supervision of all the operations of that body in the valley of the Mississippi. He organized the comprehensive work of the commission in the large section that was entrusted to his care, and during its life expended more than $800,000 in money, besides distributing hospital stores that were valued at more than $5,000,000. The whole story of that wonderful achievement, its development, and its completion was told by himself in his report of the commission in the valley of the Mississippi that was published in 1871.

With the return of peace came a new interest in the development of our institutions of learning, and conspicuous among the newer experiments was the then recently organized School of Mines of Columbia College. It was the first institution of its kind in the United States, and its success was yet to be determined. Newberry was called to the charge of the department of geology in the new school, and, with a faith in its ultimate success that never faltered, he accepted the trust. With the same genius for organization that was shown by his development of the work of the Sanitary Commission, he began the planning of courses of study. Alone he gave instruction in botany, zoology, geology, lithology, paleontology and economic geology, and a quarter of a century later left to the world as his best and greatest memorial a magnificently equipped department of the special branches taught by him not excelled by any similar educational institution in this country. Nor was this all. He created a museum of over 100,000 specimens, principally collected by himself, which served to illustrate his lectures on geology and economic geology. It contains "the best representatives of the mineral resources of the United States to be found anywhere, as well as many unique and remarkable fossils." *

* This is his own description taken from a personal letter written to me in 1888.

Kemp calls it 'a monument to his memory,' and adds:

Its wealth of fossil fish and fossil plants makes it unique and famous among geological museums.*

In 1869 he became State geologist of Ohio, and for many years he regularly spent his summers in the field, while the accumulated material was digested during the winter months in the laboratory in New York, yielding the nine large volumes of reports published by Ohio. The unwillingness of the State Legislature to permit the completion of the work as originally intended was the great grief of his closing years, and marked the beginning of his end.

It is a pleasure to remember that during the last years of his life he received the fossil plants and fishes from the United States Geological Survey to report on, and so returned to the study of those forms which, as a boy, he loved to collect in the coal deposits of eastern Ohio.

He was rich in those accumulated experiences that we call wisdom. He was a friend, faithful and true, as those who knew him can testify. He is gone, but his influence cannot die. It will live forever to 'reach through nature, moulding men.'

American astronomers hold a high place in the history of the development of their chosen science, and among those in our country who have made the study of the heavens their chief life-work, first place must unquestionably be given to Benjamin Apthorp Gould for his splendid achievements. In his time he ranked as the greatest of our astronomers, and our Association honored itself in choosing him to preside over the meeting held in Chicago in 1868.

MARCUS BENJAMIN.
U. S. NATIONAL MUSEUM.

(*To be continued.*)

THE BEST MOVEMENT FOR HANDWRITING.

IT is by no means certain that the ordinary writing movement, as taught in the

* *School of Mines Quarterly*, Vol. XIV., p. 99.

schools and used with more or less of individual peculiarity by most adults, represents, for purposes of rapid and legible writing, the best of which the human hand is capable. Every penman will recognize certain difficulties that attend the use of this movement. It is not as easy as one could wish: continued employment of it tends to writer's cramp. It is not as rapid as one could wish. It does not give as good penmanship as one could wish: it is subject to jerks and irregularities, and at high speeds requires so much exertion in making the vertical strokes that it is apt to degenerate into a flat scrawl.

In order to obviate some of these difficulties, another movement has been advocated and largely taught. This is sometimes called the 'American method,' sometimes the 'forearm movement.' In strictness, however, it is not a forearm movement, but a movement of the full arm from the shoulder. This mode of writing has at least one great advantage; it never leads to writer's cramp. It is not liable to cramp because it is made by good-sized muscles, whereas the ordinary thumb and finger movement is largely produced by the little muscles in the hand itself. The full arm movement has another advantage in the boldness and smoothness of its lines. But there is one strong objection to the use of this movement; the parts moved are much larger than is necessary for the end in view, and the amount of energy required is thus absurdly great. When this movement is hastened, it shakes the whole body. And besides this, it is not found to be specially favorable to the union of speed and legibility; it does not obviate the flattening out of the letters.

There is yet a third movement of which the hand is capable—a movement never taught for penmanship, but still possessing certain marked advantages over the movements now in vogue. It may be described as a side-to-side movement of the wrist—adduction and abduction. The forearm may also come into play, and the movement be made partly from the elbow. In order to write by this movement, let the top of a sheet of paper slant over to the right, instead of to the left as in ordinary writing. To carry the hand along the horizontal line, draw the whole arm, in the direction of the forearm, back towards the flank. Meanwhile impart to the wrist (and forearm) a back-and-forth, lateral motion, which shall produce the vertical strokes of the letters. Considerable awkwardness may at first be experienced, and the unusual position and appearance of the sheet will cause the writing to be 'back-handed.' This may be avoided by bending the elbow more sharply, so bringing the hand in rather close to the chest. The paper can then be placed square on the table, and the writing still made with the same movements, though less freely than in the other position. In order to compare the suggested movement with the others, we may reduce writing to its lowest terms, namely, to a series of simple up and down strokes, like a connected row of *m*'s. By the use of this simplified form, we can easily compare the three movements and observe their relative ease, speed and accuracy.

Extensive tests were made by this method,* and it was found that in point of speed the forearm movement averaged 23% better than either of the others. In point of freedom, likewise, it had the advantage, as was seen by the greater lengths of its vertical strokes when the movements were hastened. In regard to accuracy, several points had to be considered. In keeping the alignment, and in uniformity of height,

* This comparison was first suggested incidentally in the course of a study on the accuracy of movements, and the results are more fully reported in a paper entitled 'The Accuracy of Voluntary Movement,' published as Monograph Supplement, No. 13, to the *Psychological Review*.

the forearm movement proved slightly inferior to the more practiced finger movement, and even to the full arm movement. In this particular the full arm movement would, with practice, probably be the best of the three. But in uniformity of slant, the forearm movement was far superior to the others. There were a smoothness and grace in the tracings of this movement that were quite absent from the rest.

These analytical laboratory experiments were obtained with a high degree of agreement from a considerable number of individuals. As to the results of the suggested movement in actual writing, little more can at present be asserted than that the movement is entirely practicable. The few who have tried it are pleased with the results. The writer of this article has himself adopted it largely, and finds realized the advantages that the laboratory experiments gave reason to expect. Rapid writing is freer and more legible, showing no tendency to degenerate into the flat scrawl. Less fatigue is felt; and the muscles employed, though not so large as those of the full arm movement, are large enough to avoid the tendency to cramp. The uniformity of slant gives the page a neat appearance. The alignment is satisfactory. The possession of two movements is at times a great source of comfort. Finally, from the relative facility with which the left hand was found to acquire the various movements, as well as from the fact that the wrist movement is made by the simplest muscular coördination, it seems altogether probable that the wrist movement would possess, over the complex finger movement, the advantage of being more easily learned.

R. S. WOODWORTH.

A CENSUS OF THE FOSSIL VERTEBRATA OF NORTH AMERICA.

THE writer has been able to make such an examination of the literature appertaining to fossil vertebrates, that he feels justified in making a statement regarding the number of genera and species which are known to occur in North America north of Mexico. The writer is not aware that any one else has yet prepared a list of the species of all the groups, and apparently the paleontologists themselves have very vague ideas regarding the number of known species, outside of the groups which they are themselves studying.

It is, of course, recognized that no two men in preparing such a list would arrive at the same results, since their ideas would undoubtedly differ more or less regarding what are to be considered tenable genera and species. In determining whether or not reputed species are to be reduced to synonymy, the writer has in most cases accepted the results of the investigations of other workers, where such results have been expressed clearly and definitely; while in cases of doubt a conservative course has been followed, it being held that it will cause less confusion in nomenclature and bibliography to retain as distinct two forms which must eventually be united, than it will to unite under one name two forms which must in the end be separated.

The whole number of genera which, in the acceptation of the writer, are found in the region indicated is 1118; the whole number of species 3234. These are distributed among the large groups, as shown in table following. It is proper to note that in this list there is included a relatively small number of existing species whose remains have been found in pleistocene deposits of old lakes and of caves, accompanied by remains of other species either now extinct or having a geographical distribution different from the present. A larger proportional number of such living species is found in the group of birds than in any other, there being 33 such species.