The Magical, the Practical, the Beautiful and the Greatest

J. A. Gunawardana

Professor of Electrical Engineering, University of Sri Lanka, Peradeniya Campus.

This article discusses science and technology policy of the recent past and makes some suggestions for the future.

The Magic Solution

A few years back, the Sri Lanka Broadcasting Corporation announced the following 'main point' in a morning 'news' cast. "An uneducated technician from Rambukkana has developed an engine working on sea-water". This was shortly after OPEC had launched the energy crisis. Thus,on hearing the sentence the writer, like many others, "hit the ceiling." The laws of thermodynamics were no more. Civilisation and on further thought, the universe itself, as we knew it, had to end.

People travelled from many parts of the country to witness this miraculous invention. Some technologists burnt derivatives of the dwindling fossil fuels to travel to Rambukkana, perhaps in order to get their finger into the pie of the century. The inventor, in the company of technologists, was interviewed over the radio. A national newspaper 'adopted' the inventor. However, today, we continue to buy fuel from the Arabs. What lesson can we learn from the Rambukkana incident?

The lesson is that there is no magic path to technological progress. The Rambukkana incident was dramatic but not particularly harmful. Less dramatic but much more destructive 'magic solutions' abound in our recent history. Recall what one has heard of or read about 'Kohutex', D.D.C.s, one-university, job-oriented courses, the decentralised budget and the five-year plan to name a few. These colossal failures would have served a useful purpose if they impress on us the fact that technological progress is not the result of brilliant ideas only. Technological progress is almost always the result of painstaking work by interdisciplinary teams of workers. The obscure scientist laboriously gathering routine data usually contributes far more than the supposedly brilliant man whose name appears in the daily newspaper.

A good science and technology policy must therefore support and reward the routine research worker. Projects that claim to be major breakthroughs should be supported only if their viability is established to a high degree of certainty. Even then, such projects should not divert resources from the organisations that do the routine work and thereby maintain the infrastructure.

Practical Engineering

This is a particular type of magic solution which has been promoted heavily since *circa* 1966. Those who dabble in it attach mystical power to words like "practical", "job-oriented", "applied", "on-the-job", "in-plant" and "on-going". Judging by the queues at the bus-halts and employment exchanges, pot-holes on highways, frequency of power failures, the difficulty in getting a connection over the subscriber trunk dialling system and so on, *ad nauseum*, one may conclude that after a decade of existence, the contribution of the 'practical engineers' to the technological progress of this country has not been any better than of the old-fashioned variety.

The proponents of the new variety of technical training do come up with a never ending stream of magic solutions to our technological ills. These breakthroughs are described in the daily press, at seminars and 'work shops', and occasionally in the scientific literature. They are even known to have been the subject of paid advertisements in the newspapers.

The description of these 'practical' products of local technology and local raw materials is usually such that the non-specialist is left confused and suitably impressed. For instance, a windmill that can pump 200 gallons of water per hour over a head of 25 feet sounds terrific at a cost of only Rs. 2000/-. That is, until one realises that one is being asked to pay Rs. 2000/- for a gadget that generates less than 20 watts! That, too, when the wind velocity is more than 10 m.p.h. which is not that often.

Our policy makers must realise that there can be no good practice without a sound grasp of theory. A viable science and technology policy must therefore support and encourage the persons and the institutions that provide our future scientists and technologists with good, old-fashioned theory. This process must begin in the secondary schools.

The Local Genius

This genius is said to exist in Panchikawatta and in towns and villages all over the country. In order to make a living, he repairs motor vehicles or radio receivers. He has had no formal training in his trade. Therefore, in most cases the work is bad and needlessly expensive. However, to the technologist who has spent much of his time in the designs office, in development planning, policy-making or in social studies and therefore never learnt how to clean the spark-plugs of

his car or how to replace the fuse in his radio, the village mechanic appears to be a genius. Respect for the knowledge and skills of others is admirable. However, very often, the admirer of the local genius does so with the object of pandering to the sillier side of politicians and economic historians. The result is that our national technological policies have made little or no attempt to provide the skilled worker and the technician with the formal training which is absolutely necessary to improve his skills and to exploit his abilities to the maximum. This situation should be rectified as a matter of high priority.

Intermediate Technology

This particular magic solution has been promoted for about the same length of time as 'practical engineering'. Purveyors of intermediate technology have recently discovered a new variant called 'appropriate technology'. Its local adherents often ignore the assumptions and theorems of the older conventional technology. Thus the laws of Newton, the equations of Maxwell and the laws of thermodynamics are treated with scant regard. The fundamental axiom of the new technology is "small is beautiful." Thus hand-made goods are considered more 'beautiful' than the factory-made variety purely because they are hand-made.

Before one embarks on a policy based on intermediate, appropriate or any other kind of new technology, it is necessary to consider the following arguments:

The power output of a human being is at most one-quarter of a horsepower .The product of this quarter horse-power can be much more valuable than that of a generator of equivalent power because the human being is intelligent, skilled, and may therefore apply the power in a complex manner. However, if we use the human being to perform a monotonous task that takes up all his energy, then his net contribution to the economy is no more than the value of one-quarter of a horse-power. Thus, for instance, when a man churns a barrel full of caustic soda and paddy straw or beats a piece of metal into the shape of a mammoty. the value of his work is less than five cents to the hour. Fiscal and bureaucratic policies that provide such a worker with a reasonable standard of living, do not change this fact. Such policies merely subsidise one worker at the expense of another.

The indiscriminate application of 'intermediate', 'appropriate' and other new-fangled technologies has done much harm in the recent past. Since we are faced with a massive problem of unemployment it is possible to argue that manual labour should be substituted for machinery. This argument is valid only up to a point. With manual labour, productivity is bound to be low. Therefore, labour-intensive technology can at best serve to arrest a decline in our standard of living. If the ultimate aim is a high standard of living, there is no alternative to a machine oriented mass-production technology. That is, although small may be beautiful, by definition it is bound to be small. Full employment is very desirable. However our aim should be to obtain increased employment together with increased productivity, even if this requires increased utilisation of machinery.

We are the Greatest

This theory rests on three assumptions and has misled many of our planners, policy-makers and politicians. The first assumption is that since we are the heirs to a great civilisation, progress should be easy. All that is necessary is to do things the way they did in Anuradhapura and Polonnaruwa.

Whether the ancient Lankians had developed a great technology is beside the point. Even if they had, we do not have the faintest idea what techniques they used. Therefore the best thing to do is to develop technology as we know it now. Modern scientific knowledge is equally applicable in the developed and the undeveloped countries. Dislike of the West, the East or foreigners in general should not stand in the way of technological progress. The developed countries got to where they are by applying science, based on inductive logic. Our progress too must be necessarily based on inductive logic rather than some nebulous 'indigenous technology.'

The second assumption on which the 'greatest' theory is based on is that Sri Lanka has enormous untapped natural resources. Periodically, the press reports the discovery of fantastic deposits of iron ore, enormously rich deposits of copper and the richest phosphate deposits in the world. The actual quantities are rarely mentioned. Hence one begins to suspect that these reports are designed to impress the.

One particular 'enormous resource' deserves special mention, firstly, because it is talked about so often and secondly, because detailed quantitative studies have been made by men who are too busy to canvass publicity. I refer to our resources of hydro-power. These are supposed to be so enormous that plans were made to export energy to India. Research on electric motor cars is said to be going on and plans to electrify the railway are afoot. A plan to extract aluminium from imported bauxite was mooted. Politicians have promised to provide electricity to every household in the country. Before being carried away by these glorious prospects, consider that even if we shut down the factories, air-conditioners, radios, lifts and all other electrical paraphernalia in the country and turn on all the hydro-generators full blast we cannot get enough power to provide a small reading lamp to every Sri Lankian! Given current patterns of population growth the situation will be no different in the future even after we have tapped all the available power.

Therefore, a science and technology policy for Sri Lanka must recognise the uncomfortable fact that our natural resources are severely limited. Many of our

industries will have to depend on imported sources of energy and raw materials in the foreseeable future.

The third assumption on which the 'we are the greatest' theory rests is that our scientists, engineers, economists, etc., are the best in the world. This information is regularly conveyed to a gullible public by the daily newspapers and is usually employed to justify the appointment of persons of dubious abilities to responsible posts in the state sector (the N.S.C. not necessarily excluded).

Courtesy and the author's instinct for survival demand that he does not expand on this particular assumption any further. However, it is necessary to state that the responsibility of making policy should be given only to those who have real results to show. It should not be given to those who have merely held 'responsible' positions in the past and launched us on unproductive and therefore disastrous policies or not launched us on any policy at all.

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WORKSHOP ON THE SCIENTIFIC METHOD AND RESEARCH METHODOLOGY IN SCIENCE EDUCATION

The Workshop on "The Scientific Method and Research Methodology in Science Education" was held from the 15 to 26 August 1977, at the Medical Education Unit, University of Sri Lanka, Peradeniya Campus.

Research in science education in Sri Lanka has been a relatively neglected field inspite of the vast sums expended on Science Education itself. Since its formation in June 1976, the Working Committee on Science Education Research (a sub-committee of the National Science Council) was successful in compiling a list of priority areas for science education research. Applications were invited from universities and schools for the award of research grants. A total of twenty-five research grants were awarded during the last year. However a number of the research grantees had little practical experience with research in science education in Sri Lanka. Thus it was felt that a training course in Science Education research methodology would be most appropriate.

The organisation of a workshop under the guidance of an experienced research worker was thus undertaken. The workshop was scheduled so as to enable the grantees adequate experience with their projects before being subjected to the training course. Under the guidance of Professor R. F. Kempa, Professor of Education, University of Keele, United Kingdom, the research grantees received a basic training on the concept of science education and research methodology. A series of lectures delivered by Prof. Kempa introduced the research workers to the latest trends in science education and research in the United Kingdom.

The research grantees were trained in the art of questionnaire design and evaluation of classroom interactions. The workshop included the presentation of papers by the research grantees and their discussion. Finally, the workshop brought together isolated research workers and provided an opportunity for an interchange of ideas.