hind limbs, it is also extended between the fingers of the fore limbs. Possibly in the early flying efforts of bats the fingers were extended in such a manner as to render any accidental growth of skin between them an advantage. Differences in the locomotive habits, and in the foot development, of the progenitors of flying reptiles and flying mammals, may account for this greater extension of the flying membrane in the case of the latter. Naturally such an advantage was seized upon and improved by natural selection. The membrane extended to the tips of the fingers, the fingers themselves grew much longer, and in time the fore limb lost all its powers as a walking organ, but became developed into an efficient flying organ, Bats, by this specialization of their fore limbs, ceased to be quadrupeds, though they never became true bipeds. Sleep and flight constitute the measure of their existence.

Thus the development of all flying vertebrates other than birds pursued the same general course. It began with the extension of the skin of the sides, so as to serve for parachute motion; and ended with an extension of the fingers of the fore limbs, an extension of the membrane to the tips of these elongated fingers, and a flying motion of these limbs. In necessary connection with these were concomitant internal changes, the whole anatomy of the animal becoming adapted to its flying habits.

But in the development of bird flight quite a different mode of evolution appears. Flight is here attained not by a special adaptation of the skin, but of the dermal covering. This covering was probably not the hair in its full modern sense. It was a primitive derivation from the reptilian scale, which secondarily became the avian feather and the mammalian hair. The feather of the bird agrees with the scale of the reptile in being developed in little hillocks upon the skin. The hair of the mammal developed in closed follicles within the skin. There thus has been a specialization in both, with the production of a change in the terminal character of the feather and in the dermal origin of the hair.

The progenitors of birds were either land or tree dwelling reptiles; most probably the latter. We have seen the extreme improbability that any leaping motion from the earth developed into a flight. We have also seen how natural it is for animals to leap from the limbs of trees, and that, in several modern instances, a degree of aerial support has been thus developed. But in such a leaping motion it is highly probable that some animals would make other efforts for support in the air besides the horizontal extension of their limbs. The swimming motion is a very natural one. It is naturally adopted by all land animals which fall into the water, and the webbed feet of swimming birds have been produced by it in the same manner as the webbed fingers of flying bats. Let us now consider some early animal, so far advanced beyond the reptilian ranks as to have become warm blooded, and covered with the primitive form of hair, arboreal in its habits, and accustomed to make long leaps from limb to limb. It is by no means improbable that some such animals would seek to swim in the air. A rapid motion of the fore limbs could not but aid in keeping the body horizontal, and if these limbs were covered with thick hair this must aid in breaking the fall of the animal. Any such habit could have but one result. A thicker hairy covering of the fore limbs, and even of the whole body, would prove an advantage to the animal, and these thickly matted hairs would tend to spread laterally, precisely as we find in the tails of Flying Squirrels and Phalangers. A still further advantage would be gained were these hairs rough instead of smooth on their edges, so as to cling together, and prevent the air from passing between them.

Such a swimming motion, performed by the fore limbs principally,—the hind limbs being the leaping organs,—and aided by the lateral outgrowth, and the "felting" of rough edged hairs, would, from its inception, be more than a parachute motion. It would be incipient flight from the first, a swimming in the air. The essential advantages gained by longer and longer leaps must tend to preserve any favorable conditions of the hair, and we can readily conceive the rough edges of the hairs extending into interlocking feathery expansions. In fact it is not difficult to imagine the slow evolution of true feathers in this manner, since every incipient approach to the feather must prove advantageous to the animal in its aerial motion.

But every better adapted movement of the fore limbs must prove similarly advantageous. Not only any variation from hairs towards feathers would be advantageous, but also any variation from a swimming towards a flying movement of the fore limbs. Of course the process must have been a slow one. It was necessarily slow also in the case of the bat and the Pterodactyl. But in all these cases every increment of variation from leaping towards flying was advantageous, so that there was no hindrance to a continual evolution towards full powers of flight.

But the development of the fore limbs into feathered wings unfitted them more and more for walking organs. The slowly developing bird must have trusted more and more to its hind limbs for support. Its arboreal habit developed the toes of these limbs into grasping organs. The original quadruped in time became a true biped, with a foot specially adapted to grasp the rounded surfaces of the limbs of trees, and so changed in position as to fall under the centre of gravity of the body. Hairs became feathers, the bones of the fore limbs aborted in part and became wing bones, and the original tree leaping reptile became a flying bird.

We may close with a very brief further consideration. In the first place it is highly probable that only quite small animals first gained this flying habit. Considerable weight would hinder its development. But after it was once gained there would be no special hindrance to increase in size in the newly evolved species. Yet a very great increase in size would so greatly increase the muscular effort necessary to flight that the larger birds would most likely spend a considerable portion of their time upon the earth. And in many cases the increased weight which is apt to arise from diminution of muscular exercise might render a resumption of the flying habit impossible. Such birds would lose their aerial powers, and become true land bipeds. We may ascribe the land residence, and the aborted wings, of the Ostrich, Cassowary, &c., to some such secondary process of evolution. On the other hand, many virtually land birds have become so by an adaptation to food in the obtaining of which flight was no advantage. Organs not used soon lose their muscular vigor, their size decreases, and gradual abortion takes place, unless adaptation to some new function gives them a special development in this new direction, and checks their tendency to disappear.

II.

STONE IMPLEMENTS IN THE DRIFT.*

By Watson C. Holbrook.

Many stone implements have been found deeply buried in the clay and gravel of Whiteside county, Illinois. Mindful of the many sources of error, and fully conscious of the many grave and serious questions involved, I have endeavored to examine with care and attention every one of the finds. The first is a black chest spear head about five inches long found incased in a block of granular stalagmite. This specimen was found in a light-blue clay. Above this clay was an alluvial deposit about five feet thick. Some pre-historic man must have left his spear head in a cave or hid it in a fissure of rock. Layer after layer of stalagmite was found. The spear's head

* A. A. A. S., Cincinnati, 1881.

was first covered by this incrustation of limestone, but in the course of time was completely buried in the thin, ribbon-like layers of this stalagmite. Then the floor of the cave was broken up, and the detached piece containing this specimen was carried here by water, or ice, or both, and here it has remained imbedded in this blue clay till all of the alluvium has been deposited. Several arrow-points have been found buried seven or eight feet below the surface of the earth. I have carefully examined two of these finds. They were buried in a tough, compact clay. They were found by workmen while cutting into the hillside and grading the public roads. A small arrow point was found by a friend of mine while digging a well. It was twenty-four feet below the surface of the earth. It is a well-made and beautiful arrow-point, and my friend will not part with his valuable specimen.

FRENCH ACADEMY OF SCIENCES.

August 8, 1881.

MINERALOGY.—M. Klein presents a communication on different solutions of very great density, which can be advantageously utilized in laboratories to separate pulverulent mineral particles from foreign bodies. The salts employed by M. Klein are the tungstoborates of cadmium, nickel and cobalt. The density of the solutions of the last two salts is 3. 4; yet M. Klein prefers to them the solution of tungstoborate of cadmium, whose density is only 3. 2, but which is quite transparent, while the others are very colored. The tungstoborate of cadmium can, besides, be obtained in crystals; it melts at a temperature of 75°, and becomes a transparent liquid, whose density is 3. 6.

PHYSICS.—M. Ancelin described a method of heating intended to replace foot-warmers of water. His system is based on the fact that every body which passes from a liquid to a solid state gives off its latent heat of fusion.

M. Ancelin encloses some acetate of soda in a metallic vase, which is then heated to a temperature of about 80°. Then left to itself, the apparatus cools little by little to about 59°; the acetate of soda then commences to solidify, and gives off its latent heat. While the solidification continues, the vase remains at the same temperature. Boilers heated in this way will remain hot four times as long as by the use of water, about twenty to twenty-two hours.

EXTRACTION OF SULPHUR.—M. Dubreuil, who has devised a new method for extracting the sulphur of Sicily, announces that he has found in the mother waters of the salt marshes of Palermo, charged with chloride of magnesium and boiling at 120°, a suitable substance to separate from the sulphur the earthy bodies which accompany it.

FOR the unities of electric measures there are adopted the fundamental unities—centimetre, gramme, second, and this system is briefly designated by the letters C. G. S. The practical units, the *ohm* and the *volt*, will retain their present definitions; the ohm is a resistance equal to 10^8 absolute unities (C. G. S.), and the volt is an electromotive force equal to 10^9 absolute unities (C. G. S.). The practical unit of resistance (ohm) will be represented by a column of mercury of 1 square mm. in section at the temperature of 0° C. An international commission will be charged with ascertaining for practice, by means of new experiments, the height of this column of mercury representing the ohm. The name *ampère* will be given to the current produced by the electromotor force of 1 volt in a circuit whose resistanse is 1 ohm. *Coulomb* is the quantity of electricity defined by the condition that in the current of an ampère the section of the conductor is traversed by a coulomb per second. *Farad* is the capacity defined by the condition that a coulomb in a condenser, whose capacity is a farad, establishes a difference of potential of a volt between the armatures.

COMET (*g*) 1881, SWIFT.

At eleven o'clock last evening, Director Lewis Swift, of Warner Observatory, discovered the seventh comet of the year in the Constellation of Cassiopeia in a line between Polaris and the great cluster in Perseus, a trifle nearer Polaris. It is nearly round, faint, has a slight central condensation, but no tail is yet visible. Its right ascension is one hour and fifty minutes, (1 h. 50 m). Declination north seventy-one (71) degrees, and its motion slow westward. Estimated diameter, about four minutes. As the comet of 1812 is anticipated from this quarter, it may be the great Pons Comet. This makes the sixth comet discovered in this country since May 1st, Swift getting the two hundred dollar Warner prize twice. The fifteen hundred dollars given in comet prizes during the past twelve months by Mr. Warner has evidently given an extraordinary impetus to astronomical study in this country. Director Swift, of the Warner Observatory, will visit Egypt, by the generosity of the founder of the Observatory, in December, 1882, to observe the total eclipse of the sun and verify his celebrated discovery of an intra-mercurial planet in 1878, which has been so much disputed by astronomers.

C. S. WHITTLERE,
Sec'y. Roch. Astro. Society.

WARNER OBSERVATORY, ROCHESTER,
N. Y., *November* 17, 1881.

COPYING INK FOR READILY TRANSCRIBING LETTERS WITHOUT A PRESS.

A paper on this subject by Professor Attfield, F.R.S., &c., was read at the last annual Pharmaceutical Conference at York, England. The author stated that for the past thirteen years all letters, reports, &c., that he had written had been transcribed into an ordinary thin-paper copying-book with no more effort than was employed in using apiece of blotting-paper. It had only been necessary to place the page of writing, note size, letter size, or even foolscap, in the letter-book, and use a leaf of the letter-book just as one would use a leaf of blotting-paper. The superfluous ink that would go into blotting-paper went on to the leaf of the letter-book, and, showing through the thin paper as usual, gave, on the other side of the leaf, a perfect transcript of the letter. Any excess of ink on the page, either of the letter or of the copying paper, was removed by placing a sheet of blotting-paper between them and running one's hand firmly over the whole in the ordinary manner.

This ready transcription was accomplished, as would be anticipated, by using ink which dried slowly. Indeed, obviously, the ink must dry sufficiently slowly for the characters at the top of a page of writing to remain wet when the last line was written, while it must dry sufficiently fast to preclude any chance of the copied page being smeared while subsequent pages were being covered. The drying must also be sufficiently rapid to prevent the characters "setting off," as printers term it, from one page on to another after folding.

The author then alluded to some difficulties attending the employment of the ink which had prevented its becoming an article of wholesale trade, but, he said, any chemist and druggist could make it and sell it, giving directions for use to customers. He himself had used it from year's end to year's end without any trouble whatever. It would be particularly useful to professional men and private persons.

The principle of the method of preparation consisted in dissolving a moderately powerful hygroscopic substance in any ordinary ink. After experimenting on all such substances known to him, he gave the preference to glycerin. Reduce, by evaporation, ten volumes of ink to six; then add four volumes of glycerin. Or manufacture some ink of nearly double strength and add to any quantity of it nearly an equal volume of glycerin.