ago there was a single fluid theory which was practically the reverse of our present electron theory. In terms of this old theory, the positive electricity flowed in the positive to negative direction. According to a later theory, the positive electricity moved in one direction and the negative electricity in the other, but now this double fluid theory has been discarded and it is quite generally believed that only the negative electricity moves in the passage of an electric current through, or over, a wire and in oxidation-reduction reactions. To be sure, a positively-charged body is attracted to a negatively-charged one, and if the former is fixed in position, as the cathode when dipped in an electrolytic cell, then the positively-charged body will move, but in every case of a transfer of electricity it is the light electron that changes position and never the heavy proton. Consequently, in oxidation-reduction reactions there is a flow of negative charges from the reductant to the oxidant and never a flow of positive electricity from the oxidizing to the oxidized body.

Teachers who persist in indicating the direction of an electric current in terms of discredited theories help to bring confusion into the minds of their pupils.

WILLIAM T. HALL

## PSEUDO-ARTIFACTS FROM THE PLIOCENE OF NEBRASKA

IN SCIENCE of May 20, 1927, there appears, on page 482, a genealogical diagram by Henry Fairfield Osborn, showing his recently modified conception of the origin of man and of his culture. Near the base of the family tree is indicated the geological position of the well-known Hesperopithecus tooth and of certain accompanying fossil bone fragments, thought to be implements. Indirect textual references to the latter are to be found in the same issue (Science News, page xiv) and also in SCIENCE of May 6 (Science News, page x).

In SCIENCE of December 16, Professor W. K. Gregory published a belated article setting forth his matured views regarding the famous tooth under the explanatory title, "Hesperopithecus apparently not an Ape nor a Man." It seems timely, therefore, that available observations on the associated bone "implements" should also be made known without further delay and I accordingly submit my findings as originally set down in August.

The occurrence of anthropoid remains in the Snake Creek beds at Aldine, Nebraska, being still under dispute, the existence in these Pliocene deposits of bone objects suggestive of a tool-making being betion. Observation, unfortunately, is further limited comes a subject calling for more than ordinary caby the fact that in the absence not only of human skeletal remains and of hearth-sites, but also of stone implements such as could have been used in the production of bone artifacts, the question of man's presence comes to depend entirely on the evidence furnished by the peculiar bone specimens themselves.

Having been requested for an opinion concerning these bones, it was at once assumed that the occasion demanded something decisive. The entire available collection—or rather selection—has therefore been subjected to systematic study. To check my own observations, the material was looked over independently by a laboratory assistant who had previously shown some aptness, *e.g.*, in detecting frauds among our old Indian collections. More precisely stated, this examination involved the scrutiny of nearly 3,000 specimens with a magnifying glass and by the aid of the best obtainable light. In short, all reasonable mechanical precautions have been observed. By way of further precaution I have also, as a matter of course, asked myself these questions: What now is it you are looking for? What precisely are the standards by which you are to measure these specimens? Expressed in other terms, what are the diagnostic characters indicating bone artifacts?

Without giving a complete inventory of primitive bone implements and ornaments, it may here suffice to say that implements divide into two major groups or classes, *viz.*, sharp-pointed and sharp-edged. The ornaments, or at any rate the objects less distinctly utilitarian, separate into tubular forms (cylindrical beads, flutes, etc.), and thin flat forms of varying outlines, rectilineal and curvilineal. And what distinctive features normally characterize each and all of these four outstanding classes of objects? First of all, a certain more or less easily recognizable shape or design. In the second place, implements are generally marked by evidences of wear, often resulting in a high degree of polish. Generally, too, they are marked by abrasions, if not actual perforations; and they almost invariably show certain unmistakable straight-line cuts and scratches running diagonally or transversely across the natural striations of the bone itself. Assuming, therefore, that the bone specimens to be examined were worked or utilized in a fresh state, and that at least some of the more deep-going evidences of artificial treatment have been preserved in the fossilized objects now available, we have remaining these criteria: shape, wear, polish, cutting marks, chopping marks, abrasions and perforations. These are perhaps not infallible proofs but they are all that we have. In matters of observation pertaining to objective facts no man is entitled to call up a standard for judgment out of his own inner consciousness.

By the light, then, of these deliberate precautions, the cursory examination of all the material and the repeated critical study of the several suspect pieces were undertaken. The result is, in brief, that I find no positive evidence either of intentional design or of artificial workmanship.

It is true there are several pointed forms resembling awls and also some tubular bone sections resembling beads, which, if found, say, in an Indian shell-heap would cause a careful archeologist to look at them several times before discarding them. But, after all, aside from their suggestive shape—simulating not finished articles but rather improvised forms often adapted from accidental bone fragments—they carry none of the real telltale marks above enumerated. When, therefore, it is alleged (Science News, May 10, p. xiv) that "eighteen of the [Nebraska] types of tools have been matched with counterparts found in the ruins of cliff-dwellers," two observations become imperative. One is, that with two exceptions—awls and tubular beads—the "eighteen counterparts" are not designed tools or ornaments but merely accidental fragments, a few of which have served temporary purposes. The other is that the "matching process" referred to involved on the discoverer's part the culling over of many thousands of fossil bone fragments. We have here, in other words, a close parallel to the selective procedure of which Europeans have made so much in the accumulation of eoliths. But, as in the case of eoliths, it is pertinent here to remark that given the proper raw materials and the right natural conditions for their manipulation, nature produces many things more or less suggestive of human handiwork, and the collector by taking pains can easily gather an array of imitations which considered by themselves are sometimes deceptively impressive.

It is true also that the Nebraska collection affords several bone specimens marked by worn U-shaped grooves of varying and rather large dimensions and of unexplainable origin. These grooves are, however, weathered irregularly, and taken by themselves are meaningless, being in no sense characteristic of true artifacts.

Lastly, there are two, perhaps three, bone fragments which carry decidedly suggestive markings. Two of these specimens are so striking that once more the writer would say that if they had been found in a refuse heap one might conceivably have retained them as showing certain accidental and purposeless indications of human activity. One of these pieces is a rib fragment with some shallow irregular cut-like markings on the inner face. No one can say that these are or are not artificial. They may, however, be nothing but tooth marks. The other piece is a tibia fragment, the sharp natural angle of which carries four slantingly transverse chop-like marks. These markings, though fairly deep, are not sufficiently clean cut to enable any one to say positively that they are artificial; and close to them, moreover, are several other fainter and more irregular markings which are certainly not artificial and which therefore weaken the original possibilities.

There remains the difficult question of accidental fracture. The success of the collector's matching process is really dependent on this feature. And it can not be denied that some of the longitudinal and diagonal breaks exhibited by the Nebraska specimens resemble the breaks to be observed in the animal bones so abundant in our shell-heaps and ruins everywhere and which can with reasonable certainty be attributed to human agency. Some of these fractures in the Nebraska finds are probably old and may have been produced while the bone was green or fresh. But who is prepared to tell us of the finer distinctions—if any—between fresh bone crushed by a carnivor and fresh bone crushed by a man between two stones? Certain other longitudinal fractures characteristic of the Nebraska bones, especially those carrying the split clear through the condyles, are distinctly unhumanlike performances; besides, they seem to me to have been made since the bones were fossilized. Belonging to this latter class are also many clear-cut transverse fractures, which certainly could not have been produced in fresh bone. Finally, the various facets on the fractured pieces often show different degrees of wear and polish, suggesting again that the breaking-up process has been prolonged and at least in part subsequent to fossilization. The more or less uniformly worn or semi-polished condition of certain of the specimens is a matter which may be left for others to explain, but it can scarcely be regarded as the work of man.

The inevitable conclusion is, therefore, in my judgment, that the presence of artifacts in the Snake Creek deposits is not established and can not be established by the collections examined to date.

N. C. NELSON

THE AMERICAN MUSEUM OF NATURAL HISTORY

## THE LIFE HISTORY OF VARANUS NILOTICUS

A PAPER giving a detailed account of the entire life history of the Nile monitor, *Varanus niloticus*, is being prepared for publication, but a brief description of one of the most interesting chapters of its life will not be out of place at the present time.