

TARIQ ABDULLAH

MAKING PAKISTAN UNIVERSITIES CENTRES FOR RESEARCH

A case study of the Centre for Solid State Physics

Abstract

In the last five years (2002-2007) under the directions of the Higher Education Commission, Islamabad, a process of transforming Universities within Pakistan into research oriented Universities has been initiated. What are the prospects for these initiatives? Under this perspective Universities should not only transmit knowledge but be actively engaged in the creation of new knowledge. About 30 years ago in 1976 a number of Centres of Excellence were established in Pakistani Universities with the same objectives of initiating research in selected fields within Pakistan. This paper attempts to analyse the successes and failures of one such Centre of Excellence. The Centre for Solid State Physics established within the Punjab University, Lahore, has been engaged in producing M.Phil graduates and to a lesser extent PhDs in the field of Solid State Physics over the last 30 years. Its experience serves as a guide for current efforts at transforming Universities within Pakistan.

Introduction

The Higher Education Commission (HEC) is engaged in an initiative to transform Universities in Pakistan into institutions capable of the creation of new knowledge. This is presented as the first of its kind of initiative although Centres of Excellence were established in 1976 with a proposed focus on research. The success of this previous attempt has been limited and the lack of success may be due to more fundamental causes than are being addressed by the present initiative. Without addressing these issues this noble agenda may still not be realized. There is much to be learnt from past experience and if we do not we may repeat the same mistakes at considerable expense.

Centre for Solid State Physics: An illustrative case

The Centre of Excellence in Solid State Physics was established in 1973 in the Punjab University. The Centre was one of a series of Centres of Excellence established in different Universities within Pakistan to encourage high level teaching and research in selected fields. The focus of this Centre has been to conduct research in the field of Solid State Physics and to train students in research. The field of Solid State Physics derives from the advent of the transistor which was a solid state device as opposed to a vacuum device such as in a conventional cathode

ray tube (CRT) television. This field of Physics lies at the heart of the developments in Computer Technology and Communications Technology which underpin current technology in the home, office and workplace.

The student intake into the Centre for Solid State Physics has been students with a Masters degree in Physics and the focus of its activities has been the M.Phil in Solid State Physics programme that began in 1977 and continues to date. This programme engages the students in a two year programme consisting of one year of course work and one year of research work culminating in an M.Phil thesis. About 300 M.Phil graduates have been produced in the period 1977-2007 although approximately double this number was originally admitted in the programme. The focus of both teaching and research has been strongly linked with the Experimental Laboratories set up in the Centre and to a lesser extent with the theoretical and computational research interests of the past and presently existing staff.

In contrast to the Physics Department at Quaid-e-Azam University, Islamabad which had at its inception a focus on Theoretical Physics, the Centre for Solid State Physics has had a focus on Experimental Physics. This was developed with a substantial Japanese grant which enabled the establishment of the original laboratories of the Centre in the late 1970s.

Physics has been a science of nature which described the different forms of matter found in nature and was hence classified as a Natural Science. However with the passage of time the focus of Physics research and particularly Solid State Physics has shifted from a focus on the natural world to a focus on a man made world. Hence Physics has acquired a character which is more universal in character and less specific and unique to Pakistan.

This aspect differentiates Physics research in Pakistan from those sciences which still have a largely descriptive aspect within Pakistan i.e. sciences engaged in exploring the biodiversity within Pakistan or the Geography and Geology specific to Pakistan. An important consequence of the engagement of Physics in the contemporary world with the artificially man made world is that the gestation period for a Physics research student is much longer in years of training as compared to more descriptive sciences. Competencies in Quantum Mechanics and Electromagnetic Theory are necessary for all research students. The demands of a good academic grounding in Physics are much more necessary prerequisites for a research career in Physics than many other natural sciences.

The Centre has also engaged in the training and production of PhD students. However the production of PhDs from the Centre in the same period from 1977-2007 has been around a dozen PhD graduates which corresponds to about 5% of the number of M.Phil graduates.

As a concluding remark about the description of the Centre it may be pertinent to point out that staff members have been publishing their research work in national

and international journals regularly and in a survey completed in 2001 the staff of the Centre were found to have about 300 publications to their credit. This over a period of 25 years is a good number. One reason for this is the much reduced teaching work load that was required from teachers in the Centre. As a result they were able to focus on teaching directly related to their research activities.

Questions and Issues

When discussing science and scientific research in Pakistan many questions can be asked. For example, if we are concerned with the research students entering science departments we may wish to understand how the prior education of science graduates influences their aptitude and inclination towards undertaking scientific research. Do the incoming students have an adequate background and basic competency to undertake scientific research. In other words, what has been and is the present quality of science graduates entering a research centre and engaging in research. Are we able to attract the best students to engage in research. Are there career opportunities for students entering research fields in science?

Do the present research centres provide a stimulating environment for students to be inspired and motivated for research. Has the Centre encouraged new talent to enter the field of research? Can research be taught or is it developed by practice and by example? If it is true that research is a kind of apprenticeship then ability to develop research programmes will crucially depend on the extent to which existing staff are engaged in research rather than just teaching.

Why do we want to build Research Universities? Is it to develop a research culture and train and develop young talent with the ability to participate in this longer term project of developing an indigenous scientific culture? Or are we building Research Universities to provide manpower for a “knowledge based economy” and hence prepare students for employment in this knowledge based economy whether abroad or locally. Should the research activities in countries like Pakistan be focused on developing abilities and longer term aims or should it be orientated towards applications with economic impact within the country? Are these linkages between research and applications likely to bear fruit in societies like ours where we find ourselves integrated into a global economy where we consume what we don’t produce and produce what we don’t consume.

Aside from the geographical context alluded to above there is the historical context of education and more generally the nature of society in Pakistan where pre-capitalist social formations persist in various forms and the colonial experience persists in a neocolonial form.

These broader questions will only appear in this study in a tangential form as we will be concerned with the more particular questions like the balance between teaching and research which is desirable in developing a research culture. Are we able to build self sustaining research groups? What kind of relationship is desirable between

theoretical research and experimental research? Physics as a discipline has maintained such a distinction between these research categories that perhaps distinguishes it from most other scientific disciplines. This lead us to the question of how does Physics research differ from research in other fields of Science and points to why we should recognise this diversity in character of the various scientific disciplines before drawing conclusions and making policy in a top down approach. What importance should be given to leadership, vision and perspective in developing a research institute and as a corollary what kind of autonomy is desirable for building a research centre?

For those of us who have been engaged in a Research Centre over the last thirty years it is obvious the context of doing research has changed considerably from the 1970s to the first decade of the new millennium. The birth of the internet has changed the accessibility to research literature and the computer revolution has enabled a rapid growth of a new field in Physics, Computational Physics which introduces a triad of Theory, Experiment and Computer Experiments to replace the previous dichotomy of Theory and Experiment.

How have these developments influenced the way in which we do Science in Third World countries? For example the question of plagiarism now abounds at both undergraduate and post graduate level in universities all over the world.

In this study we will try to assess the successes and failures of the Centre in developing a research culture and training students to be promoters of this culture within Pakistan.

Many constraints will be seen to lie in the context, both geographically and historically, in which Pakistan finds itself today. Perhaps this study can provide indications in which directions can progress be made and what are the broader roadblocks to be overcome in this programme of building research universities within Pakistan.

Successes and Failures

What have been the successes of the Centre in its efforts to develop research in the field of Solid State Physics?

M.Phil programme

The Centre has successfully run a M.Phil programme for the last almost 30 years. Each year about 20 students have been admitted to this programme and about half of this intake have been successful in completing their course work and research thesis and have gained an M.Phil degree. The M.Phil course work has been focused around the research interests of the existing staff members both experimental and theoretical. The Centre has not designed its M.Phil programme to remove the deficiencies of the earlier M.Sc degree but rather it has tried to focus on the

demands of a research degree. This is in contrast to many recently initiated M.Phil programmes which do not have any particular focus in research and end up as just another degree. As a result the M.Phil research work carried out within the Centre has mostly been based on in-house research facilities. Consequently there has been a link between the first year of course work and the second year of research work and in addition most of the research supervision has been provided by the Centre's own staff. These are some of the positive experiences of the Centre.

Research activities

The staff members of the Centre have generally remained active in research work and research publications. The teaching load of staff members have been relatively small in terms of number of hours of teaching and this has enabled them to develop and modify their courses over time and focus them more on their research interests. Research is a time consuming activity which requires continuity and immersion in a particular field. As a result the Centre's staff members have been able to maintain continuity in their research activity. In many other departments and Universities PhD qualified staff have had a break in their research activity since returning from abroad with a PhD degree. These staff members find it difficult to become active again in research. As a consequence new PhD students find it difficult to find active research supervisors who can guide and advise them in their chosen research field. In these departments with newly established PhD programmes the course work requirements of PhD students are met but well designed research programmes in which these students can contribute are far and few between. This continuity in research work needs to be nurtured and sustained. In this regard the Centre has had modest success. The choice of research topic has frequently been oriented towards a possible research publication. The other possible focus of the topic of research is to provide the students an opportunity to learn about research through engaging with new topics for their personal development. A balance between these different approaches is desirable.

Research facilities

The experimental research facilities of the Centre have played an important role in the maintaining this continuity of research work over a period of almost 30 years since the inception of the Centre in 1973 and the initiation of the M.Phil programme in 1976. Although much of this equipment was acquired in the 1970s it still forms the basis of the Centre's research facilities. These laboratories include the Thin Film Laboratory, X-ray Diffraction Laboratory, Auger Electron Spectroscopy Laboratory, Scanning Electron Microscope Laboratory and the Spark Source Mass Spectrometer. For many years these facilities were unique to the Centre and it goes to the credit of the Centre that research work publishable in international journals were carried out in many of these Laboratories. Currently research facilities are being provided in many institutions within Pakistan but lack of qualified staff to direct research and design suitable research programmes are soon going to manifest themselves as a serious impediment to the development of research in these

institutions. Furthermore the Centre was lucky in that in the 1970s many fresh PhDs in Physics returned from abroad to serve in Pakistan. This has not been the case in the 1980s and 1990s. It remains to be seen if the HEC schemes for PhD training can reverse this decline in research staff following the retirement of the staff recruited in the 1970s. New experimental facilities without research staff able to design a meaningful research programme may not result in the expected boost in research activities.

Theoretical Research

Theoretical research in the Centre was never the focus of the Centre's activities. This kind of research work did not and does not require extensive funding and was always a secondary activity to the Experimental research carried out in the Centre. This is in contrast to the Physics Department at Quaid-i-Azam University which was built up from a Theoretical Physics base. Prior to the explosion of the internet in the 1990s much of the problems and difficulties facing this research activity had been one of isolation. Regular contact with the international research community abroad was difficult as travel facilities were very limited and literature not easily available. In this regard the Federation Agreement between the Centre for Solid State Physics in Lahore and the Abdus Salam International Centre for Theoretical Physics in Trieste, Italy was an important way for research staff to maintain continuity in their research work and to develop new directions in their work.

Theoretical research opportunities within Pakistan are now much enhanced with the availability of research literature through the internet and the HEC digital library initiative but this potential has not been adequately exploited due to a very small research base. However this development will take time and a research culture can grow once continuity is assured.

Furthermore the importance of theory for experimental research has consistently been neglected within the Centre and perhaps within the wider Physics community and the scientific establishment within Pakistan. The dichotomy between theoretical and experimental Physics has been interpreted as if experimental work does not require a theoretical background and understanding. Experimental research is given direction and meaning by addressing theoretical questions and in this way theory may suggest experiments and experiments may test the validity of theory. Similarly experiments may raise theoretical questions which need to be addressed. The interaction between theory and experiment lies at the heart of the scientific method. Some experimental work may be descriptive in character but good experimental work addresses theoretical issues. A narrow focus on publication number will vitiate against any progress towards quality research. Quantity and quality will need to progress hand in hand

Computer Facilities

The Centre in the 1980s was one of the first departments in the Punjab University to acquire computer facilities and eventually the present day Personal Computers (PCs). Dr. Naveed Malik was then a member of staff in the Centre and was instrumental in these early developments. These were the days before the explosion of the Internet in the 1990s and the advent of email that we all take for granted today. In the 1980s the computer facilities in the Centre were unmatched in the University. Today the facilities in the Centre unfortunately are lagging far behind other departments.

However this is not to say that the Centre has not benefitted from the overall advancement of computer facilities within Universities in the last five years. The availability of the internet, the provision of research literature more recently through the HEC Digital Library programme have impacted positively on the working of the Centre. This raises an important question of why the initial promise of the Centre has not been maintained and the Centre for Solid State Physics is anything but the leading department in the university with regard to computer facilities. The efforts of the HEC in this regard need to be complemented by a vision and drive at the institutional level.

PhD programme

The Centre has also benefited from the HEC initiated PhD program in the country. Within the last few years the provision of PhD scholarships for both indigenous and foreign training and the availability of study leave have meant that some of the best students have now been attracted towards pursuing PhD research work. Previously the PhD programme in the Centre was much more limited and was not able to attract the best M.Phil students of the Centre to pursue further studies indigenously. The availability of research literature through the internet has impacted positively on the PhD programme of the Centre. However it can be said that the impacts of these initiatives have not been up to the initial promise that was expected of the Centre.

Critical Issues

What have been the weaknesses in the attempt to build a research institution such as the Centre? Why has the early promise of a thriving, active and vibrant institute not been sustained?

Problems of staff recruitment

The Centre presently (2007) has a staff strength of 4 Professors(PhDs) and 4 Lecturers(M.Sc/M.Phil). This staff strength peaked at about 13 PhDs in the 1990s.

The first thing to notice is that the staff of the Centre does not have a continuous spectrum of staff from senior to junior but in fact has a small number of junior staff

and a small number of senior and experienced staff nearing retirement with no staff in between these two extremes. This is a very unhealthy state of affairs which does not bode well for the future of the Centre. How did this situation arise?

Much of the recruitment of staff in the Centre took place in the 1970s. Pakistani scientists were then willing to return home after completing a PhD abroad. As a Centre of Excellence the emphasis in the Centre has been on recruiting PhD qualified staff. Locally produced PhDs have been few in number and they need exposure abroad to gain experience and depth. Foreign qualified PhDs have not been attracted towards working in the Centre. Partly the problem has been one of financially attractive packages but partly it is also concerns the character of the working environment. Is the working environment a stimulating and attractive environment for research? Creating the financially attractive packages is easier than creating a stimulating research environment. The ability to create the latter may be a more decisive determinant of success in creating a research institution.

However the Centre has not tried to face the challenge of staff recruitment in any creative manner. Most departments in a University in Pakistan recruit their best students and provide them opportunities for further training abroad. The Centre has never tried to follow this avenue. The best M.Phil students of the Centre were never encouraged to join the Centre and provided incentives for career advancement. Staff recruitments should have been actively pursued rather than relying on poorly advertised and poorly publicised opportunities for young research staff. Many recent newspaper advertisements for jobs in the Centre were not even displayed in the Centre let alone in any other Physics Departments in the country.

In conclusion the recruitment policy of the Centre has been extremely passive and no active search policy has been initiated and one advertisement has followed by another in a very mechanical manner. Perhaps this is best characterised as a problem of vision and leadership by the Director(s) of the Centre. The Director needs to have the power and autonomy to push for staff that he or she feels are needed at a particular point in time. Mechanical formulas for deciding appointments on the basis of merit try to make objective decisions which try to avoid personal judgments and frequently end up as bad choices.

The personal reputation of a Director should depend on the quality of staff he is able to attract and recruit and this will eventually reflect in the scientific profile that an institution achieves in its own community. The Board of Directors appears to have neglected their monitoring role in this respect. They have not tried to dig deeper at the issues facing the Centre and have been satisfied with a superficial role.

In the early days of the Centre young people were recruited and encouraged to work in the Centre. They were viewed as assets to be groomed. Unfortunately the quality of academic leadership has declined to such an extent that talent is now assessed on the basis of its support or threat to the existing administration. Opportunities for advancement can be rapid or denied on these grounds of loyalty and affiliation. This

kind of discrimination does not bode well for the future of the Centre but is perhaps a reflection of the larger feudal culture in which we all work.

Accessibility of research facilities

The Centre has the distinction of having a large number of experimental research facilities. Many of these laboratories were established in the 1970s and were built up by individual scientists and maintained by them in a very protective manner. This meant that access to the laboratories and equipment was closely monitored and controlled in order to maintain the equipment in working order. This is understandable particularly in an earlier period when the scientists were not just users of sophisticated equipment but also had to fulfill the role of engineers to maintain equipment and rectify faults. These days the HEC has provided technical support to maintain existing equipment in working order. However new problems have arisen when the research facilities established by senior faculty have been inherited by the existing staff members. The senior staff members have either departed to new jobs or retired and these facilities are now under the administrative control of staff members who were not responsible for their establishment. Under these conditions it was expected that the use of equipment in the research laboratories would gradually become more open and available to other staff members and research students with the passage of time. However administrative control of these research facilities has resulted in a situation where access to these facilities by research students and other staff members has become more difficult and as a result in house research workers are forced to look elsewhere for their experimental needs. This trend of making common research facilities private property in the hands of administrators is frustrating and detrimental to any initiative in research work. Scientific administrators should facilitate access rather than act as gatekeepers and create impediments. The ability of a laboratory in charge to distribute patronage in the form of easy access has encouraged sycophancy and its converse discrimination. Ultimately it may be concluded that a weak scientific leadership has allowed these retrogressive tendencies to grow and flourish within the Center in recent years.

Relationship between equipment and human resource

Acquiring research facilities is part of a process of designing a research programme. The designing of the research programme should precede the acquisition of research facilities. Without an existing nucleus of research this process is frequently inverted. The research equipment is acquired and subsequently people think about what can be done with the acquired equipment. The Centre's most expensive piece of equipment acquired in the 1970s was a Spark Source Mass Spectrometer. The Centre was able to make this equipment operational and keep it operational for significant number of years after its acquisition. However no significant Physics research was published using this equipment. The impurity content of commercial copper wire was a popular M.Phil research topic during its operational period. The

weakness alluded to here is the lack of attention being paid to designing a research programme and acquiring equipment accordingly.

Another feature of the Centre's history has been the drift away from Condensed Matter research towards research in Material Science. There have been a number of reasons for this drift. Firstly Material Science research is more easily accessible to students with a weaker theoretical background than that required for research in Condensed Matter. As a result acquiring a PhD in Material Science does not entail the same amount of effort required to overcome deficiencies in the undergraduate Physics programme. Secondly Material Science has the further attraction of being more applied and hence "relevant" through its potential applications. As a result the kind of science that is carried out de-emphasises the relation between theory and experiment by negating the importance of theory. Theory is a kind of summary of experiments and expresses the way in which past experiments guide and give meaning to present experiments. Otherwise experimental research can degenerate into a collection of data with little meaning or significance.

As a community of scientific workers the answer we give to the question of why develop research in Universities is expressed by the character of our scientific practice. This may be different from the objectives given in policy documents. In practice most research within the Centre is justified not in terms of scientific questions that are being explored but rather it is justified in terms of applications, relevance to technological change and potential economic impact. If we wish to help develop a scientific culture we must relate experiments to our theoretical understanding. If we are satisfied with contributing to the pool of knowledge then acquiring data without significance may be publishable but will not contribute significantly to developing a scientific culture.

Collaborative Research

One of the popular approaches to initiating research activities in any institution has been and continues to be the idea of collaborative research. The Centre engaged in a collaboration with the Microelectronics Research Centre (MERC) of the Cavendish Laboratory, Cambridge during the 1990s. What was the impact of this collaboration on the development of the Centre? The motivation of this collaboration was to introduce an area of research to the Centre important to current developments in microelectronics. In this case the area was related to the preparation of semiconductor heterostructures and their characterization. However the collaboration did not result in this area of research continuing to grow and develop within the Centre after the conclusion of the collaboration. This experience suggests that creative collaborations requiring a pre-existing nucleus of research work and collaborations can then help this nucleus to grow and take root. However collaborations without a pre-existing nucleus will come and go without any lasting impact. In fact the results of such collaborations tend to be one sided with the developing research institute becoming an appendage of the more developed research institute. The scientific manpower trained and developed during this

collaboration has resulted more in the export of this scientific manpower abroad and this manpower has contributed less to the growth of research activities within the Centre or other research centres within the country. The nucleus of local research needs to identify a direction of research and the growth of this field within Pakistan will indicate the success or failure of the collaboration.

Plagiarism and the Push for Research

The Centre has managed to establish a tradition of regular seminars where research students are required to present their research work. Staff members are also encouraged to present their research interests but in spite of requests, the number of research presentations in the Centre are far below the number of publications of the staff members.

What does this trend indicate? Research publications are now required for the career advancement of staff members. Research publications are more generally intended to advance a particular scientific discipline. Publications are just one form of communication of scientific ideas which should be augmented by popular talks, conference presentations, research seminars and lectures. The emphasis on publications rather than other forms of communication indicate the motivation for much research is personal advancement rather than contributing to the advancement of knowledge.

The extreme manifestation of this trend is in the form of plagiarism. The pressures to publish for the sake of promotion and the monetary gains to be made from more publications have encouraged this dishonest practice. Although the Centre for High Energy Physics (CHEP) at the Punjab University has been the focus of press attention with regard to plagiarism during the year 2007 the Centre for Solid State Physics (CSSP) some years back did discover that a staff member had been engaging in plagiarism. In contrast to the instances in CHEP where in spite of evidence the Punjab University administration attempted to defend the teachers by considering the misdemeanor minor the staff member of the Centre when presented with the evidence of plagiarism voluntarily resigned from the Centre.

Plagiarism is a consequence of the pressures to publish in an environment without an established research culture and in which short cuts to success become imperative. It is also a consequence of the expansion of the internet which has made the easy availability of research literature and provided greater opportunities for this dishonest practice.

Detecting plagiarism with appropriate software has been the focus of the HEC but an alternative approach is to insist that published research work are presented regularly in the research institutions from which they originate and related institutions within Pakistan. This kind of peer review is much more likely to be able to distinguish between genuine research from research that has been plagiarized because of the availability of contextual information to the local audience.

It needs to be recognized that the balance between teacher, researcher and communicator can be different at different stages of development. The early stage of development of a research institute may need to focus on the teaching and communicating role and with the passage of time we should plan for a shift in balance towards research. An early focus on research output may stunt the growth of genuine research.

Conclusions

The issue of building research institutions within Pakistan is constrained by the overall character of the educational system within Pakistan. We cannot build a multistoried building on weak foundations. It is correct to characterise our Universities as transmitting knowledge rather than creating knowledge. But even here the transmission of knowledge has focused on the transmitting of undigested knowledge and its subsequent reproduction in examinations. A genuine transmission of knowledge requires an internalization of knowledge in which the student interacts with the subject of knowledge in an active and creative way. It is not a passive process. The transition from a process of transmission of knowledge to a process of creating new knowledge is especially challenging for our students because of this passive relationship to the object of study that has been fostered in our educational institutions. The difficulty our research students find in solving the problems at the end of each chapter in a text book is a reflection of this lack of internalization of existing knowledge. Beginning science education must emphasise the exploratory character of science and explore what are the processes involved in a scientific investigation rather than the results or conclusions. In this regard it can be said that the journey is more important than the destination.

Above we have talked about the constraints. We always have to work within certain constraints. An awareness of the constraints is important but is not an excuse for inaction. Constraints may make a task more difficult and require much greater effort than in different circumstances. The educational background of science students is one such aspects in which changes in the prior educational experiences can have greater impact than efforts made at the University stage of education.

Have we been able to attract the best talent available into our research institutions in general and the Centre in particular? Many students make academic choices on the basis of career opportunities and this has attracted students towards computer science and applied work in defence related institutions in recent years. In this respect opportunities for a financially attractive career in research have grown only in the last five years. However a small number of students have always been attracted towards the intellectual challenge of scientific research and frequently these have been driven to work abroad due to inadequate financial remuneration.

Training in research cannot be achieved by teaching research as by engaging in research. It is more in the nature of an apprenticeship and building research institutions will be constrained by the size and quality of existing nuclei of research.

As this involves a process, fluctuating policies of a denial of financial resources (drought) followed by a period of extensive availability of financial resources (flood) cannot achieve the desired results. The ability of research institutions to absorb newly available resources for research have been killed in the period of drought. Continuity has been lost. In the case of the Centre the variations in staff strength and the absence of regular recruitments indicate this malaise.

Globally scientific research has been seen as a driving force for technological advance and progress. However, locally this link between research and its applications appears quite limited. Institutions such as PCSIR (Pakistan Council for Scientific and Industrial Research) have not achieved the potential expected of them. Why has this been the case? Many research projects have significant paragraphs devoted to the applications of the research within the country and sometimes the research is justified less by the scientific question it explores and more by the applications or impact on the local economy. Frequently these impacts are not realized because of the nature of the global economy in which Pakistan finds itself embedded. In the case of the Centre this has been reflected in the manner in which the focus of research has drifted away from the field of Solid State Physics towards the field of Material Science. Solid State Physics research has a much more prominent theoretical character while Material Science research has a much more descriptive and applied character. However, the applications although emphasized in funding requests are not realized in subsequent developments within the country. As regards the contribution towards the development of a scientific culture the research related to theoretical issues is likely to have a more lasting and significant contribution to make.

These issues relate to the question of why do we want to build research universities? Are we hoping to build scientific culture which will be important for the development of Pakistan in a long term perspective or are we hoping to provide scientific manpower to fulfill the short term needs of a global economy whose character is taken as given.

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