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MR. HOLMES'S CRITICISM UPON THE EVIDENCE OF GLACIAL MAN.

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MR. HOLMES has now concluded his series of reviews of the evidence of glacial man in America, having treated of the evidence from Trenton, N.J., and of that from Madisonville and Newcomerstown, Ohio, in the first two numbers of *The Journal of Geology*, published at Chicago, and of the Little Falls evidence, in Minnesota, in the April number of *The American Geologist*. It is, therefore, an appropriate time to make some remarks upon his criticisms. This I will do with as much freedom from prejudice as possible, and I think I am in position to be as free from bias as one can well be; for all along I have been in a strait betwixt two, being under pressure from my theological predilections to discredit the evidence, and accepting it at first with much misgiving.

A calm review of the case in the light of Mr. Holmes's criticism seems to make it probable that we have been mistaken about the character of Miss Babbitt's discoveries at Little Falls. Mr. Holmes seems fairly to establish the probability that the discoveries there made were either in the surface deposits or in a talus of the bank which had fallen down from the surface. But I will leave this for further discussion by those who are more familiar with the ground.

In case of the discoveries at Trenton, N.J., however, his criticisms fall far short of discrediting the abundant evidence that had been presented by other investigators, and this I say with what I believe to be pretty full knowledge of the facts and conditions connected with the discoveries — knowledge which I have derived from numerous personal investigations upon the spot and from frequent conferences with persons who have from time to time reported discoveries. But, as the discussion of this evidence in detail will more properly fall to some others who have more immediate cognizance of the facts, I will do nothing more here than simply to express the convictions of my mind after repeatedly reviewing the evidence on the spot since his criticisms.

The last paper of Mr. Holmes, however, treats of the reported discoveries in Ohio, whose discussion more properly falls upon me. The two discoveries upon which most reliance has been made in Ohio are that by Dr. Metz, at Madisonville, in the glacial terrace of the Little Miami River, and that of Mr. Mills, at Newcomerstown, in the glacial terrace of the Tuscarawas. Mr. Holmes urges two objections to the glacial age of the implement discovered by Dr. Metz at Madisonville, and with him I understand Mr. Leverett to agree. The implement was found some distance back from the margin of the terrace, where the material was finer than that facing the river, and occurred eight feet below the surface of the loam, in the upper part of the gravel. Mr. Leverett suggests that this loam may have been deposited later than the main part of the terrace. I do not, however, understand him to have any direct evidence of this, but simply to suggest it as a possibility. I am confident, however, that it is nothing more than a bare possibility, and that any separation of that portion of the terrace from that nearer the river is in the highest degree improbable. The glacial terrace is continuous from the river to Dr. Metz's house, and, according to the laws of the formation of such terraces, the finer material would be deposited back from the main stream in exactly the manner in which it is deposited there. We may therefore reject that supposition with a very great degree of confidence.

Second, Mr. Holmes and Mr. Leverett suggest that this implement may have worked down eight feet through the loam and into the gravel by the agency of upturned trees, or of the rotting tap-roots of oak trees. Professor Chamberlin has suggested to Mr. Leverett that probably fifty generations of trees had grown upon this spot. But it is difficult to see how the number of the generations of trees growing upon the spot would materially affect the question. The most that Mr. Holmes claimed in reference to the Little Falls locality was that implements might have worked down by the upturning of trees three or four feet into the surface soil. But fifty disturbances of the soil to a depth of three or four feet would not have the effect of one disturbance of eight feet. To go half-way fifty times does not produce the effect of going the whole of the way once. The supposition of the implement's having worked down through a tap-root as it decayed seems to rest upon so slight a probability that it is scarcely worthy of consideration. The necessity of resorting to such hypotheses to explain away each item of proof in detail will impress most reasonable minds with the extreme difficulty of resisting the evidence presented in favor of glacial man in America.

With reference to the Newcomerstown implement, there can really be no better answer to Mr. Holmes's criticisms than to reproduce, with a few critical remarks, two paragraphs in which he unconsciously reveals the attitude of mind with which he has approached the question. The paragraphs are taken from his article in the second number of *The Journal of Geology*, pp. 158–159, in the midst of which there are injected two beautiful fancy sketches, illustrating how he supposed the banks might have appeared when the implement was discovered. Here are the paragraphs:—

"Professor Wright is entirely satisfied with the results of his efforts to corroborate the statements of the collector. He has examined and re-examined Mr. Mills, receiving every assurance of the verity of the find, but, after all, he really secures no additional assurance and can receive no fully satisfactory assurance that Mr. Mills was not in error. Professor Wright has visited and photographed the site, and will speedily prepare a plate for publication, for just what purpose, however, it is rather hard to see, since the nature of the gravels is not disputed, and a volume of photographs will not give additional weight to the proofs. A photograph made of the tree after the bird has flown will not help in determining the bird. No more will observations on Mr. Mills's moral character, his education, or business reputation diminish the danger of error. The specimen may not have been found in place, notwithstanding all possible verification, and it may be a reject, notwithstanding its resemblance to foreign types, and Professor Wright may be wrong in urging his conclusions upon the public, notwithstanding his painstaking efforts to secure all possible affirmative testimony.

"It is nowhere stated that Mr. Mills actually picked the specimen out of the gravels; it was probably loose when he discovered it, but, even if he could say that it was fixed in the gravel mass, the necessity of questioning the find would still exist. All the authentication Professor Wright can possibly secure will not enable him to determine whether Mr. Mills struck with his walking-stick a small mass of the gravel in place at a depth of sixteen feet, or whether he was dealing with a mass which had slid with its inclusions of modern relics from the surface to a depth of sixteen feet."

In a former communication to *Science* (Feb. 3, 1893), I had promised to publish a more detailed account of this discovery, accompanied with a photograph of the bank. It is to this that Mr. Holmes refers. The promised publication appeared in the *Popular Science Monthly* for May, simultaneously with the article by Mr. Holmes in *The Journal of Geology*. Doubtless it will strike the reading public rather strangely to have Mr. Holmes

speak so slightingly of the value of a photograph of the bank showing it as it actually was soon after the discovery, when he has himself given two fancy sketches, representing an impossible condition of things, to inform us how he thinks it might have been. The photograph of the bank taken by Mr. Mills, within six months of the time of his discovery, exhibits its face intact, and is a part of the evidence presented as to what was the actual condition of the gravel when the discovery was made. The haste with which Mr. Holmes has plunged into this discussion is shown by his statement on a previous page that Mr. Mills had "published nothing save through Professor Wright." The report of the Western Reserve Historical Society referred to by Mr. Holmes is entitled a report "by Mr. Mills and Professor Wright," and the specific account of the discovery is given in Mr. Mills's own words, in which he says that when a space of about six feet in length by two in height fell down, it exposed the specimen to view. It is true that that statement is not so explicit as it should have been, and I have given, in the *Popular Science Monthly*, the fuller details as given to us upon the spot, and as repeated two or three times to me in correspondence, namely, that the implement was seen by him projecting from the face of the gravel bank after the fall of gravel before referred to, and when the edges of the strata of gravel were all visible and undisturbed, and that he took it out with his own hands; or, if you want to avoid all error, that he worked it loose with his walking-cane until it fell out at his feet, when he took it up, made his notes upon it, and put it in his collection. Mr. Mills is as capable of drawing a section of the bank as Mr. Holmes is, and that he has done, but most readers will prefer to see a photograph, in which there is no danger of the incorporation of fanciful elements.

In view of all that Mr. Holmes has said of the importance of expert testimony, it is difficult to see, also, why he should say that observations upon Mr. Mills's moral character, education, and business reputation may not diminish the danger of error in such a case; for how else can you determine the value of an expert's testimony? If there is doubt about his moral character, that of course vitiates the evidence in a high degree. So, also, if there is doubt about his ability to discern the difference between disturbed and undisturbed gravel in such a situation, that would largely vitiate the observations. But Mr. Mills's education and habits of observation are such that his evidence in so clear a case as this is, is as good as that of any expert could be. What does Mr. Holmes suppose led Judge Baldwin and the other members of the Western Reserve Historical Society to incur the trouble and expense of going down to Newcomerstown, except it was to inform themselves of the capacity of Mr. Mills to bear testimony to the very points at issue? Of course, we cannot force conviction upon the minds of the public, but we can get the facts of the situation and the conditions under which the evidence was given with all possible clearness before them. If any portion of the reading public chances to be in the attitude of mind in which Mr. Holmes asserts he is in when he says he does not care for a photograph of the bank, and does not care to know anything about the moral character and education of the witness, and that he is sure that Professor Wright cannot possibly secure a proper authentication of the facts, it will be a difficult matter to overcome the prejudice with which the subject is approached. But the number who are biassed to such an extent and are the subjects of such "invincible ignorance" is, I presume, not numerous.

Of course, I do not deny that there are things so improbable that they could not be established by any amount of human testimony. It is more likely that the senses should be deceived in some cases than that the things which seem to happen should really occur. But this is not a case of that sort. The existence of glacial man is not a highly improbable thing, and this evidence of Mr. Mills is in analogy with a vast amount of other evidence leading to a similar conclusion. There is nothing in the character of the implement, in the conditions under which it is reported to have been found, or in the testimony presented, to raise any serious suspicion of error. The fact that Mr. Mills was not specially impressed by the importance of the discovery at the time is not at all surprising, since his thought had been little directed to the phase of the subject involved in his discovery. He had in his collection thousands of other implements found upon the surface, and, after making note of the circumstances connected with the finding of this, it was laid with them.

In conclusion, I would simply add that in procuring, as I have done during the past season, some sections of the gravel in undisturbed condition for the exhibit at Chicago, I have had ample opportunity to study its behavior, both when it is in place and when it is in a recently formed talus, and, in reply to Mr. Holmes's assertion that it is *impossible* to tell whether Mr. Mills found this in the undisturbed strata or in the talus, I would say that the observer who could not tell the difference would be one whose testimony was utterly unworthy of consideration. While I am about it, also, I might as well refer to the fact that there is a slight discrepancy, which may attract the attention of some, both in my own and in Mr. Mills's statements about the depth at which the implement was found. In "Man and the Glacial Period" I say, that it was *sixteen* feet. In my original report upon it, I say *fifteen* feet. In the more specific details given in the *Popular Science Monthly* I say *fourteen and three-fourths* feet, and Mr. Mills has sometimes spoken of it as fifteen feet and sometimes as fourteen and three-fourths feet. It is easy enough to see why both of us should say fifteen feet, for that is a round number, but not so easy to see why in one place I should have said sixteen feet. But the discrepancy is not one that materially affects the evidence. I presume, therefore, that my error arose from the principle of assimilation with which we are so familiar in the textual criticism of the New Testament. In the appendix to the third edition of my "Ice Age in North America," I give it as fifteen feet. But in writing the paragraphs in the later book, I had just had occasion to speak of one of Dr. Abbott's discoveries which was sixteen feet below the surface, and the close association of the two in my mind doubtless led to the substitution, and, since there was nothing specially dependent upon it, the discrepancy being so slight, my attention was not aroused through all the subsequent proof-readings.

PHARMACEUTICAL EDUCATION.

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DURING the past year a number of papers have appeared in *Science* demonstrating the "onward march" of institutions of the highest learning, as well as that of professional and technical schools in America. The one cry to be heard all along the line is to raise the standard. The requirements for a preliminary education have been markedly increased and the courses of studies materially lengthened both as to the number of hours required per week and the years of study. In our colleges of pharmacy there have been a similar awakening and a desire to extend the course from two to three years. It may be well, however, at this point to state for the benefit of those who are unfamiliar with the requirements of our best colleges of pharmacy, that before a diploma is granted the student must have been engaged in the drug business for a period not less than three and one-half or four years. This means practically an apprenticeship of six years, although a great many students find it necessary to work in drugstores while attending colleges.

The teachers of pharmacy have for a number of years been discussing ways by which students will be compelled to devote all of their time to college work during the sessions of study. Yet while they claim that students should not be employed as clerks in the stores and at the same time attend college, the employers are opposed to the students devoting so much of their time to college work during the winter session. There has been more or less of a compromise, but nevertheless colleges of pharmacy are raising their standard as are the other schools of learning, and it is very probable that, in a few years, three solid sessions of undivided work as well as fours years' apprenticeship will be required before a candidate shall receive his or her degree.

The position of the pharmacist is a peculiar one. He, in the majority of cases, does not make his living by means of his actual business in medicines and prescriptions. He finds it necessary to