PSYCHE AND SOCIETY

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Editorial

Comprehension related problem

Our old acquaintance (''Yet you know that we are the acquainted ones...'' Smriti, Satta, Bhabiswat – Bishnu De), the teacher has arrived and he is responsible, at least to some extent that a few natives like us have 'gone astray'. Whatever he preaches, he tries to practice that in his personal life. The motto of his whole life is to wish the well-being of his students and to make people educated and self-reliant by inclucating rational thinking amongst them.

It is quite natural that in our distressed mental condition, if we catch hold of any good and wise soul, we cling to him and ask, ''Please provide us with some explanation/interpretation on the current social scenario, we are at a loss to comprehend anything.''

Making us thunderstruck, the teacher answered in a resolute voice, ''Look, we, the people of earlier days try our best to comprehend the happenings around us up to a certain limit. But nowadays, so many things are occuring, which are of such nature that looking at them it seems to me that these are not for my comprehension.''

On hearing this, we became amazed and thought it prudent to analyse the teacher's problem on comprehension by means of Pavlovian psychology. The teacher wanted to make us understand that the style of life in which he has grown up since childhood, has enabled him to attain the capacity of applying dialectical logic. He has learned this tool so that he could evaluate the changed times. But whatever expansion of his mental horizon has been caused by application of this tool, this is not at all infinite. Of course, it is true for everybody. Generally, in order to resolve any or quantitative or qualitative occurence, which can exert influence on society or family, we try to grasp that with our knowledge gained beforehand. Sometimes, for the sake of this comprehension, we try to understand the whole thing by looking for explanation from the writings of great men or take help from an intermediary.

For example, Manikbabu has started his short story, ''The fellow, who has to be bribed'', with the words, ''Everybody knows that to take away other's article without his permission is called stealing and to do that in a large scale means becoming rich''. If this is true then all the rich men around us are thieves of high calibre. But if you say so, there would be an uproar in all social circles. Then you have to admit that Manikbabu's saying needs some revision.

The depth and complexity of this problem is realized by reading Lenin's 'State and Revolution'. In this book Lenin has stated in an extremely concise and lucid manner a few universal truths on the emergence and development of the state and its governance. Lenin has even said that the state would remain till such time the idea of private ownership of property is not removed from the mindset of man. This state would also sit tight on man as a ruler and exploiter. These words are true like sunlight in daily life.

But, without paying heed to this truth, if any social-democratic party after getting the taste of state power and being nourished by that power for a long time, starts preaching a different 'religious tale' on the gospel of state, then the ''pure people'' like the teacher tries for a while to comprehend all this through their graps of 'dialectical logic.' But at some point they resign for they consider something as the effect or result of some particular cause or attribute to something. So with the knowledge and experience gained beforehand, they continuously analyse, comprehend and adjust themselves with the happenings in the world, life or family. But when these go beyond their predictable range, they acquiesce with a deep sense of anguish.

In this situation, it certainly needs no explanation how pathetic our condition can be.

Though the advanced sections of society, as described by Marx, desire to speed away from this dawn to another like light, we are wandering around in this ''hell'' under the burning heat of the noon and seeing before our eyes that the king is roaming around in a naked condition. If the king admits this, it can be said that he is helpless. But the confusion deepens when the progressive state machinery turns different kinds of formal logic into conditioned reflex and launches propaganda to the effect that this is lack of understanding, in reality the king is not naked. He is wearing clothes with so minute designs that even after rubbing both the eyes we are seeing him naked.

Moreover, the problem is becoming more acute with the new generation, who are growing up looking at this dazzling development of hell and running around to snatch away ''solace of soul'' from this apparent pleasure, which consists of hollowness and duplicity. It is like consuming poison from goblets embellished with precious stones by Rajput women in earlier days to observe their ritual of suicide (Jaharbrata), but it is unfortunate that because of the quality of the goblet the poison does not turn into nectar.

Anyway, at the end the teacher uttered only a single sentence of assurance. We are standing on the threshold of a tremendous socio-economic change and change is going on. Now we must have resolute faith and confidence in man and have to say that we would ultimately reach to a noble course of leading life. But that is ''the task of many men for many centuries''. *P A S*

Psychiatrist Dhirendranath

(Continued article - Concluding part)

Basudev Mukherjee

[We consider Dhirendranath as one of the leading pioneers of psychiatry in India. In the previous issues of this magazine we had included the intellectual formation and socio-psychological development of Dhirendranath as a psychiatrist. He had many introductions but over all other introductions, being a psychiatrist can claim of the fundamental ones. We will continue to examine the matter further in this concluding part regarding his achievement as a psychiatrist in practice due to wholistic participation in the subject. Ed. *PAS.*]

Psychiatric diseases of the child-adolescents

Child psychiatry slowly started to develop towards the end of Dhirendranath's career. He too started to think about the child-adolescents. As psychologist Piaget had presented the (cognitive) developmental theory of biological growth of child-adolescents, having minutely registered the physical and mental growth and development of his own children, likewise Dhirendranath, although not being that systematic, started observing his grandchildren.

Moreover the guardians were regularly coming to him for help with normal and abnormal problems of their child-adolescents. It should be better said that, he used to do these works single-handedly and had got no organized help in this matter. In this context it should be said that, he didn't acknowledge the measurement of the activities of human cerebrum (intelligence, memory, motivation etc.). So he did give least importance to the method of psychometry.

In case of diagnosis of diseases of the child-adolescents, categorical and dimensional – these two viewpoints or methods are acknowledged. Naturally he used to like this very dimensional method more in case of the children too and opined that, in majority of the cases regarding diagnosis of diseases of the child-adolescents, it is not possible to follow that

categorical method. There were also enough reasons for it. Their problems rapidly change due to fast growth and development of the body and on the other hand as a result of this development their role in the family and society changes continuously.

Consequently there remains enough possibility of mistakes, if one wishes to explain those problems with any single sign and symptom or with a particular kind of signs and symptoms. As a result he used to think that the problems of the children had to be judged simultaneously in the perspective of change and continuity.

In the matter of their problems being formed, different adverse incidents and circumstances of their growing years are added to the weakness of their mind or brain. Under this consideration it can be said that, a warp and woof between these harmful social elements and helpful elements always keeps on going over them. The little ones have more physical endurance; but less mental endurance. Consequently the harmful elements, on being greater in amount, may supercede the helpful elements.

Among these harmful elements there are: 1. history of having psychological diseases in the family, 2. a poor socio-economical condition, 3. backwardness in the field of knowledge and intelligence, 4. tragic incidents such as the death of father or mother etc., 5. a restless mentality, 6. become a victim of or witness to violent incidents in the family, 7. disorder in physical or mental development, 8. get along with bad company etc.. And among the helpful elements there are: 1. a wonderful personality development, 2. wonderful familial relationship and bonding and family culture, 3. a wonderful surrounding environment etc..

Dhirendranath used to judge the matter of growth and development of the child-adolescents in the following way: 1. Whether there is any flaw anywhere in their socialization process. 2. How are they learning to express the matter of emotional growth and development, how is he being able to open up his own emotions in different environment and circumstances and what his reaction is to other's emotions. Because if he can learn this properly he would be able to integrally calculate all these things on getting into a complicated situation when he grows up. He has to learn how to manage the anxious state, tension, oppression etc.. Likewise he has to understand how we develop our emotional rationalism and intelligence.

3. His moral development is also very important. 4. Equally important is his growth and development related to the sexual behaviour etc.. Moreover in the matter of the temperament and personality of the child-adolescents being formed, Dhirendranath used to consider with enough importance this type of elements such as to what extent 1. he expresses everything with speech or in silent language, 2. his activities are purposeful or purposeless, 3. he can realize a matter having sticked to it with obstinence or quickly gives up, 4. he is active or inactive, 5. he is aggressive or a sort of calm and gentle, 6. he voluntarily does many works or whatever he wishes abruptly, 7. he opposes everything and can not easily accept or receive them etc..

On many occasions he had to face questions from the parents such as, ''Doctor, none of us are like him, where has he got these qualities or characteristics from?'' He too didn't feel much ease in this question. Because these questions made him too think throughout his life (somebody can say about it the classical *nature-nurture* debate).

In the matter of treatment what Dhirendranath used to think first is, whether this person at all needs any treatment. If he does, then how little and of what type that would be. It has been noticed that, the child-adolescents get the most irregular treatment. That's why in the matter of their treatment family therapy becomes essential on many occasions. Many a times a situation arises where the parents don't want to admit that their child-adolescents have any problem.

Perhaps complaints are repeatedly coming from the school in this matter, so the guardians are trying to know why this is happening. He used to think a lot about the future of the child-adolescents and there are also a number of his writings in this regard. One of the two personalities who exerted enough influence on Dhirendranath in the matter of thinking about

the mental and physical development of the child-adolescents is Piaget (1896-1980) and the other is Vygotsky (1896-1934). I would finish this context saying a few words about them.

Piaget: Piaget used to introduce himself as 'genetic epistemologist'. We don't properly understand its meaning and don't know what that mean even to Piaget. Actually he was a developmental (biological) psychologist. However he used to believe in Kant's philosophy and can not be said from his writings which one of the following he was - a nativist or an empericist. On the contrary it can be said that he was an interactionist. At times he had also named his theory as 'constructive structuralism'. The bottomline of his theory is 'Schema'. Through it he wanted to make us understand, how the children having slowly organized their experiences develop their brain in that perspective.

In order to build this Schema the children adopt two complementary process viz. *assimilation* and *accomodation*. According to Piaget's theory, the cognitive process gets developed in a few steps, which is a kind of certain and fixed (invariant). As a whole by the consequence of the cognitive development we generally want to explain how he is being able to form 'perception' about the external time and place (space) inside his body more precisely and appropriately through a gradual improvement. Dhirendrananth used to give importance to Piaget's theory.

Vygotsky: Vygotsky's theory was comparatively polar opposite to that of Piaget's. Because in case Piaget's theory could be termed as a theory of biological growth and development, Vygotsky's theory would be the socio-cultural theory of this growth and development. He placed a few types of proposals regarding the maturity of the cognitive process of the child-adolescents. He said in his proposal that, the children have an element called 'innate cognitive ability' in small quantities that contains the ability of assimilating innate potentialities of memory and perception. The primary cognitive ability keeps on working in the children below the age of two years.

A continuous interaction occurs between the environment and this ability. After the age of two years a child, getting matured through the cognitive process, acquires different necessary social qualities and abilities which play a role in developing his mental construct later on. In this entire transfer process the important, insignificant and trivial elements of the external environment help him. Among them 'language' is considered to be an essential element. As the age increases, the interaction with the external world through language increases and the ability of the cognitive process too increases proportionately and develops the 'internal system of speech'.

The child gradually starts to learn new subjects for the internalisation of this internal speech system. It is noticed that a zone of the proximal growth and development (which can be called as the distance between the actual development and the potentiality of further growth and development) gets developed inside his mind. Everything was right with this theory. But Dhirendranath started thinking whether it had been appropriate for Vygotsky that he absolutely kept mum about the biological elements of growth and development.

Moreover can 'language' become the only condition for development? Yet it has been noticed that the child-adolescents learn many issues from the family and the society through mere observation. Among these the imitative gestures of the body are considered as a principal issue. Can we call them language in the general sense? Otherwise how could these things be sorted out?

Although in the matter of Developmental Psychology the names Piaget and Vygotsky can be majorly heard; Dhirendranath kept Basov in mind more than anyone else. One of the pioneers of Child-development Psychology in Russia, Basov stated that a loose or flexible bonding is formed between the structural (organic) and behavioral changes of the child. These changes keep on continuously reshaping each other. The difference of human development as compared to the development of other animals is that, the human beings change their environment through making using and toying with weapons and also get changed themselves.

Although Vygotsky had mentioned about Basov's theory as one of the pioneers of Cultural-Historical School of Psychology in Soviet Union; Dhirendranath opined that Basov's issue claims to be discussed separately. Because Basov's contribution to Developmental Psychology is unprecedented from different aspects. Because having held the structures of a nuclear family and having explained and analyzed everything about it he has quite elaborately shown how all of its aspects exert influence on a child's growth and developoment. Basov had even established Piaget's well-known Dynamic Structuralism Theory far more efficiently almost fifty years before him. If we analyze the matter we would notice that, Basov's explanation and analysis are far more scientific. Because here Basov had shown, discussing elaborately, what possible interactions might occur between the society and the family with the child.

I had already mentioned earlier about Dhirendranath's objection in the matter of Vygotsky. In this case it should be also added that, from the overall point of view Dhirendranath used to object to Soviet Psychology that they had almost ignored the issue of cultural diversity in the matter of developing Psychology in their country. There was a time when Soviet Psychology was roughly divided into two classes – either it was Pavlovian (dependent on the research of cerebral cortex by Pavlov) or it was Vygotskian (dependent on Vygotsky's socio-cultural context).

He used to like a lot this portion of Vygotsky's theory such as how the children can wonderfully use this interrelation instantly with the change in the external environment and on getting new mediums at disposal. That's why at the time of doing psychotherapy and in the matter of giving suggestions to the patient, the choice of the appropriate socio-cultural perspective for him made his job quite easier as he knew Vygotsky.

At times he used to voice his objection and say that, Vygotsky had said that as a result of the communication between the elders and youngers the former helps the latter from the psychological front to build up the portion of that proximal growth and development; but practically it has been noticed that many parents or guardians oppose the young ones quite a lot in the matter of taking part in new environment and situations – therefore in that case it can be said that in no way they are helping in the growth and development of the portion of proximal development of their children. Especially the fondling boys of today understand nothing but the secured shelter of their parents.

Conclusion

Dhirendranath used to regret and say that, ''Human beings have got a brain as well as psychiatric diseases from the nature through evolution.'' These words made us think quite a lot! Because we had a question, whether animals inferior to the human beings face psychiatric problems. Therefore in case of the human beings this highest humane quality is in one hand a boon and equally a curse in the other. In spite of having spent his entire life with psychiatric patients his heart used to get filled with despair on seeing any adolescent as a new psychiatric patient.

He perhaps used to utter a soliloquy,''this one is going to suffer lifelong.'' Besides, he used to say one thing more that, the last attribute that has been added to us during the evolution is the ability of using language. Probably this genetic defect and the genetic aberration causing psychiatric diseases are related. Perhaps in the future we would be able to become sure after a lot more research in this matter; there should be no scope for doubt in this matter that psychiatric diseases are the most painful of diseases for the human beings.

Now, the more time is running out, the more our mind is becoming complicated. The imprint of this complexity of the society is being put on our minds. Therefore we may say without doing much research that, our children are growing up in a far complicated environment and this is undoubtedly true that their times would be more complex. Consequently they have to acquire the ability of thinking in a complicated procedure in order to endure this complex times. We know that, the more the situation gets complex and unsolvable, the more it creates

pressure on our mind or brain. Either we try to adapt with it, or some of us breakdown and seek for some specialists assistance. He used to say wittily, ''Can a sacrificial goat save its throat even by screaming?''

Dhirendranth's championship was in that he had tried as many days as possible to understand the gradually increasing familial and social complexities and also tried to make his patients understand that. The way out of a problem for him did not lie in avoiding the problem. He used to give his patients the very suggestion of tackling the problems face to face. In that sense he was a shining citizen and Lenin was the ideal man for him (again the two of them had striking similarity in their physical height).

We have to wait a few days more to get the answer of the questions such as how he was as a psychiatrist, how big stature he had, how successful and original he was and so on. Because we need to get scientific answers in this matter and we would be able to appropriately evaluate him only if we get that. However, irrespective of the size of his stature, he was a foreseer and had an original thinking regarding where should the human society reach in the future. He had written innumerable writings in his newspaper in this matter.

When Dhirendranath started practicing psychiatry, there was a community-feeling among the people and families of our society. That is, there was a socio-economical and cultural situation for ganging up and making an uproar. He had roamed about in this society almost as the eldest master of the worldly affairs. That is, his suggestions didn't contain only the words to cure diseases; besides there used to be the purpose, meaning, means and procedure of leading life in the future and lots of other things. This treatment used to take a long time; but the patients used to accept that because they wished to completely get cured (ultimate result). So they used to help him with his work patiently.

I can take responsibility in saying that, this scenario has now been changed. Because the families have turned smaller and the lifestyle has comparatively become faster. Moreover the young boys and girls, perhaps as a result of the atmosphere of this century, have changed their everyday language for communication. On many occasions it becomes difficult to communicate with them, primarily due to the superficiality of the thoughts of their families and of themselves. Besides it is noticed that, just like having fast food, here too they desire quick fruitition (proximate result). They behave in such a manner that, any one of the members of the small family is facing a psychological problem and he wants help from the psychiatrist for this purpose.

The psychiatrist should as if open up his head, find out the location of the damaged machineries by setting up a number of tools, dust the abnormal 'bio-chips' and complete his treatment by properly planting them again and bid him good-bye with a smile. Later on when the need arises again, he would come for the 'servicing' of his head; but he has to manage the present problem right now, otherwise he would miss the train. From the philosophical aspect, this kind of a 'professional pragmatism' (according to poet Arunachal's words it is 'a grocer's philosophy') is gradually becoming as if all-pervading in spending our lives.

During the period of Dhirendranath's career, problems concerning the patients were not this much predominate. But now-a-days no psychiatrist wants to understand the entire situation taking a little time or the circumstances don't allow him that much time even if he wishes so. Due to this reason dependance on the drugs in psychiatry has increased an impossible proportion. This situation became evident towards the end of his career. But the situation has reached such a magnitude in the last ten years, that it was impossible for Dhirendranath to even infer that. It's somewhat like the ultimate necessity dominating the proximate necessity and the temporary truth turning to be the ultimate truth.

Consequently the human beings are gradually becoming lonely and isolated; but he doesn't know where he should go or what he should do to comfort his soul. Yet if this person wishes to reduce his pain in the presence of a psychiatrist, he has to surrender before the physician;

but this individual, just like Abhimanyu, doesn't know the way out of this circular-military array.

I doubt whether Dhirendranath could have even imagined of this kind of fast consequence in the social beings he had seen. We don't know, where this situation would reach; but we don't have the ability to move the clock-hands anti-clockwise. Therefore we too have to accept this situation. Meanwhile we have to keep up working in our manner. However, let's move on to another topic for a while.

Everyday while working we used to realize that, many people are suffering from physical ailments. On many occasions there remained no way to understand that, the psychiatric diseases have increased or started due to the physical ailment. We used to get several examples where both the physical and mental diseases went on side by side. As we give importance to the treatment of psychiatric diseases, we had to take care so that we never ignore any physical ailment. We can in no way deny that, we feel anxious when we suffer from even a little physical ailment and this may become more complicated due to that, because a vicious circle may get formed inside the individual's mind through this process.

He used to admit that, he was never associated with the modern therapeutics, therefore he used to avoid the matter of physical ailments as far as possible. We could understand that the patient was having a lot of inconvenience with that. Our patients are really very poor, therefore it becomes unaffordable for them to consult a specialist physician for a minor physical ailment. However, it becomes clear that, the psychological sickness of the patient would get cured a lot if the physical illness reduces. The physical ailment may become acute due to an old chronic problem or it may appear to be a sudden problem.

Generally it has been noticed that, physical ailments may show up as well as the mental diseases may precipitate as a result of the reasons such as metabolic, toxic, infectious etc.. Due to this reason we have repeatedly felt that the psychiatrist should have the minimum idea about the physical diseases. Yet on the other hand during these times of ours, at the age of the fragmented smallness of wisdom, it is needless to say that, this situation has further worsened.

However, Dhirendranath usually didn't want to take responsibility, in case the patient had any other kind of physical illness or disease. In that case, if any of his new students used to be present there, he or she wished to take responsibility in this matter and he used to accept that in front of the patient himself. He too used to admit, the standard of treatment would rise to a great extent through it. As for example, here we can take the matter of raised blood pressure as an instance.

Any psychiatrist should take the responsibility of his patient's hypertension unless some complication arises out. Many a times it so happened that he used to suggest the patient to come again and consult his students in this matter, in case none of them was present there. While making comments in this context he used to say, ''It would take a long time to develop liaison psychiatry in a poor country like that of ours.'' The real problem used to get arised out of the psychosomatic patients.

In such cases he didn't want to give any other medicine to reduce the physical trouble, e.g. the medicines to reduce hyperacidity in peptic ulcer syndrome etc.. Therefore it can not be denied that, quite a lot of warp and woof used to take place in case of certain patients deteriorating fast and suddenly, while keeping them admitted in the hospital. He used to always admit before the patient or the folks at his home that, he wouldn't be able to do anything further than this, with his single effort.

There was nothing much original in Dhirendranath's thoughts regarding where psychiatry would reach in the future, if we leave the portion of Sociology. Yet we used to consider his thoughts to be quite important. He used to say that, the basic medical science is getting developed and will continue to do so, while fully competing with science and technology. It would help psychiatry from all aspects. Gradually we would get to know the neurotransmitter pathways of the brain through genetics even better and its nature and characteristics could

be specified accurately. Perhaps a day would come in the future, when it would become possible to change the defective brain elements by our knowledge of genetics.

Similarly, it would become possible to invent an improved and definite biological marker of it, in order to make the process of classification of diseases and diagnosis more accurate. This would get help from molecular biology and genetics. In the near future it would become possible to prevent and successfully treat contagious, endocrinal, immunological diseases and so on. Competing with it, tremendous development would also occur in the matter of complete treatment.

The child-adolescents, on getting afflicted with more problems, would come and alongwith that the grown-ups would come with problems related to sexual behaviour, the women would come depression and the marginal people of various community with various problems. However we have to remember that psychiatry is related with the department of Medicine, therefore the fate of the former too would get determined with the development of the latter.

So it's needless to say that biological psychiatry would get prominence. In this context it should be also remembered that, the mind of the human being that would get treated with psychiatry, is coming from the society and he would certainly not like to be looked at from a mechanical point of view or it's also not that he would be satisfied only with medicines. As a result he would certainly demand psychotherapy alongwith his treatment. A warp and woof between the mind and the brain would definitely keep on going due to that.

In one hand the neurologists or neuroscientists would enter this region and try to capture it. Yet in this case the human beings would naturally enrich it with all sorts of vigour they have and be present at it's door. At that moment the mind would claim, so that it is not judged mechanically with the brain only. Perhaps it might happen that the entire therapeutics would then consider as a model. Because in one hand it's true that psychiatry is getting quite influenced by the external environment surrounding it to be more humane. *PAS*

The Shadow of Modern Science on the Dream-world of a child

Gouriprasad Ghosh

[The first part of '*Ha-ja-ba-ra-la*' by Sukumar Roy showed a deep understanding about the new revolutionary inventions in physics during the past century and had magical effect on child-imagination. This article discusses the details on this and the coordination of his social ideas with the scientific views as seen in the second part of his '*Ha-ja-ba-ra-la*'. Ed. *PAS*]

To my mind there are three aspects of the individuality of Sukumar Roy that are particularly noteworthy. He had a deep knowledge and understanding of science, particularly modern physics. In addition, he was keenly inquisitive about the different aspects of science, a rare quality in the people of this country, and an eagerness to understand the bigger philosophical relevance of the various amazing scientific inventions. Secondly, his fine and deep social consciousness, his feelings about the strange contradictions present in the thought process of an Indian and his inquisitive and critical reaction on the effect of these contradictions on his neighbouring colonial world. Thirdly, his interior incomparable fountain of whims. The unrestricted tendency to move around in the impossible world of fantasy, an everpresent part of the mind of the child, was inbuilt in the mental set-up of Sukumar.

Alongside this, the feelings which arose in his mature and intelligent mind about the many strange contradictions that are innate in life and the world created a wonderful world which

provided unending joy to the children and in the case of the adults kindled in their minds a mixed feeling which is difficult to describe where a world of subtle thoughts is deeply entwined with clear humour.

There are many examples in the poems, plays and stories of Sukumar of a wonderful mixture of bubbling comedy and caricature of social consciousness. But it will be wrong to imply that the main attraction of these poems, stories and plays was their inner humour or comical social consciousness. Even the most meaningful compositions have been successful when they became a part of the inborn whimsical mind of Sukumar and became to us a form of curiosity.

The Tradition of Whimsical Imagination and Sukumar

If we go through the history of literature or arts we will come across some people who have not found fulfilment in their lives in the case of direct reality, whose creative ability has been acclaimed in such a distant place of consciouness where the boundaries of effort have lost without any direction in a strange utopia or a romantic unrealism of fancy. The poetic powers of Coleridge has been able to fly around unrestricted or unhampered on its two wings in that thrilling scenario where the real and the unreal, the human and the supernatural have combined and become one. It is only through this national medium that he has been able to give a shape to his grieving conscience regarding good and bad, fair and unfair, principles and corruption.

Cervantes, a contemporary of Shakespeare, the great realist writer of Renaissance Age, also largely followed this kind of invisible or indirect living. His comparatively realist writings are today largely forgotten, because there his fame or brilliance is curtailed, but through the beautiful depiction of the impossible adventures of the leading character of his famous *Don Quixote* he has been able to portray the everpresent conflict between the ideals and reality of life and the results of idealist efforts in a world full of corruption. In the writings of Charles Lamb tragedy and humour or comedy have both become successful when they have been picturised as fantasies.

Dickens has created his incomparable caricatures when he has made the possible nearly into the impossible. The entire world of Woodhouse is coloured with light hearted fantasies. On the other hand the ideas and hopes which Jules Verne and H. G. Wells had about the extensive progress by man in the area of science and technology have been given an unforgettable literary form by giving an independence of unrestricted movement to the scientific fantasy in the world of the impossible.

We must of course keep in mind that Sukumar Roy was a writer belonging to the modern age and even in the manner of his fantasy there is a trend or touch of modernism which was not there in the case of writers of earlier ages. Here therefore he had an absolute similarity in the case of national literature with his predecessors Lewis Carroll and Edward Lear. Here also his similarity with Carroll is particularly noteworthy. In spite of this each of them had their own trend of views, more or less independent areas and the flavour in each composition. So much so that Lewis Carroll and Sukumar Roy, who had so much overall similarity, their internal or mutual differences were extremely significant. Without doubt part of it is explained by or due to the wide differences in their nationality and period. But perhaps here the main reason for this difference is their separate mental getups.

Belonging to the middle and later stages of the nineteenth century Lewis Caroll, in spite of his love for various forms of humour, had a quiet and reserved or shy nature, deeply religious with an intense sympathy for children. His main activity during his bachelor days was to teach mathematics at Oxford, enjoy the company of children and to write various forms of fantasy for their enjoyment. Even amongst the mystery and comedy of his many writings there is a strange touch of simplicity. The twentieth century mind of Sukumar Roy was much more complicated and full of contradictions.

It seems as if his whims have gone very deep into the universal world, society and the human mind. He had deep and strong feelings about the inner unreasonableness in the surrounding or neighbouring social life, and as a result we find a strange touch of curiosity and humour on these variety of unreasonable issues in his writings. For a person who is good or proficient in fantasising has a mind which can see life and the world in a number of strange and comical unknown forms; hidden behind such a whimsical mind of Sukumar was the sight of a fine critic of life. In the normal course Sukumar through the clinical or surgical actions of his whimsical fantasy had made a sharp analysis of the Indian Psyche and particularly the outlook of the elite colonial society of this age and this remains incomparable till today. This singularity or uniqueness of his mind amazes us even more when we remember that was a close friend or associate of the theologist, idealist ever-romantic poet Rabindranath and a distinguished member of the Brahmo Samaj.

In the case of our literature we can think of only one person worthy of mention prior to Sukumar. He was Trailokyanath Mukherjee the distinguished writer of fantasies of late nineteenth century. His 'Kankabati' and other writings are placed at a very high level in our national literature. Even on him we see the influence of Alice-related or centred stories by Lewis Carroll. But clearly the basis for his fantasy was his social consciousness. There were two particular weaknesses in the society of that time (we get a clear picture of this in the well known book on sociology by Shibnath Shastri). The first is the rural society is full of supersitious, lack of class-consciousness, prickled customs and practices, ruled by the authority of zamindars (landlords) and in a shattered state of parental rule, where the humanity or individuality of the person and his simple intelligence was regularly down-trodden.

And the second is, the excellent mixture of the religious deceit in the behaviour of the new Euro-Bongs (5% Euro, 95% Bong) who have come into Calcutta from the rural areas and their blind greed for European food and clothings and its more unhealthy influence of this mentality on the ill rural life. In 'Kankabati' we find a pathetic satirical presentation of this situation of society. In this, mixed with satire there is deep compassion and the pleasantness of loving mentality. The wonderful structure of fantasy which has grown on this amazing foundation has two main constituents: the urge to run away from this stifling social-environment or escapism; and a dream to build afresh this insufferable life or wish fulfilment - although there is an awareness of the obstructions present in the path of happiness, peace and truth and the sad end of the dreams of 'Kankabati'.

Sukumar Roy with his association with the most advanced part of the colonial society in the first half of the twentieth century well understood its trend with his sharp and unbiased view. In most of his writings we get a strange or wonderful insight about the various comical oppositions or obstructions in this social environment and their unchangeability or fixity or incontrovertibility. He had neither escapism nor wish-fulfilment. He had a muted or suppressed (and coocked) critical spirit, which in the final stages (like the last part of *Hajabarala* and *Diary of Hesoram Husiyar*) was largely turned into cynicism of a frustrated or disappointed idealist. Even if not everywhere, this critical spirit was mainly expressed through the various forms of the flights of his abnormal whimsical fantasy.

Let me now talk about how Sukumar Roy in the first half of his 'Hajabarala' has created in the mind of the children an amazing dreamlike form out of the seemingly unbelievable and evolutionary inventions in physics during the twentieth century. There are two distinct parts in 'Hajabarala', whose interconnection is through Hiji-bij-bij which has formed a bridge between the two worlds of extreme fun and comical expression. The second part, which created history in a distinguished competition, is clearly (full of the beauty of the dreams of children) a wonderful social cartoon. We are not discussing here this part and its deep and inherent subject of social-consciousness. The subject of this discussion is the first half of 'Hajabarala', that is from changing the handkerchief into a cat upto Kakeswar going away closing his shop at the

end of the wrestling of two old men three feet tall.

There is a strange contradiction with scientific theories seen in the writings of Lewis Carroll such as Alice's Adventures in Wonderland, through the looking glass and what Alice saw there and 'Sylvie and Bruno' and in this she probably showed the way in modern literature. But even in this special field there are some differences with Sukumar Roy. First, in the case of writings of Carroll there is a faint overall influence of scientific principles. A clear effect of science is present only in small parts of the imaginative or whimsical writings of Sukumar. But in the case of the particular work which we are discussing, *viz* the first part of 'Hajabarala', the scientific ideas of Sukumar have shown up in a limited but strangely distinct form. Second, the thoughts of Carroll reflect the steady progress of science during the mid-nineteenth century, which in slow steps had moved ahead from Newton's Law of Gravity upto Electro-dynamics of Maxwell a contemporary of Carroll.

But the scientific principle which had an effect on Sukumar's thinking are so sudden, unexpected and strange that their effect is eye-catching as an electric spark. Another reason for this line of imagination of Sukumar was his mental get-up, a deep inherent part of his perception; on the strength of this he has been able to capture in a few pages the newly born wide area of deep principles in the form of a beautiful picture of fantasy or dream.

The Wave of New Science

The new effects of physics which had raised these feelings of wonder or amazement in Sukumar's mind were mainly Einstein's Relativity and second the Quantum Theory which had grown up through the continuing collection of ideas of many scientists like Max Planck, Einstein, Rutherford and Bohr. (The thoughts of scientists like de Broglie, Schrodinger, Heisenberg, Born, Dirac and Pauli had not yet reached the stage of 'Quantum Mechanics' during the lifetime of Sukumar Roy.) I will not try to give here any details on the history of the evolution of these theories, but shall only try to give a brief description of the new revolutionary ideas on the material world which largely proved wrong or insufficient the long established ideas of Galileo and Newton.

According to the prevailing beliefs in the nineteenth century, the famous tests in 1887 by Michelson and Morley using ether to determine the speed of Earth's revolution and the many questions raised by the research of Lorentz-FitzGerald on the curious contraction in the length of any moving material approaching the speed of light found a wonderful answer in the Special Theory of Relativity of Einstein published in 1905. It was already known that light travels at a speed of nearly three lakhs kilometer (186281 miles) per second. It was now realised that this speed is universally constant. That irrespective of the speed at which a person approaches or moves away from a source of light, he will always see light travelling at that constant speed (in a vacuum). It was also seen that the speed of light is the fastest possible for anything in the universe, and it is not possible for anything else to travel at a speed higher than or same as the speed of light.

If anything travels at speed nearing that of light, then 1. its mass will become nearly unlimited, and 2. its measurements will become practically zero (Lorentz-FitzGerald contraction), and in addition 3. in that system with light like speed, movement of time will become extremely slow (Time dilation). In our normal system when a few years have elapsed, the clock of that fast moving system will probably have moved only a few hours. If anybody can move exactly at the speed of light (which is not possible in practice) then according to relativity there will be no such thing as time consciousness. Therefore he will not grow in age and he will see the world as totally unchanged. Taking forward this line of thinking, the question may be raised – what will happen if somebody travel's faster than the speed of light (although that is not possible)? The answer is, he will then see time moving in reverse or backwards – that is he will gradually move into the past or his age will keep coming down.

This imaginative dreamlike idea of going back in time through the magic of speed of light has been expressed in a humorous verse on relativity –

There was a young girl named Miss Bright
Who could travel much faster than light
She departed one day
In an Einsteinian way
And come back
On the Previous night.

If weight increases along with speed, then there will be no such thing as absolute mass. If any thing increases its speed then all its internal speed rhythms (like movement of a clock) will slow down. Therefore absolute time will also cease to exist. And when along with speed everything else like weight, length, time is changing then in the normal course there will be no simultaneity. What we will see as simultaneous incidents in a particular speed-related system may not appear to be simultaneous in a different speed-related system.

In this universe, where everything is moving, all movements are relative, and the existence, weight, length and time-rhythm of everything in movemet is connected with their speed, space and time are interconnected, space in our universe is three-dimesional; but the status of any matter can be correctly established only by considering four dimensions obtained by connecting those three dimensions with one dimension of time. From this point of view our universe is a four dimensional space-time continuum – this also is revolutionary decision of relativity.

As a corollary of the Special Relativity Theory of 1905 it was also established that it is incorrect to say that only matter has mass and energy is without mass. Just as a ball of iron or a bucket of water or a cylinder of gas has mass, similarly energy in any form (light or heat or sound energy) also has mass. This means a ray of light also has mass, even if it be very minimal. Therefore it was also established that matter and energy (signified by M and E) are basically the same, and one can transform into the other. In addition, from the universely constant speed of light (signified as C) and the rate of change of mass, length etc. relative to the change in speed of any matter.

Einstein established a quatitative relationship of mass and energy – and its accuracy was later confirmed through the terrible experience of the atom (uranium) and hydrogen bombs. Another strange but infallible situation is the combination between quantitative relationship between mass (M) and energy (C) is represented by the mysterious universally constant speed of light (C). In brief, the relatively stable and extremely limited state of the energy of matter and the comparatively unstable and widely spread state of matter, and the two combine into that mysterious constant speed of light.

Einstein's General Theory of Relativity published in 1915-16 does not have much relevance in this particular discussion, but a few areas can be mentioned. This theory is a new and wonderful analysis of relationship of gravity. According to Newton's Theory, Gravity is a force by which two matters are attracted to each other depending on their mass. According to Einstein's Theory, the presence of matter in the four-dimensional space-time field of the universe results in differing forms and quantities as a result of which other moving matters in the neighbourhood travel in specific elliptical paths which are more accurately covered in Einstein's Theory compared to Newton's Theory.

In the case of gravitational force a moving matter can never travel in a straight line; it has to take a curved path to move from one point to another point. In such an event then there is no such thing as absolute space. This is because the geometric formations of space light also has matter, a ray of light will get slightly curved under gravitational pull. In addition, time is also influenced by gravity. The velocity of light and the frequency (or wave length) of a particular or specific coloured light proved a new theory relating to time.The frequency of light

emitted from a point or source of extreme gravitational force is reduced, meaning its wave-length is increased and the light becomes comparatively reddish. In this way under the influence of gravity the time beats will become slower in everything. The measure of every-thing, vibration of light, movement of clock, heartbeats of a living body, will reduce, even if by a small measure.

It is not very clear how much influence the Quantum Theory from the second stage of new physics had on 'Hajabarala'. But in my own view, there are some instances where the fine traces of this theory are intermingled with the relativity-influenced imagination of Sukumar making him more glorious or majestic. The main idea of the Quantum Theory which Max Planck published in 1900 was – all forms of force (whose nature was so far known to be like waves) are not dispersed in an alienated manner but as a stream of scattered particles or quantum of force. This means light has a minimal quanta – this is known as Planck's constant 'h' and remains an inseparable part of physics. Any quantity of light-force is a multiple of this minimal quantum, every coloured light has the same velocity, but the frequencies of different coloured lights differ, and the greater the frequency the shorter is the wavelength. And the force of a quanta of light increases with its frequency.

This thus clarified the 200 year old hazy picture given by Newton on the nature of light; Planck's new theory established the view so far considered impossible, that the nature of light waves is clearly a very small particle form. In addition, Planck's constant 'h' established the undisputed relationship between the frequency of any light (which in the case of visible light is dependant on its colour) and its force. The research by Einstein on Photo-electric Effect in 1905 further advanced this theory.

According to knowledge available at the time Thomson had already in 1898 found the mass of the smallest molecule having only one negative electric-charge electron. In 1912 Rutherford proved that all the positive charges of an atom are integrated in its nucleus. In 1913 Niels Bohr gave a picture of the atom. According to this around the point of the positive charge the negative electron or electrons are going around in a orbit like the planets going round the Sun, and whenever an electron moves from one orbit to another (either nearer or farther) its gains or loses one quanta of force. Much later in 1924 (about one year after the death of Sukumar Roy) the collective views of a number of world-renowed scientists proved that just as Planck had discovered that light had a wavelength similarely a wavelength connected with each electron or other basic atoms.

Finally it was seen from the Uncertainty Principle of Heisenberg that even with most accurate observation it is not possible to measure with certainity the location, speed, force etc. at any point of time of a particular electron. In the matter of these unique measurements of the molecules science had to move from 'certainity' and take shelter under 'probability'.

Universal Wonder of the Handkerchief, Cat and 'Chandrabindu'

We shall now see how these various spectrum of mystery-ideas based on the new scientific theories are reflected in the kaleidoscope of fantasy-dreams in 'Hajabarala'. With a little attention we shall see how this wonderful illusion of nonsense has been composed based on a deep understanding of difficult and complex scientific theories. In the stories relating to Alice the mysterious of dreamland have been developed slowly and gradually but in the brief span of 'Hajabarala' the writer has transported us to the world of the impossible within an instant. The handkerchief suddenly called out 'Meow', and we see that the fine white handkerchief has turned into a fat red cat. In answer to the boy's gasp of wonder the cat said,''what's the problem? There was an egg, and it becomes cackling duck – this is happening all the time.'' Meaning, here the handkerchief was there as a small article and in a flash it (in an illusion of Theory of Relativity) becomes a fat red cat.

That is, the collection of energy or force – which has expanded into something many times

bigger than the original both in measurement and extent – and its new form in terms of mass and energy is regularely and frequently happening in the world of Theory of Relativity. The transformation of the handkerchief into the cat is a wonderful example in the world of fantasy of the self-changing capability in the material world seen in Lorentz-FitzGerald Transformation and Special Theory of Relativity.

The next part of the statement has a finer reflection of the mathematical form of that theory. In answer to the boy's question, the cat tells him "you can call me a cat, or also a handkerchief." That is, the fundamental difference we had so far known between matter and energy now becomes meaningless. Therefore, you call matter as matter (handkerchief) and also its other form energy (cat). According to the new science the two are different forms of the same thing. You can call it 'äÂf¿õjÅ′ (point sign encircled by half-circle). What is 'äÂf¿õjÅ′ ? The introduction of this word or term is the most notable amongst all the bright expressions created by Sukumar.

Neither a vowel nor a consonant, this nearly intangible letter 'äÂf¿õjÅ′ is the mysterious universally constant speed of light. This speed (c) is a matter, the connection between the mutual transformation of mass (m) and energy (e). Multiplying the handkerchief by the square of 'äÂf¿õjÅ′ gives the cat ($mc^2 = E$) and dividing the cat by the square of 'äÂf¿õjÅ′ gives the handkerchief ($E/c^2 = m$); when the presence of 'äÂf¿õjÅ′ is common in the transformation of the handkerchief and the cat, we get the statement, " You can call me a cat, or a handkerchief or also 'äÂf¿õjÅ′. "or 'äÂ′ of 'äÂf¿õjÅ′, 'úÂ′ of cat and '÷±′ of handkerchief gives 'chasma' – (spectacle) – O.K.?"

There is a combination of science and non-sense in this, the sudden introduction of the word 'chasma' creates a variety of curiosity; again, 'chasma' represents or symbolises the new idea on relativity through which one can understand the deep inter-relationship between 'äÂf¿õjÅ′, cat and handkerchief.

Then comes the story about going to Tibet. Through this, we get a colourful hint about the thrilling new character found by gravity in Einstein's General Theory of Relativity. It is not necessary to get unduly worked up wanting to know why talk about going to Tibet, leaving aside so many other places. Because in this world of aimless travel of fantasy it is not necessary that each word will have a meaning relating to theory; in this oppressive heat we cannot even use the handkerchief, which has become a cat, to wipe our face; hence, naturally, "Why not go to Tibet."

The mystery lies not in going to Tibet, but 'in the straight path' leading to Tibet. Like the cat the straight path is, 'Calcutta, Diamond Harbour, Ranaghat and then Tibet.' What can be more strange and mysterious than this? But behind this there is the new view about the path of travel of a mass of material moving fast through centre of gravity. This is that in a space-time-field a vast mass of matter creates a kind of aberration or deviation; as a result its geometric form changes and all the paths become crooked or curved line – just like an elliptical or hyperbola there the shortest path between two points is not a straight line but a curved line, and a distance of an hour and a quarter – this indicates a state of great velocity in the case of all matter moving under gravity (the earth is going round the sun at a velocity of nearly twenty miles every second).

Then comes the story about 'ÎáËå±ð±ð±′ (arboreal elder brother). The instantaneous picture of 'ÎáËå±ð±ð±′ [like the obvious and bizarre form in 'Hijibij-bij' ('¿ý¿æ¿õæ–¿õæ′) – is it chaos or dosorder or entropy?] has raised waves of both curiosity and mystery in the minds of hundreds of readers and writers. We see that two particular qualities of this ever-absent and unseen 'ÎáËå±ð±ð±′ are becoming clearly evident. First, only he can give the correct and unfailing clue to the strange round-about way (meaning the accelerated curved path of a moving matter in a state of gravity) to Tibet. Second, the absolute uncertainty about his own mysterious movements and condition or state. We can now ask, 'Then in this situation who is this

'ÎáËå±ð±ð±′?' What is his scientific relevance? What kind of thinking or awareness of principles are expressed in this character? It looks as if 'ÎáËå±ð±ð±′ is on the one hand 1. Einstein himself, who can only give the correct path of movement by applying the field equations of his General Theory of Relativity. Similarly, 2. he is the symbol of accelerated non-uniform motion; and therefore, it is so difficult to know his correct whereabouts. From the motion-related system of Special Theory of Relativity it is possible to get full details of individual aspects (mass, location, length, time rhythm etc.) of this matter. Further, if the space-time field gets curved under the influence of gravity then the path of motion of this matter becomes more compli-cated. 'ÎáËå±ð±ð±′ is the symbol of the mystery of this new mechanics. In addition, there is the stamp of uncertainty of the movement and state of an electron in this ever-absconding and elusive nature of 'ÎáËå±ð±ð±′. According to the views of Niels Bohr known in 1913 an electron rotating around the nucleus continuously moves between different cell-paths. But the running around of 'ÎáËå±ð±ð±′ has cast a shadow on this view about the electron. I personally hold the view that there is an indication of more advanced thinking in this uncertain state of 'ÎáËå±ð±ð±′. 'Hajabarala' was written around mid-1928. The first indications of Quantum mechanics or wave mechanics came nearly two years later. But notice exactly when the state of 'ÎáËå±ð±ð±′ became paricularly complex and uncertain:

I asked, "Then how do you manage to meet?" The cat said, "It's very troublesome. First I have to calculate the places where Dada is not present; then I have to determine the places where he could be; and then I have to see where he is at that time. Then I have to see if I reach that place as calculated, where Dada will move to by that time. Then I have to see – ."

This means it is extremely difficult to determine the exact location of 'ÎáËå±ð±ð±′ at any point of time. His possible location could perhaps be determined with a lot of effort. In this will it be unreal to anticipate a shadow of Heisenberg's Uncertainty Principle or Principle of Indeterminacy, according to which it is not possible to determine with certainty the mass, speed, instant location etc. of a particular electron. It is also not possible to determine the exact location of the electron in its own atomic path. At the most one can get an idea of its probable instant location at any time. Is not the problem of catching 'ÎáËå±ð±ð±′ somewhat similar? It seems as though in the writings of Lewis Carroll also, there are indistinct shadows of the forthcoming inventions in science, may be unknown to the writer. For example Red Queen in Through the looking Glass is running breathlessly with Alice and saying:

"Now, here, you see, it takes all the running you can do, to keep in the same places." This seems to have a faint shadow of relative motion of Relativity. Or that curious machine of the professor in Sylvie and Bruno, which can reduce within a moment the length of a dog, or a crocodile, etc., seems to have a touch of the (nearly contemporary) Lorenz-FitzGerald con-traction. Besides, the following statement indicates the different far-reaching questions which arose in the mind of Sukumar Roy regarding the uncertain speed, location, etc. of the atom: "At one time science wanted to establish a permanency over the existence of the inert atom. Today, while making indepth enquiries about the atom we have got extensive proof on its non-permanency, and as a result science has lost its earlier confidence, and does not want to express anything as constant."

However, let us not mess around any more about the character of 'ÎáËå±ð±ð±′. Because 'ÎáËå±ËõÌ¿ð′, about whom we do not have any information, may have overheard everything about the elusive nature of her husband.

The Commentator 'Kakkeswar'

Now emerges 'ßÂ±ËßÂ•«õþ′ (crow). He is the accountant in this peculiar world of relativity. He stays on the tree branches with his slate (writing block) and pencil hanging from his mouth, serious mannerisms befitting a teacher and his first words with a child – "What happened, why aren't you answering? How much is two times seven?" Or the crow may be shaking his head and

saying, ''Incorrect. You have failed'' – creating a strange, unexpected item of curiosity. But behind this there is the influence of a basic point of relativity. New data has shown us without fail that nothing can have an absolute permanent measure: mass, length, time, everything changes with velocity. Hence an absolute statement like 'two times seven is fourteen' is no longer acceptable.

When this item with a value of 'seven' is doubled it is not possible to get the result correctly without knowing its velocity at that time. 'I' has seen this seven as something stable and constant; but the relativist crow is seeing him as constantly moving, because nothing is stable in the universe; everything has different forms of relative movement. This has been expressed in a fantasised form by 'ßÂ±ËßÂ•«õþ':

''When you had said, it was not yet fully fourteen. It was then thirteen rupees fourteen annas three paise. If I had not put down as fourteen then, by this time it would have become fourteen rupees one anna and nine paise.''

In this context I am reminded of a story about an American gentleman. One day on a busy street a gentleman with ruffled hairs was walking slowly absentmidedly, as if he was totally oblivious of his immediate surroundings. Seeing this strange person, two boys wanted to have some fun and asked him, ''Old man, does two and two make four?'' The dreamy eyes of the gentleman suddenly brightened. He smiled a bit and said, ''Yes, if they are not in motion.'' The gentleman was Einstein himself.

Beyond the Limits of Light

The revolutionary points of relativity has taken the always worried mind of the human being to extreme limits of thought and imagination where mathematical arguments has itself seems to have become a fantasy. Following this in the stage of 'Udho' and 'Budho' in that imaginary world Sukumar Roy has continued with his daring travels of his whimsical imagination. According to the Theory of Relativity nothing can travel at a velocity equal to or greater than of light. But scientific philosophers have extended it to the regions of impossible or unimaginable and have raised a question : If something is able to travel with a super velocity then what will happen? Science here largely becomes a state of speculation. Scientists have been able to form a somewhat clear idea only about one quality of this matter travelling at super-velocity – that its time sequence will reverse, meaning that instead of travelling from past to future it will go from the future to the past. Expressed in simple words, his age will gradually reduce.

But the ideas about his other conditions are more hazy. For example, about his mass and length. When it reaches the velocity of light the mass of any matter will become infinite. Then what will happen if velocity increases further? Again when it reaches the velocity of light its length will become zero. So what will happen to its length if velocity increases further. According to mathematics, we see here that to determine the mass we have to divide by the square root of a negative number, and to determine the length we have to multiply by the square root of that negative number.

We know that the square root of any negative number is an imaginary number, and hence in the case of the matter travelling at super-velocity both its mass and length become imaginary numbers; meaning it cannot be calculated in reality. This world of super-luminal velocity, a world of thrilling imagination which can be reached by using the infallible arguments of science, there Sukumar Roy in his kaleidoscopic writings about ''Udho, Budho, Kakeswar and I'' has given a whimsical imaginary scientific colour none of which can be entirely reconciled with scientific theories.

The Illusion of the Green 'ðÒ±hÂ' (Dar)

Here we will discuss the formation of the main theories, leaving out the ones which are comparatively less important. First let us look at the way the first old man appeared on the scene. ''About this time something slipped out of a hole in the tree and fell to the ground. I

find its an old man, an arm and a half in length, with a green coloured beard running down to his feet, a hookah in hand but without a holder, head completely bald and somebody writing something on it with a chalk.''

The height of the old man is one and a half arm length. This should first indicate that as a result of travelling at a velocity near that of light and following the infallible principle of Relativity his height has reduced to only one and a half arm length. He reminds us of that hurriedly conceived character Fisk in the comic rhyme –

There was a young fellow named Fisk
Whose fencing was exceedingly brisk
So fast was his action
The FitzGerald Contraction
Reduced his Rapier to a disk.

Just like smart Fisk was moving his sword at (nearly) lightning speed reducing it to a disk, similarly our (perhaps at one time four arms length) old man has certainly reduced in size due to great speed and contracted to one and a half arms length. But from further observation it seems the old man is not at all straight, but quite complicated. On the one side he is very old, his head is totally bald, but his beard running down to his feet is coloured green, signifying youth; therefore he is old and also young, and shortly we will see that his present age is thirteen.

This strange contradiction means sometimes he moves at a speed less than that of light, and this takes him forward, towards old age; but at other times he moves at super-luminal speed which takes him backwards, towards young age. For this reason we see the strange combination of old age and youth in his appearance.

Then comes the extremely funny or curious conversation between the child-narrator and that young but old man, which deeply reflects the gist of the amazing inventions of new science and the far reaching inferences. The Relativistic system of the old man did not realise the existence of the young boy. When he did realise, he whirled round a few times and faced him. Meaning thereby he increased his rotation to reduce somewhat his high speed or velocity to bring the boy within a manageable observation range. He then examined the foreign system of the boy using various instruments.

First, he observed with a hookah-telescope, then he brought out some coloured glasses from his pocket and saw him through these repeatedly. Those glasses signify the spectroscope, with which he analyses the spectrum of light of 'I' and using its Doppler effect started calculating his constituents, structure, velocity, time, rhythm (age-related) and whether at that particular velocity he is coming closer or moving farther away etc.. Then from somewhere he produced an old measuring tape used by tailors and started measuring calling out – ''Height 26 inches, arms length 26 inches, wrist 26 inches, chest 26 inches, neck 26 inches.''

It seems, two significant principles are expressed through this faultless description. First in the measurements of the boy the old man is travelling at high velocity and has contracted to one and a half arms in length, similar in the measurements of the old man the velocity of the boy is also similar and as a result of FitzGerald Contraction the length of the boy in the eyes of the old man has become 26 inches, i.e. similar to the one and a half arm length. But why is everything, height, neck, chest all 26 inches. Here again there is a mark of another fundamental principle of the Theory of Relativity.

It seems, 26 inches here signifies (at zero force - úÓòÉ÷±ËáÇ) the constant velocity of light (3 lakhs kilometer per second). We know two individuals (or matters) irrespective of the velocity at which they are travelling either towards or away from one another will always see light travelling at that velocity of 3 lakhs kilometer per second. The old man is travelling at super-luminal velocity (as a result of which he is becoming younger) and to him he also sees the boy also travelling at that super-luminal velocity. But whenever they are in relative velocities, mutually they both see the other travelling at the velocity of light. Neither more or less.

Hence, (in the eyes of the old man) the boy travelling at super-luminal speed always 26 inches in every respect, without any variations. The erasure of all numbers except 26 from the measuring tape signifies establishing the universal constant of the velocity of light.

Then, ''What is the weight?'' This question introduces another assumption on the principle relating to the mystery of superluminal travel. Mass (or weight) increases as we approach nearer the velocity of light. When we reach the velocity of light weight will become infinite. Beyond that impossible we come to more impossible ideas. If we assume everything will get reversed if one travels faster than light (as for example time moves towards the past), then surely mass instead of moving from limited to infinite will move from the infinite to the limited zone. That is, put simply, it will start reducing. At one point the weight of the old man had become infinite; now while travelling at superluminal velocity along with his age his weight is also reducing.

But, in the eyes of the old man, the boy is travelling at that extreme superluminal velocity and as a result according to measurements taken by the old man, the eight year old boy weighs two and a half seers. How did he measure? He has earlier seen all measurements of the boy, his length, breadth, everything is 26 inches. Now the old man 'used his two fingers' and felt this 'I' and measured the density of the matter, and from the measurements and density calculated the weight as two and a half seers. If you now ask, in that case relatively speaking what is the weight of the old man, then like the cat I will have to say, ''Sorry, that is not my job'', and more danger, it is doubtful whether 'ÎáËå±ð±ð±' himself could have given clarified these complicated mysteries of these developments moving in reverse. It may have been helpful if 'äÂf¿õjÅ' could be summoned; but to get him one has to run at a speed of 3 lakh kilometres per second. Therefore that hope is also far fetched.

Then we come to the question about age, and here in this world of metaphysical influences Sukumar has given his whimsical imagination total independence to move around freely. The old man said, ''Write down – wieght two and a half seers, age 37.'' He is saying the child weighs two and a half seers and he is 37 years old. What can be more ludicrously funny. But after seeing all this it may occur to us – is there any other funny thing behind all this? For that matter, 'I' protested and said, ''Get away. My age is 8 years 3 months, and he says it is 37.'' At this that difficult superluminal traveller old and young man was a bit worried. He thought for a while and asked, ''Increasing or reducing?''

Here on side the fun is getting more intense, and on the other side the writer has gone one stage deeper into his influence of theories. The momentary confusion about the boy's age in the mind of the old man is because he is thinking in that case is 'I' travelling at superluminal or subluminal speed. If at subluminal speed he will be going from the past towards future, or from lower to higher age, and if he is travelling at superluminal speed exactly the opposite should happen. Meaning he should move from the future to the past, or from old age to youth. 37 years is the age on one side, but 'I' says his age is 8 years 3 months. That is why the old man is wondering, is the youngster confusing all my calculations by running in the opposite direction?

Immediately after this we have that famous statement of principle from the old man with green beard, ''You are a fool. Why should the age be 80 years? We (the people of the world of Relativity) reverse the age when it reaches 40 years; then it does not progress as 41, 42 but starts reducing 39, 38, 37 and so on. When it reaches 10, age is allowed to increase again. My age has gone up, come down and again gone up, and now my age is 13 years.'' The various points on Relativity has spread in many ways in society and has affected not only the thinking to human beings, but also the related love for fantasy and adventure towards unexpected and extreme limits.

He is starting to dream at the velocity of light, to travel at a velocity faster than light and go beyond location limits as a traveller of the stellar region, and ignoring the rule of time freely travel between the future and the past. Through the features, mannerism and talks of that one

and a half arm length, green-bearded baldy young-old man we see the ultimate dream of the human being. The strangest thing is Sukumar Roy had formed this imaginary world in 1922.

In the story of the old man and the advertisement of the crow (I think) we get an interval of utter non-sense in the narration of scientific thinking, whose amazing illogicality has initiated the wonderful question, ''If its a 'Pakshiraj' then where is the tail?'' and the clear instruction of 'Kakkeswar' to his customers about required data, – ''The catalogue is sent by return past after receiving the essential information like size of your shoes, colour of skin, any ear-ache, alive or dead etc..'' (Of course, in the question, ''What happened to the tail of Pakshiraj?'' there may be a shadow of the question ''What happened to the wave-length of molecular light invented by Planck?'').

After this we once again and for the last time enter the magical world of Relativity. But the return this time is slow and with some brief interruptions. These interruptions have some clean humour and also social satire. Of course, these do not strictly come within the scope of our present discussion. When a bald customar was mentioned to the boy crow the old man flared up screaming, ''Look here. If you call me baldheaded once more, I shall break your slate with my hookah.'' And soon after this, the crow said ''See this'' and banged his slate on the baldhead of the old man. The old man immediately sat head in his hands and started crying like a small boy shouting ''Oh mummy, oh anntie, oh Shibuda.'' In both these instances the relevance of the amusing, child-like innocent behaviour is that, in spite of being really an old man he has become like a 13 year boy due to travelling at superluminal velocity. Hence his objection to being called 'baldy' and his inclination to start crying at the slightest hurt.

Clear as Water

Let us now keep aside the long judicial introduction of 'Kakkeswar' and come to the actual accounts. The account is 2 times 7 is 14, age 26 inches, deposit two and a half seers, expense 37 years. After seeing all the strange tricks, it may be possible to solve this problem. '2 times 7 is four' is the result of the first question of the crow, perhaps this is the only sign of relative stability. That is 7 and 7 is 14 is at that instant when the two of them are mutually not moving. It seems, other than this only relative motionless item, all the other items in the account are connected with the extreme velocity of the World of Relativity. That the measurements of extent and time are closely mutually dependant, they are inseparably mutually connected, has been displayed in the strange account item age is 26 inches; we have already seen that according to the old man the boy is 26 inches in length.

But how can 26 inches be the age? In this calculation, a matter of a particular length, travelling at a particular superluminal or subluminal velocity at a particular time can have a length of 26 inches. Hence measurement of length can also be the measurement of time simultaneously. Then 'deposit two and a half seers', 'expense 37 years'. When the crow is the accountant of this magical world, he will naturally present his accounts of deposits and expenses. The old man earlier told us the boy weighed two and a half seers. But why call it a 'deposit'? The answer is a bit complicated, but can be understood. In the world of Relativity with extreme velocities there can be two kinds of speed of travel.

First, steadily increase towards the velocity of light – and as a result weight (mass) will steadily increase, i.e. will be deposited, and time will be expended, but at a steadily reduced rate. This is because as speed increases, correspondingly the velocity of time will reduce. And the second will be starting from the velocity of light gradually move towards superluminal velocity – as a result weight will move from infinite to zero and time starting from being static will steadily increase. But in the case of this superluminal travel everything will be considered from the reverse direction, that is from the moment of passing the velocity of light and going into superluminal velocity.

According to this, in the eyes of the old man 'I' 37 years is travelling at superluminal velocity,

or he has expanded 37 years, and as a result he is steadily reducing from his infinite state and at this moment his 'deposit' or mass has become two and a half seers. These deep and complicated principles (and in 1922 there were not many people in the world who understand these) have developed as some comical forms of utter nonsense through the mind of Sukumar.

'Patla' versus 'Huko'

After this, crossing the humorous intermission of the adulterated three digit decimal arithmetic accounts diluted with water (connected with some social satire) Sukumar has presented before us the master stroke of his scientific dreams. He has again very easily taken us to the strange dreamland of Relativity, without weakening the threads of the story in any way. After getting the money the crow in happiness started dancing making noises like a drum ''Tak dumadum, Tak dumadum''; immediately our young-old man 'Udho' thought he was making fun of him and shouted ''Again you are saying Baldy (Tak)?'' and called out to Budho, the invisible owner of that voice in the tree-hole.

Without doubt the aim was a serious punishment for the crow. As a result of the call, ''A big bundle-like object fell out of the tree-hole on to the ground. I see its an old man under a big bundle throwing about his hands and feet. He looks exactly like the old man with the hookah.'' Who is this strange twin? (We have to remember there was no idea then about antiparticle; therefore there is no question of considering them as electron-positron pair.) Two things are particularly noteworthy. First, 'Budho' looks exactly like 'Udho'. Meaning, he also like our expert with the hookah, is a one and a half arm length, bald, green-bearded young-old man.

That is, Budho like Udho is a relativistic space traveller. They travel alternately at superluminal and subluminal velocity and in turns become old and young, short and tall, heavy and light. We also see, at present both are in the same condition; otherwise how can their features be exactly similar? But the second thing looks odd. ''The old man is under a huge bundle and throwing around his hands and feet.'' What is that bundle attached to the old man, and why? 'Udho' has no such bundle. It seems, the bundle of Budho is relativistic mass, meaning the mass of any matter travelling near the velocity of light (one fourth or more) increases appreciably, becomes an insuperable barrier. Budho has experienced an increase in mass having travelling at such a velocity, and he is struggling under the bundle of this excess mass.

The question then arises, why does 'Udho' not have a similar bundle? That is because 'Udho' is travelling towards the velocity of light, he is going past it at superluminal velocity. By travelling like this at superluminal velocity mass and age goes down and length increases. Here the writer has taken his whimsical fantasy incited by Relativity to its extreme limit. And we notice with amazement that the indications and behaviour of the superluminal traveller are all present in Sukumar's 'Hajabarala', which the leading scientists are today talking about the existence of the superluminal molecule tachyon.

Two relativistic space traveller Udho and Budho are continuously travelling away from one another like two shuttles. When one is going at superluminal velocity in the opposite direction, and midway while crossing one another they see 'I' with his eyes of wonder. The bundle of mass on the neck of Budho is a sign that he is gradually becoming shorter and rounder; similarly the long, narrow hookah held by Udho is a sign of his gradualls becoming slim and tall due to travelling at superluminal velocity.

Meaning, at this moment, one is moving from past to future, and the other is coming from the future towards the past; the length of one is becoming shorter and the other is becoming longer; the mass of one is increasing from zero towards infinity, and the mass of the other is moving from infinity towards zero. Midway the writer has chosen a point for them to meet where the different coordinates of their relative features have made their appearances the same. But the difference in the hookah and the bundle indicates a major difference in the direction and quantum of their relativistic motion.

The Sruggle with Age

Then we have the hand to hand encounter between the two bizarre young-old man. No doubt comedy is the main theme here, but even that wonderful humour has probably been rippled by the scientific fantasies. Perched on top of Budho with his bundle, Udho is goading him with his hookah shouting , ''Get up quickly, get up.'' Immediately thereafter Budho stands up with his bundle and there was a great struggle between them.

Before coming to the final situation, let us briefly see the mysterious analysis of the crow. ''Can you understand the situation? The load of Udho is on Budho. He has put his load on the other, why will he now give it up? As a result they are quarelling daily.'' What is this explanation, or is it becoming more complicated? Still let us see if we can retrieve anything. ''The load of Udho is now on Budho.'' What is the load which was on Udho and why and how was it shifted on to Budho? ''What will he want to give up the load?'' Does this mean Udho wants the load returned, but Budho does not agree? Further, ''There are daily fights.'' Does this mean the drama of their fights goes on regularly.

The big bundle or relativistic mass connected with high but subluminal velocity is moving towards the future. Udho was earlier in that situation, when he was gradually becoming heavier and shorter. He must have wanted to increase his velocity to faster than light, reverse the situation and to go towards the past, meaning go towards lower age and also improved his figure to being lighter and more slim. Therefore, when they met during their travels, somehow he could shift the relativistic load on to Budho. Probably Budho also did not object. He may have been looking for an opportunity to go at superluminal velocity towards youth and lose excess weight. That is what he achieved.

But in the meantime, Udho without his load was travelling at superluminal speed, reached 13 years and two and a half seers, got fed up and wanted to return towards future. But for this he had to get back the relativistic mass. Hence he wanted it back from Budho. But now Budho will not agree. Probably he is now obsessed he has to reach the velocity of light, and therefore he wants to cling to the heavy load, though its very uncomfortable.

But what is the result of this struggle? ''Within a moment I see Udho is flat on his back and panting, and Budho is very uncomfortable and rubbing his bald head.'' Meaning, the situation has again reversed. The condition of Udho and Budho are again interchanging. Udho is now on the ground panting, meaning the relativistic mass is again joined to him and he is again a traveller towards the future. On the otherside Budho free of his load will be travelling towards the past at superluminal velocity. But as a result of the exchange of loads and the resultant basic change in their conditions somehow confused the relativistic connection between Udho and Budho.

And this is bound to happen, because having retrieved the load Udho made an about turn towards the future, and consequently the sudden loss of load by Budho hurled him towards the past at superluminal velocity. As a result of speed, direction, mass, length, time-rhythm, everything changing within a moment, it seemed as if Udho and Budho lost one another at that moment. That is why Budho started crying, ''Oh brother Udho, where have you disappeared now?'' And simultaneously, Udho started crying, ''Oh my goodness, what has happened to our Budho.''

After this there is no scientific relevance to their embracing one another and crying together. This is just a comical ending of this mysterious drama. Only both of them disappearing into the hole in the tree probably signifies their disappearance into the vast universe – our slow and steady movements in life will not be able to follow this mysterious state. The cheshire cat of Alice, whose body disappeared but the laugh lingers on, had also shown up on the branch of the tree where the ever-elusive 'Î á Ë å ± ð ± ð ± ′ (with his wife) lived. Kakkeswar had shown the magic of his accounts sitting on the tree. Udho and Budho had both come into our sight after emerging from the invisible interior of the tree and now they have again disappeared

into that tree.

Then is the beauty of the first part of 'Hajabarala' the depth and fineness of the scientific theories expressed in it. Certainly not. 'Hajabarala' is a clean composition of an unblemished mixture of bizarre and mysterious circumstances; every reader, whether young or old, first and mainly gets from it clean and endless fun. This composition gives an introduction to the ability of a class of writers who can represent the elements of life by showing them in many clean and unimaginable forms.

First every incident every image has a touch of a wonderful impossible which raises in the mind a shiver of both humour and mystery. Second, these impossible incidents or images have appeared in a sequence of impossibles. In this world all incidents flow of definite mutual cause and effect relationship. Here the impossible incidents have come up one after the other in a current of the logic of the impossible.

We have not been able imagine at any time what form one stage will take after another, but when it does come it appears with such a new and definite appropriateness that it has been seen as totally logical in that situation. We have probably not seen anywhere else the high level of excellence indicated by this easy movement in the dreamland world ''subject to other rules'' by turning reality into imaginary situations.

But we can never forget that all the results of the perceptions of man is based on reality. No matter how much a writing is full of fantasies, based on dreams, or tends to be unrealistic in the ultimate reckoning it will be seen that there is an effect of some reality behind that fantasy or dream or apparently unrealistic. Therefore there has to be even a distant basis to a composition of nonsense. I have said earlier, the writer himself had referred to it as simple nonsense, but the most successful verses of 'Abol Tabol' reflect the incisive insight of the author on the social environment prevailing at the time.

In overall consideration on 'Hajabarala' also clarifies this fact. The second part of the book, i.e. 'Hiji-bij-bij', Byakaran Singh and from the begining of 'Nara' to his hanging for seven days and order for 7 days in jail – it is clear as daylight that the whole thing is a beautiful comic on our highly respected judicial system. Here fantasy of nonsense and humour has shown up, in the language of fantasy in equal and opposite reaction. The connection between reality and nonsense is much clearer here than in many other cases, and in places is so concealed that we will miss its presence if we do not feel its finest tremor.

But whether clear or concealed its connection with reality is always there. Not only that, the lifelike effect of this composition of nonsense, the intensity and stability of its appeal to the sensitive reader large depends on this implied connection with his conscious mind. To my mind this is particularly true about, Sukumar, the supreme writer of fantasy.

In the first part of 'Hajabarala', which we have discussed, we find another kind of reality, the result of the amazing actions of new science of that period. As in the second part, here also the wonderful work of humour could not have been possible without the amazing clarity and depth of the real consciousness. But there can be another question on the overall structure of 'Hajabarala': what is the connection between the science-based humorous compositions in the first part and the social satires of the last part? Why are two different subjects dealt with in the same book.

It is likely that the reason for this combination is that in the last stages of his life (he was bedridden with a serious illness) Sukumar's mind was deeply affected by the innate contradictions and self-conflicts in the world around him and in life. His poems in 'Abol Tabol', stories like 'Drighanchu' and plays like 'Lakshaner Shaktishel' give numerous indications of the strange and unbelievable turmoils present in the conscience and lifestyle of the civilised people of our country.

But the description of the assembly of justice in the last part of 'Hajabarala' reflects his sharp and firm consciousness about the strange lack of justice in this society. There is an extreme contradiction in the very core of this society, a society known to be so civilised and

well organised. There is an amazing contradicion between appearance and reality.

Relativity and Quantum Theory had given clues to strange contradictions in the organised picture of the old material world; the scientific mind of Sukumar seems to have found in it an image of internal strife within society. The inconsistencies in social life seem to be similar to the impossible matters of the world of science. Hence those glimpses of illustrations are like introductions to the contradictory pictures of social life; and one can easily move from one to the other through the amazing humour of 'Hiji-bij'.

[**Sukumar Roy** (1887-1923) a versatile genius was principally noted for his writings for young children. He mixed comic elements and subtle satire in all his works – poems, plays, stories or paintings. His satire is marked by his social consciousness. His prominent writings include *Abol-Tabol* (Nonsensical Mnemonics or Jibberish, 1923), *Ha-Ja-Ba-Ra-La* (Topsy-Turvy, 1928), *Pagla Dashu* (1940), *Bahurupi* (The Jester, 1944), *Khai Khai* (I want more, 1950), *Abak Jalpan* (Strange Drink) etc..

Gouri Prasad Ghosh (b.1928) was professor of English, Maulana Azad College, Calcutta and Lecturer in English, Calcutta University. His principal works are on Shakespeare and Tagore. His interests are varied. He has been a Himalayan trekker all his life. He is a well-known amateur astronomer whose writings have appeared in various science and astronomy journals. He was awarded the Tagore Memorial Prize for one of his semi-popular works on cosmology. He is the chief editor of an English-to-Bengali dictionary which has also won as the best work in the field. His Bengali translation of Shakespeare's sonnets has been acclaimed by scholars.

This article, originally written for the Bengali magazine 'Prastutiparba' in the year 1976, is translated by **Pradip Sen**.] *P A S*

Five More Carvaka Fragments (Verse)

Ramkrishna Bhattacharya

No authoritative text of the Carvaka philosophy has survived. We have only a few fragments quoted by others (mostly opponents). They consist of three kinds of material : (a) aphorisms, (b) phrases or sentences from the commentaries of those aphorisms, and (c) a number of epigrams satirizing the belief in rebirth, the existence of after-life, sacrificial rites and their efficacy, etc.. Most of these verses are found in Sayana-Madhava's fourteenth-century philosophical digest, *Sarva-darsana-samgraha*. Some others are quoted in various sources.[1]

Many of these fragments have already been collected and translated into a number of Indian and European languages.[2] A few, however, seem to have escaped the notice of the compilers. We give below five such specimens which have an unmistakable Carvaka/Lokayatika ring. Although there is no way to prove their authenticity (i.e., to provide evidence that they were actually composed by some Carvaka Philosopher), it is highly probable that they arose from the Carvaka circle. They are, however, not satirical, but intensely serious, expounding the basic tenets of the Carvaka philosophy. Deceived by the idealist-fideists or naive writers of college and university text-books, many people still believe that the Carvaka-s were mere hedonists, having no interest in any higher pursuit of life. Some Brahminical and Jain writers have portrayed them as saying 'eat, drink, and be merry'.[3] The verses given below will show how mischievous such attempts are.

The following verses occur consecutively in Jayanta Bhatta's *Nyaya-Manjari* (ninth century CE).

1. The inference of God and the like are ones in case of which the inferential cognition (*pratiti*) is to be acquired [on others' advice].

Indeed, who will deny the validity of inference when one infers fire from smoke, and so on; for even ordinary people ascertain the probandum *(sadhya)* by such inference, though they may not be pestered by the logicians.

2. However, inferences that seek to prove a self, God, and omniscient being, the after-world (*paraloka*), and so on, are not considered valid by those who know the real nature of things (*tattvadarsibhih*).

3. Simple-minded people cannot derive the knowledge of the probandum by such inferences, so long as their mind is not vitiated by cunning logicians (*vita-tarkikaih*).[4]

One of the charges brought against the Carvaka-s is that they do not believe in any kind of inference (*anumana*), perception (*pratyaksa*) alone is admitted by them as the one and only means of valid knowledge (*pramana*). The verses quoted above show how misconceived the complaint is. The Carvaka-s did believe in the efficacy of inference in matters of everyday life. They were, however, opposed to extending it to unperceived and imperceptible objects, such as God, the after-world, etc.. Inferential knowledge, the believed, should be confined to perceptible objects which can be verified whenever one needs to do so. But inference drawn scriptures and not preceded by perception are to be treated as invalid.[5]

The two fragments that follow may appear to be rather difficult to the uninitiated reader. The issue again is the validity of inference. The Carvaka-s, we have seen, had no objection to *lokaprasidhha hetu*-s (reasons well established among the people), such as, 'Wherever there is smoke, there is fire.' But there is another question. Even if in hundreds of instances the consistence of smoke and fire is perceived, can it be said that there is an invariable relationship between them? The Carvaka-s, like the modern logicians, did not believe in absence, or the application of the two methods together could lead to any universally valid conclusion.[6] These methods cannot be regarded either as a method of discovery or as a method of proof. Hence, the Carvaka-s would not accept inference as a means of valid knowledge. Such a means, they said, should be primary (*aguna*), independent of any other means. Inference, on the other hand, is dependent upon perception. Thus it is not primary but secondary. This is why they refused to accept *anumana* as a *pramana*.[7] The prefix, anu suggests, among other things, 'after', 'subordinate to', 'under' whereas the other prefix, pra denotes primary (*prathamya*). The Carvaka-s, then, were opposed not only to the validity of inferences drawn from scriptures or verbal authority, they denied that casual relations can be proved by mere observation, either by the method of agreement, or that of difference, or that of both.

The verse quoted below points out the limitations of all inferences:

> If the particular is to inferred then there is the absence of invariable concomitants; if of the universal, it is setting out to prove what is already known. In this mire of vanquished inference are floundering the disputant elephants.

This reading is found in the work of a Mimamsaka philosopher, Parthasarathi Misra (eleventh centure CE).[8] A variant reading of this verse is found in the *Nyaya-manjari* by Jayanta Bhatta. It ends as follows: 'How can, therefore, one talk about inference (as a source of valid knowledge)?'[9]

The verse also occurs (fully or partly) in nearly a dozen sources. Everywhere it is implicitly attributed to the Carvaka-s.[10]

The verse that follows adduces another reason why inference is not acceptable :

> Moreover, it is easily possible to find, in all cases, that one's inference is contradicted either by a probans (*hetu*) which nullifies one's own thesis, or by a probans which is an invariable opposite.

This verse is found quoted in two sources, first in the *Nyaya-manjari* (see above) and in the work of a Jain philosopher, Vadideva Suri (eleventh-twelfth centuries) with a little variation in the second line.[11] Most probably the latter quoted the verse from the former's work.

Notes and References

1. For details of such sources see ''Five More Barhaspatys Fragments'', *Indian Skeptic*, Vol.12, No.4, August 1999, pp.16-18.
2. See Karl H. Potter, *Encyclopedia of Indian Philosophies*, Vol.1, New Delhi: Motilal Banarasidass, 1995, Section 1, *passim*; Section 2, pp. 902-905.
3. For a refutation of such calumnies, see my article, ''What did the Carvakas mean by 'Sukham Jivet'?'', *Indian Skeptic*, Vol.11, No. 12, April 1999, pp.4-8.
4. *Nyayamanjari*, ed. Gourinath Sastri, Varanasi: Sampurnananda Samaskrita Visvavidyalaya, Part 1, Ch.2 1992, p.184. I have quoted from the translation as printed in *Carvaka Lokayata*, ed. Debiprasad Chattopadhyaya and Mrinal Kanti Gangopdhyaya, New Delhi: Indian Council of Philosophical Research, 1990, p.140.
5. For a detailed discussion, see my article, ''The Parable of the Wolf's Footprints'', *Indian Skeptic*, Vol.12, No.1, May 1999, pp.31-36.
6. See Morris R. Cohen and Ernest Nagel, *An Introduction to Logic and Scientific Method*, Bombay, etc.: Allied Publishers Private Limited, 1972, pp.251-67.
7. There is a Carvaka fragment which says: 'It is a very difficult to have an ascertainment regarding an object through inference.' See my article, ''*Paurandarasutra* Revisited'', *Journal of Indian Philosophy* (Dordrecht), Vol.27, No.5, October 1999, pp.485, 491.
8. *Sastradipika*, 1.1.5, ed. Sri Dharmadattasuri, Mumbai: Nirnay Sagar Press, 1915, p.63. I have quoted from the translation by D. Venkatramiah, Baroda: Oriental Institute, 1940, p.81.
9. *Nyayamanjari* (n4), p.177; trans., p.130.
10. The sources range from the ninth century to the fifteenth and include authors of Brahminical, Jain and Buddhist persuasions.
11. *Nyayamanjari* (n4), p.179; *Syadvadaratnakara*, ed. M.L. Osvala, Delhi: Bharatiya Book Corporation, 1988, p.263.

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Kosambi on Science and Society

Subhendu Sarkar

Damodar Dharmanand Kosambi (31.07.1907 – 29.06.1966)'s popularity rests primarily on his achievements as a mathematician and an historian. What is often overlooked is that Kosambi was a keen observer of his times as well. Being a Marxist, he not only assessed the role of the Indian bourgeoisie and imperialist machinations in the post-independence era but also endeavoured to popularize scientific outlook and find ways of using science for the benefit of the masses. In what follows, I propose to give a brief account of Kosambi's attitude towards science that is never dissociated from the idea of the overall development of society.

''Science'', according to Kosambi, ''is the cognition of necessity''. Science progresses by working out theoretical and experimental solutions to the perceived human needs. What we often forget, particularly in case of considering scientists of the past, is that both the scientist and his invention are products of a specific social environment. No matter how exceptionally talented the scientist might be, his discovery is made possible only when it fulfils some deep-felt social necessity. The futility of various designs and schemes worked out by Leonardo da Vinci in the fifteenth century is a case in point. Kosambi does not, however, forget to remind us that the society and its property relations are the ultimate deciding factors in spreading the benefits of scientific discoveries. As an illustration, he points out that the invention of flying-machine does not enable a person freedom to fly; he must have money (the necessary control over means of production) to enter an airplane. It is, therefore, by realizing a society

based on just distribution of resources that we could liberate science from the hands of the profit-reaping few.

No doubt, modern science ''is the creation of the bourgeoisie'' and it has helped the bourgeois-capitalist mode of production to displace the feudal. But it must also be noted that science is not the monopoly of the bourgeoisie. In fact, the freedom of science from servitude to the capitalist class is the only way to benefit all mankind. Kosambi observes :

> He [the scientist] belongs to the forefront of the great tradition by which mankind raised itself above the beasts, first gathering and storing, then growing its own food; finding sources of energy outside its muscular efforts in the taming of fire, harnessing animals, wind, water, electricity and the atomic nucleus. 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 over-populated and the atom-bomb 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 tribal witch-doctor.

It is with this attitude towards science that Kosambi approaches problems ranging from religious to socio-political. Commenting on the social aspects of religion, he suggests:

> The *panchang* almanac sell by the hundred thousands all over the country, each area having one or more of its own. Their very existence must be turned to good use by inserting useful information: first aid hygiene, element of legal rights for the citizen, possibilities of getting aid from sources other than the blood-sucking money lenders in time of need, and so on. Let the planets stay, and give their positions by all means; but make the traditional almanac into a really useful educational document.

This, at once, proves that Kosambi was a practical socialist, not a utopian thinker.

Regarding the question of population control too, Kosambi's opinion remains noteworthy. Perceiving the socio-economic necessity of producing children (means of subsistence for poor parents in their advanced years), Kosambi remarks, ''population control will be successful only if people are convinced that there would be enough for them to live on in their old age even if they have no children.'' The improvements in living conditions, by doing away with the prevalent exploitative system, would also ensure the removal of social evils like drunkenness, prostitution and theft.

Kosambi, in his characteristic manner, provides an insight into the workings of imperialism as well. ''The crooked roots of imperialism'', he maintains, ''lie deep in the need for profits and ever more profits – for the benefit of a few monopolists.'' It is for their profit that the imperialists wage wars and thereby exploit science. This is why huge amount of money is spent on secret atomic research and in producing weapons of mass destruction. If the entire humanity is to be saved from the war-mongering profiteers and peace and true democracy are to be established in the world, Kosambi advocates :

> We have to make clear to the common people of the world that any aggression anywhere is, in the last analysis, war against them. We have to tell them not to be misled by the familiar but insidous whisper : ''Things were better when we had a war.'' This is just like a criminal drug peddler saying to his victim: ''See how much better it was for you when you had the drug than when you sobered up afterwards. Buy another dose.'' The real problem is how to straighten out our thinking and to change our economy, to transfer control of all production to society as a whole. Only then can we have real democracy and lasting peace.

Kosambi not only talked on general issues in abstract terms but also offered definite solutions to concrete problems. But here again, it was his general approach that informed his specific suggestion. What is significant is that Kosambi never ignored the economic condition

prevailing in contemporary India. Instead of blindly following the models propagated by the developed western countries, he was in favour of exploiting local conditions to bring about development. Thus, in place of using atomic energy, he offers the alternative plan of using solar energy in India, at least in certain spheres. He reminds :

> This has the defect of being irregular, but can be put to uses where regularity is not in demand. For example, pumps for irrigation, of 5 to 1O horse-power capacity, run by solar energy would help our agriculture immensely. This would not need centralised administration and a fantastically top heavy basic establishment. If mass produced, the pumps would be cheap; their fuel cost nothing at all and the irrigation they provide would be a real god-send. Maintenance would be easy and would also help mechanise the population in the most backward countries. Similarly for cooking by solar energy. This will not only save such fuel as oil, but (in most of our lands) the firewood thus saved means reforestation on a countryside now denuded. Without such reforestation, no real agricultural reform is possible as we all know.

Besides, Kosambi chalks out plans for cashew plantations, coconut-related researches and construction of many small dams instead of a big one.

Soviet science was a model for Kosambi since the Soviet scientists worked for the increase of production and not for the increase of profit regardless of who was fed and who was not. It was certainly a result of long-term planning and co-operation. He was of the opinion that an underdeveloped country like India had much to learn from the scientific experiments carried out in the USSR, particularly in the fields of engineering, geology, researches in medical science, surgery and pure mathematics.

Kosambi's attitude to science was never solely technical. In fact, he showed genuine awareness of the integration between science and society, particularly in respect of underdeveloped countries like India. Marxism provided him with a worldview that promotes happiness and freedom for the maximum number of people. Kosambi believed that fighting relentlessly for a society in which science can be used for the welfare of the toiling masses is the surest way to achieve this end.

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Heinrich Heine

There lies the heat of summer
on your cheek's lovely art:
There lies the cold of winter
Within your little heart.

That will change, beloved,
The end not as the start!
Winter on your cheek then,
Summer in your heart.

[Buch Der Liedu : Lyrisches Intermerro :
'Es lieght der heisse Sommer']

On two Types of Conditioned Reflex

J. Konorski and S. Miller (1937)

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Skinner's paper on two types of conditioned reflex (15) is of considerable interest as an attempt to introdue [sic] more clarity and precision than has been formerly done into that old often discussed topic of conditioned reflex. In his paper, which is based on his former experimental findings (10,11,12,13) and on certain theoretical considerations of his own concerning general nature of the reflex (9,14), Skinner gives two following paradigms [in which S=stimulus, R=response, (S-R) = reflex (9,14), (S-R) = reflex ..... = is followed by].

Given such a sequence, conditioning occurs as a change in strength of (S_o-R_o) : an increase in (A) and a decrease in (B).

Type – I

	S_o	——	R_o →	S_I		R_I
(a)	Lever	—	Pressing	Food	—	Salivation, Eating
(b)	,,	—	,,	Shock	—	Withdrawal Emotional Change

Type – II

	S'_o	——	R'_o
(C,D)	Light	- - -	r (Not Important)
	S'_I	——	R'_I
(C)	Food		Salivation, (Eating)
(D)	Shock		Flexion, Emotional Change

It is quite obvious that while Type II corresponds to the ordinary Pavlovian conditioned reflex, Type I (and the appropriate ''pseudo-type'') represents a phenomenon of habit formation by the method of ''prize and punishment.'' The problem of the relation between the two the author solves in the following way. Though habit can be classified as a conditioned reflex, it is of a different type from the classical one, and it is hardly possible [p.265] to reduce the two to one type– too many important differences separate them.

The expressing of habit formation as a distinct form of conditioned reflex is, naturally, of prime importance, so much more in view of a frequent tendency to state in merely general terms the identification of habits with conditioned reflexes, or to proclaim such an identification as a program. The drawing up of an exact fundamental pattern lays a foundation for future research and makes it possible to investigate habits according to their basic properties. It constitutes a procedure similar to the methods employed by the school of Pavlov. It is, therefore, most important that this first step in the investigation of habits (or of similar phenomena) be conducted correctly. If the structural analysis of facts under examination contain some error, further researches may be conducted in an altogether wrong way.

In our opinion, Skinner's main lines of analysis are correct. He rightly discriminates two types of conditioned reflex– his Type I against the classical Pavlovian type – and stresses the absence of the signalizing function in the former. Nevertheless, the very construction of his Type I is built up in a faulty manner and is not in agreement with the present state of experimental facts.

As we have since 1928 been conducting physiological investigations of the phenomena which in psychology are known as habits, we would desire to make on the basis of our findings a critical examination of some of Skinner's statements.

To begin with, a little remark on terminology for the sake of avoiding confusion of term. In our first paper published in 1928 (8) we made a discrimination between the ordinary conditioned reflex and a new type of reflex, which, by all appearances, corresponds to Skinner's Type I. That new type we have named ''the conditioned reflex Type II,'' since in relation to the classical Pavlovian conditioned reflex it presents a next form of conditioning. We have demonstrated that this reflex, Type II, is based on a different cortical mechanism from that of the ordinary reflex, and that its mechanism cannot be reduced to one of the Pavlovian conditioned reflex, Type I, although it implies the functioning of such. In the paper referred to, we expressed a supposition that other new cortical mechanisms might possible be discovered in the future and that they would represent further types of conditioned reflex. Accordingly, it would seem to be desirable to change the numeration of types given by Skinner and to call the classical Pavlovian conditiond reflex the reflex Type I, and the new one, the reflex Type II, all the more so, as Skinner himself used such a numeration in one of his former papers (11).

Let us now pass to the merit of the case. Skinner builds up a new type of reflex – chiefly making use of his own experimental material – in the following way. An animal has a reflex, S_o,-R_o, e.g., an ''investigatory [p.266] reflex'' of pressing a lever upon seeing it. When this reflex is reinforced by food, its strength increases, and, when it is reinforced by a stimulus eliciting a defensive response, e.g., an electrical shock, its strength diminishes. Such a strengthened or weakened reflex constitutes the very new type of conditioned reflex. In addition to that, Skinner introduces a special form of this reflex, the one of ''pseudo-conditioned reflex,'' in which the reaction of pressing a lever is associated with some indifferent external simulus, e.g., light. The formation of ''pseudo-conditioned reflex'' is, according to Skinner, based on differentiation – the animal at first responds exclusively to the lever, but later, as the combination, ''lever+light,'' is continually reinforced by food, while the lever alone is not reinforced, the animal learns to press the lever solely, or nearly so, when the light is present.

As we see, the main point in Skinner's conception is that the new type of conditioned reflex is formed from an already existing reflex, the strengthening, *resp.* weakening of the connection being the only acquisition. This property is to discriminate the new type from the old one, since the latter begins ''at zero'' and ends in an entirely new connection. To be consistent in application of this discriminative property, Skinner attempts to explain a special case, his ''pseudo-type'' where this property seems to be absent. This is the case when the animal learns to react to a stimulus (light) formerly having no connection with the given response. According to Skinner, the ''true'' stimulus in the ''pseudo-type'' which elicits a reaction of pressing the lever is not light but the sight of the lever. Light is supposed to serve here only as a factor determining *when* the reflex ''lever-pressing'' gains in strength. Skinner says, ''the response is not principally to the light, but to the lever; the light is only a component member of the whole stimulus, and 'light-pressing' is not legitimately the expression of the reflex.''

To bring out the fallacy in Skinner's way of conceiving the structure of the new type of conditioned reflex, let us consider the following experiment. As a primary reflex S_o-R_o, let us choose, instead of an investigatory reflex used by Skinner, a more distinct one – the raising of a leg in a dog under weak electrical shock. A dog is kept in a stand in an experimental camera, and every display of reflex S_o-R_o is reinforced by food. Falling in line with Skinner, we should expect as a result of reinforcement an increase of strength in reflex S_o-R_o (electrical shock-raising a leg). But what actually happens is that after a few reinforcements the animal starts to raise its leg independently of electrical shock – as soon as it finds itself in the given experimental situation (2,4). If, following Skinner, we denote the stimulus value of the experimental situation by S_G, the above result will indicate the establishment of a *new* reflex, S_G-R_o.

How should Skinner classify this reflex?

He could not identify it as his true reflex of the new type, since there is no increase of strength in the primary reflex S_o-R_o. Neither could he recog- [p.267] nize it as his "pseudo-reflex," since it is not established through differentiation. In fact, the stimulus S_G is here not merely a determining factor for the elicitation of R_o by S_o, but the very stimulus eliciting R_o.

To consider further possibilities of reinforcement we could proceed, after the reflex S_G-R_o is just started, in two different ways: (1) to reinforce every movement of raising a leg displayed in situation S_G, or (2), following strictly Skinner's paradigm, to reinforce only those movements of raising a leg which follow the application of electrical shock. In the first case, the animal would learn to raise its leg with maximal possible frequency, and the electrical shock would become wholly superfluous. The new reflex, S_G-R_o, would then be fixed. In the second case, contrary to Skinner's assumption, the strength of the response R_o to the stimulus S_o would not increase, but diminish. The reason for this is that the electrical shock under continual reinforcement soon becomes a conditioned stimulus for food reaction, and, in consequence, its unconditioned defensive reaction, according to the law of negative induction, becomes inhibited. [This matter had been treated in detail in the well-known old experiments of Erofeeva (1)]. Of course, the movements of the leg, which at first started to appear in response to the stimulus S_G, would be extinguished as unreinforced.

As we see, the mechanism of the new type of conditioned reflex is quite different from what Skinner thinks. The primary reflex, S_o-R_o, does not grow in strength, but subsides. In the new type, the stimulus, S_o, is replaced by a new stimulus, S_G. This amounts to saying that an entirely new reflex, S_G-R_o, is established.

What could have caused Skinner's erroneous interpretation, which at first glance seemed to fit facts so easily? The error, it seems, is due to his fundamental experiments' not being quite happily chosen. The lever in his experiments plays a double role. On one hand, it is S_o, as far as it elicits an investigatory responder R_o (pressing). On the other hand, it is also a prominent component of the whole experimental situation, S_G. Since the true mechanism of the new type of conditioned reflex consists, as we have shown, in the replacement of S_o by S_G, this substitution in Skinner's experiments could not have been noticed, since S_o and S_G, were represented by the same object. The only effect he could have recorded was an increase in frequency of pressing the lever, a fact which he erroneously attributed to the increase in strength of the investigatory reflex. The mere fact of increase in frequency is quite natural if we remember that any investigatory reflex, on account of its general property to become easily extinguished, is normally displayed rather rarely, while the new reflex, S_G-R_o, if reinforced by food, shows continued existence.

It is to be pointed out that the stimulus, S_o, plays only a subsidiary role in the formation of a conditioned reflex of the new type. It serves only to bring about the response, R_o, and once the connection, S_G-R_o, is estab-[p.268] lished, it loses any further experimental significance. What is more, the movement, R_o, may be brought about not necessarily by way of reaction to some stimulus, but simply by mechanical means, as a passive movement, e.g. when the experimenter lifts a dog's leg (2).

It would be of interest to mention here one of our experiments analogous to those of Skinner (4). In that experiment the passive striking with a dog's leg at a lever has been used as a movement, R_o. The dog in relation to the lever displayed none of the investigatory reflexes and never would have come to the point of striking the lever, had not this been artificially brought about. After reinforcing this passive movement by food, we brought it about that the dog started to strike the lever by himself. There the lever acted exclusively as a prominent part of the stimulus, S_G. The stimulus, S_o, was entirely lacking, since the movement, R_o, was passive.

It is not our task to present here the full mechanism of the formation of conditioned reflexes of the new type. This matter has been discussed by us elsewhere (4,7). We shall confine ourselves only to those points which pertain to the explanation of the phenomena taking place in Skinner's experiment.

When, in a given experimental situation, S_G, the movement, R_o- brought about by one of the following ways: as a response to electrical shock, as an investigatory response, or as a passive movement – is reinforced by food, the first thing to happen is the establishment of a conditioned food reflex to the whole complex of stimuli entering into S_G. If, after Skinner, we denote food by S_1 and the unconditioned food reaction by R_1, the resulting reflex will be S_G-R_1, the so-called "situational conditioned reflex," so well known in Pavlov's laboratories. This phase of conditioning however, is transitory. The reflex, S_G-R_1 cannot be fixed, since S_G is followed by food only when combined with R_o. As a result, differentiation sets in, and S_G, when without R_o, becomes inhibited. The conditioned food stimulus that remains is the complex S_G+R_o, i.e., the movement, R_o (more correctly – the kinaesthetic stimuli aroused by that movement), at the background of the experimental situation, S_G. [2]

Thus, in the second phase of conditioning a double effect is achieved. On one hand, a conditioned food reflex is built up which has for its stimulus [p.269] a complex of kinaesthetic excitations raised by the movement, R_o; this is R_o-R_1. On the other hand, the experimental situation, S_G, has become an inhibitory stimulus for food reaction giving rise to an inhibitory reflex, S_G- ($-R_1$).

The facts rest so far wholy on the laws of Pavlovian conditioned reflexes. But, as our experiments have brought out, in this second phase of conditioning a certain new phenomenon occurs which is not considered by the Pavlovian laws. The specific stimulus eliciting the movement R_o becomes superfluous, for the animal starts to respond to the experimental situation, S_G, by the movement, R_o. In other words, a conditioned reflex of a *new type* makes its appearance. Its fixation and continued existence depends on food reinforcement. When it has ceased to be reinforced by food, it is extinguished simultaneously with the extinction of the conditioned food reflex, R_o-R_1. It can also be differentiated, Skinner's "pseudo-type" being then obtained.

As it could be seen, this new type of reflex arises under the following conditions.

1. The movement which constitutes its effect in a conditioned food stimulus.

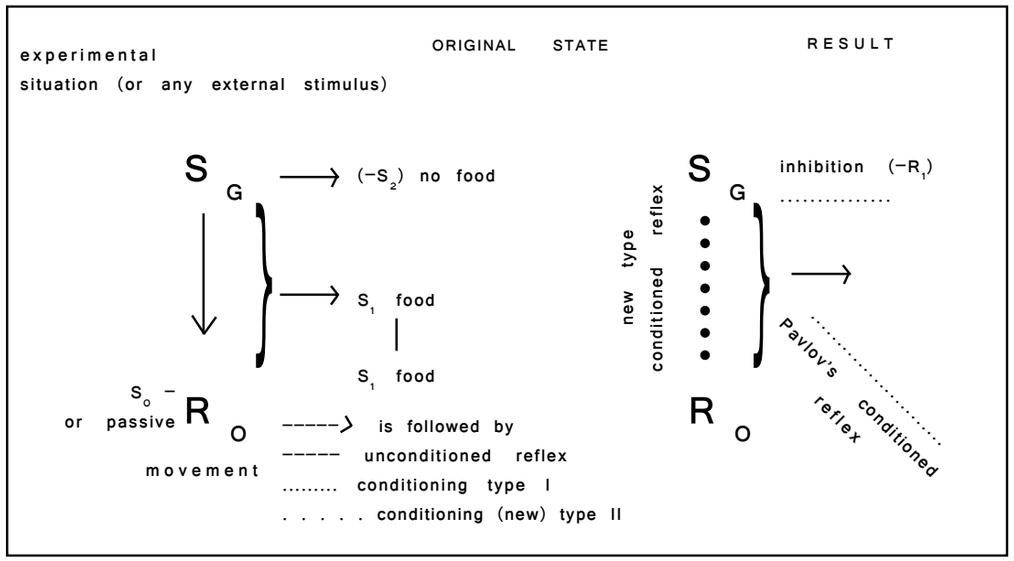
2. The stimulus for that movement is an inhibitory food stimulus in a certain phase of inhibition.

The universality of these conditions has been demonstrated by us in various experiments (3,4,5,7).

The paradigm on page 270 presents the structure of this reflex.

Coming back to Skinner's experiments, we can easily see that their results fall in line with our explanation. By virtue of food reinforcement, the experimental situation becomes to a rat a conditioned stimulus for food reaction. Be it continually reinforced – independently of pressing the lever – it should remain a conditioned food stimulus, and no conditioned reflex of the new type could ever be built on it. Since, however, by not giving food, save when the movement appears, Skinner makes out of it an inhibitory stimulus, and, on the other hand, by constant reinforcing pressing movement, he makes out of it a conditioned food stimulus– both conditions state by us are fulfilled, and a conditioned reflex of the new type is established; the animal, as soon as it finds itself in the experimental situation, starts to perform the movement of lever pressing as long as this movement is reinforced. When the reinforcement is discontinued, the reflex S_G-R_o does not return, as Skinner guesses (12), to its former state of an investigatory reflex, but becomes extinguished, i.e., actively inhibited.

Skinner's interpretation of the second (B) group of conditioned reflexes of the new type (see paradigm I) is also incorrect. This group embraces those reflexes which are formed under negative reinforcement, e.g., by application of electrical shock instead of giving food. According to him, the [p.270]



[p.271] strength of such reflexes decreases. When faced with actual facts, one can see that there is something more to it (4). We have shown that under negative reinforcement the movement, R_o, as a response, is transformed into an antagonistic movement, $-R_o$, while the same movement, R_o, as a stimulus, becomes a conditioned stimulus for a defensive reflex, S_1-R_1. The whole process may be described thus: The animal inhibits the movement, R_o, which signalizes to him an obnoxious stimulus, and makes instead a preventive, antagonistic movement, $-R_o$. This shows that negative reinforcement has a more complex effect than a mere decrease of strength in reflex, S_o-R_o. It leads to the formation of a new, antagonistic reflex.

Let us point out one more detail overlooked by Skinner. Speaking of reaction, R_o, we used an expression, ''the movement R_o,'' instead of ''the response R_o,'' We did it for the following reason.

According to the existing state of knowledge – and we dispose of no facts the contrary – the conditioned reflex of the new type (our Type II) is confined exclusively to striped muscles, while the classical type has no restrictions laid on effectors and includes among them, besides striped muscles, smooth muscles and glands. Skinner's imaginary case [See (15), p.67] shows that he overlooks this restriction, saying that a salivery hypothetical reaction to a stimulus different than food (unconditioned), e.g., light, is liable to be increased by food reinforcement. Being a glandular reaction, salivation cannot by any means be made a conditioned reaction of the new type. Skinner's case is not so much imaginary as impossible.

In conclusion we must say that the structure of Skinner's paradigms for the new type of conditioned reflex contains important errors and gaps. Yet we must point out once more that his seeking of new forms of conditioned reflex and his attempts to present their fundamental properties with great detail and discrimination are to be applauded.

Footnotes

[1) We desire to express here our gratitude to N.G. Olekiewicz for his valuable suggestions and for his help in translating this paper.

[2) A slight inaccuracy is here introduced for the sake of simplification, for, as a matter of fact, the complex followed by food consists of S_G+S_o+ R_o. This simplification, however, has no practical consequences for the experiments of the kind conducted by Skinner, S_o being there almost wholly identical with S_G. In experiments similar to those with electrical shock, S_o ought to be made sufficiently weak to be prevented from becoming a disturbing factor. Further discussion of this matter exceeds the limits of the present paper.

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Contemporary Study of Pavlovian Conditioning

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Pavlov's first report on conditioning emphasized its role in allowing the animal to adjust to its environment. Contemporary theories have seen this adjustment in terms of developing accurate knowledge of the environment. Three aspects of that thinking are explored : how the animal acquires initial knowledge, how it changes its knowledge when conditions of the world change, and how it makes use of multiple knowledge representations.

Keywords : error correction, overexpectation, superconditioning, extinction, modulation, Rescorla-Wagner model.

A central theme in Pavlov's first public discussion of conditioning, which we are commemorating here, was that conditioning allows the organism to adapt to its world. In speaking of the unconditioned reaction he said, ''Observing the normal activity of these glands, it is impossible not to be struct with the high degree in which they are adapted to their work. Give the animal some dry, hard food, and there is a great flow of saliva, but with watery food there is much less'' (Pavlov, 1928, p.48). He went on to emphasize the same property of conditioned reactions, ''... these substances ... act exactly the same upon these glands ... when they are a certain distance from the dog. Dry food, even from a distance, produces much saliva; moist food, only a little'' (Pavlov, 1928, p.49). Thus, for Pavlov, one important purpose of conditioning was to allow the animal's behavior to reflect accurately the world in which it had to function.

For Pavlov, this reflection of the world occurred at the level of behavior itself. Hence his emphasis on what we would now call the issue of the similarity between the CR and the UR. Certainly discussions of adaptation at this level have been a continuing theme of students, especially in the middle part of the last century. However, I think it is fair to say that for many of us, conditioning represents adaptation at a more cognitive level. For many contemporary students of learning, conditioning provides a way in which the animal adjusts its knowledge so as to reflect the state of the world. Influenced not only by the physiology of Pavlov but also by the associationism of British philosophers, many see conditioning as a means by which organisms build up knowledge of the structure of the world. Like Pavlov, they see the organism as changing so as to reflect accurately the world; but unlike Pavlov they have seen that reflection less directly at the level of behavior and more at the level of knowledge representation.

This article touches on three aspects of this contemporary view of conditioning as generating an accurate knowledge representation : how the animal constructs that knowledge initially, how it modifies that knowledge when its experience with the world changes, and how it can maintain and use multiple knowledge representations as conditions demand. This discussion will illustrate something of the current state of work in conditioning, naturally enough using examples from work done in my own lab.

Constructing Initial Representations

Let me begin with the building of initial knowledge representations. Perhaps the key idea in our contemporary idea of how conditioning develops is that of error-correction. It is common to view the organism as comparing its current knowledge of the world with the new experiences that it has, evaluating the degree to which its knowledge is an accurate reflection of that experience. To the degree that the knowledge of the world and experience do not agree, the organism detects an error. It then uses that error to correct its knowledge. The idea is that the animal builds an accurate understanding of the world by continually adjusting its knowledge in the light of its current experience.

A primitive, but still serviceable, version of such error correction was described by Rescorla and Wagner (1972) a quarter of a century ago. Although oversimplified, and even demonstrable incorrect in many ways, it has continued to provide a rough description of conditioning and to serve as the basis for a variety of more elaborate models. Figure 1 shows a version of this theory.

This theory follows Pavlov in attempting to characterize knowledge representation in term of the formation of associations between a conditioned stimulus (CS) and an unconditioned stimulus (US), when the two are paired. As shown in the below equation in Figure I, this model describes the changes in the strength of those associations that result from experiences such as

A -- > US

$V_A = k (\quad - V_A)$

AB -- > US

$V_A = k (\quad - V_{AB})$

$V_B = k (\quad - V_{AB})$

$V_{AB} = V_A + V_B$

AB -- > O

$V_A = k (O - V_{AB})$

$V_B = k (O - V_{AB})$

$V_{AB} = V_A + V_B)$

Figure 1. Error-correction equations for three kinds of conditioning trials, according to the Rescorla-Wagner model. In the first case, stimulus A is presented alone and followed by the US. The associative strength of A (V_A) is compared to the asymptote that the US will support . Some percentage (k) of their difference governs changes in the associative strength of A (ΔV_A). In the second, case stimuli A and B are both followed by the US. In the third case, the AB compound is nonreinforced.

the following of stimulus A by a US. According to the theory, the change in the associative strength of a signal A (V_A) is characterized by $\Delta V_A = k(\quad V_A)$, where is the asymptotic associative strength that the US is capable of producing. That is, on each trial, the organism calculates the discrepancy between its current associative strength, V_A, and the appropriate strength, , and then adjusts its current strength by some constant percentage of this discrepancy, or error. As can readily be seen, when the organism first experiences a US after a novel CS, the error will be substantial, because there is no existing associative strength; that is, initially V_A will be zero. As a result, the trial will produce a marked adjustment in V_A in order to bring it into line with . Repeated experiences of this sort will result in smaller and smaller error terms, with the result that the V_A will eventually become quite close to . Moreover, V_A will approach in a way that is characteristic of many conditioning processes, by a negatively accelerated path. That is, with experience, V_A provides an increasingly accurate representation.

Many error-correction models also apply this mechanism to situations that are somewhat more complicated, involving two alternative signals of the US. The second set of equations in Figure 1 displays the Rescorla-Wagner version of this application. According to such models, the animal adopts the same error detection and correction procedure for multiple signals, resulting in equations of the form $V_A = k (\quad -V_{AB})$, and $V_B = k (\quad -V_{AB})$, where $V_{AB}=V_A+V_B$. That is, the animal is seen as evaluating the error between the total strength of the AB stimulus (V_{AB}) and , allowing each stimulus to use that joint error term as a basis for correcting its strength. That correction will continue until the two stimuli together yield an accurate representation, a near – total associative strength.

Error signal models of this general sort are widely adopted not only within conditioning but more broadly in neural network and connectionist models, as well as in engineering applications. They provide a local learning rule that turns out to do a surprisingly good job of generating global representations of the world.

one early success of such models was to provide an account of some of the phenomena that Pavlov himself reproted. For instance, Pavlov noted that the amount of conditioning that he observed to a stimulus, A, when it was paired with a US, would be diminished if another stimulus, B, were jointly presented with A. Pavlov called this phenomenon ''overshadowing.'' It is as though the stimuli complete with each other for developing associative strength. Although there are multiple explanations for overshadowing, error correction models give one natural account: If an animal receives A+trials, then the error must be corrected entirely by changes in V_A. However, if the animal receives AB+trials, then changes in both V_A and V_B contribute to that correction. As a result, simple A+trials will mean that V_A approaches , whereas AB+trials will result in V_A approaching a value less than .

An extremely influential application of such models came in the phenomenon of blocking, first observed by Kamin (1968) but anticipated in the writings of Konorski (1948). In a blocking experiment, AB+ trials are preceded by separate A + trials. Under these circumstances the overshadowing of B by A can be enhanced substantially, sometimes to the point where prior conditioning of A entriely prevents any conditioning of B. Error correction models naturally account for this finding because the prior conditioning of A results in a V_A that is close to , yielding only a small error term on the AB+ trials. Because the error is small on these trials, B undergoes little associative change; i.e., B is blocked despite its being followed by a US.