

gravels, and no highly specialized forms or other works of art are found with them, the conclusion is reached that they are palæolithic implements and that the art of the gravel-forming time was exclusively rude or palæolithic. Yet we may go down to the Potomac in the District of Columbia, or to the Washita in Arkansas, or to the Neosho in Indian Territory, and gather tons of similar rude forms made by our modern neolithic tribes, without finding a single specialized form or a single object of art aside from these rude forms. It is not my intention, however, to try to reconstruct the culture of that time, as I am not sure that there was any culture, but to point out the total inadequacy of the evidence upon which the theories of a particular culture are based.

The torrent-swept flood-plains of glacial times were hardly habitable places, and we do not know that there was game or fish to be sought there; but the great beds of boulders then and there accumulating furnished more or less raw material suitable for flaking, and if men, supposing they existed, coming down to the banks of the streams during periods of low water, essayed to rough-out their spear-points and knives in the usual fashion, the ever-recurring torrents would scatter the refuse about, leaving the coarse pieces in one eddy and whirling the lighter ones to other eddies below.

From this and from what has gone before it is clearly seen that these reputed gravel objects are probably not implements at all, and, whether they are or not, that they are as likely to have been left by neolithic as by palæolithic men.

So far have the advocates of a European classification for American phenomena gone beyond the limits of prudence in the treatment of these so-called palæolithic stones, that a radical change is demanded in the methods of classifying and labelling these objects in many of our museums; and it is to be lamented that a revision of all literature relating to the subject cannot be made in order to prevent the further spread of errors already too deeply rooted in the minds of the people, without offensive criticism of the work of living students.

This point may be illustrated by one example of the many that could be cited. The quartz objects from Minnesota, usually known as the Babbitt finds, of which so much has been said and written, prove on careful examination to be modern work-shop refuse settled into the talus of the glacial terrace. The slightly worked pieces heretofore collected and published as palæolithic implements almost without question on the part of archaeologists as to their origin or manner of occurrence, have no more intimate relation to the history of the glacial terraces than have the trees that grow upon their surface or the rodents that burrow in their sandy soil.

No rude flaked stone should be classified or labelled as an implement until it is proved to be an implement, and no specimen should be called palæolithic simply because it is rude or because it is found in the gravels, howsoever old. The attempt to classify these rude stones and to arrange them under types after the manner of European implements is sufficiently characterized, when it is stated that there is not in the museums of Europe or America a single piece of flaked stone found in place in the gravels of America and satisfactorily verified that can with absolute safety be classified as an implement at all.

If I should find a rude stone in place in the gravels—I have tried long in vain—I should permit myself to say only this, "Here is a work of art dating back to glacial times, I cannot tell whether it is a finished implement or not, as there are but slight signs of specialization and no indications of use, and I cannot tell whether it was made and left by a palæolithic or by a neolithic people, because neither of these peoples had a patent upon rude forms." Even if rude flaked stones are found in gravels ten times as old as the Trenton gravels, it must still be shown that they are not neolithic before it can be safely asserted that they are palæolithic, for the exclusively rude period of flaked art observed in Europe is so extraordinary that its repetition in other countries would approach the marvellous.

Little by little the advocates of a period of palæolithic culture in America have been forced to give up the idea that there is any other reliable test of the age of a culture than that furnished by geology; yet they are still going on utterly failing to recognize

the equally important fact that geologic phenomena cannot be safely observed save by geologists, and I may add with respect to gravel phenomena that the observations of geologists are not always infallible, the observations of geologists who have not especially studied gravels being of little greater weight than those of laymen. They must further concede that the finding of rude implements in the gravels or other ancient formations is not proof of a palæolithic age until it is sufficiently proved that the culture represented is exclusively rude culture, a point not attained, and I fear well nigh unattainable.

It follows from the above considerations that all speculations upon the culture status, ethnic relationships and geographic distribution of gravel-man in America based upon the discovery of rude forms of art are premature and misleading, and that, instead of being on firm ground and well advanced in respect to the antiquity and history of early man in America, we are not yet safely on the threshold of the study; and it is patent that until geologists take hold of the problem and prosecute the work, not as a side issue but as a great and leading question germane to the field of geologic research, little true progress will be made.

My explorations have been made with the greatest care and rarely without the aid and advice of some of the foremost geologists and anthropologists of the country. The conclusions reached have been freely discussed, and are generally approved by those familiar with the facts. These conclusions are subject to modification through the acquisition of new evidence derived from actual research in the field and in no other way.

In closing I would add that conservative students of American archæology will find it wise to consider well the following points relating to early man in America. 1. Is there a sufficiently full and sound body of evidence to demonstrate the presence of glacial man in America? 2. Is there satisfactory evidence that glacial man, if his existence be admitted upon the evidence available, was in any particular region in the palæolithic stage of culture? 3. Is there satisfactory evidence that the rude glacial finds in any case are implements at all? 4. Are deductions as to the habits, customs, arts, industries, institutions, and racial affinities of a people called for until at least one implement left by them is discovered, verified, and found to bear indisputable evidence of adaptation to or employment in some kind of use?

MODERN SYNTHETIC GEOMETRY VERSUS EUCLID.

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FOR more than two thousand years Euclid has held almost undisputed sway in the field of synthetic geometry. So strong a hold has it on school men that few American colleges dare offer anything else to freshmen. Is this because of tradition, or is there something in Euclid that makes it intrinsically better than anything mathematics has produced in modern times? To say that it holds its place merely because of tradition would probably be too severe a criticism, and would certainly call forth vigorous protest from its friends and defenders. To say that the wonderful advance in geometrical science in the last two hundred years has given us nothing superior to Euclid would be a doubtful statement, and almost an insult to the labors of such men as Monge, Poncelet, Carnot, Steiner, Von Staudt, and Cremona. No other branch of mathematics clings so tenaciously to that which is old, as geometry. In analysis, physics, mechanics, astronomy, everywhere but in geometry, the results and methods of modern thought are freely used, and no one doubts the propriety of their use. Why not take advantage of the same advances in geometry?

I have no quarrel with Euclid. It has been and is still a great factor in education. The severe training it gives in logical, clear thinking would be hard to equal. No doubt every student leaves Euclid with his mental powers greatly strengthened, and with increased ability to grapple with other studies and with the practical problems of life. Considered as to its educational value, but few objections can be urged against it. Mathematically considered, there are many things in favor of the modern synthetic geometry. Euclid is far more nearly a treatise on logic than on

mathematics. That a student succeeds well in Euclid does not argue that he will be a mathematician or even a lover of mathematics. Every teacher of experience knows how often his hopes, built on success in Euclid, have been dashed to the ground when the pupil began analysis. Euclid gives no hint of the mathematics which is to follow, and hence does not seem to fit in as an integral part of the science. Many of the proofs are long and tedious, with no hint whatever as to the method by which they were originated. The traditional limitations surrounding Euclid narrow the field of work by excluding almost all other mathematics, and thus must necessarily reach results that are special. The student who wishes to go on in mathematics finds himself almost totally unprepared for the next step.

Modern synthetic geometry meets all these criticisms. It is thoroughly mathematical, and the student who succeeds in it is assured of success in any branch of the science that he may undertake. Its steps are all logical, but logic is not emphasized as the end to be attained. It is constantly whetting the student's desire for mathematical study by giving him hints of that which is to follow. It also prepares thoroughly for trigonometry and analytical geometry. It is surrounded by no traditions, and so is free to use everything that serves its purpose. Its proofs are simple and direct, its results broad and general. Its symbolism and nomenclature are in harmony with mathematical science, and are at least two thousand years in advance of Euclid. It has a great fascination for the student, and classes are invariably enthusiastic over it. This year, as an experiment, one division of the freshman class in Indiana University studies the modern synthetic geometry, while the other divisions take Euclid. The modern synthetic class is by far the most enthusiastic, and gives strong evidence of the more rapid mental development.

The student who reads modern mathematical works must know the modern synthetic geometry. Modern writers appreciate its power, and use it freely. It is to be hoped that our American schools will give more attention to it. From a mathematical standpoint it is certainly desirable that it may soon entirely replace Euclid. The admirable elementary text-books of Dupuis of Toronto, Smith of Missouri, and Halsted of Texas, which have recently appeared, prove that the subject is growing in interest, and also make its general introduction more easy.

WEIGHTS AND MEASURES IN ENGLAND VERSUS THE DECIMAL AND METRIC SYSTEMS.

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It is impossible for a comparatively new country like America to conceive the mode by which the English conduct their internal commerce, and the difficulties which exist in trading not only with foreigners but between the different portions of the United Kingdom, owing to the versatility of the weights and measures used in conducting her business, the different values of the varied denominations within the United Kingdom, and the many quantities represented by the same denominations when applied to articles of daily commerce.

If the ingenuity of man had been strained to the utmost to introduce a system of weights and measures calculated to throw difficulties in the way of commercial progress, to perfect a system that no one man has thoroughly mastered, and to place irritating obstacles in the path of education of both pupil and teacher, that end has been thoroughly attained, and, strange to say, it is the system pursued in the educational establishments throughout the kingdom at the close of this nineteenth century, although most of the colonies have set the Mother Country a better example.

Can anything be more absurd than the following? We sell "pickled cod" by "the barrel," "trawled cod" so much "each," whilst "large hooked cod" are sold by "the score," and "crimped cod" "per pound," shrimps by "the stone," soles by "the pair," Dutch smelts by "the basket," and English smelts by "the hundred."

This is the Billingsgate system, but at Grimsby (another im-

portant fish market) quite a different style of weights and measures is made use of, and the sale of fish is very much by "the box" and "the last."

A customer once asked a Grimsby fish salesman to let him have a stone of oysters, the reply was "We don't sell oysters by weight, we sell them by measure." "Then let me have a yard," said the buyer. Butter in Ireland is sold by "the cask" and "the firkin;" in England by "the pound" of 16 ounces, by "the roll" of 24 ounces, "the stone," and the "hundred-weight," which is not 100 pounds but 112 pounds.

Analyzing the quantities of the various denominations only makes confusion doubly confounded.

What is a "load?" A load of straw is 1296 pounds, a load of old hay is 2016 pounds, and a load of new hay 2160 pounds; but my tables do not tell me at what age hay becomes old.

What is a "firkin?" A firkin of butter is 56 pounds, a firkin of soap 64 pounds, and a firkin of raisins 112 pounds. A "hogshead" of beer is 54 gallons, but a "hogshead" of wine is 63 gallons, a pipe of Marsala wine is 93 gallons, of Madeira 92 gallons, of Bucellas 117 gallons, a pipe of port 103 gallons, and a pipe of Teneriffe 100 gallons. Again, what is a stone? A "stone" weight of a living man is 14 pounds, but a "stone" weight of a dead ox is 8 pounds, a stone of cheese is 16 pounds, of glass 5 pounds, of hemp 32 pounds, a stone of flax at Belfast is 16½ pounds, but at Downpatrick 24 pounds, while a hundred-weight of pork is 8 pounds heavier at Belfast than it is at Cork—another injustice to Ireland.

England is slow to adopt new principles, but as more than 400 millions of people are using the metric system, surely it is time she took a step in that direction, a hint that probably may not be thrown away upon the grand American Republic.

In cataloguing the above absurdities of English measurement, I must not omit to inform you what quantities a barrel represents. A "barrel" of beef is 200 pounds; butter, 224 pounds; flour, 196 pounds; gunpowder, 100 pounds; soft soap, 256 pounds; beer, 36 gallons; tar, 26½ gallons; whilst a barrel of herrings is 500 herrings.

One example of the comparative merits of the existing system with the decimal system will suffice.

Reduce 987,654,321 inches into leagues. To arrive at this we must divide these figures by 12 to get them into feet, then divide the product by 3 to make yards of them, next by 5½ to find the number of poles, another division of the product by 40 exhibits the furlongs, then if the brain will stand it, for we have decimals in the quotient, we must divide by 8, which gives us the miles, and lastly by 3 to furnish the leagues, *quid erat demonstrandum*; and, if we have made no mistake, we have arrived at a satisfactory result.

To attain the same end by the decimal system, allowing the same number of denominations but each a decimal, no calculation is necessary, no sums to work out, but as there are six denominations, place the pointer on the left-hand side of the 6, the figures on the left of the pointer, viz., 987, show the number of leagues, whilst the figures on the right of the pointer furnish the fractions of a league, viz., 6 miles, 5 furlongs, 4 poles, 3 yards, 2 feet, and 1 inch.

Yet, can it be believed? the old system is taught in every school in England, and the cruelty inflicted upon the brains and the temper of the young, to say nothing of the loss of time and the cost, cannot fail to lodge a grave responsibility upon the legislature which permits such a condition of things to exist.

Nov. 4.

A CHEAP FORM OF BOX FOR MICROSCOPE SLIDES.

BY GEORGE P. MERRILL.

PRESUMABLY no one ever started out with making a collection of slides for the microscope but has wrestled long with the problem as to how they may best be taken care of. In the administrative work of this department the problem early became a serious one. For its satisfactory solution I am indebted to my brother, L. H. Merrill, then assisting me.