stood. I have said that we must obtain the complete mythologies of each linguistic stock of America, and we must work until we have shown what the characters of the myths of each stock really represent. This done, each stock is to be compared with that most nearly related to it, and then a general comparison of all. The final result will be a scientific American mythology. If the Aryan field is worked in a similarly careful manner, we shall have a complete Celtic, Teutonic, Greek, Slavonic, Persian, and other mythologies, and, finally, Aryan mythology as a whole.

"There still remain Africa, Australia, and the Pacific Islands, where there are materials of the highest value for the completion of mythologic science and the history of the human mind, — materials which are perishing every day, and which will never be collected if missionaries and travellers are to collect them. You could no more make a collection of myths through the agency of missionaries and travellers than you could make a geological survey of the United States if you depended on the voluntary and intermittent efforts of missionaries and travellers, some having, but most not having, definite ideas about geology or topography.

"Though mythology is as nothing on Wall Street in comparison with geology, the time, I think, is coming when a good number of men will place it higher; because mythology is to the history of the human mind what geology is to the history of the earth, — documentary evidence of the character of its different epochs. Even now there are few persons who would say that the earth on which he treads is better than man. You remember the words of the great poet, —

> "'The cloud-capp'd towers, the gorgeous palaces,
> The solemn temples, the great globe itself,
> Yea, all which it inherit, shall dissolve,
> And, like this insubstantial pageant, faded,
> Leave not a rack behind.'

"When that time comes, it will be found that the only real, the only permanent, results achieved on earth were those relating to the human mind."

SCIENTIFIC NEWS IN WASHINGTON.

Phonographs, Graphophones, etc.; Curious Experiments with Jets of Water. — Replenishing Rivers with Shad. — More about the Water-Spouts. — United States Fish Commission Work on the Pacific Coast.

Instruments for Recording and Reproducing Speech.

PROF. ALEXANDER GRAHAM BELL read, at the last meeting of the Fortnightly Club, a paper upon recent inventions for recording and reproducing speech, exhibiting, to illustrate what he said, some of the latest and most curious devices that have been produced. He explained the nomenclature of the subject as he thought it ought to be used, by saying that a phonograph is an instrument for making a record of speech; phonogram, the record so made; and graphophone, an instrument for reproducing speech from a phonogram. In some cases the phonograph and graphophone are the same in most of their parts, but in many they are entirely different.

Professor Bell exhibited the graphophone, of which a number are now in practical use, and which, in its essential parts, is similar to Edison's phonograph. The record is made on a cylinder covered with wax or paraffine, and the speech is reproduced by conducting the sounds to a diaphragm connected to an open trumpet-shaped instrument, or, by wires to devices placed upon the ears, vibrations corresponding to those that were produced when the record was made.

A modification of these instruments was shown, in which the record was made upon a pasteboard disk revolved upon a shaft in a horizontal plane. The upper surface of the disk is covered with wax, upon which a similar impression to that on the wax-covered cylinder is made by a stylus connected with a diaphragm which is caused to vibrate by the sound of the voice. The record is a spiral groove cut in the wax. The reproduction is obtained in a manner similar to that used in the cylindrical machine. The principal advantage which this form of the instrument is expected to present over the older, cylindrical form is in the greater facility of multiplying copies. Electrotypes are much more readily made from the flat disks than from the cylinders. From these electrotypes other disks covered with wax, and that with tinfoil to prevent sticking, obtain the spiral impression by pressure of the former upon the latter; and when one of these duplicates, the tinfoil having been removed, is put into the instrument, the reproduction of speech is as perfect as from the disk on which the original record was made.

The most interesting and curious part of Professor Bell's paper related to experiments based upon investigations and discoveries made by Dr. Chichester Bell in regard to the effects of sounds upon jets of fluid. It is well known that if a jet of fluid, like water, is placed in sound-waves, it is not only sensitive to them, but it reproduces them as the string of a musical instrument, tuned in unison with that of another, will vibrate, and reproduce the tones given out by the first. It is not easy to hear the sound or speech reproduced by the jet of water. The former mode was to connect the hearing-tube with a rubber diaphragm placed in the jet of water, which is discharged perpendicularly from above, at a given pressure, from a very small orifice. When the rubber is held very close to the orifice, the sound reproduced is very faint; but, as it is moved away, it increases in volume until the point of maximum loudness is reached; then it diminishes again until near the point where the stream begins to break; and then it is broken up, and is entirely unintelligible. As the sounds to be reproduced by the jet have to be made in the same room, and very near to the jet of water, it is very difficult for any but a practised ear to detect the one from the other.

In order to make this more satisfactory, Dr. Chichester Bell made the following experiment. Substituting two platinum wires for the rubber diaphragm with a small piece of some non-conducting substance inserted between their ends, he placed this in the jet at the point where the largest volume of sound has been found to be reproduced. These wires being connected with an electric battery, and a telephone placed in the circuit, it was possible to have the speaker and listener almost any distance apart. With this apparatus, speech was not only reproduced, but with increased volume: the jet of water not only spoke, but acted also as a microphone to magnify the sounds it made.

Upon these experiments were based those which Professor Bell explained to the club. The jet of water, somewhat colored, was discharged upon a glass plate placed in it at the point from which the greatest volume of sound was known to issue in reproducing speech. This caused the jet to spread out in a thin film over the plate. The under side of the glass was covered with an opaque substance in which there was a small slit through which a small amount of light could pass. Behind the slit a moving piece of photographic paper was placed, upon which the record was made. Then a person spoke over the plate, and the result was a very curious line upon the photographic paper. When this line was transferred to gelatine in the ordinary way, it was found that a series of elevations and depressions was produced, which could be felt with the fingers, and from which an electrotype could easily be made. This showed that the sound-waves, striking the film of water on the glass, caused constant changes in the thickness of the latter, and thus caused a variation in the intensity of the light that passed through the slit. From such a record as this, it will probably be a simple problem to reproduce the speech. Professor Bell exhibited specimens of the original record upon the photographic paper, of the negative that is made for the transfer to the gelatine, and of the gelatine after the transfer had been made. The possibility of developing from these experiments an instrument for the reproduction of sounds that may be superior to any yet made is what makes them so interesting.

Shad-Hatching.

The shad-hatching by the United States Fish Commission this year is confined to four stations, — one at Fort Washington, on the Potomac; one at Havre de Grace and another at Battery Island, on the Susquehanna; and one on board the 'Fish hawk,' on the Delaware. The season for taking eggs will continue until the last week in May or the first week in June; and the number of eggs captured this year up to May 19 was far greater than had been taken at the same stations at the corresponding date of 1887, when the

whole number for the entire season was more than 200,000,000. The three rivers are now yielding from 12,000,000 to 15,000,000 eggs daily. The commission is also giving attention to the moving of eggs and the hatching and planting of young shad in the rivers that flow into the South Atlantic and the Gulf of Mexico: 30,000,000 eggs will be disposed of in this way this season.

Whatever opinion may be held of the other work of the United States Fish Commission (and the importance of all branches of its work is coming to be universally recognized), its success in increasing the supply of shad in the rivers to which it has given its attention, and in introducing it where it did not before exist, has been demonstrated beyond question. The value of shad taken in the United States in 1887 was $325,000 greater than in 1880, and this in spite of the fact that the market-prices of the fish are now much lower than formerly. Shad can be bought on the wharves in Washington for from ten to twelve dollars per hundred, and at retail in the market for twenty-five cents each. Before 1884 the retail price of similar fish was seventy-five cents each. The increase first became noticeable in 1884.

The Water-Spouts of April.

Science republished, about six weeks ago, one of the charts of the Hydrographic Office, showing the location of a great number of water-spouts observed in the western Atlantic in March and early in April. Since that time many more detailed reports have been received; and among them one of the most interesting is that made up from the log of the steamer 'Pavonia,' and from the testimony of eye-witnesses who were on board of her. The following is the substance of that report. The spout formed south-west of the ship, and travelled in a north-east direction, making it necessary for the 'Pavonia' to change her course in order to avoid it. Its movement was at the rate of thirty miles an hour; and from the time it was first seen, until it burst near the vessel, only ten minutes elapsed. Its rotary motion was against that of the sun. The agitation of the sea at the base was tremendous, so that the ship was greatly affected by it when the water-spout passed near. The wind at the time was a light breeze from the south. As the water-spout passed, the ship experienced a perfect whirlwind for about a minute. The water-spout broke off the starboard bow, and this was accompanied by a great deluge of rain, vivid lightning, and heavy thunder; and chunks of ice fell upon the decks of the 'Pavonia,' irregular in shape, as though broken from a block, many of them from four to six inches in diameter. As the water-spout broke, the wind shifted to the south-west, and increased to a moderate gale. The cloud hung very low, and the water-spout took the form of an hour-glass. A terrific roaring noise was heard as it passed the ship, and, as it went along, it threw the water to a height of sixty feet at least, and churned it up into a mass of foam. There was no evidence of ascending or descending currents. The water appeared to be lifted bodily into the air, and held there until the water-spout broke near the vessel. No observations of barometer or thermometer were made.

United States Fish Commission Work on the Pacific Coast.

The United States Fish Commission steamer 'Albatross,' Capt. Z. L. Tanner, arrived at San Francisco last week, and, as soon as she is fitted out, will start on her summer cruise. She has been ordered to cruise from Kodiac to and along the Aleutian Islands, for the purpose of studying the fishing-grounds of the Alaskan coast. The most important fish found there is the cod. Captain Tanner is instructed to make a careful and systematic study of the whole coast, not only hydrographically, but for the purpose of determining the kinds of fish to be found there, the limits of their distribution, and their abundance. He is also to make a thorough study of the fauna of the sea and its distribution over the sea-bottom. Important results are anticipated from this summer's cruise of the 'Albatross.'

ELECTRICAL SCIENCE.

Edison's Improved Phonograph.

THE first phonograph made by Edison, in 1878, differed from many inventions — for example, the telephone and telegraph — in that it was not the result of a process of evolution, and it was not almost simultaneously discovered by different investigators. As it was first exhibited, it consisted of a diaphragm to which was fastened a needle whose point pressed against a strip of tinfoil: the tinfoil was rolled around a cylinder, which was rotated by hand, and which had, besides its motion of rotation, a forward motion on a screw, so that the needle traced a spiral on the surface of the foil. When the diaphragm was spoken to, the cylinder being at the same time turned, the needle made a record on the foil; the number and depth of its indentations depending, of course, on the vibration of the diaphragm, and therefore on the sound it received. When the needle was made to traverse the record again, it transmitted vibrations to the diaphragm similar to those it had received, reproducing the original sound. There were several disadvantages in this first instrument: the reproduction was by no means perfect, and the mechanical arrangement was not convenient. Mr. Edison has, however, continued his investigations on the subject, and has lately produced an instrument that leaves little to be desired as far as faithfulness of reproduction goes. There is no radical change in principle. In place of the tinfoil, wax cylinders are used, and they are uniformly rotated by an electric motor. The instrument is so arranged that words can be repeated that are not understood. The wax cylinders are of different sizes. One of two inches in diameter, four and a half inches in length, and one-eighth of an inch thick, will contain from one thousand to twelve hundred words, and can be used over ten or twelve times, a turning-tool in front of the diaphragm shaving off the old record. The accuracy with which sounds, vocal and instrumental, are reproduced is remarkable. On May 12 an exhibition of the phonograph was given at the New York Electric Club, and Mr. Gilliland described the history of the invention. Various applications were shown, and a number of different sounds reproduced. There is no doubt that the phonograph can accurately record all varieties of sound, from the human voice in ordinary conversation to a brilliant piano concert. The records are portable and easily reproduced, and the field of application of the instrument must be wide.

DYNAMO AND STEAM TURBINE. — A combined dynamo and steam turbine that has been in use in England for some time, has recently been introduced into the United States for ship-lighting purposes by the United States naval authorities at Newport, R.I. The armature of the dynamo is connected directly to the shaft of the turbine, which revolves at the extremely rapid rate of ten thousand revolutions per minute. The turbine works on the general principle of Helmholtz's double siren, except that instead of two disks there are perhaps fifty, arranged on horizontal axes; the steam entering at the middle, and exhausting at the ends. While this is in all probability not economical, it is extremely compact, — a very important consideration on board ship, where space is valuable and belting is objectionable. The electro-motive force of the dynamo is kept constant by an electric governor which regulates the throttle valve of the turbine. The extremely high speed necessitates the best possible lubrication: the bearings are long, with ample oil-channels.

PRIESTMAN'S PETROLEUM-ENGINE. — The London *Electrical Review* contains reports of tests of this engine made by Sir William Thomson, Sir Samuel Canning, and others. The reports are most flattering. Tests were made of engines giving six-horse power at the driving-pulley, with the result that the consumption of oil was about 1.7 pints per horse-power per hour, while they need very little attention. To quote a part of Sir Samuel Canning's report: "We consider that there is a great field of usefulness for this motor, and especially in America, where gas averages something like 7s. 6d. per thousand cubic feet, and where, owing to the vast expanse of the country, it is very difficult to get motive power in more or less inaccessible localities; . . . for isolated electric light installations, and even larger operations of the kind, and for every use to which a gas-engine can be put, with the special advantage of being capable of employment where gas cannot be utilized." The engine is run by the petroleum vapor, which is exploded in the cylinder, as is the gas in the cylinder of a gas-engine. There must, of course, be a water-jacket to the cylinder, to prevent excessive and dangerous heating. Let us consider what the cost of isolated lighting would be, using this engine, as compared with gas. An