CORRESPONDENCE.

THE STUDY OF MAMMALS.

SIR,—I am indebted to the reviewer of this work in your last number for pointing out that the family *Tritylodontidæ* occurs twice in the systematic table. Its second occurrence is not, however, as he supposes, an inadvertent repetition, but a "misprint" for *Triconodontidæ*. Another slip occurs on p. 99, where in giving the range of *Oryx* Persia stands instead of Syria. R. LYDEKKER.

DYNAMIC METAMORPHISM "AGAIN."

SIR,—Personally I am sorry to be called upon to point out briefly that Mr. Fisher (GEOL. MAG. Sept. 1891, p. 430) has made the mistake of substituting exclusion (or "outness") in space for *logical* exclusion of one term from a series of other terms used in a train of reasoning, and that this misconception seems to run through the whole of his letter except the last paragraph. It is not Mr. Fisher's $(P - W)\ w$, but the "*last term*" *of the four which I had just enumerated* (p. 299), which is logically outside the other three. To say that it is outside the cubic unit (not "element") of the mass, on which the work is done, is something to which I am unable to attach any meaning at all. The energy, to which the motion of the train (in my illustration) is due, is *dissipated* (not annihilated or necessarily "converted" into some other form of energy) according to the ordinary laws of thermodynamics, having been obtained as heat from the potential energy of the fuel and atmospheric oxygen, and utilized, while in a condition of high intensity (the H_2O being the carrier of the energy), to move the piston of the engine with the load attached. In running down from a state of high intensity (in which work can be got out of it) to a state of low intensity (in which it is either absorbed by surrounding bodies, or passes off by radiation into the general entropy[1] of the universe), there is no destruction, there is only dissipation, of energy; and when it is thus dissipated, you cannot get any more work out of it. If energy were (under the conditions specified) "stored up in the train," after it had come to a standstill (the idea which was before my mind, though, I fear, not explicitly stated), the train would be, after translation, in a *position of advantage with respect to motion*, as compared with its position before translation, which is absurd. Certainly during the accelerating stage of translation energy is being stored in the train, just as you store energy in the weight of a clock in winding it up; but the same amount of energy is taken out of the train in bringing it to a standstill, just as it is taken out of the clock-weight, when it runs down. There is therefore no more energy stored in the train, after it has come to rest, than there is in the weight and works of a clock after it has run down. So in the case of the rock-mass under consideration, the source of the energy is gravitation. The work done on the rock is only a case of

[1] "Entropy" in the sense in which the word was first used by Clausius.

potential energy of position becoming kinetic, without taking aught from the force, with which gravitation continues to act upon the portion of the earth's lithosphere, to whose descent towards the earth's centre of gravity the lateral thrust is due. The clock has merely run down, as it appears to me. Work has been done, and that work is the equivalent of the *potential* energy. In the infinitesimal amount of molecular change in the iron (where bad material is used), which I had overlooked, and Mr. Fisher recognizes as a case of "dynamo-metamorphism," we have indeed an excellent example (so far as it goes) of *metatropy* resulting from the action of forces purely mechanical, as I have contended for the last three years; but as this is quite a different thing from what we understand by chemical change, there is no "storage of chemical energy," which is the *crux* of the whole business.

Turning now to Mr. Harker's rather donnish letter (p. 431), in which he persists in regarding the phrases "chemical combination" and "chemical change or action" as convertible terms, I can only say that there is nothing to be gained by discussing that point further. The remainder of the paragraph is, I think, answered by anticipation in what I have already written. I certainly have maintained that ever since this globe began to cool down in space through dissipation of its energy by radiation, that cooling has been (and is still) retarded by a considerable exothermic balance of heat, as mineral changes in the lithosphere have upon the whole advanced from less stable to more stable states of combination; and in doing so I take my stand upon the broad teaching of *thermal chemistry* in its recent development. It is there that Mr. Harker must look for the "proof" that he wants. Perhaps Prof. Roberts-Austen's recent address to the Chemical Section of the British Association at Cardiff may help him. To his appeal to an imaginary *consensus* of "physicists" it is, I think, a fair reply that there are physicists and physicists; and that, although a good deal of what I have written (in the GEOLOGICAL MAGAZINE and elsewhere) may seem to some of them to be written in an "unknown tongue," I am happy to know that there are others to whom it is all perfectly intelligible. The term "intensity of heat," for example, is used to emphasize the inverse variation of absolute temperature in relation to distribution in time and mass (allowance being made for what Sir William Thomson calls "diffusity") for a *given quantity* of heat, as velocity and mass are related in the *momentum* of a body in motion. The term must stand on its own merits.

The importance of the *indirect* action of pressure in promoting chemical change, by making the existence of superheated water possible (the action of which is exceedingly well illustrated by the recent work of Kroutschoff) is not, I think, lessened by the failure of our two friends to appreciate it. There is surely in this a storage of *potential* chemical energy. Why do they refuse to use the weapon placed in their hands?

A. IRVING.

WELLINGTON COLLEGE, BERKS, *8th September.*