CHAPTER 10

SUMMARY AND CONCLUDING WORDS

Faltering ahead with a torch in hand

In this book we have taken a close look at two aspects of human inferential activity, of which the making of scientific inferences constitutes a special instance. The two aspects are apparently contrary to each other, which makes the inferential process, or, to be more precise, our *understanding* of that process highly non-trivial and *problematic*.

It is to be clearly appreciated at the outset that inference making is the activity of the cognitive system aimed at making sense of the world and achieving certain ends, where the aspects of *achieving* and *making sense* have an intricate relation to each other. In these acts of making sense and achieving of ends, the cognitive system engages in an act of *interpreting* the world around it. Now, in order to understand how exactly the cognitive system interprets the world, we engage ourselves in understanding and interpreting the *activities of the cognitive system itself*. Thus, there are two *levels* of interpreting and making sense: one is the cognitive system making sense of the world at large, and the other is the system engaging in the reflective act of understanding its own inferential processes, especially those relating to the sciences. Of the two, the latter is actually a special instance of the former since the cognitive system is itself a part of the world at large, though that truism does not help us much *except* in realizing that both of these are *open-ended* processes.

The open-endedness will get explained as I now recall the two apparently contrary aspects of the human inferential activity (including the one of making scientific inferences), which has been the recurrent theme in this book: *inferences are rooted in the cognitive system of the individual and of groups of individuals (such as the scientific communities in the case of scientific inferences) while, at the same time, these are aimed at grasping relevant aspects of a mind-independent reality.*

The inferential process of the individual is fundamentally of an inductive nature, where logically driven deductive processes find their place only *within* the ongoing inductive flow. The inductive process is generally in the nature of a deeply personal one, where beliefs and emotions play an essential role though, paradoxically, the end product of the inferential process has to be *effective* with reference to the world out there, a world that does not know of the personal beliefs and emotions. For instance, the scientific hypotheses and theories have to correctly correspond to features and mechanisms inherent in nature or, in other words, have to be bearers of *truth*.

The *personal* aspect of knowledge about the world was highlighted by Michael Polanyi who, moreover, stressed upon the *tacit* nature of the greater part of that knowledge and of the process

of gaining that knowledge. Later generations of cognitive scientists worked upon the idea of tacit cognition, thereby bringing out a number of basic features of the cognitive activity of the human mind, including the *irrationality* of the cognitive process.

The 'irrationality' becomes apparent when individuals are given psychological 'tasks' of various types by way of requiring them to address little problems whose solutions are known to the test-givers (the cognitive psychologists) in terms of sets of *rules* supposed to be *normative* ones. It then becomes necessary to recognize the distinction between the normative and the *descriptive*, the latter being the way the cognitive and inferential processes *actually* proceed within the human mind. Now, this is a tricky question that requires a deep look at how the cognitive process operates tacitly, i.e., at an *unconscious* level.

The unconscious mind is capable of greatly complex cognitive activities, most of which were previously assumed to be exclusively dependent on focused awareness and intention. While some revealing indications of the range of activities of the cognitive unconscious are available by means of psychological studies, there remains a huge unexplored area, which calls for speculations and interpretations so that the few pieces of solid information available can be interpreted and woven into a coherent framework. Evidently, there may be alternative frameworks of interpretation and speculation, some of which will prove to be inadequate in the light of subsequent findings, while some others will gain in strength, and this process of speculating, pruning, and gaining in strength will continue and, additionally there will be occasional *major* transformations in our conception of how the cognitive process, including the processes of inference, works.

This, incidentally, is *also* the way that science approaches nature and natural phenomena. Mechanisms operating within natural phenomena are revealed to science in successive stages, in each of which nature appears in a new perspective as greater and greater depths are probed by means of improved instruments, backed up with improved conceptual frameworks. In other words, at every stage of interpretation of reality, there exist unexamined substrata and unacknowledged natural boundaries, due to which the fit between nature and the theories of science shows up small anomalies and faults symptomatic of an innate vulnerability of these theories. The latter get replaced by broader and deeper theories at a later stage which, however, do not bear a clear and simple relation of reducibility to the earlier generation of theories. The transition from one stage to the next is often a complex process where hypotheses, essentially of the nature of inspired guesses, are proposed, and highly speculative ideas are subjected to criticisms, counter-criticisms, and meticulous appraisal examining their consistency with evidence and with vast bodies of concepts of proven worth. In the process, some of the speculations and hypotheses get abandoned while some others are selected for further scrutiny and examination.

In the special case of building of theories aimed at describing our cognitive and inferential processes, the vulnerability of speculations, hypotheses, and theories is especially pronounced because of the fact that most of these processes are in the nature of hidden ones, taking place within the cognitive unconscious. However, one seems to be on fairly solid ground in saying that all the inferential processes are contextually determined, where there is an *external* context as also an *internal* one to be reckoned with, both of which are of a deeply complex nature. The

external context, described by the stimuli and inputs from the external world that sets an inferential process in motion is complex in virtue of the fact that out of the infinite number of environmental inputs that the cognitive mind can possibly pick up, only a subset (which may be a *very large* one) is actually selected depending on their relevance and salience. However, the selection is made complex by the fact that, first, the criteria of relevance and salience depends on the *current state of mind* (including the current set of goals, purposes and values) of the individual concerned and, secondly, many of the inputs received from the environment, and subsequently used for inferential purposes, are of a *subliminal* nature. Most of the inputs are in the form of cues picked up tacitly and subsequently transformed into unconsciously formed heuristics.

The internal context of an inferential process is of a similarly complex nature, if not more, since it is made up of heuristics and beliefs, mostly of an unconscious nature, *additionally* involving emotions and affects. In other words, there exist vast repertoires of *hidden* components in both the external and internal contexts relevant to the inferential process.

An inference involves a processing of information of a tangled and complex nature where a vast hierarchy of *rules* are made use of, again, mostly at an unconscious level. The rules are of various categories, some of which are independent of beliefs and modes of thought of individuals and groups of individuals while some others are *not* so. The latter include rules of a person-specific and those of an inter-subjective nature, mostly answering to the description of *heuristics*. The latter are half-baked rules of thumb and hunches, many of those of a transient and fluid nature, liable to be discarded unless proven to be of some worth. On the other hand, there is a vast web of beliefs, many of which are resistant to revision and are of a relatively remote relevance with reference to the inferential act in question. What is of special significance is that a number of heuristics and beliefs act as resources that propel the cognitive mind across logical gaps, where the latter are gaps that cannot be bridged by means of objectively defined rules. In this, the cognitive mind is greatly aided by *emotions* and affects that facilitate the making of decisions that acquire relevance in the bridging the logical gaps. It is this process of leaping across logical gaps that is specific to *inductive* inference, which makes it fallible and, at the same time, *personal* in nature while being uniquely *effective* too.

Of especial relevance in the sciences is the process of abduction, i.e., the one of making of *hypotheses* that subsequently germinate into scientific theories. A novel hypothesis that leads to the transformation of an entire conceptual space is mysterious process indeed, the true nature of which can only be speculated upon. It is likely to involve a greatly enhanced exploration of the conceptual space where local instabilities in the sequential progression of information processing, caused by the amplifying action of emotions, lead to the development of parallel branchings in the exploration process. In this, efficient organizing principles like the detection of analogies play a crucial role whereby relatively remote ideas get correlated and eventually *coalesce* together to lead to a conceptual transformation engendering remarkable possibilities.

The scientific theories that result from these processes of an abstruse nature have a dual significance: these sprout from grounds abounding in beliefs and cultural resources of individuals and groups of individuals, and are built upon prior structures of *existing* concepts and theories and, *at the same time*, these are aimed at revealing the inner mechanisms of nature. As a

result, the theories are bearers of *truths* about nature that have strange and conflicting aspects to these. On the one hand, these are truths largely independent of opinions and points of view of individuals and groups of individuals (though this is conditional upon a more or less prolonged process of exchanges and communications of ideas) and, in this sense, are *objective* in nature while , on the other, these are aimed at a mind-independent reality. The mechanisms inherent in the latter are explored in successive stages of incommensurable nature, through conceptual transformations akin to a change in perspective. In this, the truths are in the nature of *socially conditioned interpretations*.

But the fact that the inferential acts in science, including the ones arrived at by the process of abduction, are fundamentally in the nature of interpretations, with logical gaps remaining within, need not imply a weakness in these. On the contrary, it constitutes a *strength* of great relevance in our inquiry into nature and in our incessant engagements with a largely unknown, uncertain, and complex world. There does not exist any sure-shot way of coming to grips with a vast and complex reality with our limited and meagre cognitive resources other than the one of guessing and groping for our way ahead, sticking our neck out, making use of what has proved to be of some worth and discarding what is found to be ineffective while, at the same time, retaining the lessons of the failures.

The cognitive abilities are, to a quite considerable extent, results of a protracted evolutionary process that is essentially of a similar nature as the one outlined above – building upon the past in a piecemeal way, in response to contingent necessities. Cognition has no ultimate goal precisely because it faces nature in an infinite variety of contexts. Inferences, abstractions, and theories are not aimed at producing a facsimile description of how nature exists and behaves as a whole, but at providing us with a *summary understanding* of parts and aspects of nature as we face these in specific contexts so that we can make *effective* sense of these. Our theories are like *maps* drawn from a *limited* exploration into nature, based on which we make hypotheses regarding the way ahead. We then commit ourselves to further explorations in keeping with our hypotheses and, when rewarded with success, remake the maps, where the new set of maps differ from the earlier ones in that new *aspects* are incorporated into these, requiring novel ways of reading the maps. Theories, in other words, make possible new *encounters* with nature. In this, science is continuous with and constitutes a heightened form of our mundane, day-to-day engagement with reality where we make great use of our ability to guess, and guess correctly, albeit with equally great support from our judgement based on sound logic.

The naturalist point of view looks at the actual process by which scientists go about their business of interpreting nature, without burdening itself with *logical* and abstract considerations of what the aim of science is, what the scientific method is, and what constitutes scientific progress. In this, the naturalist point of view focuses keenly on the *cognitive roots* of how science inquires into nature. It focuses keenly on how inferential processes actually proceed in the minds of individuals, how a great variety of cultural resources affect our cognitive endeavour, and how hypotheses are actually formed, giving rise to theories about the world around us, without burdening itself too much with questions of *norms* of rationality; more precisely, it tells us that questions relating to norms are misplaced ones.

Still, questions relating to norm are *not irrelevant*. And, abstract and logical considerations are not irrelevant either. In a manner of speaking, considerations *in the abstract* are as relevant as those *in the concrete*. In the context of human cognition and of the scientific process, the naturalist point of view entails the considerations of the latter variety, while the former are the ones that were the mainstay in the philosophy of science up to the sixties of the last century. The logical approach in the understanding of human cognition, principally geared to realizations of cognitive mechanisms in artificial intelligence, captures quite an impressive number of aspects of the cognitive process, and a logical analysis of the scientific process brings in sharp focus quite an impressive number of issues relating to the cognitive roots of scientific exploration and the way the latter relates to a mind-independent reality.

Questions of norm in human cognition cannot be shaken off by the simple assertion that these do not relate to how cognition *actually* works. Human cognitive and inferential processes are not limited within the narrow horizon of effectiveness, because effectiveness is meaningful only with reference to *goals* and *values*. And, questions relating to goals and values are not confined to the field of cognition alone, because these are deeply existential ones. Ultimately, these relate to our desires and drives, our cravings for power, our yearnings for fulfilment, our deep-rooted instincts for sharing and understanding, our need to *improve* upon what we have become, and our endless quest for *making sense* of our own existence in this world of ours – a world that is *within* us as it is *around* us.

Both the two worlds are fathomless, revealed to us contextually and discontinuously, in bits and pieces. Our perception of either of the two builds up, shimmers before our eyes, and then dissolves into a new picture, revealing novel aspects in a new context. This makes for a quest that remains open-ended even as it constitutes an intoxicating and dizzying journey. We do hold the powerful torch of *logic* in our hands, but the rays emanating from it are too straight to obviate the necessity of guessing, groping, and faltering ahead along twisting paths in a world that is at once labyrinthine and layered.