able), find a good measure of their degree of similitude with a given orientation.

The problem is one over which the late Sir Francis Galton was at times much exercised when discussing the resemblance of portraits of the silhouette type. It was further considered very fully when the proposal to prepare average or type cranial contours was originally discussed in the Biometric Laboratory some five or six years ago. Prof. D'Arcy Thompson's scheme is suggestive, but it is very far from unique. I feel doubtful whether any scheme for all these contours could possibly be other than conventional, but I suggest that, even for a good conventional scheme to be reached, we must have further knowledge of the mathematics of the subject, *i.e.* we want to study measures of the similarity or dissimilarity of what we may perhaps call "resemblant contours."

KARL PEARSON.

Biometric Laboratory, London, February 11.

The Mnemic Theory of Heredity.

IF it were explained clearly in what respects an "acquired" character is more acquired and less innate, germinal, and inherited than an "inborn" trait, a real service would be rendered to science, and, possibly, a controversy which at present seems interminable might be ended. A unicellular organism distributes itself between its daughter-cells. Here, obviously, there is actual inheritance; and, if the acquirements of the parents persist in the offspring, there is inheritance of acquirements. But a multicellular organism does not distribute itself. It is a cell-community, and, so far as is known, offspring are derived not from it as a whole, but from particular members of it—the germ-cells. There is thus no inheritance from the "parent" in the sense that there is inheritance among unicellular types. For example, the child does not inherit the parent's nose, leaving the parent derelict. The latter keeps the whole of his nose for himself.

The germ-cell is a bundle of potentialities for development. It develops into an animal or plant of the species whence it is derived under the influence of various stimuli —food, temperature, light, moisture, internal secretions, use, injury, and the like. Thus in man one kind of stimulus causes a hand to develop, another a scar, a third a use-callosity. Nothing develops in the individual, nothing can develop, unless both the potentiality and the appropriate stimulus are present. All kinds of potentialities are equally products of evolution, and are equally rooted in the germ-plasm. Thus the potentiality to develop a scar is as much a part of the germ-plasm as the potentiality to develop a head. Some characters develop more certainly than others, but this is only because the stimulus (not the potentiality) under which they grow is more certainly present. Thus a head develops more certainly than a particular scar, but the scar would develop as certainly as the head were its stimulus (a particular injury) as constantly present. In man the scar left by the destruction of the umbilical cord is as constant as the head.

It is customary to term traits which develop under the stimulus of use and injury acquired, while all others are called inborn. But if all potentialities are equally present in the germ-cell, if all characters are alike products of a reaction between internal potentiality and external stimulus, what is the peculiarity that makes one kind of character more inborn and inheritable than another? As far as I am able to judge, the Lamarckian controversy has been conducted on the basis of a misuse of terms, or on the (at present unwarrantable) assumption that the multicellular organism is derived from its parent in the same sense as a unicellular is derived, or under the belief (also unwarrantable) that the only characters that arise in response to stimulus from the environment are those which grow through the influence of use and injury. I am able to understand, for instance, how a negro who has a scar differs both innately and by acquirement from a white man who has no such scar. His potentialities are different, and therefore he differs innately; the stimuli to which he was exposed differed, and therefore he differs by acquirement. But it is one thing to apply these terms to likenesses and differences between individuals and another to apply them to characters as such. I take it that the words "inborn," "acquired," and "inheritable" have been illegitimately transferred from a connection in which they have meaning to a connection where they are unintelligible: for can anyone state precisely in what sense the skin colour of a negro is more innate or germinal than his scar?

When it is maintained that "acquirements are transmissible," it is held, in effect, that characters (*e.g.* scars and use-callosities) which the parent was able to acquire in a certain way (as reactions to injury and use), because a long course of evolution had rendered such acquisitions possible to members of his species, tend, at the time of observation, to be reproduced by the offspring in a different category of characters and in ways (as reactions to other stimuli) in which no ancestor had acquired them before, and with which, therefore, evolution had nothing to do. The evidence on which we are asked to accept this improbable supposition is usually equivocal, and, in recent times, invariably such as cannot easily be verified.

But turn to common experience. Facts are not the less valuable or certainly true because they are familiar. Take characters which develop under the stimulus of use, or, what in the case of mind is the same thing, experience. The development of some physical and mental traits, for example, the hair, the teeth, external ears, reflexes, and instincts, is not influenced by this stimulus. Other characters, for instance, in man, the limbs, heart, kidneys, brain, and all that is learnt, all that is intellectual, owe their growth after birth mainly to it. Such characters tend to atrophy when disused or little used, and to hypertrophy when much used. Low in the scale of life, animals develop less under the influence of use and more under other stimuli. But all the higher animals, in proportion as they are highly placed, impelled by an instinct, sport during youth, and thus stimulate mind and body to the acquisition of traits without which maturity is incomplete. Parental care after the beginning of conscious life is an adaptation the function of which is to afford time and opportunity for the acquisition of use-acquirements. It is not found low in the scale of life among animals that, at each stage, come ready armed by "inborn traits" to the struggle for existence, and is most elaborate and prolonged among the highest types. We call an animal intelligent in proportion as it is capable of profiting from experience. A human idiot is nothing other than an individual who, reverting to a remote ancestral type, has lost the power of growing mentally under the influence of experience.

Manifestly the so-called acquirements are more advantageous as responses to injury and use than they would be if they grew in response to the more unvarying stimuli. As they are, they render the animal adaptable, capable of fitting himself to a diversity of environment. Compare the adaptability of a man with that of a beetle. Manifestly also "inborn traits" have undergone great retrogression and use-acquirements great progression in the higher animals, which, presumably, are derived from lower types. It follows that, while a supposition that "inborn traits" tend to be transmuted into "acquirements" might be maintained with some appearance of plausibility, the contrary Lamarckian doctrine that "acquirements" tend to be transmuted into "innate traits" is untenable. The mnemic hypothesis does not demonstrate the transmission of acquirements. It merely makes confusion worse confounded by misusing another word. According to it, the germ-cell remembers that which it never knew, and forgets that which it knew.

Southsea, February 17. G. ARCHDALL REID.

THE reply to Prof. Dendy's comments upon my letter (NATURE, February 8, p. 482) is briefly as follows. The germ-cells are unicellular *living organisms* with a life-cycle of their own, part of which they pass in a metazoan individual. When they enter it, they are all in potentialities so many twins identical with this. For the time being its environment is theirs. The non-existent protoplasmic bridges need not be postulated. If the germ-cells could not "remember events in the past history of the race," I fail to perceive how any developmental unfolding would be possible. The relation of the doctrine of acquired characters to the theory depends solely upon the embryological facts of the cycle of animal life.