 is not a rare catch with one pound. The Bay fish are, however, smaller and leaner than those caught further north.

As this fish refuses the hook its capture is limited to pounds and nets. The first pound in the Bay was built in 1875. Now there are 164. The first gill-net used there was in 1877, while now there are 175 men fishing by this means. A net 100 fathoms long will average forty fish per twenty-four hours, the fish weighing from one and a half to two pounds each.

In the New York market the price per pound ranged from eighteen to thirty cents during 1879; for May, 1880, from fifteen to forty cents; but owing to the large shipments in June the price fell to ten to fifteen cents. On special occasions the fish have been sold readily at one dollar per pound. The catch of 1873 at Newport, R. I., was sold at prices varying from seventy-five cents to one dollar per pound.

This fish usually appears in the Chesapeake in May, when the temperature has reached 65° or 70°, and the number increases until the middle of June. They remain abundant until September, and diminish as the temperature of the water falls, until, in early October, nearly all have disappeared. They come in small schools, but later get scattered, and often quite isolated. Before leaving, the schools seem to be somewhat reformed.

The United States Fish Commission, under the management of Professor S. F. Baird, the Secretary of the Smithsonian Institution, has long desired to experiment upon the artificial propagation of this fish, but has been deterred by the lack of knowledge of its spawning time and places. These were both discovered June 1st by Messrs. Earll and McDonald, Assistants of the Commissioner. At that date the lower Chesapeake, especially Mobjack Bay, was found to contain large numbers of spawning mackerel. This opened the way for experiments, and Professor Baird was ready to seize upon the opportunity. He directed Mr. Earll to make every effort to hatch some fish.

June 21 Mr. Earll started for Crisfield, Md., on the eastern shore of the Chesapeake, and during the following ten days there conducted his experiments.

He found the number of eggs produced by a single fish to be from 50,000 to 500,000, according to the size of the fish, the latter number having been taken from a fish weighing one and three-fourths pounds. Instead of all the eggs ripening at once, as is true in the case of the shad, only a part are thrown at a time, and at intervals of a few days, probably extending through two or three months. This is analogous to the cod, which deposits its eggs at intervals during five or six months. Different individuals of mackerel were found to vary in their time of spawning; some ripening a considerable time before others, and the males seeming to ripen somewhat in advance of the females. From 40,000 to 130,000 eggs were obtained at one time from a single fish. The shad, however, yields only 20,000 to 30,000 as its fruits of an entire season. The cod, on the other hand, are so prolific that a twenty-one pound fish has yielded 2,700,000 eggs, and a seventy-pound fish has yielded 9,000,000 eggs.

When the fish had remained in the nets several days Mr. Earll found that the most of the spawning females had deposited all their ripe eggs. The greatest quantities were secured from individuals that had remained in the pound but a few hours. It is believed that when confined the female presses against the netting in its efforts to escape and produces an abnormal discharge of eggs; but it would result in the impregnation of a much larger number of eggs than would chance to be fertilized in a natural way. The males and females being caught side by side in considerable numbers, both eggs and milt would be present in the water in such quantities that they could not fail to come in contact before vitality is lost. A half hour after contact with the milt, the eggs swell and become too hard to be broken by pressure of the thumb and finger. Their specific gravity is now so nearly equal to that of salt water that when the water is at rest they float upon its surface, remain suspended in the water, or occasionally sink slowly to the bottom. The least current will cause them to be distributed through the liquid. Mr. Earll discovered a small oil globule in each egg which serves the purpose of buoying it. The impregnated egg is also so transparent that the fishermen, who are not usually very observing, would never suspect their presence. The eggs are smaller than eggs of almost any other species, and have an average diameter of only one-twenty-eighth of an inch. It has been estimated, it will be seen, that 21,952 would make a cubic inch, and a quart of 57¾ cubic inches would hold 1,267,728 eggs.

The period of hatching is greatly influenced by the temperature of the water. The average temperature during the experiments at Crisfield was 84° Fahrenheit. Ten hours after contact with the milt the outline of the fish could be discerned by the naked eye. The fish is formed with the curve of the back at the lowest point of the egg. In fifteen and one-half hours the fish began hatching. In eighteen hours one-half of the eggs had hatched, and in twenty hours all were out. Experiments in water at 78° Fahrenheit showed that twenty-four hours were necessary for hatching. A more remarkable effect of temperature is observable in the case of the cod. In water at 45° cod have been hatched in thirteen days, but in water at 31° fifty days were occupied in hatching.

The newly-hatched mackerel are about one-eighth of an inch in length, and so small as to escape through wire cloth with thirty-two threads to the inch, and are almost colorless. The food sac, situated well forward, is quite large in proportion to the body, the anterior margin extending to the lower jaw. While floating on its back for several hours, during its helpless condition, it passes safely over the heads of its enemies, and is protected from being wrecked in sand or weeds. After a few hours, becoming more vigorous, it gets to a depth of an inch or more below the surface of the water. After a day or two the food sac is less prominent, and the fish experiences less difficulty in swimming at various depths. The young mackerel hatched by Mr. Earll were so hardy that forty were confined in a goblet without change of water for two days before the first fish died; others placed in water which was allowed to cool gradually and immediately transferred to water ten degrees warmer, were not injured in the least. In fresh water they slowly sank and died in a few hours. Mr. Earll also found that a fair percentage of eggs could be hatched in still water with but one or two changes during their development. Eggs taken at 6 P.M., and allowed to remain in a basin of water till morning, when another change was made, hatched with very small percentage of loss. Samples of all the different stages of development were preserved in alcohol and glycerine for the National Museum. Over half a million were hatched by the various methods and at various times.

The apparatus used in these experiments consisted simply of floating boxes with bottoms made of wire cloth. The cloth was plated with nickel to prevent injurious action of the salt water, and contained thirty-two wires to the inch. After it was found that a lot of fish had escaped through it, only the shells remaining to prove that hatching had actually taken place, the wire and each aperture were covered with coarse cotton cloth. The boxes were provided with covers for protection against storms, or wind, or rain, but were provided with openings on the sides to admit fresh water from above.

The commissioner has been intensely gratified at these results due to the ingenuity of Mr. Earll. They open the way to the systematic propagation of the species in waters where they do not now exist, and to the countless multiplication of them in the Chesapeake. The season being in mid-summer will not conflict with the shad season of the Spring, the salmon season of the Fall, or the cod season of the Winter. The eggs are much more abundant and hatch more easily and rapidly than those of any fish now propagated. During the four days consumed in hatching a lot of shad, five lots of mackerel could be hatched, and during the twenty-four days necessary to hatch one lot of cod-fish, thirty-two lots of mackerel would be produced. A suitable station for hatching was chosen at Cherrystone, Md. The fishermen are kindly disposed and will render every assistance. It is hoped that young fish may be thus successfully planted as far North as Narragansett Bay.

SMITHSONIAN INSTITUTION, Washington, D.C., *November* 6, 1880.

THE ISLAND OF MONTREAL.*

By WILLIAM BOYD.

A considerable portion of the waters of the Ottawa, at the foot of the Lake of Two Mountains, divides on the Island of Montreal. The branch that is directed to the northern part of the island soon sub-divides on Isle Perrot. There rapids are in each of the sub-branches. The sub-branches encounter the St. Lawrence on its northern side at two points,—shortly after it leaves the Cascades Rapids and below Isle Perrot, from that island's inner shore. The waters of the St. Law-rence bound also, indirectly, the southern side of the Island of Montreal, flowing in the same river-bed with the Ottawa, but beyond or outside its stream. The water of the St. Lawrence is greenish, that of the Ottawa reddish-brown. The two rivers run side by side unmixed to the Ottawa's lowermost mouth, at the foot of the Island of Montreal; and thence onward in the same manner, with increased volume on the part of the Ottawa, to Lake St. Peter, where they finally mingle. If the Ottawa should cease to exist and the St. Lawrence remain, what is now the Island of Montreal would probably—from the high level of the then Lake of Two Mountains, and from a great fall which would, on the extinction of the Ottawa, take place in the St. Lawrence below the Cascades Rapids—be an island no longer; but if the St. Lawrence should disappear and the Ottawa remain, the Island of Montreal would continue to be an island still. Therefore the writer is of the opinion that the Island of Montreal is an island not in the St. Lawrence as has heretofore been held, but in the Ottawa.

FRIEDRICH MOHR'S LIFE AND WORKS.

By DR. GEO. W. RACHEL.

On September 28, 1879, *Prof.* FRIEDRICH MOHR, one of the greatest philosophers Germany has ever produced, died after a short illness at *Bonn* on the Rhine. He was born at Koblenz on November 4, 1806, and, therefore, at the time of his death, was nearly 73 years old. In spite of this advanced age, he remained active and bright almost to the very moment of death, dictating to his daughter Anna until within a few hours of it in his usual clear and coherent manner.

His father was a pharmacist and proprietor of one of the principal drug-stores of the town; he is described as having been unusually proficient in the arts of his trade, and an ardent lover of his special profession as well as of science in general. A wealthy man, comparatively speaking, he bestowed great care on little FRIEDRICH, the only surviving child of six. The opportunity offered to the sickly, quiet boy who had to be kept from school during the greater part of his boyhood, was eagerly taken advantage of by him. Test-tubes and retorts almost took the place of play-toys with him, and his involuntary leisure enabled him to lay the foundation for his future greatness, viz.: an ability for labratory work almost unsurpassed. Thus it was that his methods as well as many of the instruments and apparatus he devised, are found to-day in every laboratory and are used all over the globe wherever chemistry has an abode.

* Read before the A. A. A. S., Boston, 1880.