PROBLEM OF INDUCTION IN BIOLOGY

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The problem of induction was originally posed by David Hume in his book 'A treatise of human nature'(1739). It goes to the heart of the question of whether and how we may 'know' something about the future occurrence of an event, based purely on its (repeated) occurrence in the past. A central example being of course, the events predicted by a scientific law. Hume himself concluded that there was no rational grounds to infer that an event would occur merely on the basis of its occurrence in the past. The solution that he proposed was based on a form of skepticism or agnosticism. Hume's argument against the existence of god - that there is no constant conjunction between god and his deeds - opposes the argument from design or teleological arguments and is closely related to the problem of inference, using the principle of induction. Since the time of its formulation by Hume, the problem of induction has been studied by both philosophers and scientists; and within the discipline of mathematics, the 'principle of induction', is an indispensable tool for most working mathematicians.

We shall try to show below, that the roots of the problem really lie in human evolution and ultimately perhaps in biology. However, from a strictly scientific point of view, the problem has a resolution, within the framework of determinism. The reason that we may indeed expect the future occurrence of an event, given its past occurences, is because of the action of deterministic laws and we may expect the recurrence of such events as long as the conditions required by the law are satisfied. There are two aspects of this solution that are worth noting. Firstly, the 'framework of determinism' can only yield a half way solution, since scientific laws are, thanks to quantum mechanics, ultimately random. Even if we were to adopt the 'practical' view that, it is only at the microscopic level that determinism breaks down, it is by no means clear that the macroscopic domain belongs exclusively to deterministic laws. Much of our environment must be considered random and subject to the vagaries of uncontrolled energy flows at different scales. Yet, it is within this framework of randomness that deterministic laws, like that of gravity, prevail and to that extent provide a solution to the problem of human cognition posed by inductive logic.

The second aspect of the 'deterministic solution' to the induction problem that was mentioned above, is that the natural setting for the problem and one that we believe is often obscured, is that of time. Problems of philosophy, as distinct from history and evolution, are more often than not, posed in a transcendental logical form that, as in the present case, obscures its temporal setting. The problem of induction may then be considered as one that is related to our notion of time viz. an undefined future, juxtaposed against a definite past. The problem is of constructing knowledge as we move from the past into the future. It is worth restating, if only to not lose the thread of time (sic), that the problem of induction is related to uncertainty of the future and indeed to the relation between knowledge of the past and knowledge of the future. But this uncertainty is common to all species. In other words the problem of induction in a biological context may be posed as follows : how do species create knowledge to move from the past into the future? And to the extent that they are successful, a species may be considered to have solved the problem of induction in some sense or the other. This is rightfully a problem in the theory of evolution on which, in this note, we shall venture to make a few comments.

A fundamental feature of the Darwinian theory of evolution is that species adapt to their environment. This

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in turn is closely related to the reproduction and survival of their offspring. Here we consider that an important aspect of the changes in an environment is that they are cyclical in nature. Typical examples of cyclical changes that many species are adapted to are the diurnal and annual motion of the earth with respect to the sun. It is a moot point whether reproduction and survival of offspring are at all possible without anticipating future changes i.e. without any inductive inference based on past events. A mechanism that makes this induction possible is ‘cyclical change’. In other words, adaptations to particular environments could be considered as adaptations to particular cycles of change into which such environments may be considered to have been embedded. Evolution may thus produce a working solution to the problem of induction by making it contingent on species to adapt to cyclical changes and thus relieve the pressures arising out of an unknown future.

Cyclical changes could provide a framework of predictable (rather than deterministic) changes that makes adaptation in a random environment a feasible proposition for a species. Here it is necessary to clarify that by cyclical changes (of a system) we mean a sequence of changes in time in which the system (in our case the environment) returns to its initial position in some approximate sense, after a fixed interval of time. It is not clear whether consciousness of time as a linear progression of events (as opposed to a cyclical progression) can provide an effective basis for adaptations to a random environment for any species. Physicists often study the behavior of their models under time reversal. In contrast, the problem of induction as posed by Hume reverses a sequence of events from the past and asks what would happen in the future. The answer, perhaps, depends on whether we distinguish between changes that form a linear progression from those that are cyclical in nature.

The adaptation to cyclical change, hypothesized above, may be a useful tool in the search for extra terrestrial life. In recent times, the search for ETL has centered on exo planets like that of the star Proxima b. where the physical conditions for life such as water and atmosphere and the right temperature are thought to have a higher likelihood of supporting life similar to that prevailing on earth - the only planet known to support life so far. However, while physical conditions like the ‘right atmosphere’ and the ‘right temperature’ may be necessary conditions for life, they need not be sufficient for the sustainability of life in a random environment. We need, in addition, that the changes in its environment provide pathways for the evolution of life.

Cyclical changes could provide the necessary pathways for evolution. Indeed, adaptation to cyclical changes may be necessary to support evolution in a random environment. They could provide the necessary stability, by way of a return to ‘initial conditions’, when the conditions of life face signicant disruption due to the occurrence of random events.

More interestingly, cyclical changes could also provide a template for the evolution of communication in a random environment - again a necessary condition for an intelligent species. As is well known, noise is a significant disrupter of communication that cannot be eliminated even in the best designed communication channels. On the other hand, it is a well known fact that ‘time varying’ signals can be built out of periodic signals (sines and cosines) the latter being perfect examples of cyclical changes. Thus the periodic components of acoustic signals (or sound waves) provide an example of cyclical changes that may have been used in the course of evolution to adapt to a random environment. Could it be that the human ear is a product of evolution working together with inductive logic ? Given the wonders of evolution we need not be surprised if it were. ❐