

Tehardghoni in the course of the eighteen months, but houses and cottages for employees, a line of telegraph, and sand-sheds, were also established. The object of the sand-sheds is, of course, to protect the line against sand-storms, which constitute one of the difficulties with which it has to deal. Active preparations have been made for the construction of the remaining section to the Amu Daria: the necessary workmen have been collected, a large mass of materials has been brought together, and General Arrenkoff expects to complete the whole line through to Amu Daria by Nov. 15.

#### LETTERS TO THE EDITOR.

\*.\*The attention of scientific men is called to the advantages of the correspondence columns of SCIENCE for placing promptly on record brief preliminary notices of their investigations. Twenty copies of the number containing his communication will be furnished free to any correspondent on request.

The editor will be glad to publish any queries consonant with the character of the journal.

Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.

#### Comparative psychology.

PRESS of work has prevented me from replying before to a certain form of presentation, in *Science* for April 1, of my paper published in the *Popular science monthly* for March, on comparative psychology, and which really amounts very largely to a misrepresentation not only of what I think, but of what I actually expressed in the address referred to above.

It is assumed throughout by *Science* that I have ignored Professor Morgan's view of the case as to the study of animal intelligence, for it is stated that "he [the writer] has not faced this argument," etc., and "These limitations and considerations carry with them many consequences, but we can find in Dr. Mills's address no evidence that he has ever given them any consideration."

A few extracts from my own paper, followed by others from Professor Morgan's (in *Mind* for April, 1886), will test this matter. I am quoted in *Science* as saying, "Animals are the 'poor relations' of man; the latter is one of them, not only in body, but in mind. In not a few respects they are not only equal, but superior, to man." Professor Morgan says, "I am, moreover, fully persuaded that my four-footed friends have feelings and emotions distinctly akin to and dimly foreshadowing my own;" "I by no means deny the existence of animal mind;" etc.

Again he says, "A material difference in the ratio of the senses must, we may suppose, make a material difference in the mental product." He then alludes, as I do myself after the very passage *Science* quotes from my paper, to the superiority of the senses in the animals below man; for though *Science*, referring to my use of the expression 'lower' animals, says ironically, "We presume he uses the adjective 'lower' merely in deference to a custom of some antiquity," I have explicitly stated that it must be conceded that man as a totality stands at the head of the animal world, as the following extract will show: "The assumption that man is only accidentally the

superior of the brute would but lead to confusion, for it must be admitted that there is a scale, and that man ranks first. We are simply desirous of doing the lower creation that justice which we feel assured has not yet been allowed them, and of seeing the human family interested in those that we think scientific investigation is proving constantly are much more our fellow-creatures than has generally been supposed." "We are not contending for the equality of man and the rest of the animal kingdom," etc.

Again, *Science* represents me as saying that "man has only developed a superiority to the brute because of his social tendencies, resulting in the division of labour," etc.

Now, what I did actually write was as follows: "Man's present superiority over the lower animals is traceable in large part to his eminently social tendencies," etc., which is a very different thing; and I have elsewhere in the paper called attention to many other agencies which have tended to make man the supreme animal.

Professor Morgan holds, that, strictly, the only mind one can know is his own mind; that at best human psychology is a "psychology of sages, but not of savages; that all our knowledge of human minds other than our own is necessarily ejective; that our systems of human psychology hold good only for the philosophers who frame them; that our ejective inferences concerning our neighbours' minds, motives, and characters, are liable to error."

Now compare with this the following from my own paper: "And at this point allow me to indicate a danger that should make us cautious and modest in attempting to explain the behavior of animals. We infer from our fellow-man's behavior similarity of motive and mental processes to our own under like circumstances. We find, the more experience we have, that we are often at fault as to both. And when we are more free from the thralldom of so-called systems and methods in education, we may learn that the activities of the human mind cannot be reduced in all persons to precisely the one plan, like so much clock-work. This may mar somewhat the completeness and beauty of our philosophy of education, but it may also in the end conduce to human progress by providing the greater freedom, and end in insuring an individuality of character which seems to be now rapidly disappearing. Now, if individual men so differ in psychic behavior, how much more is it likely that still greater differences hold for the lower animals! An objection may be based, however, on this to the whole study of comparative psychology. The objection holds to some extent even for human psychology; but, as we infer similarity of behavior in men to denote similarity of inner processes, so are we justified in the same as regards the lower animals, though it must be conceded somewhat less so. We must always be prepared to admit that there may be psychic paths unknown and possibly unknowable to us in the realm of their inner life. But if we regard man as the outcome of development through lower forms, according to variation with natural selection—in a word, if man is the final link in a long chain binding the whole animal creation together, we have the greater reason for inferring that comparative psychology and human psychology have common roots. We must, in fact, believe in a mental or psychic evolution as well as in a physical (morphological) one."

How, in the light of these extracts, *Science* can say, "We can find in Dr. Mills's address no evidence that he has ever given them [Professor Morgan's views] any consideration," it is difficult for me to understand.

Now, Professor Morgan bases his belief in the mind of the lower animals on, 1°, "*the justification by results*. We habitually act towards our four-footed friends as if they were conscious beings, with results which point to the correctness of our hypothesis." 2°. "*The justification based on evolution*. Animals have inherited brain-structures in many respects similar to those possessed by man, and there is no reason for supposing that in them no psychoses run parallel or are identical with their neuroses." Now, the whole tenor of my paper shows that I have adopted a similar line of reasoning.

It will be perceived that up to this point Professor Morgan and myself are very much in accord. The difficulty which Professor Morgan feels in regard to all our knowledge of minds other than our own is one that occurred to me many years ago with great force. The views expressed in the address now under consideration were penned months before I had read Professor Morgan's paper in *Mind*; and it was with much gratification that I found my own opinions, formed independently, shared by so able a thinker. Professor Morgan's position may be logically impregnable; but while there is need for the greatest caution in regard to the 'eject' we form, it seems to me impossible for one, at least, who believes in the *evolution* of mind, to agree with Professor Morgan, "that our ejective inferences concerning their motives, minds, and characters, are so largely liable to error as to render the drawing of them unprofitable for purposes of scientific investigation, except in so far as they may aid the objective study of habit and activity."

Professor Morgan defines *intelligent* actions as "those which are performed by the individual, in virtue of his individuality; in special adaptation to special circumstances." Now, is it *possible* to understand this adaptation at all except by some sort of 'eject'? Professor Morgan's views, if pressed, strike at the root of all psychology as a science. There is great need of such caution, as he and I myself have urged; but the belief is irresistible that the inner life of the lower animals is not totally and radically different from our own.

It seems to me the whole difference between Professor Morgan and those who would, like myself, be a little less conservative as to the 'eject,' is that of mere *quantum*; and, as psychology does not admit of exact weighings and measurements, in the present state of knowledge it cannot be expected that men will agree as to how far we shall be justified in using the ejective method. But of one thing I am fully convinced, that the study of the psychology of the lower animals cannot but improve the highest, whether he considers himself of them or apart from them.

In conclusion, I think it will now appear that *Science*, Professor Morgan, and myself are much more in harmony than was supposed.

T. WESLEY MILLS.

Montreal, April 23.

[We print Dr. Mills's lucid communication with much pleasure. He brings out very clearly the fact which we did not gather from the reading of the address in question, namely, that he has not only read

but carefully weighed Professor Morgan's argument. We still think, however, that this fact is not readily inferrible from the original address without the emphasis of the present letter. — Ed.]

#### The relations of the International geological congress to geological workers.

A very wide-spread misapprehension exists of the purposes of the International geological congress which is to hold its fourth session in London next year, as well as of the definite steps it has taken in the way of recommendations to geologists.

In order to throw some light on the matter, the following list has been prepared, which includes all the points upon which the congress has expressed a decided opinion. It ought to be remembered that this congress has not any interest in maintaining this or that theory, but has been organized by geologists, of geologists, and for geologists (to slightly alter Lincoln's noble definition of our republic).

It has no authority but that of the influence of the large number of eminent geologists who either compose it or support its conclusions; yet when one considers the advantages which must result from agreeing upon a common scientific language (written and spoken) whereby widely separated observations may be made comparable, and may be utilized by persons of any nation as soon as they appear in print, to add to their own observations, and thus form base lines from which to triangulate to new generalizations, it does not seem to be a fatal objection to these recommendations either that they have not attained perfection, or that it may be found desirable with later experience to modify them.

It is apparent from the modest number of decided preferences which the congress has yet expressed, that it will not be difficult for any geologist to adapt to its large framework any provisional scheme which he may prefer. It is only those having strongly defined prejudices in antagonism to the broadest generalizations generally accepted among geologists, who will have any difficulty in joining in the acceptance of the recommendations of the congress.

1. The congress voted (solely for the purpose of bringing out the map) that a gray color should be provisionally chosen, of which different tints should be applied to the carboniferous and Permian (*Report of Amer. com.*, p. 20, ¶ 3).
2. Solely for the purpose of printing the European map, the committee on the map was authorized to select a color for the Silurian (Cambrian inclusive), but this choice was not to affect the scientific question connected with the classification at all (*Ibid.*, p. 21, ¶ 1).
3. The eruptive rocks were to be represented by seven tints, ranging from dark to light red (*Ibid.*, p. 21, ¶ 3).
4. The solution of other questions which might arise in the construction of the map were left to the committee on the map (*Ibid.*, p. 21, ¶ 4).
5. The congress decided that 'Archaean' should be the term applied to the group preceding the paleozoic (*Ibid.*, p. 23, ¶ 2).
6. The congress agreed to abandon Protogine as a division of rocks (*Ibid.*, p. 23, ¶ 10). The division of the Cambrian and Silurian was postponed till the congress at London.
7. The upper limit of the Devonian was placed at the base of the carboniferous limestone, that is to say, that the system comprises the psammites