Chapter 2
Adventure into the Unknown

This essay, published posthumously in the collection Current Trends in Indian Philosophy [28], *resulted from an invitation from scholars at Andhra University to write on his 'personal philosophy as a scientist and research worker'. A somewhat bowdlerised version of this article has been excerpted and published as 'Steps in Science' in the collection* Science and Human Progress: Essays in honour of late Prof. D.D. Kosambi, scientist, indologist and humanist [59]. *The important Epilogue (Sect. 2.6) was unfortunately left out of 'Steps in Science'.*

2.1 Why Science?

The question 'Why solve problems?' is psychological. It is as necessary for some as breathing. Why scientific problems, not theology, or literary effort, or some form of artistic expression? Many practising scientists never work out the answer consciously. Those lands where the leading intellectuals speculated exclusively upon religious philosophy and theology remained ignorant and backward, and were progressively enslaved (like India) in spite of a millennial culture. No advance was possible out of this decay without modern techniques of production, towards which the intellectuals' main contribution was through science. There is a deeper relationship: science is the cognition of necessity; freedom is the recognition of necessity. By finding out why a certain thing happens, we turn it to our advantage rather than be ruled helplessly by the event. Science is also the history of science. What is essential is absorbed into the general body of human knowledge, to become technique. No scientist doubts Newton's towering achievement; virtually, no scientist ever reads Newton in the

R. Ramaswamy (ed.), *D.D. Kosambi*, DOI 10.1007/978-81-322-3676-4_2

original. A good undergraduate commands decidedly more physics and mathematics than was known to Newton, but which could not have developed without Newton's researches. This cumulative effect links science to the technology of mechanised production (where machine saves immense labour by accumulating previous labour) to give science its matchless social power in contrast to art and literature with their direct personal appeal. Archimedes, Newton and Gauss form a chain wherein each link is connected in some way to the preceding; the discoveries of the latter would not have been possible without the earlier. Shakespeare does not imply the pre-existence of Æschylus or of Kalidasa; each of these three has an independent status. For that very reason, drama has advanced far less from the Greeks to the present day than has mathematics or science in general. Even the anonymous statues of Egypt and Greece or the first Chinese bronzes show a command of technique, material and of art forms that make them masterpieces, but the art is not linked to production as such, hence not cumulative. The artist survives to the extent that his name remains attached to some work that people of later ages can appreciate. The scientist, even when his name be forgotten, or his work buried under the wrong tombstone, has only to make some original contribution, however small, to be able to feel with more truth than the poet, 'I shall not wholly die; The greater part of me will escape Libitina'. The most bitter theological questions were argued out with the sword; for science, we have the pragmatic test, experiment, which is more civilised except when some well-paid pseudo-scientist wishes to 'experiment' with thermo-nuclear weapons or bacterial warfare.

2.2 Natural Philosophy

It was obligatory for me to learn several European languages in school and college in the USA. The libraries were the best in the world for accessibility and range of books. Alexander von Humboldt's Cosmos surveyed the whole universe known to the middle of the nineteenth century, from the earth to those mysterious prawn-shaped figures visible through the powerful telescopes, the spiral nebulae. The Einstein theory, arousing passions of theological intensity, had just been regarded as proved, and offered new insight into the structure of space, time and matter. Innumerable outlines made it easy to learn something about every branch of science. Freud had taught men to take an honest look at their own minds. H.G. Wells showed in his *Outline of History* how much the professional annalistic historian had to learn, though Spengler's *Untergang des Abendlandes* made it extremely unlikely that the historian would learn it. The inspiring lives of Pasteur and Claude Bernard proved that man could gain new freedom from disease through the laboratory; the deadliest poison became a tool for the saving of life through investigation of the body's functions. Such were the real *ṛṣis* and *bodhisattvas* of modern times, the sages whose scientific achievement added to man's stature. This contrasted with the supposed inner perfection of mythical Indian sages, expressed in incomprehensible language and fantastically interpreted by commentators. The ability to replace incomprehensible

Sanskrit words by still longer and equally meaningless English terms can make a prosperous career. It cannot produce an Albert Schweitzer, whose magnificent study *Von Reimarus zu Wrede*, analysis of Bach's music and record as medical missionary at Lambarene were impressive even in my irreverent undergraduate years.

Engineering is based upon physics and chemistry, which are qualified as 'exact sciences' precisely because they admit a mathematical basis. Mathematics unlocked the door to the atom and to the movement of celestial bodies equally well. Aptitude granted, mathematical research needed the least financial resources of any science. Mathematical results possess a clarity and give an intellectual satisfaction above all others. They have absolute validity in their own domain, due to the rigorous logical process involved, independent of experimental verification upon which the applications to the exact sciences must depend. This was the very language of nature, *scientiarum clavis et porta* as Roger Bacon put it. Its supreme, transcendental, aesthetic fascination can only be experienced, never explained.

Unfortunately, not every kind of mathematics unlocks every door to nature's secrets. For some twenty years, my main work lay in tensor analysis and path-geometry (my own term). The structure of space–time had been analysed by the measurement of 'distance' in space and time; I showed that it could be done without distance, merely by the racks that explored the 'space', even when the concept of 'space' was generalised beyond physical recognition. In 1949, Einstein pointed out to me during one of several long and highly involved private technical discussions that certain beautifully formulated theories of his would mean that the whole universe consisted of no more than two charged particles. Then, he added with a rueful smile, 'Perhaps I have been working on the wrong lines, and nature does not obey differential equations after all'. If a scientist of his rank could face the possibility that his entire life-work might have to be discarded, why insist that the theorems whose inner beauty brought me so much pleasure after heavy toil must be of profound significance in natural philosophy? Fashions change quickly in physics where theory is so rapidly outstripped by experiment. It seemed and still seems to me that non-associative linear algebras and Markov chains would remove many of the physicists' theoretical difficulties; the experimenters are satisfied with abandoning the principle of parity. The 'redshift' of distant stars will perhaps be explained one day as due to the absorption of energy when light travels at cosmic distances through extremely tenuous matter, rather than evidence for an expanding universe. Such speculations are of no use unless they tally in mathematical detail with observed data.

2.3 Chance and Certainty

Borderline phenomena of classical physics illustrate the inexhaustibility of the properties of matter. Ice, according to the textbooks, melts and water freezes at zero degrees centigrade. But when carefully purified samples of water are slowly cooled and the ice slowly melted again, a considerable gap is found between the melting and freezing points. Fundamental particles that make-up the atom and its nucleus show another type of aberrant behaviour. An electron can cross a potential barrier, as if a stone were of itself to roll uphill against gravity and down the other side. Even the observation of isolated particles becomes difficult, for the very act of observation means some interaction and effect upon the observable. The certainty of classical physics develops only when many fundamental particles are organised into higher units with clear patterns. In the same way, individual molecules of water may move in any direction with almost any speed, but the river as a whole shows directed motion in spite of eddies, so also for aggregates of living matter. In human society, the net behaviour of the group smooths out the vagaries of individual action.

The mathematical analysis best suited for handling such aggregates is the theory of probability. Variation is as important a characteristic of the collective as the mean value. Prediction can only be made within a certain probability, which sounds like the language of the race course. But when the chances of a mistake amount to one in a million, most people take the effect as certain. The level of significance desired may be a personal matter. For example, there is a chance of a letter being lost in the mail; whether or not we register or insure it depends upon our estimate of the risk involved and the expectation of loss. Thus, modern statistical method can be an excellent guide to action. It extends the assurance of exact science to biological and social sciences. Though no man can say when death will come to him, as it certainly must, it is fairly easy to predict within a reasonable margin of error about how many men out of a large group will die after a set number of years. That is why life insurance manages to be a highly paying business, without recourse to astrology. It is further possible to say how occupation and living conditions affect longevity. The man who has to work in a lead mine (without special protection) has his expectation of life reduced by a predictable number of years, more surely than if he were shot at by lead bullets on the battlefield.

Deductions based upon probability differ radically from those of pure mathematics. Conclusions cannot be 'true or false' without qualification, when the variation inherent in the trials is assessed. The standard method is to set up a 'null hypothesis', and take the observed results as due to purely random independent variation. The theory suitably applied (and the application needs profound grasp) then gives one of two conclusions that the numerical observations (if relevant) are compatible with the hypothesis or not. But either conclusion would be true only with a certain calculable probability, which tells us about how often we would go wrong in action. The trick is to set up the experiment in such a way that the desired action may be taken if the null hypothesis is contradicted, for incompatibility implies falsehood whereas compatibility need not imply truth.

This may lead to difficulties when the experimenter's will to believe is stronger than his common sense. Parapsychologists test *ESP*, 'extra-sensory perception' (such as telepathy) by having two people match cards at a distance. The effect is so faint and irregular as to call for delicate statistical tests, which show that the chances are very small, for random matching, wherefore the parapsychologists claim victory. Unfortunately, my own experiments showed that the kind of shuffling practised for *ESP* is inefficient when judged by the same kind of statistics that is applied to card matching. Cards originally next to each other tend too often to stay together.

Claims of *ESP* would be more convincing if one produced supplementary evidence (say matching encephalograms for sender and receiver) for a physical mechanism of transmission. Some regard the effect as beyond normal sensation, transcendental, not accessible to material analysis. In that case, laboratory tests and the statistical ‘proof’ become mere ritual.[1]

One of my theoretical papers deals with probability and statistics in infinitely many dimensions. There has been no effective use, because we could not get or make the special electronic calculating machine needed to translate this theory into practice. On the other hand, a brief note on genetics was unexpectedly successful. Professional geneticists use it for all kinds of investigations, such as heredity in house mice. It seems to have given a new lease of life to genetical theories which I, personally, should like to see revised. I am accused at times of not appreciating my own formula. It would have been pleasant to see the formula applied to the increase in food production, but the pure scientists of the country which grows the world’s greatest food surpluses and suppresses or destroys them to keep grain prices high in a hungry world sneer at ‘clever gardening’. There is some difference of opinion here as regards the proper relation of theory to practice.

2.4 Ancient Indian Culture

To teach myself statistics, I decided to take up some practical problems from the very beginning. One such was the study of examination marks of students. It turned out that even the easiest of examinations in India (the first-year college examination) was based on a standard that differed from that of the instruction, if in 25 years no student of the 90 % or more that passed could score more than 82 % overall while the professors who taught and examined had scored much less in their own time. Improvement of the system (whether in examination or instruction) was out of the question in a country where the teaching profession is the waste-basket of all ‘white-clothes’ occupations and the medium of higher instruction still remains a foreign language.

A more fruitful problem was the statistical study of punch-marked coins. It turned out that the apparently crude bits of ‘shroff-marked’ silver were coins carefully weighed as modern machine-minted rupees. The effect of circulation on any metal currency is obviously to decrease the average weight in proportion to the time and to increase the variation in weight. This is the mark any society leaves upon its coinage, just by use. The theory of this ‘homogeneous random process’ is well known, but its application meant the careful weighing, one at a time, of over 7,000 modern coins as control. Numismatics becomes a science rather than a branch of epigraphy and archaeology. The main groups of punch-marked coins in the larger Taxila Hoard

[1] All the well-designed experiments in parapsychology have used random procedures for target selection, and the statistics used in *ESP* research were approved by the American Statistical Institute as early as in the 1930s—K.R. Rao.

could be arranged in definite chronological order, the oldest groups being the lightest in average weight. There seems to have been a fairly regular pre-Mauryan system of checking silver coins.

Arranging coin groups in order of time led naturally to the question: Who struck these coins? The hoard was deposited a few years after Alexander's death: but who left the marks on the coins? The shockingly discordant written sources (*Purāṇas*, Buddhist and Jain records) often give different names for the same king. Study of the records meant knowledge of Sanskrit, of which I had absorbed a little through the pores. Other preoccupations made it impossible to learn the classical idiom like any other beginner. So, the same method was adopted as for the study of statistics: to take up a specific work, of which the simplest was Bhartṛhari's epigrams (*subhāṣitas*). The supposed philosophy of Bhartṛhari, as glorified by commentators, was at variance with his poetry of frustration and escape. By pointing this out in an essay which caused every god-fearing Sanskritist to shudder, I fell into Indology, as it were, through the roof.

There was one defect in the essay, in that the existence and the text of Bhartṛhari were both rather uncertain. This meant text criticism, which ought to have been completed in a few months, as the entire work supposedly contains no more than 300 stanzas. Study of about 400 manuscripts yielded numerous versions with characteristically different stanzas, as well as divergent readings in the common verses. Two and a half years of steady collation work showed that I should never have undertaken such a task, but abandoning it then would mean complete loss of the heavy labour, which could yield nothing to whoever came after me. It took 5 years to edit Bhartṛhari, but even the critics who dislike the editor or his philosophy maintain that the result is a landmark in text criticism. Different methods were needed to edit (with a very able collaborator) the oldest known anthology of classical Sanskrit verse, composed about A.D. 1100 under the Pāla dynasty. The main sources were atrocious photographs of a palm-leaf manuscript in Tibet, and of a most corrupt paper manuscript in Nepal. My judgement of the class character of Sanskrit literature has not become less harsh, but I can at least claim to have rescued over fifty poets from the total oblivion to which lovers of Sanskrit had consigned them.

All this gave a certain grasp of Sanskrit, but hardly of ancient Indian history; the necessary documents simply did not exist. My countrymen eked out doubtful sources with an exuberant imagination and what L. Renou has called 'logique imperturbable'. One reads of the revival of Nationalism and Hinduism under Chandragupta II, of whom nothing is known with certainty. Indian nationalism is a phenomenon of the bourgeois age, not to be imagined before the development of provincial languages (long after the Guptas) under distinct common markets. Our present-day clashes between linguistic groups are an index to the development of local bourgeoisies in the various states. Hinduism came into existence after Mohammedan invasion. Clearly, one of two positions had to be taken. Either India has no history at all, or some better definition of history was needed. The latter I derived from the study of Karl Marx, who himself expressed the former view. History is the development in chronological order of successive changes in the means and relations of production. Thus, slavery in the Graeco-Roman sense was replaced by the caste system in India only because commodity production was at a lower level. Indian history has to be written without the episodes that fill the history books of other countries. But what were the relevant sources? Granted that the plough is more important than a dynasty, when and where was the tool first introduced? What class took the surplus produced thereby? Archaeology provided some data, but I could get a great deal more from the peasants. Field work in philology and social anthropology had to be combined with archaeology in the field as distinguished from the site archaeology of a 'dig'. Our villagers, low caste nomads, and tribal minorities live at a more primitive stage than city people or the brahmins who wrote the *purāṇas*. Their cults, when not masked by brahmin identification with Sanskritised deities, go back to prehistory like the stone axes used in Roman sacrifices. Tracing a local god through village tradition gives a priceless clue to ancient migrations, primitive tracks, early trade routes and the merger of cattle breeding tribesmen with food gatherers which led to firm the agricultural settlement. The technique of observation has to be developed afresh for every province in India. The conclusions published as *An Introduction to the Study of Indian History* had a mixed reception because of the reference to Marx, which automatically classifies them as dangerous political agitation in the eyes of many, while official Marxists look with suspicion upon the work of an outsider.

Field investigation continues to give new and useful results. Experts say glumly that my collection of microliths is unique not only in range of sites but in containing pierced specimens. A totally unsuspected megalithic culture came to light this year. It fell to my lot to discover, read and publish a Brāhmi inscription at Kārle caves, which had passed unnoticed though in plain sight of the 50,000 people who visit the place every year. The suggestion for using the Māḷsheṭ Pass should give Maharashṭra a badly needed key road from Bombay to Ahmadnagar, and save a few million rupees though the funicular railway down Nāneghāṭ would have been more spectacular.

2.5 Social Aspects

The greatest obstacles to research in any backward, underdeveloped country are those needlessly created by the scientist's or scholar's colleagues and fellow citizens. The meretricious ability to please the right people, an attractive pose, glib charlatanism and a clever press agent are indispensable. Mere scientific ability is at a discount. 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 pilfered from some grandiose temple. Many eminent intellectuals have mastered this technique in India.

The deep question is not what floats to the top of a stagnant class but of fundamental relationship between the great discoverers and their social environment. Conservatives take history as the personal achievement of great men, especially the history of science. The Marxist assertion is that the great man is he who finds some way to fulfil a deep though perhaps unstated social need of his times. Thus, B. Hessen explained Newton's work in terms of the technical and economic necessities of his class, time and place. The thesis was successful enough to be noticed and contested by a distinguished authority on seventeenth-century European history, Sir George Clark. Clark's knowledge of the sources is unquestionably greater than Hessen's, but the refutation manages to overreach the argument. According to Clark, the scientific movement (of the seventeenth century) was set going by 'six interpenetrating but independent impulses' from outside and 'some of its results percolated down into practice and were applied'. The external impulses were 'from economic life, from war, from medicine, from the arts and from religion. What is left then of the independence of science?' The sixth impulse was from the 'disinterested desire to know'. So far as I know, all six impulses applied from the very earliest civilisations of Mesopotamia, Egypt, China and probably the Indus Valley, without producing what we recognise as 'science' from, say, the time of Galileo. What was the missing ingredient, if not the rise of the proto-bourgeoisie in Europe? No Marxist would claim that science can be independent of the social system within which the scientist must function.

Much the same treatment may be given to the literature. Disregarding oversimplification, can one say that Shakespeare's plays manifest the rise of the Elizabethan proto-bourgeoisie, when the said dramas are full of kings, lords and princes? The answer is yes. Compare *Hamlet* or *Richard the Third* with the leading characters in *Beowulf* or the *Chanson de Roland*. The fattest Shakespearean parts such as Shylock and Falstaff are difficult to visualise in any feudal literature. The characters in those plays have a 'modern' psychology, which accounts for their appeal to the succeeding bourgeoisie and hence for the survival value of the dramas. Troilus and Cressida are not feudal characters any more than they are Homeric; Newton's Latin prose and archaic geometrical proofs in the *Principia* make that work unreadable, but do not make it Roman or Greek science.

It would take a whole book to develop this thesis for India's trifling successes and considerable failure in modern science. In what follows, only the most obvious defects in applying science to major Indian problems are considered, without discussion of the extent to which this accounts for the lack of really great scientists in India.

India, the experts tell us, is overpopulated and will remain poor unless birth control and population planning are introduced. But surely, overpopulation can only be with respect to the available food supply. Availability depends upon production, transport and the system of distribution. What is the total amount of food produced? We have theological quarrels between two schools of statisticians, but no reliable estimate of how much is actually grown and what proportion thereof escapes vermin—including middlemen and profiteers—to reach the consumer. If shopkeepers can and do raise prices without effective control, what does a rise in the national income mean? Is the scarcity of grain or of purchasing power? A great deal is said about superstitious common people who must be educated before birth control becomes effective. The superstition which makes the poor long for children has a solid economic foundation. Children are the sole means of support for those among the common people who manage to reach helpless old age. The futility of numerical 'planning' of the population, when nothing is done to ensure that even the able-bodied have a decent level of subsistence, is obvious to anyone but a born expert. Convince the people that even the childless will be fed and looked after when unable to fend for themselves and birth control will become popular.

Let me give examples of scientific effort which could easily have been turned to better account. Considerable funds will be devoted during the Third Plan to research on the uses of bagasse (sugarcane pulp). At present, it is used as fuel and the ashes as fertiliser, whereas paper and many other things could be made from it. But are the other uses (quite well known) the best in the present state of Indian economy? The extra money to be spent on fuel, not to speak of difficulties in getting fuel, would increase the already high cost of sugar manufacture; new factories for by-products mean considerable foreign exchange for the machinery and for the 'experts'. However, if the bagasse is fermented in closed vats, the gas given off can be burned, so that the fuel value is not reduced. The sludge makes excellent fertiliser, which saves money on chemical fertilisers and improves the soil. The scheme (not mine, but due to Hungarian scientists) has apparently been pushed into the background. Again, the proper height of a dam is important in order to reduce the outlay to a minimum, without the risk of running dry more than (say) once in 20 years. The problem is statistical, based upon the rainfall and run-off data where both exist. The principles I suggested were adopted by the Planning Commission, though not as emanating from me. Neither the engineers nor the Planning Commission would consider a more important suggestion, namely, that many cheap small dams should be located by plan and built from local materials with local labour. Monsoon water would be conserved and two or three crops raised annually on good soil that now yields only one. The real obstacle is not ignorance of technique but private ownership of land and lack of cooperation among the owners.

This country needs every form of power available, but is too poor to throw money away on costly fads like atomic energy merely because they look ultra-modern. A really paying development will be of solar energy, neglected by the advanced countries because they have not so much sunlight as the tropics. Our problem lies deeper than power production. The reforestation, indispensable for good agriculture, will not be possible without fuel to replace the firewood and charcoal. Coal mining does not suffice even for industry; fuel oil has to be imported. A good solar cooker would be the answer. Such cookers exist and have been used abroad. The one produced in India was hopelessly inefficient (in spite of the many Indian physicists of international reputation). Neatly timed publicity and a fake demonstration made the gullible public buy just enough useless 'cookers' for a quick profit to the manufacturer.

A flimsy 'Indian Report' on the effects of atomic radiation shows our low moral and scientific calibre by ignoring the extensive data compiled since 1945 in the one country which has had the most painful experience of atomic radiation applied to human beings—Japan. The real danger is not death, which is a release for most Indians, but genetic damage to all humanity. We know what radiation does to heredity in the ephemeral banana-fly *Drosophila melanogaster*. A good deal was found out in the USA about what happens to laboratory mice. What little has been released for the publication is enough to terrify. Man is as much more complicated than a mouse as the mouse than the fruit fly. Humans take a proportionately longer time to breed and to reach maturity, giving fuller scope for genetic derangements to develop. It may take some twenty generations to find out just what these derangements amount to. By then, they will have been bred into many millions of human beings, not as a disease but incurably as a set of hereditary characters. Mankind cannot afford to gamble with its own future in this way, whether that future lies in the hands of communists or not. Atomic war and the testing of nuclear weapons must stop. These views on nuclear war are now fashionable enough to be safely expressed.

2.6 Epilogue

A mathematician must earn that designation by enriching mathematics with original theorems of basic importance. Einstein, for all the stimulus his ideas gave to contemporary differential geometry, was not, and never regarded himself as a mathematician. So, my excursions into statistics, Indology, archaeology and the rest are irrelevant unless some real mathematics emerged at the end. Alternatively, is there something wrong in the philosophy that asserts the unity of theory and practice?

Mathematics is no longer the by-product of a natural philosopher's investigations, as it had been from Pythagoras to Gauss. All sorts of mathematical technique exist today, fully developed long before the physicist feels the need for it. One should contrast G.H. Hardy's *Mathematician's Apology* (Cambridge, 1941) with L. Hogben's *Mathematics for the Million* (London, 1936). The former, though leader and virtually creator of the modern school of British mathematics, was indifferent to the applications and the social context of mathematical discovery. Those were the aspects of mathematics of primary interest to the biologist Hogben, who thereby presented rather elementary mathematics in attractive popularisation. Hardy counted uselessness among the great assets of real mathematics; forgetting Archimedes's military engines, he blamed 'Hogben mathematics' for the senseless destruction of world wars. This was just before the manufacture of nuclear weapons by the 'Science has known Sin' group, in collaboration with outstanding mathematicians like J. von Neumann. If any important mathematics came out of the atomic and hydrogen bombs, the secret has been well kept.

The theory of numbers is the oldest branch of mathematics. Hogben mathematics would not exist without numbers, while Hardy and his associates devoted their best efforts to number theory. Two outstanding problems here are as follows: (1) Fermat's Last Theorem, which can be explained to a schoolboy in spite of its melodramatic title and (2) the Riemann Hypothesis, decidedly more recondite. Both have defeated the efforts of great mathematicians to prove or to disprove them. The Fermat theorem, if true, would lead to no new mathematics; proof of the Riemann conjecture would lay the very foundations of analytic number theory. These unsolved problems gave rise to a distressing possibility in mathematical reasoning: Was there a category of propositions 'neither (demonstrably) true nor false'?

Riemann's conjecture has to do with the distribution of primes, which are those integers (like 257) not divisible by any smaller number except unity. Every whole number can be expressed in just one way as the product of primes, hence their importance. There are infinitely many primes. A given integer is either a prime or not, with no question of probability; yet the occurrence of primes among the integers is highly irregular, without a pattern. Given a specific prime, it is always possible to find the next by hard work, but not by formula. This parallels an experimental situation. Weights of coins of the same denomination fluctuate so much that I could never predict what the next coin would show on delicate balances. However, if there was a next coin, its weight could always be recorded as one more figure of a series. Enough such figures outlined a curve for the distribution of weights. The series of weights formed a *sample* from a population assumed subject to probability laws. Could something of the sort not be proved for the primes? It was necessary to change the scale, because primes occur with less and less frequency (on the whole) as the integers grow larger. The change gave a fixed *average* number of primes per interval of any constant length on the changed scale. Still, the number varied unpredictably from interval to interval. The number of primes per interval was then shown by me to follow a simple though unsuspected probability law, the Poisson distribution. This describes many experimental samples such as the number of cosmic rays per second, of bacteria in thin cultures and of calls in a telephone exchange. The previous failures in prime number theory resulted from the attempt to fit an exact description to an infinite set of infinite random samples.

Every competent judge who saw only this radically new basic result intuitively felt that it was correct as well as of fundamental importance. Unfortunately, the Riemann hypothesis followed as a simple consequence. Could a problem over which the world's greatest mathematicians had come to grief for over a century be thus casually solved in the jungles of India? Psychologically, it seemed much more probable that the interloper was just another 'circle-squarer'. Mathematics may be a cold, impersonal science of pure thought; the mathematician can be thoughtless, heatedly acrid, even rabid, over what he dislikes. Let me admit at once that I made every sort of mistake in the first presentation. There is no excuse for this, though there were strong reasons: I had to fight for my results over three long years between waves of agony from chronic arthritis, against massive daily doses of aspirin, splitting headaches, fever, lack of assistance and steady disparagement. It was much more difficult to discover good mathematicians who were able to see the main point of the proof than it had been to make the original mathematical discovery. How much of this is due to my own disagreeable personality and what part to the spirit of a tight medieval guild that rules mathematical circles in certain countries with an 'affluent society' need not be considered here. There is surely a great deal to be said for the notion that the success of science is fundamentally related to the particular form of society.

http://www.springer.com/978-81-322-3674-0

D.D. Kosambi
Selected Works in Mathematics and Statistics
Ramaswamy, R. (Ed.)
2016, XXIII, 232 p. 5 illus., Hardcover
ISBN: 978-81-322-3674-0