
Science is the Cognition of Necessity

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Kosambi's classic definition of "science" is by itself sufficient to secure him a place in the history of thought. It is as profound as it is brief: 'Science is the cognition of necessity'. The significance and power of his definition is brought out in his essays on science and society, where he repeatedly refers to and develops this theme. Some of these essays are reviewed in this article.

Understanding 'necessity' as manifested in a historical context – 'historical science', or a 'materialist conception of history' has its origins in the philosophical and scientific debates of the late 18th and early 19th century in which developments in the natural sciences were most important. The reconstruction of biology as a historical science had begun well before Charles Darwin (whose *Origin of Species* was published only in 1859). In the preceding century it was becoming increasingly clear that two sciences – geology, and biology, could only be rationally understood as historical sciences. The fossil record, where geology and biology met were the pages of a history book, with a strong thread of causation linking the later pages of the book to the earlier ones.

This chain of causation strengthened the claims of the materialists. Developments in astronomy had already shown the irrelevance of divine intervention to explain the motions of the planets around the sun. In the battle between the religious establishment and the new scientific understandings in various areas of natural science, the religious establishments had to repeatedly retreat from the areas under debate. By the early 19th century, through the works of geologists like James Hutton and Charles Lyell, and biologists like Leclerc (Buffon) and Lamarck, it was being asserted that all of nature had a history, that this history could be understood, and that moreover, human beings, as a biological species were a product of this natural history. The threads of necessity running through natural science in the form of natural history were becoming increasingly evident. Natural science was taking shape as a program of cognizing this necessity. But what about human activity and social history?

The contribution of Marx and Engels was to show how human social history could be incorporated into the agenda of science. Human social history presents a new problem – understanding human activity. Human societies too show regularities, have laws, but these laws are fundamentally different from the laws of nature which cannot be changed, and are only to be discovered. The laws governing human action are not only biological but also social. Social laws are made and can be changed by conscious human action. In natural science the theory does



not and cannot change the phenomenon. But social theory ‘can grip the masses’ and change the very reality being studied. Human beings can act consciously; have the freedom to choose. How can this freedom of choice be reconciled with the aspect of necessity that is central to all scientific analysis? Comprehending ‘necessity’ in the context of society is more complex than in Nature. There is the realm of the objective, the inevitable, what necessarily must happen, what is compelled by underlying conditions – and there is also the realm of the subjective, the desirable, the possible, the needs of human beings. Marx’s brilliant ‘Theses on Feuerbach’ of 1845 shows how this is to be done, taking both the objective and the subjective into account.

With all of reality – both natural and social – becoming the subject of science, science itself ceases to be a subject, and instead becomes a method for understanding and engaging with reality as a whole. Kosambi’s great achievement is to give a definition of science which can properly encompass this new comprehensive, universal role.

Science and Freedom

Kosambi examines the implications of his definition for the development of science itself in his article ‘Science and Freedom’. Written for *Monthly Review* in 1952, this is the most important of his essays on science. He begins by critiquing an abstract concept of ‘Freedom’, now as professed by the bourgeois Western scientist. He begins by taking on the intellectual dishonesty of a section of the American scientists who while themselves actively participating in the research activities of the US war machine, developing more and more lethal thermonuclear weapons, also would write profusely about intellectual freedom and its absence in ‘totalitarian’ societies.

“In 1949, I saw that American scientists and intellectuals were greatly worried about the question of scientific freedom, meaning thereby freedom for the scientist to do what he liked while being paid by big business, war departments, or universities whose funds tended to come more and more from one or the other source. These gentlemen, living in a society where he who pays the piper insists upon calling the tune, did not seem to realize that science was no longer ‘independent’ ... The scientist now is part of a far more closely integrated, tightly exploited, social System; he lives much more comfortably than Faraday, but at the same time under the necessity of producing regular output of patentable or advertising value, while avoiding all dangerous social or philosophical ideas. As a result, the worthies I mention were quite worried about the lack of scientific freedom in a planned society, but only indirectly and perhaps subconsciously as to what was actually happening to their own freedom in an age and time of extensive witch-hunting, where being called a communist was far more dangerous than being caught red-handed in a fraud or robbery.



There is an intimate connection between science and freedom, the individual freedom of the scientist being only a small corollary. Freedom is the recognition of necessity; science is the cognition of necessity. The first is the classical Marxist definition of freedom, to which I have added my own definition of science. Let us look closer into the implications”.

A scientist while performing his professional tasks of understanding the necessities of Nature – Nature’s laws – is also governed by other aspects of necessity:

“... in addition, there is a technical level, which cannot be divorced from the experimental. Finally, there is a social structure that is not only intimately connected with the technical level, but also conditions the freedom of the individual by introducing a social necessity that in the abstract seems unnecessary but exists nevertheless.....

What most of us do not realize is that science is also a social development; that the scientific method is not eternal and that science came into being only when the new class structure of society made it necessary. Of course, science really comes into its own with the machine age, which cannot develop without science and which in turn contributes highly useful technical aid to scientific discovery... Modern science is the creation of the bourgeoisie.”

Kosambi then argues that since not only technical necessity, social necessity also is a powerful impetus to new science, it is not at all accidental that Newton, Lagrange, Laplace, Ampère, Berthelot and Gauss appear on the scene at the same times that the English, French and German bourgeoisie come into their own.

The point of this essay is that, *“There is no reason for science to remain bound any longer to the decaying class that brought it into existence four centuries ago. The scientist needs this freedom most of all, namely freedom from servitude to a particular class. Only in science planned for the benefit of all mankind, not for bacteriological, atomic, psychological or other mass warfare can the scientist really be free... But if he serves the class that grows food scientifically and then dumps it in the ocean while millions starve all over the world, if he believes that the world is overpopulated and the atom bomb is a blessing that will perpetuate his own comfort, he is moving in a retrograde orbit, on a level no beast could achieve, a level below that of a witch doctor.”*

Kosambi concludes this essay with the question: *“After all, how does science analyse necessity?”* to which he answers: *“ In the final analysis, science acts by changing its scene of*



activity... There is no science without change... "The real task is to change society, to turn the light of scientific inquiry upon the foundations of social structure. Are classes necessary, and in particular, what is the necessity of the bourgeoisie now? But it is precisely from cognition of this great problem of the day that the scientist is barred if a small class should happen to rule his country."

The theme that the growth of the sciences in any society is conditioned by the kind of society in which this growth takes place is examined in other contexts like socialism and fascism by Kosambi in his essays : "Revolution and the progress of science", written for *New Age* , "Soviet Science – what it can teach us" (*Indo–Soviet Journal*, 1944) and in his review of Bernal's '*The Social Function of Science*' (1940). Space does not permit a detailed discussion of these essays. However, comments about science in India made in the Bernal book review deserve mention.

Kosambi quotes with approval the following excerpt from Bernal's book:

"...there is hardly any country in the world that needs the application of science more than India. In order to release the enormous potentialities for scientific development in the Indian people, it would be necessary to transform them into a free and self-reliant community. Probably the best, workers for Indian science today are not the scientists but the political agitators who are struggling towards this end".

Kosambi follows this with scathing comments on the sycophant science as it then existed in British India:

"After this fair appraisal it would be our duty to say a few of the things that the author has left out for lack of space, or of malice. The research work today in this country is confined to the universities and to a few special institutions, controlled by and often actually worked by people who know nothing of science. Though it is no longer the custom to shove all the fat jobs of the educational system to one side for third rate Englishmen who cannot be accommodated in their own country, the mark of the beast has by no means been eradicated. The men who occupy the key posts have obtained them by other means than research ability, usually by pure charlatanism, bootlicking, and politics of the most decadent sort within academic circles.... Under these circumstances, it is not surprising that the Indian "Professor" was a parasite on the already parasitic official services, assiduous only in licking the boots that seemed capable of kicking him the hardest, reactionary in politics, and proud at best of having helped some of his students to the supreme bliss of admission into the Indian Civil Service. Research was a difficult proposition for such people."



Writing two decades later, in an autobiographical essay 'Steps in Science'. Kosambi's views on the Indian science establishment had not changed much.

"The greatest obstacles to research in any backward, under-developed country are often those needlessly created by the scientist's or scholar's fellow citizens. Grit may be essential in some difficult investigation, but the paying commodity is soft soap. The meretricious ability to please the right people, a convincing pose, masterly charlatanism and a clever press agent are indispensable for success. The Byzantine emperor Nikephoros Phokas assured himself of ample notice from superficial observers, at someone else's expense, by setting up in his own name at a strategic site in the Roman Forum, a column stolen from some grandiose temple. Many of our eminent intellectuals have mastered this technique.

There is little point in discussing personal experience of the scum that naturally floats to the top in a stagnant class."

Science for Developing Countries

The paragraph just quoted is typical of Kosambi's style. His language is direct and often caustic. His purpose in writing is to call a spade a spade unmindful of the consequences. At a time when being a communist was surely a career liability, he did not hesitate to write for *New Age* and other left wing journals. Even in international conferences he was never averse to making a political statement when he thought it was necessary. In an address before an international conference of scientists on 'Problems of Science and Technology in the Developing Countries' in 1964, he has this to say:

"The political situation is all-important. Most under-developed countries have been under foreign domination for a long time. That is, in fact, the primary reason for their being underdeveloped. So, freedom must come first. We cannot speak of science and technology for Angola and Mozambique, for example. The South African situation is even more complex. The land has a few outstanding technological developments; their laboratories and engineering works are by no means to be despised. But the real Africans are not even citizens in South Africa, which remains for them under-developed, while being in a quite satisfactory stage of development for property-owning whites and for the investors in London who stand back of them... In such cases, we have no solution to offer, for our conference restricts itself to science and technology.

The lack of resources is fortunately not present in all countries. Several Arab lands have discovered in oil and natural gas a commodity, which can be exploited sufficiently well



to solve their economic problems. However, whether the oil and other resources are properly used or not depends once again on the context. First, the foreigner must not take away the lion's share, as happened in Iran for so many years. Secondly, those in power must feel the need for developing the country rather than for building palaces for their own families and living a life of Arabian Nights Style. This remains, therefore, again an internal political matter, namely who plans and for whose advantage. It is not sufficient to announce grandiose plans; one has to convince the people that they stand to gain and to secure popular support. Development in Ghana and Indonesia show what happens otherwise. Going deeper into this question but that would cause unpleasantness.

However, we reach one important principle here: under-developed countries need a planned course of development, which necessarily implies a planned economy. Merely admitting this principle is not enough. The context once again thrusts itself upon your attention: who does the planning, and for whose real advantage? The solution generally offered is to invite foreign experts to offer advice and draw up schemes. With the best will in the world, this will not succeed. The foreign expert has been used to planning for an entirely different purpose, in totally different surroundings. He pays little attention to local needs during the course of development. Oftener than not, the foreign expert is interested in selling the products of some companies with which he might be connected.

Here, we could learn a good deal from Chinese experience, were it not for the political problem, once again, which makes it impossible to secure co-operation from that great country at such a meeting.

Hitherto, I have only pointed out the difficulties without suggesting a solution. As a matter of fact, I hold very strong views on the proper political structure and the correct foreign policy for under-developed countries; but this is not the time not the place to a develop those views.... The scientific approach, on the other hand, tends to be rather vacuous and devoid of application unless these primary difficulties are solved”.

Atomic Energy

The issue of atomic energy is a recurrent theme in Kosambi's writings, in the context of peace and disarmament, as well as in discussions on energy policy for India and other developing countries. Typically, Kosambi is both critical and outspoken on the issue of atomic energy. In his articles and talks he repeatedly points out that in discussions on the relative cost of atomic energy, the real cost is usually ignored, suppressed or hidden. Giving a popular lecture to the Rotary Club in Pune, in 1960, Kosambi says:



“The main question that most of you will ask is: What is the investment value of atomic energy? If the preliminary research and refining is to be done, there is virtually no investment value, for the private sector. The whole affair is fantastically costly. Those who say that atomic energy can compete with thermal or hydro-power, carefully omit to mention the fact that the preliminary costs have always been written off to someone else’s account, usually that of some government. Only in some socialist countries, where uranium is relatively plentiful, and new lands have to be opened up, is it possible to utilize atomic energy properly. Even there, military considerations play a considerable part, because of the cold war”.

At the international conference on science in the underdeveloped countries referred to earlier, he does some blunt speaking:

“For example, many of you here are bound to be impressed by India’s advance in science and may even persuade your own governments to copy us. But in what particulars? We have top class physicists, for example, our department of atomic energy is spending several hundred millions a year on an imposing establishment. But how much atomic energy is this country actually producing? The plant that should have been in commission in 1964 will not be operating till 1968 at the earliest. The delay has passed without criticism, while some politicians demand that we should produce the A-bomb to put us on at par with the big powers. In effect, the establishment we have was built by foreign ‘experts’, is outdated already, and will produce atomic power if run as designed which is costlier than such power elsewhere and costlier than conventional power in India. Even then, all the basic cost will have been off under the heading of ‘research’, (Science, or some such beautiful title).”

Energy cost is something that can be rationally calculated. The cost of private sector nuclear power plants proposed to be imported into our country is several times the present cost of conventional power plants. Yet this critical issue which should be central to any debate on the subject has been effectively censored from mainstream media discourse. Kosambi’s writings on issues of science and technology in an age of US Imperialism are still topical, though nearly fifty years have elapsed since they were written. In an article for *Monthly Review* written in 1951, he gives a masterly analysis of what he terms the ‘crooked roots’ and ‘crazy logic’ of imperialism.

“The crooked roots of imperialism lie deep in the need for profits and ever more profits –for the benefit of a few monopolists. The “American way of life” did not solve the world problem of the great depression of 1929–33. In the United States this was solved by



World War II. But only for a short time. Korea shows that the next step is to start a new war to stave off another depression. The one lesson of the last depression, which stuck, is that profits can be kept up by creating shortages where they do not and need not exist. War materials are produced for destruction. Producing them restricts consumer goods, which increases profits in double ratio. Any logic that proves the necessity of war is the correct logic for imperialism and for Big Business, which now go hand in hand. Mere contradictions do not matter for this sort of lunatic thinking where production of food is no longer the method of raising man above the animals, but merely a way of making profit while millions starve.

Destroying stockpiles of food is the same kind of action as building up stockpiles of atom bomb. But the war waged by means of food is different in one very important respect from national and colonial aggression. It is war against the whole of humanity except that tiny portion to whom food is a negligibly small item of expenditure, war also against millions of American workers. In a word, it is class war, and all other wars of today stem from attempts to turn it outward. Even the Romans knew that the safest way to avoid inner conflict, to quiet the demands of their own citizens, was to attempt new conquests.

Quite apart from the destructiveness of total war, the crooked logic of Big Business and warmongers is fatal to the clear thinking needed for science. The arguments that modern science originates with the bourgeoisie, that the enormous funds devoted to war research are a great stimulus to science are vicious. The scientific outlook came into being when the bourgeoisie was a new progressive class, struggling for power against feudal and clerical reaction.

But for modern capitalists, a class in decay, the findings of science (apart from profit-making techniques) have become dangerous; and so it becomes necessary for them to coerce the scientist to restrict his activity. That is one reason for vast expenditure on secret atomic research, for putting third-raters in control to bring big-business monopoly to the laboratory. The broad cooperation and pooling of knowledge, which made scientific progress so rapid, is destroyed... Science cannot flourish behind barbed wire; no matter how much money the war offices may pay to "loyal" mediocrity. Freedom is the recognition of necessity; science is the investigation, the analysis, and the cognition of necessity. Science and freedom always march together. The war mentality, which destroys freedom, must necessarily destroy science."

Solar Energy and Alternative Technology

The better half of Kosambi's address to the Pune Rotary Club on Atomic Energy for India was



not about nuclear power plants on earth, but about the nuclear power plant in the heavens – i.e., about solar energy. There is an impressive conviction and consistency in Kosambi's essays on this subject. In his characteristic style, issues of basic science, technology, science policy, politics, economics and ideology are seamlessly interwoven in these popular essays, which, if anything are even more relevant today than when they were written. Kosambi repeatedly makes the important point that whether or not an alternate technology is viable is not only a technical question, but also a political and organizational question.

“Where does that leave us in India? We do need every available source of power quickly. Can we utilize atomic power for national progress? This question has already been answered in the affirmative by the high command.

The question is whether this cost is worthwhile. I do not propose to answer this question, because all of you here are intelligent to work out the answer for yourselves. But I do wish to point out that the main work in producing atomic energy has already been done without cost to India by a permanent source, which has only to be utilized properly. This generous source is the sun, which goes on pouring its blasting rays into every tropical country, at an uncomfortable rate.

The most important advantage of solar energy would be decentralization. ... Solar power would be the best available source of energy for dispersed small industry and local use in India. If you really mean to have socialism in any form, without the stifling effects of bureaucracy and heavy initial investment, there is no other source so efficient.

...What India could use best in this way still remains to be determined. The principle involved in the use of atomic energy produced by the sun as against that from atomic piles is parallel to that between small and large dams for irrigation. The large dam is very impressive to look at, but its construction and use mean heavy expenditure in one locality, and bureaucratic administration. The small bunding operation can be done with local labour, stops erosion of the soil, and can be fitted into any corner of the country where there is some rainfall. It solves two fundamental problems: how to keep the rain-water from flowing off rapidly into the sea, unused; and how to encourage local initiative while giving direct economic gain to the small producer. The great dams certainly have their uses, but no planners should neglect proper emphasis upon effective construction of the dispersed small dams. What is involved is not merely agriculture and manufacture, but a direct road to socialism.”

Kosambi's comments on research on energy for a country like India are controversial and courageous. His essay 'Sun or Atom' (1957), poses the issue sharply:



“In all this, the question of India has naturally to be foremost in our minds. ... Our fissionable materials consist of the lowest grade uranium in Central India, plus the radioactive (Thorium) Sands of Kerala, which are not immediately utilizable for power production. Add that to the low achievements of our costly but inefficient science and technology, and the problem becomes formidable. All the more so because foreign sources of uranium are controlled, atomic research is everywhere a painfully guarded secret; power politics has entered into the thing else, with new gusto. Is there no other way that would be more paying, without interference with any other mode of power-production? The answer, for India is a definite YES. Instead of competing with the sun, what we have to do is to find some way of utilizing what the sun thrusts upon us with matchless persistence. Let the sun split the atom, fuse the nuclei for us. Why should we not use the energy directly rather than wait for it to be absorbed by plants, converted into firewood, and so on?”

The cost of research on direct utilization of solar energy would be far lower than for atomic energy. India has much greater supply of solar energy than most other countries; in fact, the problem is to keep the land from being blasted altogether by the sun. One difficulty is that the sun’s energy is not constant.

The advantages are that the fuel – the sun’s radiation – costs absolutely nothing, and there are no harmful exhaust gases or radioactive byproducts. Moreover, the installation can be set up anywhere in India, and will work quite well except perhaps in the heaviest monsoon season. The research is of no use for war purposes. This is why it attracts some of us, but does not attract those who control the funds.

But the huge primary source of energy today remains the sun. Direct utilization is hindered only by the desire for prestige, which makes India waste so much of her money in supposed research along other lines.”

Writing similarly on the subject of ‘Solar Energy for the underdeveloped countries’ (Seminar, September, 1964.), Kosambi throws a challenge to the future:

“These strictures seem rather harsh, but surely not undeserved. When some years ago, the main ideas of this note were spoken out in a popular lecture, the matter roused some heat not due to the sun... Questions were asked in parliament and answered by high authority with the words that such projects are designed to keep India backward, in the bullock-cart age. This, in spite of the remark made during the lecture that the bullock-cart is inefficient, and that India needs every form of energy it can afford.



REFLECTIONS

A question of science, technology and economics was reduced to one of ostentation and prestige. However, the sun has not yet been abolished by decree, so that the matter may be taken up at some future date when common sense gets a chance.”

The resistance to science today comes not only from traditional quarters like reactionary religion, but also from modern sectors of the conservative ideological establishment. The belief that science must be apolitical, or antipolitical and that politics has no place in science is widespread among professional scientists. Many scientists take pride in professing their political illiteracy as if this were a necessary consequence of their being scientists. Kosambi would have been the best person to demolish the obfuscation that is at the root of this retreat from science by the ‘science establishment’. But he does not do this, leaving an important unfinished task for those committed to rigorous comprehensive science.

Why has science revolutionized every area that it has entered? It does so because to progress with rigour it must clear its path of all obfuscation and misconception. Since large-scale misconception is vital to the existence of societies based on the exploitation of the masses, science cannot but be revolutionary, when it takes up social investigation with rigour. Kosambi’s thought provoking essays throw light on a number of subjects and issues which are today even more important than when he wrote about them. His writings are addressed directly to those working on issues of science policy in contemporary India. They fall squarely within the framework of the people’s science movement. In fact, they both inspire and challenge all those committed to science to take forward an unfinished agenda. We can add a corollary to Kosambi’s definition: “Science is the cognition of necessity. Scientific practice is understanding and doing what is necessary.”

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