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One of the more commonly accepted reasons why science courses are taken up in the formal educational process even of those persons who will very rarely deal with scientific matters in their careers is that life in this latter half of the twentieth century is inextricably interwined with the benefits and problems generated by scientific, or more properly, scientific and technological, activities. This is true enough for the most part. Practically every human activity in an urban environment where more and more people find themselves, even in the more underdeveloped regions of the world, is influenced by the products of science and the techniques that it has created. What a person eats, what he wears, where he lives, how he moves about, how he gets information and how he disseminates information ... all are very likely to be the consequences of scientific activity. Even a person in a rural environment is not entirely dissociated from this all pervading influences. Increasingly, how agriculture is done, how animal husbandry is practiced and how fishing is accomplished depend on what science has found out and created.

In more recent times, many of the problems that the individual (and the societies of which he is part) finds confronting him are spawned by the same processes, most of them generated by the workings of science, that influence his daily activities. Thus the fact that he uses the internal combustion engine as his main source of motive power has created in many areas problems of various pollutants in the air he breathes. Advances in medical science has so altered life expectancies and survival of individuals that population densities now pose real problems in many parts of the world. Moreover, each one of these problems so generated

tend to produce other problems. Thus increasing population densities create problems of housing, waste disposal, food production and distribution, and so on and on.

A mature human being, if he is to appreciate this all pervading influence of science, must to a certain extent be scientifically literate. He must understand how science goes about its business, at least to the point where he appreciates how certain problems arise, how certain techniques were developed and for what purposes they are applied, and how certain solutions could alleviate certain problems. To take a particular example, the impending problem of petroleum supply, to be properly appreciated, would require understanding the development of the internal combustion engine from its steam predecessors, the biology and geology of petroleum deposition, as well as the technological developments that lead to urbanization and the consequent need for a fairly flexible means of massive transportation of raw materials and goods. Possible solutions to this problem, to be considered properly, require some knowledge of problems in energy conversion from relatively dilute sources (solar power), nuclear processes like fission and fusion, geology of underground hot water sources, etc.

Given this tremendous importance of what science does or what it creates on the lives of practically all human beings, it would seem that science courses in our schools should be of the utmost interest both to the teacher and to the student. Yet it is rarely so. Somehow science courses in our schools have turned in most cases into chores which the students feel that they somehow must get through. The situation seems to be worst for those students in our secondary schools who have no idea yet of their eventual specializations and the non-science students in our colleges. In a world which is rapidly reaching a state where problems could be seen multiplying significantly with each generation of students in college and where possible solutions become increasingly dependent on science and technology, the slow rate at which scientifically literate graduates are turned out point to a future where the problems could very well overwhelm the society.

Perhaps the reason for this inability of most students to appreciate their science courses is that these courses give basically foreign and probably an erroneous picture of what the scientific endeavor is all about. In our secondary schools, for instance, science courses present the sciences in terms of finished structures .... bodies of facts and the theoretical constructions that explain them .... rather than a continuing human activity that millions of years of biological evolution and hundreds of years of cultural evolution has developed "for the malleable adaptation of man to his environment and the adjustment of his environment to man". And our colleges and universities are not much better.

Science, as J. Bronowski defines it in his "Science and Human Values", is the "creation of concepts and the exploration of their consequences in fact". This entails interaction with reality in terms of our perceptions, creation of abstractions at various levels, extracting from these abstractions certain consequences in reality, testing or confirming these, and modifying the abstract structures to refine their consequences so they fit reality better, in never ending sequence. One obvious aspect of the scientific enterprise, at least to their practitioners, is that reality is at the root of the whole structure, upon which all concepts must be based and upon which all the results of reflection must be tested. Yet this is seldom brought out in the actual classroom and laboratory in most of the science courses in our schools ... the student almost certainly would feel a disjunction between the abstract structures and the physical facts before him (if he is at all confronted with physical fact at any time during his course).

In a country like the Philippines (or Thailand, or Indonesia or Malaysia) where physical reality tends to be more muted than sociological, psychological and theological realities, particular care must be taken to present the student with the actual sequence of activities which characterizes the scientific process. But there is an apparent difficulty here which many teachers in developing countries encounter. Since physical reality should be paramount, encounters with it must be as often as necessary for good science teaching, and in turn this implies access to labora-

tory, experiments, equipment, materials, etc. In many cases these are not at all available in quality and quantity which many teachers feel adequate for good science teaching. That this difficulty is more apparent than real can be brought out by considering that the physical reality that the student must encounter must be *his* physical reality and not anybody else's. Therefore it is possible, and in fact very often necessary, that the things dealt with in his science courses be those that he has access to and this makes those things automatically available. There is no reason that any poorer understanding of the scientific process would result from using available materials and many reasons to expect a better understanding since the alienness of the experience would probably never arise.

Although the actual encounters with reality that the students have in their science courses can be simple, the abstract concepts that these can lead to can be as powerful as those from employing more sophisticated materials and equipments. What is of primary importance here is learning to see the relation between the physical reality and the created abstract conception that runs parallel with it and how one can go back and forth between these two at the same time keeping clear in one's mind when one is dealing with actual facts and when one is dealing with mental constructs.

It is perhaps in this last mentioned activity, the consciousness that fact and mental constructs are basically different but reconcilable, that the greatest value of science courses in our schools lie. Because in learning to perceive this difference, the student learns to look at his own mental and physical activities. In the history of science (and probably in most areas of human endeavor as well) it is only when the practitioners learned to turn inward to analyze what they were doing when they were doing science that great strides were made in its development. Our science courses offer the best opportunity for the teacher to introduce the student to this self-consciousness.

Eventually all areas considered by our students must converge on this technique which the sciences opens so naturally, to consider what he is doing when he is doing something. To expose

the conceptual machinery of human activity and understanding. It may be the most powerful tool we can supply him with to help find himself.