It was a sheephead, *Archosargus probatocephalus*, about 1 to 1½ ft long. The crab by a deft maneuver was able to avoid the initial clumsy rush of the fish, which then found itself at the surface with no headway and with the crab poised over its tail fin. It turned clumsily first one way and then the other, but the crab turned similarly on the smaller circle and remained poised right over the tail fin. The fish turned circles and figure eights but the crab continued to hold its precarious vantage, with the dangerous head always pointed the wrong way for capture. Whether this veritable little dance of death went on for 5 sec or 25, I cannot say, since I was too intent upon watching and never thought of timing the contestants, but it did continue until the fish abandoned these tactics and swam out of sight in the murky water below. Then within a few seconds the same fish, or another just like it, attacked again from below, this time successfully and quickly vanished with the crab in its jaws. That, undoubtedly, was the end of the sagacious crab.

Several questions arise from this simple observation. The crab appeared to know that headlong horizontal flight away from the fish would place it immediately in a vulnerable position. At least it did not take such action. The crab also seemed to know that the head of the fish was dangerous, rather than the tail over which it swam, a point for which, incidentally, I would not have given a crab credit prior to this observation, and about which I still wonder. But if the crab did know, the question is how? It would seem that lessons on this point are usually fatal. We could fall back on instinct, but there are other enemies in these waters who can change ends much faster than any crab can maneuver, and a crab species with instinctual behavior attuned only to relatively clumsy sheepheads would not last long. I draw no conclusions, except that such behavior must have survival value, although it was unsuccessful in this instance, for any prolongation of life in time of great danger must ultimately result, in some instances at least, in a change of events permitting escape.

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Citation of Fraudulent Data

The occasion for these remarks is the recent treatment by some British scientists and historians of science of the claims made by Paul Kammerer.

Almost the entire story of the Kammerer affair can be found in the back volumes of *Nature*. Kammerer was a Viennese zoologist who published a number of papers, later summarized in a book (*1*), in which he claimed to have proved that acquired characters were inherited. He based his claims chiefly on two series of experiments. He stated first that the black viviparous Alpine salamander (*Salamandra maculosa*) and the black and spotted oviparous lowland salamander (*forma taeniata*) could each be made to acquire the characters of the other. The second series of experiments was made with the midwife toad (*Alytes obstetricans*), the male of which lacks the pigmented thick thumb pads that some other toads possess. Kammerer claimed that, as a result of his experiments, the male of this species could be made to inherit thumb pads.

These claims were challenged by William Bateson as early as 1919, and a very acrimonious debate ensued (*2*). Kammerer replied (*3*) to Bateson's attacks, and he was defended vigorously by E. W. MacBride (*4*). The controversy developed into a most interesting chase. Bateson wished to examine Kammerer's preserved specimens but could not; no matter where he went, Kammerer managed to be elsewhere. Bateson never caught Kammerer, but the chase ended in 1926. In that year, G. K. Noble of the American Museum of Natural History and Hans Przibram, director of the institute where Kammerer worked, examined the famous specimens. They reported their sensational findings in adjacent papers in *Nature* [**118**, 209 (1926)]. The acquired characters, which Kammerer claimed to have made hereditary, turned out to be India ink.

Kammerer admitted the fraud in a letter to the Presidium of the Communist Academy of Moscow—the letter in which he announced his impending suicide—but he claimed to have been personally innocent of deception and ignorant of the identity of the person who was responsible for the chicanery (*5*).

Western biologists as a whole have tended to excuse Kammerer and blame the fakery on some overzealous assistant. Such "assistance" was actually given the great Russian physiologist, I. P. Pavlov. At the International Congress of Physiology held in Edinburgh in 1923, Pavlov announced that he had proved that the conditioning of reflexes was inherited (*6*). This turned out to be false, and Pavlov retracted the statement (*7*). Further details were given by B. G. Gruenberg (*8*).

Although it is remotely possible that Kammerer, like Pavlov, was fooled by an assistant, the probabilities are against such an interpretation. For 7 years Kammerer skillfully evaded his critics' demands to allow them to examine his specimens. It was not until 1926 that his specimens were finally investigated and, when examined, were found to be frauds. Apparently Kammerer preferred suicide to repeating his work.

For the last quarter of a century, Kammerer has not been taken seriously in the West. In Russia, however, attempts were made immediately to salvage his reputation (*9*). Serious attempts to spread the rehabilitation of Kammerer from Russia to western Europe, however, appear not to have been made until 1948, when the inheritance of acquired characters became an official Soviet doctrine.

The Lenin Academy of Agriculture met in 1948 from 31 July through 7 Aug. (This was the session in which Lysenko triumphed and five geneticists found it

expedient to recant.) The fifth speaker in the second session (2 Aug.) was Academician N. G. Belensky. In his speech he quoted Kammerer's work on salamanders as proof of the inheritance of acquired characters. His speech was included in the official proceedings, which were translated and printed in English (*10*). In the English version, Belensky devoted two pages to listing and endorsing Kammerer's data and wrote nothing whatever about its admitted fraudulence. This, of course, did no harm in itself, for the biologists of the world have been alerted to the standards of Lysenko's followers.

Two years later, however, Kammerer's data were being cited in Britain by Alan G. Morton (*11*).

> The classical experiments of Kammerer are certainly very striking, and it is unfortunate that they should have been surrounded by so much irrelevant prejudice. It is no argument to say that they have not been confirmed merely because no one else has undertaken the necessary laborious investigation.

In another 2 years Kammerer's claims had become incorporated in the history of science. Philip G. Fothergill (*12*) devoted two pages to a description of Kammerer's data on salamanders, and nowhere does he mention the fact that Kammerer had written, "Indeed there were still other objects (blackened salamanders) upon which my results had plainly been 'improved' post-mortem with India ink." More recently, Stephen F. Mason (*13*) refers casually to Kammerer, "Kammerer in 1924 observed colour changes in salamanders which he claimed were induced by, and were adaptive to, environmental changes." This statement perhaps could be accepted as sound if it were understood that the environment included India ink and that the adaptiveness meant the ability to be colored. But nowhere does Mason give those details.

Nothing that has been written here should be taken to mean that all those who describe Kammerer's work are knowingly citing fraudulent data. Indeed, there is internal evidence that some are writing in complete innocence, and this fact illustrates the danger in the present situation. A single knowing misrepresentation may start a chain reaction. And not only Kammerer is involved: Academician Belensky (*8*) quoted a great many other data that had been discredited by later and more careful work which he did not mention. The governing board of the American Institute of Biological Sciences even had to protest against the Russian's distortion of the data of Western geneticists (*14*).

The immediate problem raised by the spreading of dishonest data seems to be caused by the existence of an official doctrine. The inheritance of acquired characters is now *de rigueur* in Communist countries. It probably also has a special attraction for other Marxian cults, inasmuch as both Marx and Engels were complete Lamarckians, although they accepted Darwin's natural selection only in part. Whatever the cause, scientists will have to be alerted to the possibility that data now quoted to support the inheritance of acquired characters may do nothing of the sort. It may simply be misinformation disguised as scientific data.

Since the foregoing portion was written, more evidence has been found that shows the existence of a widespread attempt to rehabilitate the doctrine of the inheritance of acquired characters by quoting Kammerer's falsified data. A review of a book by J. Ségal (*15*) indicates that the author followed the Communist Party line in claiming that the Western geneticists had unfairly rejected Kammerer's work without repeating his experiments. The review appeared in a reputable publication (*16*), and the anonymous reviewer—obviously no Communist—furnishes us with another example of the innocent spreading of the misinformation:

> He [J. Ségal] very rightly criticizes geneticists for making no effort to repeat the experiments of Kammerer and others in proof of the inheritance of acquired characters, but makes no mention of the now numerous investigators who have attempted to repeat those of Lysenko and his followers, with negative results. . . .

The attempts to rehabilitate Kammerer in the West present geneticists with an unusual problem. Very rarely in the history of science have efforts been made to propagandize falsehoods knowingly. It should be very interesting to learn how long the attempts will last, how successful they will be, and how many scientists will be deceived.

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