More on Popper and biology: the utility of induction

Sir,

Drs. Smith and Mogie (*BioEssays* 22.3) criticise Robin Holliday for ''Taking an inductionist stance'', and later in their letter consider an argument in favour of induction in order to dismiss it. But surely it is a bit odd to dismiss induction. Without it we would be groping in total darkness, not only in science but in every aspect of our everyday lives. All knowledge of the world depends on it. There is indeed a place for deductive logic, but it only discovers what was implicit in our previous conclusions, which could only have been based on empirical observation and induction.

We never needed Popper to tell us that it is possible to make mistakes. The use of his refutations is in demolishing claims to have discovered Laws of universal application. But whatever may be the case in Physics, there are no such Laws in biology. We have only a lot of useful generalisations, some attracting a great deal of confidence but none guaranteed to rule everywhere without exception. We are certainly not going to throw away a generalisation of broad validity because we have found an organism that operates a somewhat different system. So I agree with Holliday that Popper is no great help.

John R. S. Fincham
20 Greenbank Road
Edinburgh
Scotland EH10 5RY
E-mail: J.FINCHAM@ic24.net

Sir,

The recent exchange in *BioEssays* about Popper's analysis of scientific inference left out two considerations worth noting. One is that a truly critical experiment can use the principle of falsification to ''confirm'' a hypothesis by falsifying its alternative—or even all conceivable alternatives.

Consider, for example, the classical experiments on the general structure of the genetic code by Crick, Brenner, and colleagues. The crucial discovery that a combination of three, non-leaky, frameshift null alleles of one sign produced a pseudo-wild phenotype is utterly inexplicable on any class of hypotheses OTHER than the one class it confirmed. The point is that the finding is inconsistent with anything ELSE. That is what made the experiments so powerful.

In short, the critical aspect of confirmatory results is not so much what hypothesis they are consistent with but what (and how many) hypotheses they are NOT consistent with, and therefore rule out of consideration. The scientific literature is crammed with examples that overlook this distinction by reporting results which are ''consistent with'' one hypothesis, but also perfectly consistent with others as well.

Holliday makes an important point by reminding us of certain aspects of Biology, in particular, which do not seem amenable to Popperian inference. These aspects, like the universality of the genetic code, are the consequence of the particular historical path that living systems have followed. Much of interest in Biology has to do with unravelling historical paths, rather than discovering physical mechanisms. And history is not the same kind of discipline as physics.

But perhaps there are analogues of Popper's principles that apply to historical questions as well. For example: could one imagine tests to falsify the null hypothesis that the Nazi party never ruled over Germany and most of Europe? Of course one could, by means of the CONSEQUENCES of the event in question. Certain of these consequences—such as the near disappearance of the Jewish population of central and eastern Europe during just a few years—would be virtually impossible to account for on the basis of any other hypothesis. And if the existence of these consequences falsifies the null hypothesis, this then permits us to conclude that the Nazis must have held power. A series of progressively more refined null hypotheses would permit us to narrow the likely historical paths through which the Nazis came to rule the areas in question.

Evolutionary inference follows similar principles. The construction of an evolutionary tree of sequence relatedness could be viewed as a test of the null hypothesis that the sequences in question are independent creations. For example, one could (in principle) calculate a probability that related sequences A and B in fact originated through independent creation. This probability would be minute compared to that of descent with modification to explain the relatedness.

This is more like detective work than physical theory, but only in this respect: instead of absolutely falsifying the null hypotheses, we show that their probability is much lower than that of alternatives. I think Popper would approve the procedure.

Jonathan Gallant
Department of Genetics, SK-50
University of Washington
Seattle, WA 98195 USA

BioEssays 22:684, © 2000 John Wiley & Sons, Inc.