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Till Science Transcends the Scientist: Role of Human Factor in Science

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Most people would baulk at a phrase like 'literature (or music) and culture' on the ground that the first term is already contained in the second. But they would uncritically accept a construction like 'science and culture'. The reason probably is this. Like a poet or a painter, a scientist is also culturally anchored; but there is a difference. When scientists discover fundamental laws, uncover patterns in nature or establish linkages among seemingly disparate phenomena, they do so on behalf of the whole humanity. Their work in fact transcends even humanity in the sense that laws of nature as discovered on the earth will be recognized as such by scientists working elsewhere in the universe even though one cannot even imagine what the cultural setting of these extraterrestrial scientists would be.

In other disciplines, creative work remains the property of its creator. Science, however, aims to liberate itself from the scientist. For a scientific theory, hypothesis or model to become established, be accepted as received wisdom and treated as textbook material, its author's name must cease to be proprietory and become merely descriptive instead. Till such time as science transcends the scientist, human factors like values, judgements, foibles, idiosyncrasies, prejudices and biases play a role, but not afterwards.

It is notable that controversies in science are not settled by the contestants but by time. Timescales needed to establish theories are longer than those associated with individual scientists. At any point in time, science raises questions that cannot be answered by the scientists of the day. It is on such questions that scientists take positions. The issues are settled not because one set of scientists succeeds in convincing the other, but because new evidence accumulates and slowly the issues resolve themselves. The controversies however do serve. an important scientific function. They bring the issues into sharper focus and encourage further observations/experiments.

An important question that needs to be addressed is this: When the existing evidence is not adequate to choose between two competing models or hypotheses, what are the arguments proffered by the adherents of each side in support of their point of view, and how these arguments influence the future course of development. We can illustrate the above points with the help of some examples, drawn from astronomy and cosmology. In 1920 two leading astronomers of the day, Harlow Shapley and Heber D Curtis, participated in a 'great debate' on the scale of the universe. The debate raised a number of important questions: Was the galaxy bigger than hitherto assumed? Yes, Was the sun at the centre of our galaxy? No. Was our galaxy the only one in the universe, or were there others like it? [It was one among many].

"In the debate, both participants supported their conclusions with formidable arrays of observational data that they themselves had secured. Both had carefully scrutinized observations by others and checked their results. Written statements were prepared by both men and exchanged before the meeting. Each had made minor revisions after reading his opponent's views, but neither found it possible to accept the others principal conclusions."[1] Significantly, "nor were other astronomers able to decide definitely between the two points of view."[2] The debate provides "a glimpse into the reasoning processes of eminent scientists engaged in a great controversy for which the evidence on both sides is fragmentary and partly faulty. This debate illustrates forcefully how tricky it is to pick one's way through the treacherous ground that characterizes research in the frontiers of science."[3] The scientific issues involved in the debate were resolved over a period of two decades when the frontiers of knowledge got progressively pushed further.

Three decades later there erupted another controversy, this time on the origin of the universe. Did the universe begin by exploding from a hot dense state ('big bang'), or was it without a beginning ('steady state'). (Interestingly, the now standard technical term big bang cosmology with the same initials as British Broadcasting Corporation, was coined rather pejoratively, in 1948, by Fred Hoyle.) The steady state model was finally proved wrong by the detection in 1965 of the three degree kelvin microwave background radiation, which proved that the universe was hotter in the past. While the controversy lasted, it brought into focus philosophical postulates (Was there need for a 'perfect cosmological principle'?) as well as questions of methodology (What constitutes Popperian testability in areas such as cosmology?). How do proponents of a theory respond to its rejection? Max Planck, the founder of quantum physics, held a rather extreme view. "An important scientific innovation rarely makes its way by gradually winning over and converting its opponents. What does happen is that its opponents gradually die out, and that the growing generation is familiarised with the ideas from the beginning."

While it is true that many propounders stick to their views till their physical or intellectual death, there are any number of examples where the proponents of a view have willingly abandoned it when new evidence to the contrary came along. In one respect however Planck was right, that is, about the growing generation. Even though attempts are still on to salvage steady-state model, the new generation of researchers is being brought up on the standard big-bang. (I was once told by an American academic that his pro-steady state proposal was turned down by funding agencies on the ground that younger generation should not be involved it. An otherwise well-respected American astronomer was refused telescope time for his non-standard observational programme, and moved over to Germany, a reversal of the historic scientific traffic.)

Human factor has played a role in the case of mathematical theories as well. Einstein himself intervened in his entirely self-consisted gravitational theory, erroneously called General Theory of Relativity (GTR), by introducing an arbitrary term to prevent the theory from permitting expansion of universe which he thought was unphysical. Once the universe was observationally shown to, be expanding, sensibly the theory was left alone to speak for itself. The Nazi attempts to brand GTR as Jewish science were short-lived, for two reasons. First, the well-known failure of Newtonian gravitation to explain Mercury's orbit had already created a slot for an improved theory, even if nobody had any clue as to what the new theory would look like. More importantly, within four years of its enunciation, a prediction by GTR (bending of starlight by sun) was experimentally verified.

Einstein was fortunate that the verifiability of his theory was within the capabilities of the technology of the day. Subramanya Chandrasekhar was not so lucky. He was the first to apply Theory of Special Relativity to problems of stellar evolution. His mathematically rigorous work on the white dwarf stars, which essentially predicted the existence of black holes, was ridiculed by Sir Arthur Eddington, the then most influential astronomer in Europe. With a haughtiness one associates with Viceroys rather than scientists, he declared: "I think there should be a law of nature to prevent a star from behaving in this absurd manner." Sir Arthur was blinded by his self-righteousness; the others by the glare of his personality.[4] It was not that one hypothesis was competing with another. It was an exact mathematical theory that was pitted against refusal to listen. Eventually, the discovery of the pulsar stars and quasar galaxies vindicated Chandrasekhar. Interestingly, though Chandrasekhar won a number of academic awards for his subsequent researches, it was only in 1974 that an award citation referred to his pathbreaking white dwarf work. Eddington's prejudice had delayed the development of relativistic astrophysics by forty years! Ironically, a film on white dwarfs recently made by BBC was titled 'Absurd Stars' and showed a photograph of Sir Arthur rather than Chandrasekhar, making light of the former's prejudice. Therefore, the journey of a scientific theory from its enunciation till its enshrinement in textbooks is often a long one. It is in the interim period that human factors come into play.

NOTES

1. Struve, O. and Zebergs, V. 1962. *Astronomy of the 20th Century*. New York: Macnultan. p. 416.
2. Ibid. p. 444.
3. Shu, F. 1982, The Physical Universe. *An Introduction to Astronomy*. Mill Valley: University Science Books.p.286.
4. Struve and Zebergs.

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1. Kochhar, Rajesh. 1995. 'Transcending the Limits: Chandrasekhar's Stellar Contribution". *Times of India*,19 October.
2. Shu, F. 1982. *The Physical Universe*. *An Introduction to Astronomy*. Mill Valley: University Science Books.
3. Struve, O. and Zebergs, V. 1962. *Astronomy of the 2Oh Century*. New York: Macnultan.