speed of the revolving belt and travelling cable to the speed of the motor, and thus enables a gradual start or variable train-speed without injury to the grip or cable. To the left of the capstan-wheel is a vertical shaft having on top a crank with handle or a wheel, and terminating below in a bevel-gear wheel which engages with another keyed to the long shaft, by means of which the pick-up is operated, as well as the carrying-sheaves at the end of the motor, which serve to properly guide the cable in its relationship to the revolving belt, and cause it to revolve at the same speed as the travelling cable, before their contact. These are all very simply and positively accomplished by the continuous turning of the one crank, which, being a uniform motion, precludes any confusion of the operator.

Fig. 4 shows the pick-up and supporting wheels in detail, and their transposition when operated. Though the pick-up is capable of being worked at any time, its use is seldom required, as the cable travels through the supporting wheels almost continuously, — during stops at stations and when varying the speed, — and is seldom dropped but at crossings, ends of sections, and the termini. In dotted lines below the capstan-wheel is the automatic tripping-device to release the cable at the end of a section or at any fixed point.

Fig. 5 is a cross-section showing the shape of the clip-belt in its position between the gripping and braking jaws, which get their force from the connected compound levers and toggle, actuated by the large capstan-wheel. This grip is seen holding the right-hand cable, but may be easily shifted on its movable supporting-frame, pneumatically with cylinders, as shown in plan view in Fig. 6 (or with a capstan-bar), by the engineer or grip-man, to the centre (as required with a single cable), or to accommodate the left-hand cable (as in this duplicate system); which cable is seen supported by the end guide-wheels (previously referred to in connection with Figs. 3 and 4) in Fig. 7 in their relationship with the guard-wheels to the guard-rail and curve-carrying sheaves, Figs. 8 and 9 respectively showing the same duplicate cables in plan of track on curve, and its approach. This motor is also provided with combined air-pumps and engine-cylinders, and reservoirs.

Being adapted to a duplicate cable system that provides against the delays which might possibly occur in the use of a single cable, the grip is shifted to a position directly over the cable it is desired to take (see Fig. 6), two methods being provided in case of accident to one or the other. The horizontal crank or wheel actuating the vertical shaft (see Fig. 3) is then revolved continuously in the same direction. This causes the pick-up at each end of the motor (see Figs. 3 and 4) to descend, pass under the cable, lift it, and throw in the carrying-wheels (see Figs. 3 and 4) to support the cable in an elevated position, to be gripped by the clip-belt after the same has been put into motion by contact of the same supporting-wheels with the travelling cable; following which the pick-up is lowered slightly, and withdrawn to one side of the cable. The train can now be started and speeded with a graduation exactly as the operator may intend by the turning of the large capstan-wheel that governs the powerful mechanical combination (see Fig. 4) which actuates the braking and gripping-jaws, increasing or lessening the required tractive power, and correspondingly regulating the speed of the train without any undue exertion of the operator.

If for any reason it should be necessary to communicate with or signal to the power-house, or stop one cable and start the other, it may be done direct from the trains or motors, at any point on the line of railway, by a patent electric device; and, in the event of thus transferring the power from one to the other of the duplicate cables, the grips are shifted conformably (see Fig. 6).

THE WORK OF THE PEABODY MUSEUM OF AMERICAN ARCHÆOLOGY AND ETHNOLOGY.

THE twenty-second annual report of Professor F. W. Putnam shows that the work of the Peabody Museum of American Archæology and Ethnology is constantly growing in importance. From the interesting contents of his report we glean the following facts.

The museum purchased for a moderate sum, from the Rev. Samuel Lockwood of Freehold, N.J., a collection of particular importance in supplementing the Abbott collection from the vicinity of Trenton. Over thirty years ago Mr. Lockwood investigated the great shell-heap at Keyport, and was the first to call attention to its character. This shell-heap, with many of the objects from it, was afterwards described by Dr. Rau, and has become historical in American archæology. From this large refuse-pile the most important part of the Lockwood collection was obtained. In addition, there are many stone implements from various places in Monmouth, Middlesex, Mercer, and Ocean Counties. Among them are several paleolithic implements, and a large number of argillite points, found under peculiar conditions, and showing a degree of weathering which is conclusive evidence of their extreme antiquity. As the shell-heap at Keyport, once covering a mile or more in length along a narrow strip, bordered upon one side by the ocean and on the other by Raritan Bay, is entirely obliterated, it is of importance that the materials obtained from it be now in the museum for comparison with the very extensive collections from the shell-heaps of New England. The fact that at certain places on this narrow strip between the bay and the sea the prevailing implements were of argillite and of great antiquity has a peculiar significance in connection with those from Trenton, and again points to an intermediate period between the paleolithic and the late Indian occupation of New Jersey. The collection also contains three Indian crania from Monmouth County, and a few objects from various places beyond the immediate region of Keyport. Mr. Lockwood has a considerable number of field notes, made during his long-continued explorations of the vicinity of Keyport, and it is his intention to prepare a full account of his observations and of the collection, for publication by the museum.

In the list of officers given in connection with the last report, it will be noticed that the name of Mr. Hilborne T. Cresson of Philadelphia is given as a special assistant in the field. Mr. Cresson, while studying abroad, became interested in the archæology of France and Switzerland, and while at home has devoted his leisure time to a study of American archæology, upon which he has published several important papers. About 1870 his attention was called to the existence of stakes or piles, observed by a fisherman, in the mud at the mouth of Naaman's Creek, a small tributary of the Delaware River. Circumstances at the time did not permit of more than a hasty examination and the taking of a photograph of the locality. It was not until Mr. Cresson's return from France, in 1880, that means were furnished, by a gentleman of Philadelphia, to prosecute the work. His examinations soon led to the discovery of three distinct localities, near to each other, which he designated Stations A, B, and C, and around which were found a very important and instructive collection of stone implements, a few points and fragments of bone, and a human tooth. At one station a number of fragments of rude pottery were found, and at this were obtained the several pile-ends now in the museum. This collection he has generously given to the museum, and proposes soon to prepare a full account of his discoveries for publication. The museum is also much indebted to Mr. A. B. Huey of Philadelphia for a number of specimens which he obtained while with Mr. Cresson during the examination of Station B, and to Mr. W. R. Thompson of Philadelphia, for several potsherds, and a large stone maul with a hole drilled through it, from the same station.

When it is recalled that this is the first indication in North America of any thing even remotely resembling the crannoge-like structures of the European bogs, the importance of Mr. Cresson's labors will be appreciated; and the museum is fortunate in having his co-operation in its work, — a co-operation which he states he freely gives from his appreciation of the objects and methods of the museum. The specimens are now exhibited in the museum, and are of great importance in the study of the periods of occupation of the Atlantic coast. The discovery by Mr. Cresson of the fact that at only one station pottery occurs, and also that at this station the stone implements are largely of jasper and quartz, with few of argillite, while at the two other stations many rude stone implements are associated with chipped points of argillite, with few of jasper and other flint-like material, is of great interest in connection with the specimens collected by Dr. Abbott and Mr. Lockwood in New Jersey, to which allusion has been made.

In connection with his studies of the river-stations, Mr. Cresson has examined the peat marshes and land along the shore of the

Delaware, and has obtained stone implements from various points, both personally and by interesting friends and residents in the work he was engaged upon. He has also made a collection to show the character and relation of the peat to the river-deposits, and in various ways has made a thorough study of the connection of the river-stations with the early inhabitants of the shore.

Mr. Cresson's investigations have also been carried on in relation to the paleolithic implements found in the gravel, and he has been so fortunate as to discover two specimens *in situ* in the older gravel near Claymont, Newcastle County, Del. He also, in company with Mr. Thompson, made a visit to Indiana, and examined the gravel on White River above Medora in Jackson County. Here he was so fortunate as to find a large paleolithic implement of gray flint, in place in the gravel of the bluff of the east fork of White River. A rudely chipped implement, probably of later date, was also found in the gravel about a mile distant from the first, and was presented to the museum by Mr. Thompson.

Mr. Cresson has prepared a full account, which will soon be printed, of the discovery of these implements. In the mean while it is only necessary to call attention to the importance of these discoveries in relation to the distribution of paleolithic man in America. The value of the material for this purpose cannot be overestimated, containing as it does nearly all the implements known from the New Jersey gravels, in the Abbott and Lockwood collections, the two specimens from Delaware and one from Indiana in the Cresson collection, the two from Ohio found by Dr. Metz, and the Babbitt collection from Minnesota. For comparison with these, the museum has numerous specimens from the gravels of France and England.

Professor Putnam's remarks on the results of his researches on the Serpent Mound will be read with interest. He says, —

"We have discovered many facts pointing conclusively to considerable antiquity in the occupation of the region about the Serpent Mound. We know historically that a hundred years ago the region was inhabited by Indians, and we have found graves that probably belong to that time, or immediately preceding it, and we have also found another class of burials having every indication of far greater antiquity. Here upon the Serpent Mound Park, the property of the museum, and not far from the Serpent, are three burial-mounds with two entirely different methods of burial. Here are a village site and a burial-place occupying the same area. A recent and an early period are everywhere evident as the exploration goes on. Every thing relating to the construction of the great earthwork points to antiquity. The signs of the later occupation of the region about it have nothing remarkable: simple ash-beds where the dwellings stood; burials in the black soil, with or without protecting stones about the graves; no elaborate structures or indications of special ceremonies in connection with the burial of the dead; intrusive burials in a conical burial-mound; — every thing, on the one hand, pointing to a recent and not long-continued abode upon the spot; on the other hand, antiquity and special ceremonies; — a conical mound of considerable size, erected as a monument over the body of a single person, buried after some great ceremony in connection with fire; another mound under which were four graves (one deep down in the clay under many large stones; three others over this, with large stones about the graves and over them, and a mound of earth over all); in another instance a grave deep in the clay, with flat stones at the bottom, upon which the body was placed, and over the body many large stones, covered by the black soil of recent formation; and in this black soil, over the stones, a grave of the later period; in another place, under the black and recent soil, stones irregularly placed upon the clay, marking graves, or places where fires were made; two and three feet under these once surface-piles of stones, the graves, with skeletons so far decayed that only fragments could be secured (in several instances only the outlines of the bones could be traced in the clay; in some cases the bones in part were preserved by the infiltration of iron, and the crevices in the clay about the bones were filled with limonite, — all showing great antiquity in contrast to the more recent burials). These older burials were made in connection with ceremonies during which fire played an important part, as shown by the burial of ashes and burnt materials with the bodies, and also by the stone fireplaces near the graves. In several of these ancient graves, objects were found similar to those which we have obtained in the ancient mounds of other parts of the State. In the recent graves, with the skeletons just under the recent black soil, only now and then an arrow-point of flint or a stone celt was found, with fragments of rude pottery, such as are distributed over the surface of the village site. In the ancient graves not a fragment of pottery was found. In one of the oldest graves containing two skeletons were nearly fifty stone implements and several ornaments, among them one cut out of a crystal of galena.

"Of the two periods, our explorations have shown that it can hardly be questioned but that the Serpent Mound was built by the people of the first, that it was connected with their beliefs and their ceremonies, and that in its sacred precincts some of their dead were buried.

"This seems to be the legitimate conclusion reached by our work to this time. I shall still have time for further explorations before leaving this interesting spot, and there is much to be done in the immediate vicinity another year."

NOTES ON THE USE OF GRATINGS.[1]

THE ghosts are very weak in most of my gratings. They are scarcely visible in the lower orders of spectra, but increase in intensity, as compared with the principal line, as the square of the order of the spectrum: hence, to avoid them, obtain magnification by increasing the focal distances instead of going to the higher orders. The distances from the principal line in my gratings are the same as the distances of the spectra from the image of the slit when using a grating of 20 lines to the inch. They are always symmetrical on the two sides, and about $\frac{1}{18}$ of an inch for the violet and $\frac{1}{8}$ of an inch for the red in a grating of 21 feet 6 inches radius in all orders of spectra. When the given line has the proper exposure on the photographic plate, the ghosts will not show, but over-exposure brings them out faintly in the third spectrum of a 20,000 grating or the sixth of a 10,000 one. They never cause any trouble, as they are easily recognized and never appear in the solar spectrum. In some cases the higher orders of ghosts are quite as apparent as those of the first order.

The gratings with 10,000 lines to the inch often have better definition than those of 20,000, as they take half the time to rule, and they are quite as good for eye-observation. They can also be used for photographing the spectrum by absorbing the overlying spectra, but there are very few materials which let through the ultra-violet and absorb the longer wave-lengths. The 10,000 gratings have the advantage, however, in the measurement of wave-lengths by the overlapping spectra, although this method is unnecessary since the completion of my map of the spectrum. By far the best is to use a 20,000 grating, and observe down to the D line by photography, using erythrosin plates from the F line down to D. Below D, cyanine plates can be used, although the time of exposure is from ten to sixty minutes with a narrow slit. The solar spectrum extends to wave-length 3,000, and the map has been continued to this point. Beyond this, the coincidence with the solar spectrum cannot be used, but those of the first and second or second and third spectra can be.

Some complaints have been made to me that one of my gratings has no spectrum beyond 3,400, even of the electric arc. I have never found this the case, as the one I use gives wave-length 2,200 readily with thirty minutes' exposure on slow plates, requiring five minutes for the most sensitive part, and using the electric arc. With sensitive plates, the time can be diminished to one-fifth of this.

For eye-observations, a very low power eye-piece of one or two inches focus is best. This, with a focus of 21 feet 6 inches, is equivalent to a plane grating with a telescope of a power of 100 or 200.

In measuring the spectra, an ordinary dividing-engine, with errors not greater than $\frac{1}{1000}$ of an inch, can be used, going over the measurements twice with the plate reversed between the separate series. The plates are on so very large a scale, that the microscope must have a very low power. The one I use has a 1-inch

[1] From Johns Hopkins University Circulars, May, 1889.