Replicative Nature of Indian Research, 
Essence of Scientific Temper, 
and Future of Scientific Progress*

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ABSTRACT

A lot of Indian research is replicative in nature. This is because originality is at a premium here and mediocrity is in great demand. But replication has its merit as well because it helps in corroboration. And that is the bedrock on which many a fancied scientific hypothesis or theory stands, or falls. However, to go from replicative to original research will involve a massive effort to restructure the Indian psyche and an all round effort from numerous quarters.

The second part of this paper deals with the essence of scientific temper, which need not have any basic friendship, or animosity, with religion, faith, superstition and other such entities. A true scientist follows two cardinal rules. He is never unwilling to accept the worth of evidence, howsoever damming to the most favourite of his theories. Second, and perhaps more important, for want of evidence, he withholds comment. He says neither yes nor no.

Where will Science ultimately lead Man is the third part of this essay. One argument is that the conflict between Man and Science will continue till either of them is exhausted or wiped out. The other believes that it is Science which has to be harnessed for Man and not Man used for Science. And with the numerous checks and balances in place, Science will remain an effective tool for man’s progress. The essential value-neutrality of Science will have to be supplemented by the values that man has upheld for centuries as fundamental, and which religious thought and moral philosophy have continuously professed.

Key terms : Replication, Refutation, Mediocrity, Scientific Temper, Religion, Value-neutrality, Ethics in Science.

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I

Introduction

*That white horse you see in the park could be a zebra synchronised with the railings.*

- Ann Jellicoe*

Most researchers and science-watchers would want to bring about a wider discussion on the need for an Indian Science, to focus attention on the true scientific temper and remedy the rot that has set into it in this part of the globe. It is no doubt true that a lot of Indian research is replicative in nature, and originality is at a premium here. In this, the rigid hierarchical system that governs scientific establishments (as it does others) has its own significant role to play. But we cannot discount a host of other factors, not the least being our lack of sophistication in research tools, low priority to research, bureaucratization and politicking in research projects and grants. And, last but not the least, the sociocultural ethos, and the Indian psyche itself, amongst other things, favours compliance and abhors change, regardless of its need. It is thus inevitable that mediocrity of various hues should be in great demand, and perfection or its search considered impracticable, if not impossible. Mediocrity is the best guarantee of conformity and status-quo; duplication and ad-hocism is the maximum that lies within its capacity. Any trend-setting must involve the ability to significantly depart from earlier convictions, and defend this on the basis of adequate evidence. This is basically anathema to a system that thrives on rigid notions that perpetuate a deeply ingrained love of traditionalism and obscurantism. Ad-hocism bugs Indian Science as much as it does other worthwhile disciplines. This is of course only a reflection of the state of Indian society itself and is a separate topic in its own right.

Replicative Research

Having said this, however, let some points be clarified. Replicative research, though lacking originality, is a legitimate part of scientific research all over the world. In Science, as elsewhere, one of the major

*All quotes marked (*) from Cohen and Cohen(1986). See References list. This quote on p.173.
Though greater finesse and expertise can help bring larger number of leads in scientific research from elsewhere, it is in their confirmation and their universal relevance, or denial, that centers in the developing countries can help. And let us not forget that corroboration is the bedrock on which many a fancied scientific hypothesis or theory stands, or falls.

problems to contain is an unbridled search for newer entities in research. Most creative energies are siphoned off in tracing out only that which can become trend-setting. In this, hypotheses that appear novel and likely to radically change perspectives are eagerly put forward, and as eagerly imbibed. Scientific progress no doubt does involve the production of certain false leads: this is a professional hazard of being a scientist, as well as a legitimate fall out of the branch itself. But most scientific researchers have to beware that not more than the bare minimum of creative energies are utilised in such vain pursuits. At the same time, most researchers are seized of the need to replicate an experiment and verify the results of the original research team. This is precisely because reaffirmation or denial, or any further subtle nuances of a process studied, are laid bare only by these means. They are also the means of refining methodological errors in the original experimenter, which is another major scientific exercise that leads to its progress. Further, to prove that a certain phenomenon is universal, it needs to be studied at different centres and at different times. This is the crux of scientific research and its constant concern - the search for universal phenomena eschewing personal idiosyncrasy, subjectivity, demagogy or blind faith. This is what has lead to the rationale for collaborative research centres or projects at different places the world over, with one of which one of us was associated for some time.

To be sure, one would expect the lead in most such projects to come from the developed part of our globe. This is a reality none can deny. But this need not take away the credit from corroborative research done elsewhere. Though greater finesse and expertise may help bring larger number of leads in scientific research from elsewhere, it is in their confirmation and their universal relevance, or denial, that centres in the developing countries can help. And let us not forget that often corroboration is the bedrock on which many a fancied scientific hypothesis or theory stands, or falls. It is only when replication is attempted that most scientific hypotheses or theories, or even proofs, stand the test of objectivity, and therefore remain acceptable, or get discarded.
Discrimination and Assimilation

What we therefore need to condemn is not replicative research as such. (And we can use the words duplicative and replicative synonymously here, for sans its pejorative connotation, what is duplicative work if not replicative?). It has its legitimate place. What we need to condemn is a blind duplication, and a total involvement purely with this type of work. This can be a manifestation of servility that the Indian psyche has to rid itself of. In a country where for everything innovative, superior or trend-setting, the people have learnt to look to the West, is it any surprise that the scientist isn’t any different? This is a pity, true, but it is a fact as well, a fact that cannot be wished away by chanting pious patriotic slogans. The war, if at all, has to be fought at a totally different level. For this, firstly, we will have to develop the power of discrimination which must guide every assimilation. As of today, the order is reversed. It is senseless assimilation that has dulled any discriminatory capacities. Reversing this trend would mean reversing the colonial mentality, wiping out our historical blemishes, disciplining a whole mass of people. It must ultimately involve giving up on our ‘underdeveloped’ status as a nation. When so put, we immediately realise the enormity of the task. After all, the quality of the scientific work, as of any work, cannot but be directly proportional to the calibre of the collective cerebral pool of a society. And its social values, its collective priorities, and particularly, the personality strengths of its stalwarts and its torchbearers.

What has to be done

Once we realise this, we can see that just blaming or pointing out what ails Indian Science is not adequate at all. What will have to be done is to adopt concrete steps to achieve and reward academic excellence and originality, to encourage genuine research potential and further commitment to fundamental research. For this of course a firm grounding in scientific methodology and temper is a must, and that too from the very beginning of education. But also equally important is a truly professional commitment of a dedicated band of researchers who have the backing of an enlightened bureaucracy. In this, therefore, research amateurishness is out, as is maybe the inability in today’s setup to make a comfortable living as a researcher. Along side this is involved the need to remodel educational policies to further the creative potential as opposed to rote learning, to encourage students to deal with...
concepts rather than with information alone, to hone their critical - analytical apparatus and learn to sift and sieve rather than uncritically accept. This will involve a massive effort to restructure the Indian psyche. And will be reflected in the quality of its cerebral pool, its personality strengths, social values and priorities we talked of earlier.

II

The Essence of Scientific Temper

This is the essence of science: ask an impertinent question and you are on the way to the pertinent answer.

- J. Bronowski*

It is inconsequential, if not frivolous, to enter into any dialogue of delinking science from religion, faith, superstition and other such entities. This is the favourite past time of some modernists, and that brand which prefers to call itself rationalist. Usually, true scientific temper does not have to make any conscious attempt to delink itself from anything. The delinking is automatic. Anything that is not objectively verifiable, that cannot be experimentally proved and does not have the possibility of replication cannot fall within the purview of scientific investigation or research. That need not negate its truth, or its worth, for nowhere does science claim that it knows, or will know, the whole truth. All it means is that any truth, opinion or merit it has is extramural to science. It means it falls outside the domain of scientific verifiability.

... the pronouncements of science are made tentatively, on a basis of probability, and are regarded as liable to modification. This produces a temper of mind very different from that of the medieval dogmatist... (And science) pronounces only on whatever, at the time, appears to have been scientifically ascertained, which is a small island in an ocean of nescience (Russell, 1985, p.480). Parenthesis added.

Science, the discipline, and Scientist, the man

Having said this, we must immediately realise that science, therefore, can have no basic animosity, or friendship, either with religion, religious belief, or faith. A scientist, however, can. And there is every reason to believe such a distinction can be made, and legitimately so. A scientist is human, and, being so, has his own share of aspirations, beliefs and hopes which cannot, however,

*Cohen and Cohen (1986, p54).
be a part of the branch to which he belongs. A large part of his energies can be legitimately spent in discriminating between the two, and not allowing one to negatively influence the other. No doubt he attempts to rid himself of viewpoints that are not based on evidence. But as regards entities he cannot scientifically verify, or has still not developed the methods to scientifically study, he prefers not to comment as a scientist, and yet retains his right to believe, reject or defend, as a human. In this, no doubt, lie shades of his hypocrisy which is inevitable in all such ambivalent situations. But neither pointing it out nor condemning it is of any great worth. The latter, if anything, leads to the worship of science, by raising the branch to the level of a dogma or a faith, which itself can have no less disastrous consequences for mankind. What must be attempted is a realization of this ambivalence, of this duality of cognition, and a sincere attempt made to allow the bare minimum of unhealthy interaction between the two. For this, there are two cardinal rules a scientist must follow with regard to his branch. First, he should never be unwilling to accept the worth of evidence, however damning to the most favourite of his theories. Second, and perhaps more important, for want of evidence, science withholds comment.

Scientific Temper and Religiosity

Science, therefore, or scientific temper, need have nothing to do directly with how religious or otherwise an individual is. That should clarify why the best of scientists have been both pious and atheists. This is not to say that religiosity, or its denial, makes them better scientists, although personally they may so claim. All it means is that personal preferences and biases are difficult to delink for even those who are in disciplines that involve the most rigorous objectivity. Secondly, as far as the question why religion, or its
refutation, is accorded diametrically opposite value by the committed believer or the established iconoclast amongst the scientists goes, the answer is not very difficult. It is more an indication of their personal qualities of single-minded pursuit and devotion. It is this that makes them rise to the top and gets exercised as much in their scientific research as their metaphysical opinions. And faith, or its denial, can become important catalysts in both pursuits. The scientist concerned, however, may give it a totally different, personalized, colour. This, again, is only proof that the scientist is human after all and, in spite of his best efforts, human failings cannot but become manifest at times.

**Refutation**

*It is a good morning exercise for a research scientist to discard a pet hypothesis every morning before breakfast. It keeps him young.*

-Konrad Lorenz*

There is another facet to the advancement of science. Just as replication is important, refutation is equally so, in fact more so, according to certain authorities. The march of scientific progress is the result of refutation. Karl Popper, a respected name in the philosophy of science, believes there is in science an inherent (or inbuilt) quality of development by refutability (Popper, 1968; 1969). Progress in science, therefore, is more the consequence and product of the refutation of a theory, concept or idea, less of its confirmation. Controversy, and slanging, are therefore just logical consequences. Similarly, Thomas Kuhn talks of paradigm shifts which fundamentally alter perceptions that cause scientific progress (Kuhn 1970; see also p. 48 of this book). This means that instability of scientific hypotheses is an inbuilt feature of scientific advance. This may appear an anachronism to the science worshippers. But its worth is apparent when we see how the most recent of scientific research become out dated tomorrow. To the human-being it means that although science is a method to search for means to rid one of error, it is a search that only approximates, but may never finally lead, to the truth in the ultimate analysis. That need not make the search any less intense, or the genuine pursuit of science any less important, as it can apparently do as an immediate reaction. Amongst other things, the very fact that scientific progress occurs itself helps mankind achieve so much of material advancement in its wake. But what is

*Cohen and Cohen (1986, p211).*
materially beneficial to mankind is only incidental to scientific progress. It is never its goal, or even its major thrust.

For science knows only one commandment : contribute to science.
- Bertolt Brecht*

This determinism is best realized early by the more prudent, and is neither disliked nor lamented. It helps, if anything, in sobering down unrealistic expectations from science and in not involving it in any unnecessary controversies with those aspects of human endeavour (like politics, religion, social activism etc.) with which it need not have any quarrel whatsoever.

Some Conclusions

To conclude the second part, one may say that the true scientist withholds himself from passing comment on a phenomenon which his experimental method can either not verify or which falls outside the purview of his branch itself. That does not mean he shirks his responsibility. It does not also mean he may not take up this phenomenon for study at a future date, when he develops the necessary methodology and the expertise. All it means is that at the existent state of his knowledge, he withholds himself from either attempting something which he cannot scientifically assay, or passing judgment on something he cannot objectively verify. He withholds judgment, mind you. He says neither yes nor no. Often most people err in considering withholding of judgment to mean no, or the lack of courage to say yes. This is because dislike of a state of suspended animation is natural to human beings. But the scientist has to constantly live with it. There is hence no justification for such a belief.

III
Two Contrary Streams of Thought

There are two streams of thought which must engage our attention in this section. One is deterministic and leads to pessimism. The other is intent on controlling the perils into which scientific progress can lead mankind and is hopeful of success if checks and balances are in place. It keeps to the forefront the question whether man is for science or science for man. Let us take up each of them one by one.

* Cohen and Cohen (1986, p51).
The painful truth is that not only is science neutral in its value orientation, this neutrality makes it eminently suitable to the machinations of man’s ulterior motives. This is the reason why, for example, nuclear weapons keep on getting produced inspite of the fact that every scientist knows the vast devastation they can cause.

The practical importance of science was first recognised in connection with wars. Galileo and Leonardo obtained government employment by their claim to improve artillery and the art of fortification. From their time onwards, the part of men of science in war has steadily grown greater (Russell, 1987; p.480).

This is again a dilemma for the scientist as a propagator of his branch, and may be considered a defect of scientific advance by the activists of nuclear nonproliferation and disarmament (or, for that matter, even the environmental activists). This is also the reason that scientific development will continue to use its own perpetuation as its only guiding factor, irrespective of whether it causes the welfare of mankind, or otherwise. And also the reason that as long as scientific progress is our major thrust, nuclear disarmament activists (or even the environmentalists) will continue to fight a losing battle. And why the scientist, as a man of science, will never be able to resolve the pangs of guilt and remorse aroused in him as a person belonging to the race he will ultimately help to destroy:

If only I had known, I should have become a watchmaker.

-Albert Einstein (Of his making the atom bomb possible. Quoted in News Statesman, 16 Apr., 1965)*

To be sure, the conflict between ‘Man’ and ‘Science’ will continue till either of them is either exhausted or wiped out. In the meantime all that we may succeed in doing is

*Cohen and Cohen (1986, p 108).
try and achieve some state of equilibrium wherein, till this final stage is reached, life can continue with the simulations and masks that make it tolerable. No. This does not mean destruction is round the corner, or the final deluge predicted is most theology is just waiting in the wings. It only means we still have time to prepare ourselves for the final reckoning. And if to discard Science as a remedy to this existential despair appears an attractive alternative, perish the thought. No one, supposedly in his senses, will accept your ‘obscurantism’.

Resolution of the Pessimism

The earlier paragraph ends on a rather sombre note. And a pessimistic one at that. There may arise howls of protest, or at least an extremely uncomfortable feeling in most readers. It is like the feeling one gets after watching a tragedy movie. Having witnessed the benefits of scientific and technological advancement pervade every aspect of our lives it is disconcerting to accept such a proposition, to say the least.

What shall we do then? How shall we place this thought in perspective? How shall we resolve the pall of gloom that sets in with such a realisation? Well, let us try.

It is in the nature of entities that begin to also end at some time. It is fundamental to the rhythm of nature, and the universe. Man is born and must die. Seasons start and must end. Days end into nights and nights into days. Years start and end, as do decades, centuries, eras and epochs. None of the material entities have the attributes of beginninglessness, and therefore endlessness (except perhaps primordial matter itself). That quality, if at all, religion attributes to entities like Soul and God, which are considered timeless, beginningless, endless etc. etc. Science has no methods, as yet, to study these entities, and so can learn nothing about them.

Two thoughts can comfort us in this situation.

One is, even if we grant that what starts must end, it does not mean we cannot enjoy the interlude. Although we may start driving from our house to a certain destination, just the thought that the journey is going to end need not deter us from enjoying the whole drive. Man is born and must die. True. But the fact that he must die need not prevent him from living his life well, fruitfully and happily. For, in so doing, he only fulfils himself.

This is what man can do in spite of a realisation of the inevitable and inexorable direction in which Science will propel him. Granted, the realisation adds a tinge of
Man for Science, or Science for Man?

As apposed to the former view, which we set out to resolve (and succeeded to an extent), is the view while must engage our attention here. If the former thinks of Man as getting used for Science, this wants Science to be firmly utilised in the service of Man, and never the other way around.
Man’s well-being has never been strictly defined but it has always acted as a universal value. It must be the overriding goal. Human life, the possibility of its comprehensive development, is of the greatest value. Science, and development, are the means to such an end. The price that humanity must/ must not pay for truths to be discovered in nuclear physics, molecular biology and such other fields must not be such as to undermine man’s welfare for the welfare of science. The essential value-neutrality of science will have to be supplemented by the values that man has upheld for centuries as fundamental, which religious thought and moral philosophy have continuously professed. For:

*There is no evil in the atom: only in men’s souls.*
- Adlai Stevenson*

This however need not lead us to scientific nihilism or to Rousseauistic views that slow down scientific progress to ‘zero-growth’, or to ‘anti-science’, or a science counter -culture. All it means is the modern scientist must weigh the progress of science and technology (especially the latter), with the consequences of their progress for mankind. In all such procedures, the well-being of man must be the over-riding goal.

These issues are discussed in contemporary science, and notably in philosophy, chiefly in connection with the admissibility of certain kinds of research which by themselves, or in application, may damage man and humanity. Not only nuclear physics is the subject of controversy, but also molecular biology, genetics, medicine, psychology, psychiatry and other fields of knowledge where man is the object of study. Many scientists believe that man will come across political, moral, ethical and psychological problems which will make those facing nuclear physics seems like child’s play (Frolov and Yudin, 1986). Especially the developments in biology (like cloning, surrogacy, stem-cell research etc.) pose fundamentally new and very complex problems for the thinking man in general and philosophers in particular. It makes sense to say that philosophers of science would do well to think a great deal more in the future about ethical problems than about logical problems (Glass, 1970). The dangers of using biological findings in warfare, the consequences of psychopharmacological drugs, the practice of organ transplants (‘What makes the individual’) all pose many complex and fundamental questions before man and humanity.

For all these reasons, the development of strict socio-ethical standards of experimentation with man

*\(^*\)Cohen and Cohen (1986, p 172-73).*
becomes a vital need. Equally important is the need for stringent social and ethical supervision of such standards. Thus, on the one hand, the scientist must self consciously follow such codes himself. On the other, regulatory bodies must see to it that such codes are strictly enforced, and any transgressions adequately prevented and /or punished.

**In Closing**

Let us now ask once again: Where, then, is the existential despair? Where the need to discard science? We may indeed perish the thought, for where is the obscurantism?

We may also consider ourselves duly comforted and even a bit happy at having revolved the issue partially, at least for now. The tinge of inevitability and tragedy lingers. True. But that is what makes the comedy of living all the more enjoyable. And desirable. And Science is about the joy of living, if nothing else, even if it is about the depths of eventual despair.

We have decided to enjoy the journey while it lasts.

How about you?

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6. Popper K. (1969), *Conjectures and Refutations*, Routledge and Kegan Paul.
7. Russell B. (1985), *A History of Western Philosophy*, Counterpoint, London, Unwin Paper backs, p.481-82: “Unlike religion, it (science) is ethically neutral: it assures men that they can perform wonders, but does not tell them what wonders to perform… The men at the head of the vast organizations which it necessitates can, within limits, turn it this way or that as they please. The power impulse thus has a scope which it never had before. The philosophies that have been inspired by scientific technique are power philosophies, and tend to regard everything nonhuman as mere raw material. Ends are no longer considered; only the skillfulness of the process is valued. This also is a form of madness. It is, in our day, the most dangerous form, and the one against which a sane philosophy should provide an antidote”. Parenthesis added.
Questions that the Fourth Monograph raises*

Q.1. What should governing bodies and funding agencies do to encourage original research?

Q.2. How can Indians graduate to original research from replicative research?

Q.3. In which fields is original research taking place in this country? And to what degree?

Q.4. What changes in education pattern in schools/colleges will ensure that Indians take to original research in a big way?

Q.5. Will science ever answer questions like: Is there God? Is there an afterlife? Are miracles for real? etc. etc.

Q.6. How can scientific temper and religious belief coexist? On this planet? In an individual?

Q.7. Will scientific progress ultimately lead to mankind’s annihilation? Is there an antidote?

Q.8. If evidence is so important, what happens to belief and devotion? Should they be discarded, although they are useful to mankind at every step?

Q.9. The clinician believes the research evidences presented to him in conferences and journals. Should he discard this belief and trust only his own evidence? Is that a practical method of working?

Q.10. ‘Science without religion is lame, religion without science is blind.’ So said the great Albert Einstein. Is that sufficient enough resolution of the divide between religion and science?

Q.11. ‘Every genuine scientist must be... A metaphysician’, said George Bernard Shaw. Does this not have the danger of making him a poor scientist?

Q.12. How do you like the proposition: howsoever thin you slice a cake, there are always two sides?

*See also page 71-75.