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Science, Technology and Society

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Okay, now till now what we have discussed now first let us see, let us review and then move on to another module namely inequalities in science, but let us first review what we have done till n now. If you slightly recall we started with the very thematic preliminary each concerning science technology and society the way this three forces are production namely science technology and society have evolved over time and across space.

And then we moved on to forces the relationship between science and technology on the one hand and science technology and society on the other, okay. I mean we started with the ontological questions and then from there we moved on to a discussion on how HTS science technology and society is a discipline is a sub-discipline which is a bi-predict of accumulation of three important disciplines namely philosophy of science, history of science and sociology of science, okay.

And then we tried to discuss epistemology as a body or theory of knowledge why is epistemology considered a body or theory of knowledge precisely because the kind of central philosophical political questions that epistemology addresses that is what is knowledge, how is knowledge produced, how is knowledge generated okay, but the scholars of epistemology ignored for a pretty long period of time the question of ethics and then we see the demarcation between natural philosophy and moral philosophy, okay.

I mean what is ethics, ethics is a study of nature of conduct okay, as we have already discussed why is it so, why is ethics called a study of nature of conduct. Precisely because of the central philosophical, political questions which ethics addresses, they are what is good what is bad, what is right, what is wrong and so, and if you combine the epistemology with ethics we get

philosophy of science okay, that is why it is very important for HTS scholars to look at not simply epistemological questions but also ethical considerers, okay.

Then from those ontological questions we moved on to a more normative structure of science propounded by Robert Martin there we discussed ethos of science I mean institutional imperatives of science what do you mean by ethos of science, by ethos of science we mean affectively toned complex of values and norms which is held to be binding on the man of science and these norms are expressed in terms of prescriptions, proscriptions, preferences and permissions.

When I say prescriptions it is a broad normative frame work, proscriptions are those norms which are legally bond, preferences come under the rubric of motivational norms values and ideals whereas permissions come under the frame work of institutional mandates, institutional values, institutional norms and institutional ideas okay, in this scene Martin used these terms, these concepts. Then we discussed the goal of science as the extinction of certified knowledge then we discussed the imperatives of science which are derived from the goal of science and also the kind of methods which science reproach, okay.

When I, when Martin said methods technical methods I mean empirically confirmed in logically consistent statements of regularities okay, and then Martin went on to flag four institutionally imperatives, four ethos of modern science they are universalism, communism, disinterestedness and organized skepticism. Whereas universalism, communism and disinterestedness come under the broader rubric of Martinitoren goal of science organized skepticism comes not simply under Martinitoren goal of science but also Martinitoren technical methods of science.

That empirically confirmed and logically consistent statement of regularities that is why organized skepticism refers to the fact that we must keep on postponing our judgment we must keep on temporarily suspending our judgment unless and until all facts are attended okay. From the ontological questions we moved on to the normative structure of science, from the normative structure of science we came to methods of science and from methods of science we will come to inequalities in science okay, in methods of science what we have discussed.

We started with the famous Aristotelian question, that what is the method of science okay, the question what is the method of science is as old as science itself, I mean how do we produce

knowledge becomes central to the existence of science itself, becomes central to becomes an integral part of the existence of knowledge itself, okay.

Till I mean from, I mean till in the 17th century we came across termed called modern philosophy of science I mean the birth we saw we vanished the emergence of modern philosophy of science from 17th century till 20th century okay, we witness to rival methodologies which suggested that there are two methods or there are two ways to produce knowledge okay, I mean if you slightly recall we have already discussed I mean science is a term which was coin by where well in the 19th century.

Earlier science was known as natural philosophy okay that is why we discussed how moral philosophy was branched out from natural philosophy in the form of ethics okay, that is. Now if you look at these rival methodologies in the form of inductivisim and hypothesism which dominated the center stage from the 17th century till 19th century three centuries taken together okay, for the propounds of objective is, for the propounds of inductivism okay, science starts with observations remains at the level of observations and ends with observations.

I mean observation is the source of knowledge producing then what are, what were the steps that we discussed in inductivism no, let in the inductivistic schema science must start with observation without recourse to any theory okay, and from that observational data without recourse to any theory we come to the second step that is tentative generalization which requires verification, and then we come to conclusion hypothesism suggest that no, science does not start with observation rather science starts only when we go beyond of general science.

Because whatever observation that we make, observations are not presupposition less, observations always involve certain amount of selection and selection is based on cultural relevance okay, from here onward if we look at this discourse on these two rival methodologies okay, from 17th century till 19th centuries what we find in the 20th century the emergence of a dominant school of thought.

So for as the question what is the method of science is concerned okay I mean the dis-positivism that is why when inductive argued that science starts with observation hypothesis argued no science does not start with observation science begins only when w ego beyond the observations science starts with a hypothesis which reject intuitive solution to problem are hunch okay.

In this is if science starts with the hypothesis which is a tentative solution to a problem are hunch then that tentative solution to our problem are hunch must be subjected to some tests. If the hypothesis is tested wrong then it must be rejected, and if a hypothesis is tested right then it must be accepted in the hypothesis test right. And in positivism as we have already discussed how positivism emerged positivism emerged in a social economic political cultural context institutional context ideological context whereby we see the transition of different layer of society I mean transition in the development of society.

Society was conceptualized in the form of metaphysics sorry I mean initial litho logy then metaphysics and then positivism what are those things? I mean we have already discuss this that the theological stage okay try to examine changes in terms of super natural forces the other worldly forces the proponents of metaphysics try to examine changes in terms of only natural forces but of course not sup0er natural forces only natural forces okay that is why this I mean the proponents of metaphysics use to say that only nature mediates are changes only intervenes can be made only through nature okay.

Whereas positivism stage suggest that no it is not super natural forces or they are not simply natural forces but human accent determines what kind of changes that we have today or we are going to have tomorrow okay then we have discuss this central tenets of positivism I mean that to give a few examples what we have discussed I mean that science is distinct from all areas of human activity or creativity because science processes method unique to it that is methodology that there is only one method coming to all sciences irrespective of their subject matter that is methodological monism.

That the method of science is the method of induction that the hallmark of science consist in the fact that all scientific statements must be systematically verifiable that is systematic verifiable there must be a dichotomy between fact and value facts or value neutral whereas value id do not have any factual contain okay there must be uni-linear relationship between observation and theory observation leads to the formulation of theory but the converse is not true I mean theory does not lead to observation in the positivistic scheme okay.

Then what are the steps that we have followed in positivism I mean it must start with science must start with observation followed by a set of large then set of statements describing initial conditions and the explanation that we are going to make or the conclusion that we are going

derive from this remises that a statement okay describing the phenomenon to be explained okay explains okay. As critics to positivism suggest that no as we have already discussed to no observation is pre supposition less in the hypothesis schema observation critics of projective is positivism suggested that you see whatever observation that you make observations through observations do not have any language or idiom for expression.

Theory provides as with a language or an idiom of expression observations are not presupposition less observations always involve certain amount of selections, selection is based on cultural relevant whatever observations that we make they must be adequate what kind of adequacy want to arrive at adequacy can be judged in terms of statistical generalizations also and also at the level of meaning generation okay. This is what we have discussed and such positivistic construal of science was systematically attack by popper.

For whom what is the central question of philosophy for popper the central question of philosophy lies in the problem of cosmology, what is the problem of cosmology? The problem of cosmology is the problem of understanding the world including ourselves as part of the world okay if we dissociate ourselves from this world then we are not going to understand this world then he goes on true discuss context or justification and does not say anything about context of discovery because for popper there is no I mean it is impossible it is not possible to provide anything about context of discovery or provide a rational account or rational explanation of context of discovery.

Which Henna Hanson and other they also brought about a preterit to peppermint methodology. For popper what should be the states to produce knowledge what kind state science follows to produce knowledge, for popper science must start with identifying the problems a research question, science must start with the question a problem and from that problem we must formulate a hypothesis as we have already know that hypothesis is tentative solution to our proble3m are hunch and as hypothesis argues earlier that a hypothesis requires to be tested so on so popper said is he should be tested but it should be tested through the process of systematic felicity caser.

If positive is suggested that science can be cross checked knowledge the kind of knowledge that we produce can be cross checked verified I mean cross checked through systematic verifiability popper replaces systematic verifiability with systematic falsifiability that is why a particular

hypothesis must be systematically falsified and the process of systematic falsification may result in the hypothesis being refuted I mean hypothesis may be tested wrong if it is tested wrong then it must be refuted.

But if it is accepted I mean if it is tested right as hypothesis argues that it must be accepted popper deviated from this popper immediately said no we cannot accept this hypothesis because under certain limiting conditions under certain limiting circumstances such hypothesis has been tested right not under all conditions in the world that is why a particular hypothesis even if it is tested right under certain conditions must be collaborated then systematic I mean collaborated I mean collaboration means you must keep your hypothesis permanently tentative okay.

Then hypothesis in I mean a hypothesis when it goes through the process of systematic falsification okay is subject to refute it is in and collaboration in the popper scheme, from this we have also discussed a critic to popper then we moved on to Kuhn okay for Kuhn every science pass through two different distinct stages namely pre paradigmatic stage and paradigmatic stage natural science is namely astronomy physics chemistry and biology okay only they have till now entered the paradigmatic stage from pre-paradigmatic stage because they have been because these four disciplines have be able to build some concerned about the respective disciplines I mean if pre-paradigmatic stage is characterized by divergent thinking.

Then paradigmatic stage is characterized by convergent thinking if pre-paradigmatic stage is characterized by plurality of practices then paradigmatic stage is characterized by uniformity of practices okay that is why Kuhn suggested that creative areas like art literature music dance forms philosophy and even medicine okay.

Perhaps they will not be able to reach the paradigmatic stage because of the inherent divergent thinking in this discipline because of the inherent plurality of practices implicit in these disciplines oaky and then you have to say that no astronomy was the fast discipline to enter the paradigmatic stage followed by physics chemistry and biology okay.

Then what is the paradigm, the paradigm model a paradigm is something is the one which possess model questions not only possess model questions but also provides model answers to the model questions not only provides model questions model answers to those model questions but also provides the methods to arrive at those solutions.

In other words a paradigm is the one which possess model questions tries to provide model answers to those model questions and also attempts to so in demonstrate what are the wage procedures and methods to solve that problem okay in this sense that is why perhaps social sciences can never reach that stage okay.

Because of the nature of research questions because of nature of research problems emplace now then if you look at this then what are the steps which Kuhn followed Kuhn follows certain steps through which will look to look forward to the further of knowledge in science okay what are those things for Kuhn after pre-paradigmatic stage to paradigmatic stage within certain paradigms there is a normal scientific tradition when I say normal I am normal bound science is institutional framework bound science okay rural bound science liberalization bound science okay.

And while carrying I mean normal science is your tradition bound activity normal science refers to the day to day research activities that scientist are engaged in and within normal science we encounter certain anomalies, anomalies refers to the unanticipated or unexpected appearances or happiness okay.

In theses case if when anomalies happy when anomalies occur within normal scientific tradition and we do not have adequate acumen expertise within that existing paradigm to address those anomalies then that the paradigm itself will be crises to it okay then the scientific community of each discipline or respective disciplines they start looking for a new paradigm which you can address such anomalies.

Which can address the problems of knowledge and once they find out a new paradigm then the new paradigm will replace and called the old paradigm or the existing but from crises to the new paradigm is mediated by revolutionary science or scientific revolution what Kuhn suggested okay if in this case if normal science is the tradition bound activity then revolutionary science is the tradition stuttering activity to the compliments of the tradition bound activity of normal science okay that is why it goes beyond the preview of normal science to address the problems of right then when you look at theses I mean disused these we moved on to a comparisons between popper and Kuhn we also discussed the I mean we made a comparison even between positivism in popper and Kuhn.

What how positivist if positivist suggested that it is systematic verifiability that we our science can be considered legitimate and valid for Kuhn for popper it is systematic confusability fro Kuhn it is not simple through systematic verifiability or systematic confusability but consists okay that is why I gave you the example that weather India should go ahead with nuclear tests are not is it a scientific question or a quality question it is the consciences through which we make these decisions okay.

But what is the similarity that similarity among inductivist hypothesis positivist popper and Kuhn they all these traditional philosophers of science they have always placed science on a higher pedestal deserving non science, for them science is supreme science is unique okay there must demarcation between science and non science and such kind of demarcation autonomy and cogitative authority of science have a right I have always laid the traditional philosophers of science to make a distinction between science and non science there in comes there in line the significant of pula interventions.

When he I mean the kind of interventions that he made okay he has become a listen in his own life time okay second I have be wrote against method okay he said that what traditional philosophers have science have been doing they have been trying to look at the question what is the method of science is that a method of science can there be the method of science okay that is why fare I have been repudiated the very idea of scientific method okay he said that what on what bases they are trying to look at the question of or they are try to answer the question what is the method of science okay.

Only by following constancy condition as well as corresponds condition where one need to discuss this and for him this is nothing but law and order and philosophy of science okay that but he also say but where have been said easy science is as made progress, science can make progress not through logic and experimental one but also through if you look at the history of the science it has evolved over a period of time and across space through dominant views which a historically conditioned.

That is a science is historically conditioned even Kuhn in passing said this that I mean science must be examined in terms of it is historical integrity okay and then where I have been moved on to discussed various things about not having a particular methods science okay then if you look at I mean the way I have been propagated and anarchist method people also say that this is a part

of I mean this is a part of this also as laid us to look at what kind of utopian pedagogy we can have if you can look at Richard days works on you utopian pedagogy and others or discoloring by you leach okay I think feyerabend provides the frame work of this for this kind of characterization of schooling or education or pedagogy or science or training or life and so on okay, now from if you look at this from ontological questions to the I mean ontological questions about of technology science and society have involved to those of science to the methods of science and now I mean those of science not be the structure of science the non mate it institutional frame work of science, two methods of science and let us now discuss okay how science is inherently.

Or science the way science has been designed and controlled okay is inherently unequal okay now let us we will discuss what kind of in equalities that which persist in science okay we will discuss inequalities in science in terms of how Robert Martin daily lat it discuss these things in the 1960s and till almost, almost for three indicates three in half indicates till he died in the in the very, very earlier part of the 21st century okay, in terms of the Mathew effective science okay I mean how the if you look at this slide here okay you will find that how.

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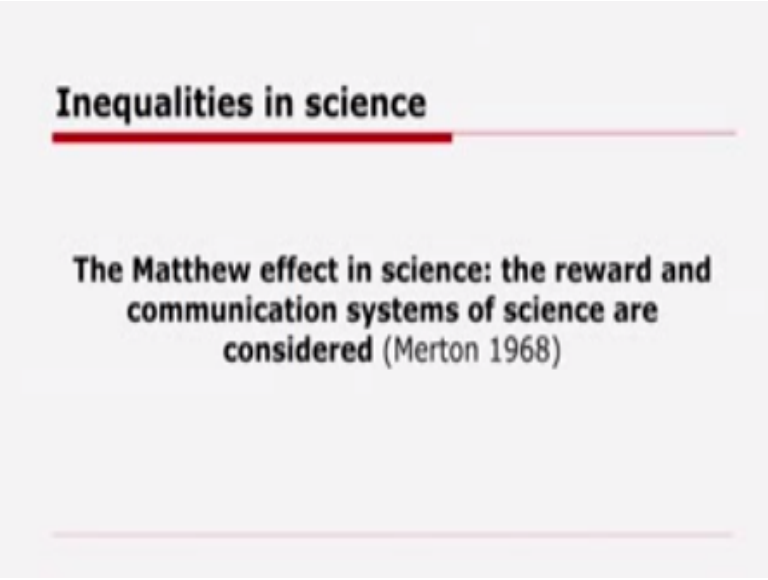

The reward in the communication systems of science are considered while dwelling up and the Mathew effective science, according to Robert King Mart okay I have already discussed we have

already discussed that how Mart and though functionalist how the I mean not I mean if you look at mertonian functionally okay how he try to deploy the method of functionally to understands science, how science is inherently unequal how science always try to maintain hierarchy okay in a given social and political set up economic set up.

Cultural set up institutional set up ideological set up and so okay that is why the way Martin try to look at the Mathew effect in science okay, what is the Mathew effect will come okay I mean the Mathew effect in science, in this where we going to discuss the reward and communication systems of science okay, what is that Mathew okay where it quickly we will try to cover the suspect that the Mathew effect of accumulated.

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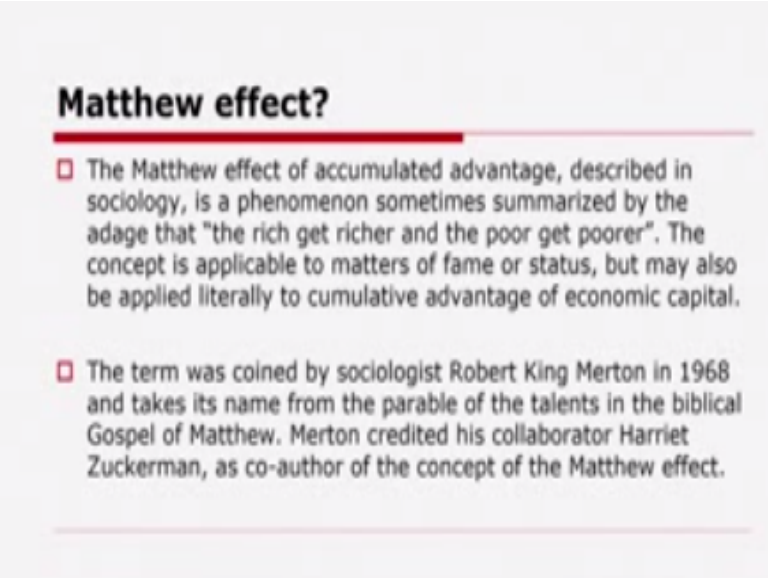

Advantage described in sociology is a phenomenon sometimes summarized by the adage that the rich get richer, and the poor get poor the concept is applicable I mean the concept of the Mathew effect is applicable to matters of frame or status but may also be applied literally to cumulative advantage of economic capital okay, this terms Mathew effect was coined by a Martin in 1968 I mean the paper appeared in science one of the most prestigious journals in the world okay, and this term take it is name from the parable of the talents in the biblical Gospel of Mathew.

Okay and martin credited his collaborator and his second wife Harriet Zuckerman as co-author of the concept of the Mathew effect, okay now we see how martin develops a conceptions of if you look at this psychosocial processes okay.

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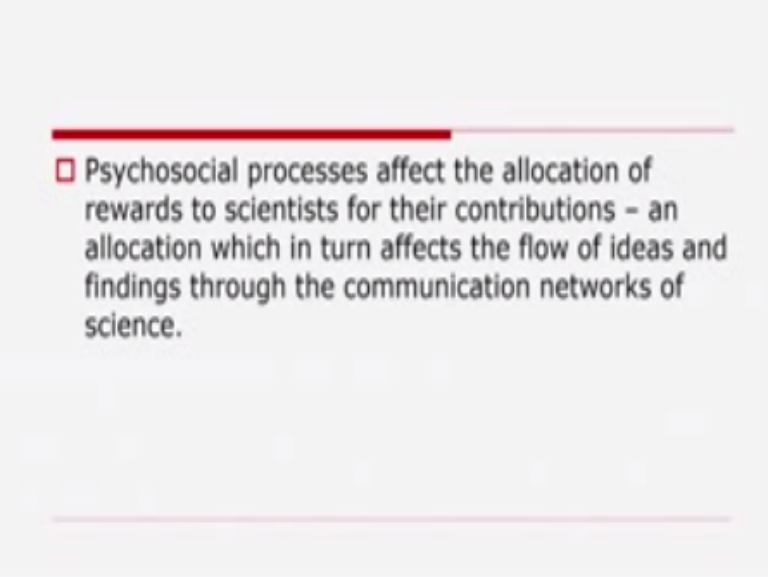

How martin develop a conceptions of which in which a conceptions of wage in which certain psychosocial processes affect the allocation of rewards to scientists for their contributions that is an allocation which in turn affects the flows of ideas and findings through the communication networks of science, okay.

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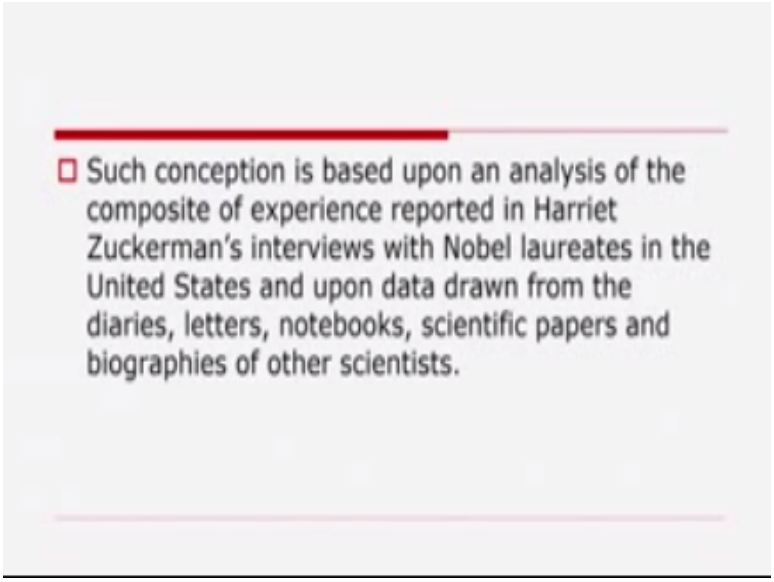

And such conception is based upon an analysis of the composite experience reported in Harriet Zuckerman's interviews with Nobel laureates in the United States of America and upon data drawn from the diaries, letters, notebooks, scientific papers and biographies of other scientists, okay. Let us begin with some general observations on the reward system in science basing these on earlier theoretical formulations and empirical investigations.

Some time may go I mean if you look at the 1940s, 30s, 40s, 50s also 60s also okay, it was noted that gradient rewards in the real of science are distributed principally in the coin of recognition accorded research by Ferro scientist, okay and these recognition if you look at is stratified there is a process of social economic, political, cultural stratification okay, this recognition is stratified for varying grates of scientific accomplishment as just by the scientists be accounts scientist peers.

Both the self image and the public image of scientist are largely set by the communally validity testing on your of significant others okay, that they have various lived up to the exacting institutional requirements of their roles, okay. If you look at this okay, a number of workers in empirical studies okay, a number of workers in empirical studies have investigated various aspects of the reward system of science as this conceived okay.

Suppose for example glacier, glacier has found for example that some degree of recognition is required to stabilize the carriers of scientists. In a case studying Dina crane okay, crane use the quantity of publication apart from quality okay, that is what scholars of I mean experts on

scientometrics also do today okay, that forget quality only you look at only the number okay, that is why Crane used the quantity of publication apart from quality as a measure of scientific productivity and found that highly productive scientist at a major university gain recognition more often than equally productive scientist as a at a lesser university, okay.

That is why reward system in so far as educational institutions are concerned is also very important, okay. Similarly H Trome has developed and partly tested the hypothesis that material rewards in science function primarily to reinforce okay, the operation of reward system in which the primary award of recognition for scientific contributions is exchanged for access to scientific information.

Suppose Storrer has analyzed okay, the ambivalence of the scientists response to recognition as a case in which the norm of disinterestedness ethos of science the norm of disinterestedness okay, institutional imperative of science that we have already discussed, disinterestedness operates to make scientists deny the value to them of influence and authority in science. Martin's collaborated okay, Zuckerman and the Cols have found that scientist who received recognition for research done earlier in their carriers are more productive later on then those who do not.

And the Cols have also found that at least in the case of contemporary American physics the reward system operates largely in accordance with institutional values of the science in as much as quality of research is more often and more substantially rewarded then nearer quantity, okay. In science as in other institutional realism are special problem in the workings of the reward system turns up when individuals okay, I mean individuals scientist or organization institutions okay, take on the job of caging and suitably rewarding okay.

A lot of performance of behalf of a larger community okay, that is why we always say that in science you get a larger scientific community but a few pears okay, pear group is small that okay, becomes small. In this way okay, what we see that ultimate 20^{th} century science that is even in 21^{st} century that is called the noble prize which is conferred zone many intellectuals by the academic okay is often assume to Mark of its recipients from all the other scientists of the time okay because of this reward recognition and because of such unequal structure in science.

Okay how unequal will come this okay yet this odd so it the well known fact that a good number of scientists who have not received the prize and will not receive it have contributed as much to

the advancement of science okay as some to recipients or more this can be described okay in the rewards of I mean many, many you can look at different rewards those who have power those who have authority okay.

They are rewarded more as compare to those who do not have power and authority what holds what martin tired it was trying to do here that what holds the suppose for example French of science okay what holds the French academy I mean in hold in varying degree for every other institution design to identify and reward character okay.

And in part such circumstances results from errors of judgment for martin impart this circumstances okay results from errors of judgment that load to inclusion of less talented at the expense of the immortality okay and history as an apple escort ready to reverse the judgments of the lower courts which at limited by the myopia of contemporary okay.

In this sense okay will come to the Mathew effect of the reward system I mean reward system in science itself we have discussing now and then Mathew effect in the reward system, Mathew effect in the communication system and the Mathew effect on Mathew effect on functions of redundancy and social and psycho social psychological basis of the Mathew effect, Mathew effect and allocation of scientific resource says but before getting into these okay what we are doing.

When a particular generation region achievements of a very high order it follows from the rule of fixed number that some person some individuals okay whose accomplishment rank as I has those actually given the reward will be excluded from this honoring firmness indeed that accomplishments sometimes far out and those which in a time of less creativity to enough to qualify a individuals for this high order of recognition.

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