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second
annual
number

the alumni association
indian institute of technology
madras

B. SENGUPTO
DIRECTOR

INDIAN INSTITUTE OF TECHNOLOGY
MADRAS-36.
Dated 16th July, 1966.



To my young friends,

As you embark on your life's journey have confidence on your own strength, capacity and tenacity. March on with determined steps with out any fear or fatigue.

Let the torch of knowledge that has been kindled in you shed its light on your path for ever.

B. Sengupto

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Editorial

The Second Alumni Day that is to come off on the 29th of July, that is, a day prior to the Third Convocation, it is hoped, will not be one of those Annual Tea Parties. A party there will be, and certainly platitudinous exhortations but apart from the good-will and comraderie generally present in abundance on such occasions, it will be the meeting of minds and the strengthening of bonds between the Alumni and their Alma Mater that will matter most. Such a happy state will naturally prevail as long as there is a two way traffic. The Alumni Association on its part has been doing its best to bring about such an intercourse by acting as liaison between the I.I.T., Madras, and the Alumni. The co-operation from both sides has been splendid and it is only to be hoped that this state of affairs will always continue.

The Alumni Association has been, in the course of last year, playing a very satisfactory role in conveying to the Institute the news of its alumni and their creditable performance both in our own country and abroad. And through the News Letter the Association has also been keeping the Alumni posted with the latest developments in the Institute. The Alumni Association is growing in membership too. This year a further enrolment of some two hundred members is assured and with added strength the Alumni Association will be nearly 700 strong. One can only hope that every single Alumnus will join the Association and share its benefits.

The Association is happy to acknowledge receipt of numerous letters and articles from its members. The variety of topics on which the members write is really staggering and the Alma Mater is justifiably proud that its sons are exercising their minds and knowledge in so many intellectual pursuits. Because this is a special occasion and because Pradeep is an 'annual,' we are unable to publish letters and articles of 'news' interest. These, along with current news, will appear in the next 'News Letter'.

We, at the Institute, here, wish all the members a bright future and look forward to their presence here not only on special occasions like the Alumni day, but whenever they feel like visiting their Alma Mater.

Student Wastage in Engineering Educational Institutions

PROF. B. SENGUPTO.

Introduction

The problem of student wastage in engineering educational institutions has lately engaged the attention of a large circle of educationists and administrators.

Students and their parents feel that, as only the better class of those aspiring for admission succeed in getting into the engineering institutes on account of the keen competition for entrance, there is a right to expect all of them to complete the course satisfactorily, in the minimum time, and wastage, if any, should be negligibly small. This view finds support from many administration and Government agencies who tend to look at the problem of student wastage from the point of view of the financial outlay on technical education and the consequences of the wastage of human resources in the context of technical manpower shortage. The Institute of Applied Manpower Research Working Paper No. 13/1965, on "Student Wastage in Engineering Educational Institutions" is an elaboration of such a point of view.

On the other hand, educationists feel that the proposition of negligible wastage represents an ideal situation and is unrealistic under practical conditions. This feeling has its genesis in the following arguments :

- (i) The students admitted to the Engineering Colleges may constitute the 'best' that is available, but their attainments at the time of their admission may not be adequate in all cases, in relation to the requirements of the technical education programme that follows.
- (ii) The basic abilities and intellectual qualities of the entrants may be quite good, but their aptitude and motivation for engineering studies are doubtful in a number of cases. It is well-known that quite a few students, with basic inclination toward other courses e.g., Science, get admitted to engineering colleges, because of the pressure exerted by parents and guardians, and because of the wider opportunities currently available for scholarships and freeships in the area of technical education and the more attractive employment potential in engineering.
- (iii) Students with good inherent ability may join engineering institutes but eventually may not apply themselves seriously to the tasks on hand because of a feeling that once they are enrolled as engineering students, they will emerge as products with a high market value even if they pass in the lower divisions and take a longer period than others in completing the work for their degrees.

The purpose of this note is to examine further the problem of student wastage in engineering institutions, in general, and the Indian Institute of Technology, Madras, in parti-

cular, from the point of view of educationists, and in the light of the data presented and recommendations made in the I.A.M.R. Paper referred to above. The main conclusions, that emerge from the analysis made here using the figures pertaining to the I.I.T., Madras as the frame-work, will, it is believed, be applicable to the other I.I.Ts. and several engineering institutions in the country.

Record of the I.I.T., Madras

The flow-pattern of the first three batches of students admitted to the five-year B. Tech. Degree course at this Institute is sketched in the diagram at next page. The diagram is self-explanatory showing as it does the progression of each batch of students from year to year; it indicates the drop-outs at various stages as well as the number of those who failed in a given year and joined the next year's stream, and those who failed a second time and joined the third group of students. For any one set of entrants, one can read off from the chart, the number of those who graduated within the minimum stipulated period of 5 years, those who took six years to complete the requirements, those who took seven years, and so on.

The following observations would appear to be in order :

- (i) Most of the students, who discontinue, do so in their first two years of study. Out of the 375 students freshly admitted to the I.I.T., Madras during the years 1959, 1960 and 1961, 18 left in one year and 19 in two years. 13 out of the former left in the early part of the first year of study and may be presumed to have joined other institutes/colleges which were nearer their homes or offered them seats in courses of their choice.
- (ii) The number of students dropping out during the last three years of study is negligible.
- (iii) The percentage of passes at every stage is uniformly high, as the following tabulation will show.

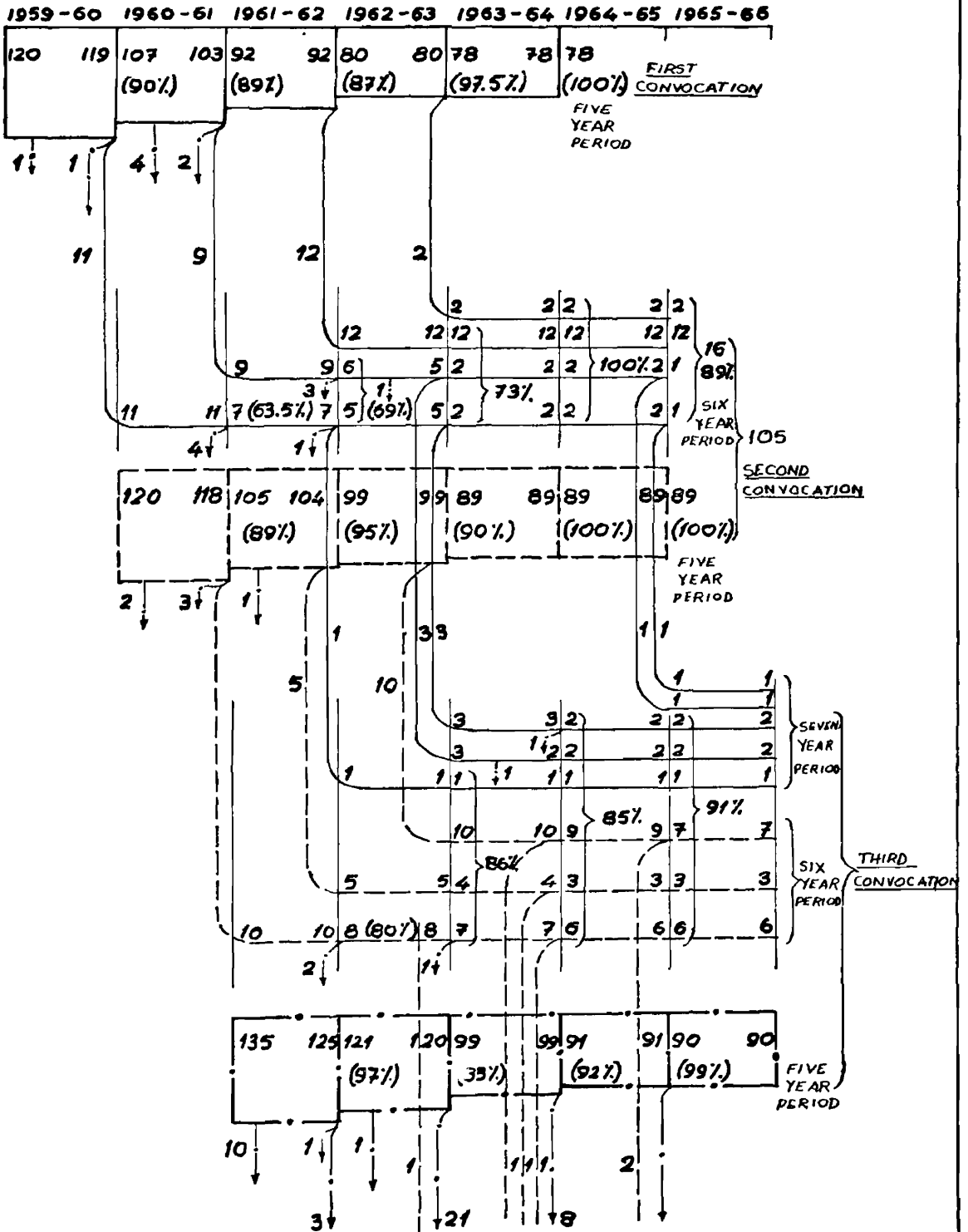
Table I. Pattern of student progress in the Five-Year Degree course at the I.I.T., Madras.

Admission year	In-take	Drop-out	No. graduating in			Total No. completing in 7 years	Average rate of passes per year
			5 yrs.	6 yrs.	7 yrs.		
1959	120	19 (16%)	78 (65%)	16 (13%)	7* (6%)	101 (85%)	96%
1960	120	9 (8%)	89 (74%)	16* (13%)	6* (5%)	111* (93%)	99%
1961	135	12 (9%)	90* (66%)	20* (15%)	13* (10%)	123* (91%)	...

*Anticipated figures based on the experience of the last few years.

The rate of failure is generally high during the first three years of the B. Tech. degree course and is attributable to the students' inadequacy in the background knowledge of basic science subjects, want of aptitude and, in some cases, a disinclination to take interest in subjects that have a practical content. At the third year level, where specialisation in a particular branch of technology commences, the failure of students usually stems from a wrong choice of the branch and the ensuing difficulties encountered in adjustment. It is noteworthy that a large proportion of students in this category manage to complete the course after lagging behind by a year, and drop-outs from among these are a rare occurrence.

INDIAN INSTITUTE OF TECHNOLOGY-MADRAS
FLOW PATTERN OF GRADUATION
FIVE-YEAR B.TECH. DEGREE COURSE



In an over-all assessment, the graduation pattern, for the first two batches of students admitted to this Institute in 1959 and 1960, with an average annual pass percentage of 96 and 99 respectively, is very encouraging. The pattern for subsequent batches will, it is hoped, show the same trends.

The problem of student wastage

The Institute of Applied Manpower Research, on the basis of data collected from various institutions, has arrived at the conclusion that there is an alarmingly high percentage of student wastage in technical institutions. The Report carries a recommendation that even 15% wastage is excessive as an average, and that the rate should be brought down to 10% by the end of the Fourth Plan period. To reach this objective, the I.A.M.R. has formulated recommendations for certain measures, which are summarised in the next section.

The Report does not appear to have taken into account some of the basic and inescapable reasons, under prevailing conditions, for student wastage, such as insufficient background training at the High School and/or Pre-University level, disparities in standards in various regions of the country, lack of aptitude on the part of the students, parental pressure exerted on the candidates to enroll in a particular course, and the migration of students to institutions nearer home and into preferred courses as seats in them become available. The matter requires devoted and careful scrutiny, before answers can be found for the following questions :

1. Is the present Wastage Rate to be regarded as abnormally high ?
2. If so, what practical remedial measures will be in order, to minimize this wastage ?

In this context, it may be helpful to distinguish between the following three categories of students who contribute to the wastage figures :

- (a) Those, who drop out of one Institute, to join another which is located nearer their home-towns, or in order to effect a change, in preferred career, from Engineering into Science, Medicine, Commerce, Law and Arts.
- (b) Those, who leave within the first two years, having initially joined due to parental pressure and on finding that the curriculum does not appeal to them or is beyond their level of attainment, resulting in their failure in the examinations that are conducted during these years.
- (c) Those, who fail in one year or the other during the course, but repeat the concerned year of study and eventually succeed in completing the course in six or seven years, instead of the normal, minimum period of five years.

At this point, two types of "wastage-factors" may be recognised, namely, "pupil-wastage" or "student-wastage" and "time-wastage". Students in categories (a) and (b) above contribute to "Student-wastage"; and those in category (c) to "Time-wastage".

It is reasonable to suggest that category (a) be not included at all in a computation of "wastage". In any case, the Institutions offering admissions in the first instance cannot be held responsible for these drop-outs. Many engineering institutions, I. I. T., Madras among them, have made it a practice to admit, at the outset, 5 to 10% more than the sanctioned strength, in order that when a few students leave, for reasons stated under (2), those who continue through will constitute the desired strength. A few of the students with the right aptitude and ability may have left, but only to join some other technical institute, and, in these cases, there is no wastage of manpower from the national point of view. The students, who leave the

first institute which offered them admission, do so at a fairly early part of the educational programme, and, in consequence, only a minor order of wastage of time and effort, if any, is involved.

The wastage that occurs under category (b) is partially attributable to the engineering institutes. It is capable of minimisation by the adoption of a comprehensive, complex scheme of entrance tests which may help to weed out those who seek admission only because of parental pressures and others who do not possess the aptitudes and mental and physical qualities needed for success in pursuing engineering studies. This problem is very difficult of solution by ordinary means. Any kind of tests for the assessment of the aptitude of the examinees should pay due regard to their social and economic environmental conditions and take note of the fact that their concepts are likely to be in a formative stage at the time that their admission is under consideration and it is only with passage of time that the young recruit will develop well-defined propensities for one type of course or another. Some loss in this category is inevitable. It is best allowed to occur at an early stage. If all the students admitted are pressed hard to continue, regardless of whether or not they have the correct attitude to engineering studies, a more significant wastage of effort and time takes place, and some of the final products emerging may be misfits.

The wastage that occurs under category (c), referred to as "time-wastage", arises out of a certain number of students, taking more than the normal duration (5 years) to complete the course requirements and qualify for the award of the Bachelor's Degree. The responsibility for this "wastage factor" is solely that of the engineering institutes which run the various courses. The tabulation given below (Table 2), shows the "Student-Wastage" and "Time-Wastage" factors, worked out for this Institute, for its first two sets of entrants.

Table 2. "Student-wastage" and "Time-wastage" factors, at the I. I. T., Madras.

Year of admission	In take	"Student Wastage"			"Time-Wastage"		
		Drop-out	Factor	No. who completed the course (x)	No. of minimum student years reqd. (5x)	No. of actual student yrs. spent (y)	Factor $\left(\frac{y - 5x}{5x}\right)$
1959	120	19	16%	101	505	535*	$\frac{30}{505} = 6\%$
1960	120	9	8%	111	555	583**	$\frac{28}{555} = 5.4\%$

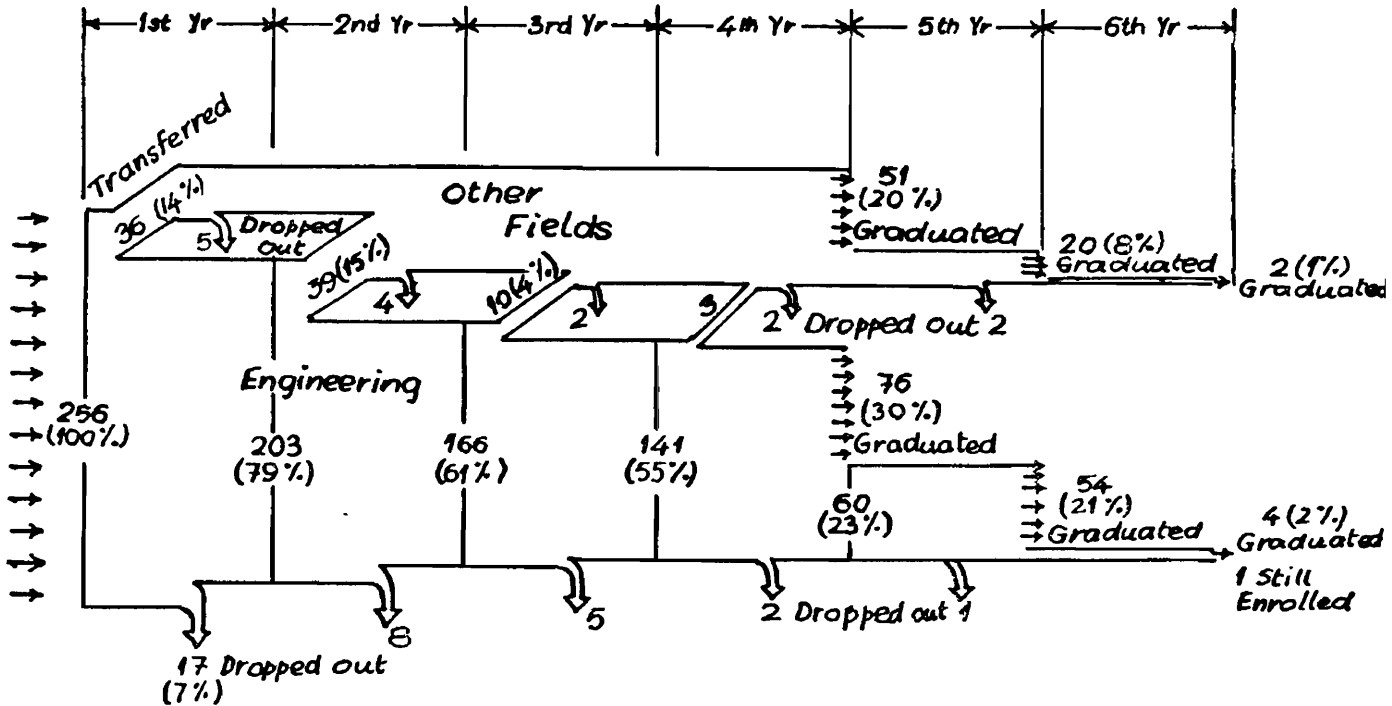
$$*535 = (78 \times 5) + (16 \times 6) + (7 \times 7)$$

$$**583 = (89 \times 5) + (16 \times 6) + (6 \times 7)$$

The "time-wastage" factor has to be looked at in the proper perspective. If it is already at a satisfactorily low level, any attempt to lower it still further will involve wastage of another kind, namely "money-wastage" or "investment-wastage". What level of effort should be exerted to obviate "time-wastage" and what its ramifications will be in relation to the financial resources that will have to be provided, are matters calling for deep and thoughtful consideration.

It would be interesting and useful to have some idea of the "student-wastage" and "time-wastage" factors, currently obtaining in other advanced countries. Two instances, from West Germany and the U.S.A., are cited for purposes of comparison.

ACADEMIC SURVIVAL OF ENGINEERING STANFORD FRESHMEN



A Study by Associate Dean Laress L. Wise.
 — Stanford Engineering News, No. 48.
 November, 1964.

More than 50 per cent of the students who enter Stanford University in engineering as freshmen ultimately graduate in Engineering. Another 29 per cent that enter in Engineering successfully graduate in some other field.

The study involved freshmen who entered in 1953, 1955 and 1958. The average number of engineering freshmen during those years was 256. Out of this group 76 (or 30 per cent) graduated in Engineering at the end of four years. Another 54 (or 21 per cent) graduated during their fifth year, and 4 more graduated during the sixth year.

Most of those who transferred to some other field did so during their freshmen or sophomore year. Their graduation pattern closely paralleled that of students who remained in Engineering.

A Report of the Technical University at Aachen, West Germany, describes, as of 1962, the graduation pattern in the Mechanical Engineering discipline, in the following terms :

“Of the students who ultimately got through the Diploma-Engineer Examination, only 40% completed the course within 8-10 semesters, 8 semesters being the minimum prescribed period ; 50% needed 11-13 semesters ; and the remaining 10% of the students required longer time. Of those registered, only 75% finally received the Diploma. In the case of foreign students, only 50% were eventually successful. In later years, there has been a slight improvement with regard to both the duration of study and the pass percentages.”

Stanford University, in the U.S.A., is in a commanding position with regard to engineering studies and is a private institution which admits students solely on the basis of merit. The graduation-flow-pattern (averaged over a few years) at this leading University, is given in the accompanying diagram. It is noteworthy that 40% of those initially enrolled drop-out in the first two years of the four-years period, to join other courses and avocations. Only 80% graduate in the minimum prescribed period (4 years). Only 50% of the students graduate eventually. It is highly probable that a similar situation prevails in other top engineering institutes in the U.S.A. If this is the character of the pattern obtaining in highly industrialised societies where, thanks to favourable environmental conditions, well-defined aptitudes form at an early age, advanced facilities are available for testing and evaluating these aptitudes, and employment conditions are more equitable among various professions, the drop-out situation and the wastage occurring in our institutes are by no means such as to cause alarm or despondency.

Recommendations of the I.A.M.R.

The I.A.M.R. Report has made the following recommendations :

1. The curricula, now followed in our engineering institutions, are not rational and have therefore to be revised and improved.
2. The assessment of students' performance has to be done on the basis of the semester-system and not through a terminal examination.
3. A large number of supplementary tests should be held to facilitate student's passing.
4. A system of credits should be introduced.
5. English should be taught.
6. Tutorial assistance for various student-groups should be organised *prior to each examination.*
7. The Principal and the Heads of the various Departments should be charged with the responsibility of ensuring that an appropriate number of lectures are delivered, backed by adequate preparation.
8. No migration of staff should be permitted to take place during an academic session.
9. Teachers should be carefully selected and trained.
10. Hostel accommodation should be provided for the students.
11. A certificate, marking the successful completion of the third year of the engineering course, should be issued to the students, to enable such of these, as desire to do so, to move from one institution to another.

12. Equivalence should be established between *various types* of courses, at the first, second and third year levels, to enable students to transfer from Engineering to Science and vice-versa.

Some of the recommendations aim at making instruction more effective and fruitful. Educational institutions will study them with care and will have no hesitation in adopting them to the extent that they find them practical and economically feasible under their operating conditions.

One of the recommendations appears to convey the idea that the curricula currently being followed by the engineering institutions are not rational, and that this situation contributes to "student-wastage". But this argument is not clearly explained. Curricula and programmes of study in engineering have to be kept under continual review and have to be revitalized and the purpose in doing this is to keep track of modern developments and to help provide a class of engineers capable of facing, on their own initiative and in their respective fields of professional activity, the challenges of advancing technology. It is not clear how this aspect of improvement in the quality of the educational content, which is mainly addressed to the gifted students, can play a role in eliminating "student-wastage".

The main motivation underlying several of the recommendations is a desire to secure 100% results. Action on such recommendations will inevitably convert all the Engineering Colleges and Institutes into low-grade tutorial and coaching establishments geared to the needs of average and below-average students, and force these institutes to organise an unending series of supplementary examinations with the specific objective of passing eventually *all* the students who managed to secure admission into one Institute or another. There can be no surer way to kill initiative and breed complacency.

The recommendation that calls for the establishment of equivalence at various levels among the different streams of education, *viz.*, Arts, Science, Engineering, Medicine, Law, etc. is a retrograde one, because by its very nature it will encourage fissiparous and unsettling tendencies on the part of the students and will upset the planning and orderly working of all the concerned educational institutes. It runs counter to the concept of an integrated approach in the learning of and preparation for work in a particular discipline. The equivalence principle, if given effect to will diversify and dilute the curricula of the early years in all courses of study, to such an extent that the objective of laying a proper foundation for the specialisation that follows in one branch of study or the other will be rendered completely null and void.

In general, it may be stated that the recommendations collectively suggest a course of action that will prove to be academically unsound and unacceptable from the point of view of the Institutes that impart technical education.

Conclusion

The picture provided by fluid flow through a pipe forms an apt analogy for the present discussion. To achieve a reduction in

- (a) material wastage, due to leakage taking place at cracks and joints, and
 - (b) time wastage due to different fluid velocities at different layers,
- one has to use better pipes and joints, and make the flow turbulent by exerting greater pumping energy. These steps require a larger capital outlay and increased running expenditure and

thereby invoke "wastage" of a third kind, *viz.*, "money wastage". An economic design will be one that makes a compromise between two conflicting requirements—reduction of wastage and rise in operating cost. In the case of student-flow, wastage, reckoned in terms of students lost on the way and time lost on the way, may be sought to be reduced by employing a larger number of qualified teachers, by intensifying tutorial assistance and by adopting a realistic examination and assessment scheme for promotions. However, the high cost involved in taking the wastage level to a lower depth than now is a matter for cautious consideration.

It may be pointed out that the strikingly low percentages of "student-wastage" and "time-wastage" obtaining at the I.I.T., Madras—as well as the other I.I.Ts.—are the direct results of their staffing patterns and their instructional schemes of which the outstanding characteristics are: individual attention bestowed on the students, intensive laboratory practice and rational methods of assessing, on a continual, almost daily, basis, the progress of the individual student, and the laying down of norms for the successful completion of the various subjects of study incorporated in the curriculum. These steps, salutary by themselves, have led to an increase in the per capita cost of the training of undergraduate students at the I.I.Ts. (Rs. 2100 is the approximate figure for I.I.T., Madras) vis-a-vis other institutions in respect of which the cost may be somewhat lower (Rs. 1,700 or so) but the "wastage" factors are much higher (45%). The enhanced level of expenditure at this Institute seems worthwhile and would appear to be repaid amply by the reduction that it has brought about in the combined "wastage figure" from the 45% or so, of other institutions, to its own 15% and below.

As long as the primary aim of engineering education is to train young men in the theory and practice of the engineering profession and to inculcate in them, the confidence and capacity to carry out their professional responsibilities in a competent manner, the question of "wastage" should play a subordinate role and should not lead to a tinkering with the fundamentals of the educational programme.

In conclusion, it may be pointed out that a 100% elimination of "student-Wastage" and "time-wastage" is possible only if one is prepared to do away with an organised form of education and training and to abolish tests and examinations that help to estimate the extent to which the pupils absorb and assimilate the knowledge presented to them by their teachers. A 100% transmission-efficiency on the part of the teachers and a 100% reception-efficiency on the part of the students are unattainable ideals. The adoption of short-circuits, improvisations and temporary expedients in education will lead to a false and pretentious idea of progress, abnormal costs and a fall in the true standards. All that can be done is to improve teaching and training methods, consistent with the calibre of the students that qualify for admission and the financial resources made available for the purpose of turning them into useful products. The singular objective of reducing "wastage" to negligible proportions—for the mere sake of 'reduction' by means that are artificial and of doubtful academic merit—will be a serious step directed against the cause of higher technical education in the country, because it will result in producing young men who will possess an engineering degree but not the competence to carry out the tasks and discharge the responsibilities that await them in the various engineering fields. This would be "wastage", on a big scale, of the nation's potential resources.

PRADEEP

ANNUAL NUMBER

1965-'66

*Presented to Alumni
Association
by Prof. C.S. Swamy
Chemistry (1961-96)*



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*C.S. Swamy
13/06/2011*

**The Alumni Association
The Indian Institute of Technology
MADRAS**

Choosing Engineering as a Career To-day

BHAGABAN DAS*

It is undoubtedly true that career planning is of the greatest importance to-day. This being the arbitrator of one's future destiny, careful thought and consideration must be exercised in properly orienting the career at the beginning. This would result in the reduction of losses in time, money and human talents. Some time ago, engineering profession was considered to be a matter of honour, prestige and high social status, but engineering activities are continually changing in nature and scope. Hence, one should clearly understand what he wants out of life—material success, or opportunity for service, security, or freedom of action, opportunity for leadership, or freedom from responsibility, social prestige, or personal privacy, creative satisfaction or freedom from pressure.

Deciding upon this if one takes up engineering as a career he should visualise the great task he has to implement in order that he may attain the goals of his life.

As engineering is the professional act of applying science to the efficient conversion of natural resources to the benefit of man, this has to be translated into action in reality. Then only can the charm of this noble career be realized.

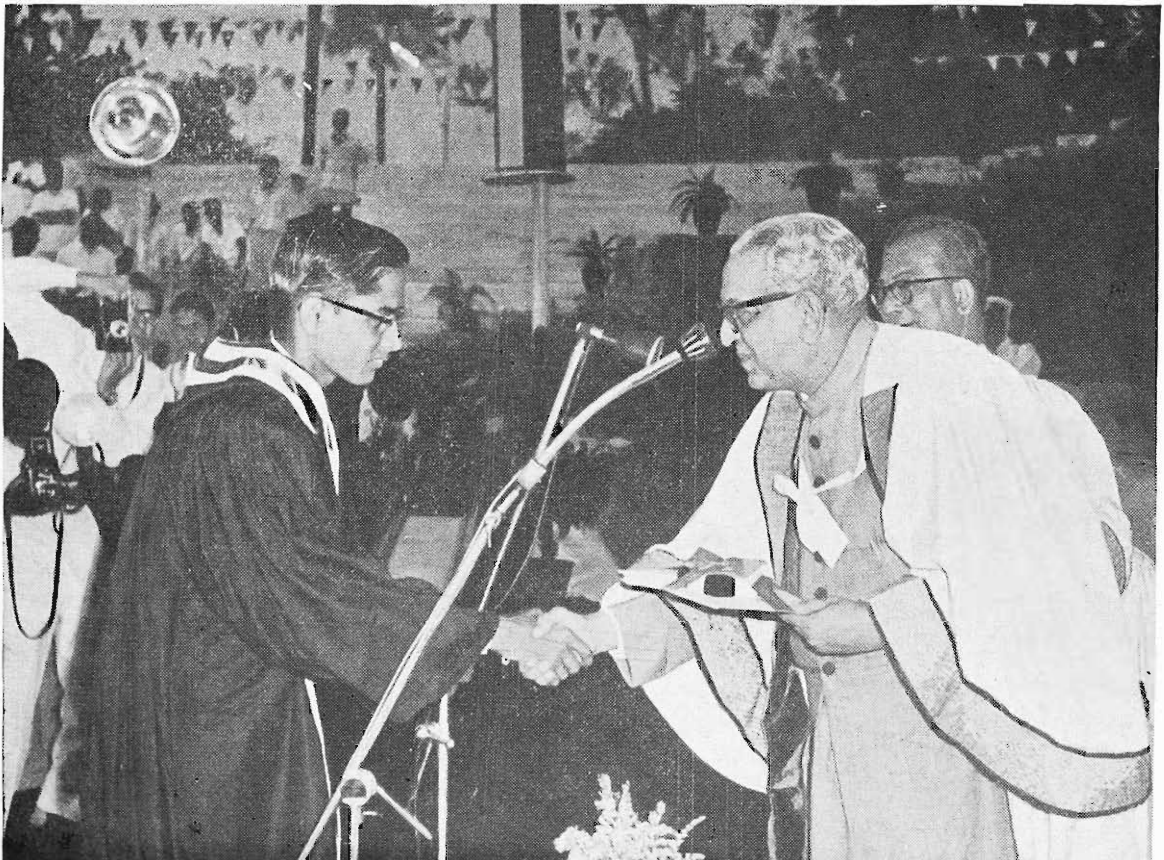
But unfortunately engineers in our country are not so well placed by and large. They are placed in posts where lesser skilled people could discharge the duties with ease. Slight introspection into the matter would reveal the tremendous waste of labour and human talents, by not properly fitting the person to the job. The intrinsic worth of education that an engineer receives is really great. So naturally greater returns should be expected of an engineer. It may be that in advanced countries, if engineers do their normal duty, it may be a satisfactory return, but in a country like ours something more is to be expected if it is to develop materially and industrially thereby raising the standard of living of the masses.

It is not difficult to pin point where exactly the mistakes lie in the present occurrences in our country, but taking things as they are, an engineering student should realise that it is the day of the survival of the fittest and engineering, at present, is more of a challenging nature, rather than an easy passage. There is so much to learn and so little time that many hours of concentrated and efficient study are required. It is not only difficult, but it is also so exacting. "Almost right" or "correct except for the decimal point" is not acceptable.

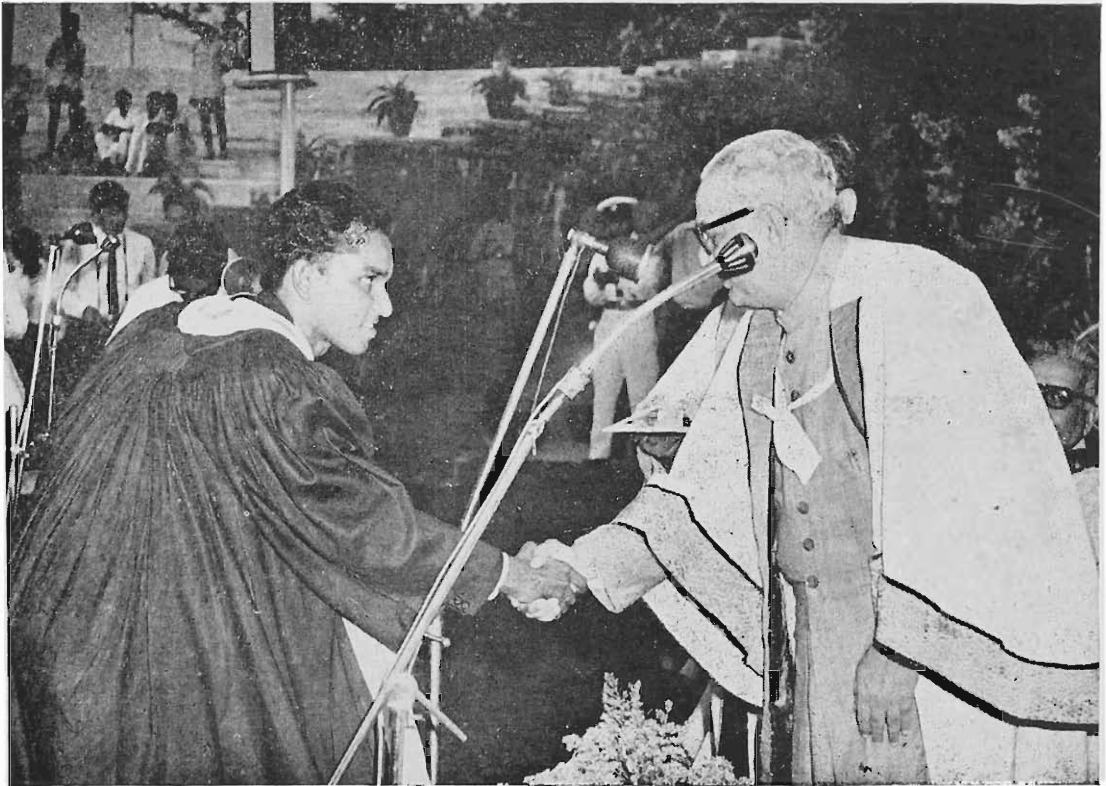
The engineer is engaged in creative, productive and constructive work, whereas the doctors' patients are usually ill and the lawyers' clients are in trouble, the engineer is primarily concerned with healthy growing and productive activities. Then why can't better performance be exhibited by an engineer?



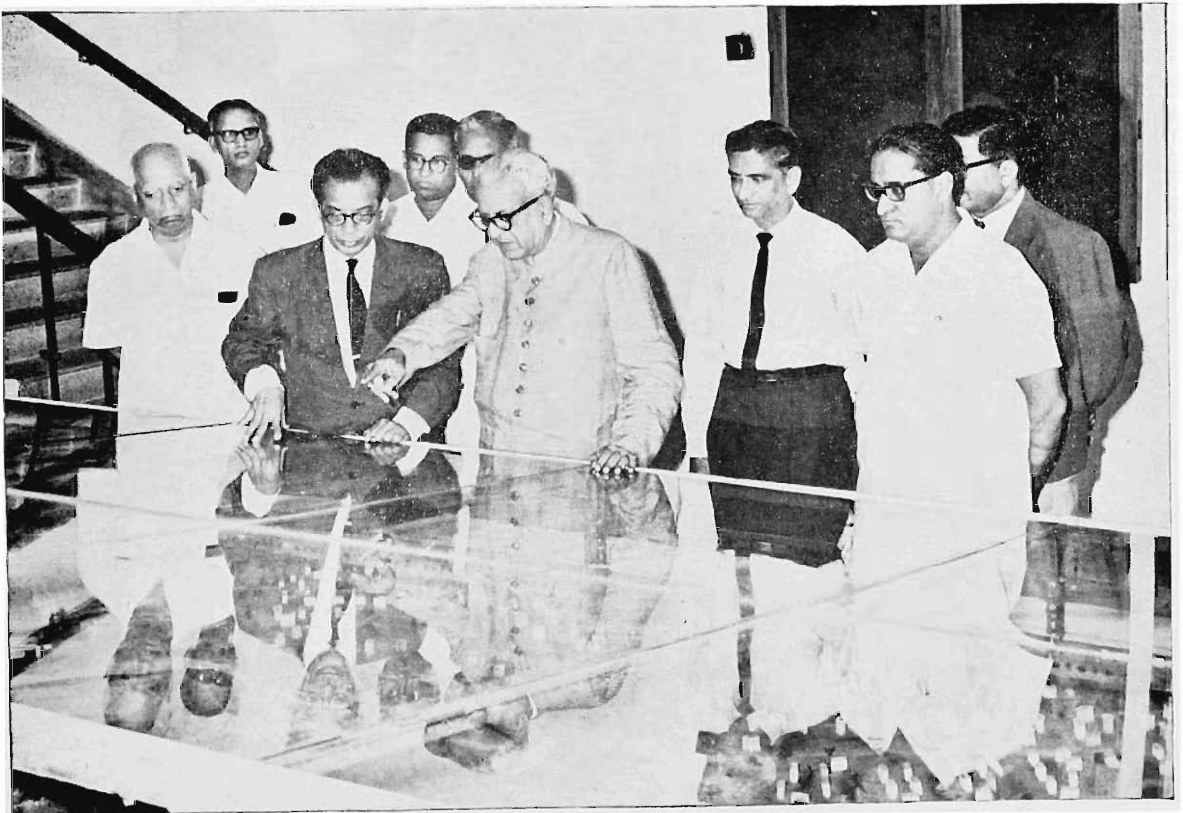
The Chairman, Board of Governors, signs the Register of Degrees.



Sri Muthukrishnan receiving the President's Medal from Sri. M. C. Chagla for standing first among all the branches in the 5-year course.



Basu John Vetteth receives the Governor's Silver Medal for the best All Rounder from Minister, Sri M. C. Chagla.



Mr. M. C. Chagla, Union Minister for Education examining the lay-out model of the Institute during his visit on 17-6-66.

Every successful engineer would know the joy of creation, creation of a new concept, device, process, or procedure out of his own knowledge, thought and experience.

Success in engineering usually requires interest, aptitude and drive ; however a deficiency in one characteristic can be compensated for by extra strength in the other two.

If students of engineering guide themselves along these lines and gain technical knowledge, engineering is a wonderful field full of a host of opportunities for exciting, satisfying work and a life time career.

An Engineer Dreams

VINOD KUMAR BATRA*

“Boy, what great fun it is going to be when I have that diploma in my hand. I am going to show the world what I can do, just give me a chance. Life now on is going to be what they call a bed of roses, believe me. No more slogging with those boiler designs and Kirchoff’s laws. I am going to design I have an idea you see. I could patent it, make all the money in the world and live a quiet, of course, a comfortable life.”

Personally speaking, I don’t think the dream started at such a late stage. It was one of those fine sundays after Christmas when life seems to be making a smooth role. I was working on my “aeroplane kit”--one of those things that the rich aunts give to their nephews to play with. I wonder if it was intuitive or more of a fashion to see the tiny tots play with such gadgets. I don’t think I even knew how to open the box properly but here I was, surrounded all around with bits and pieces of complicated machinery. Didn’t even have an idea where it was all going to end. That was when my dad walked into the room. A noble old soul ! He had the surprised look as if he had found a gold mine.

“Sonny, you are going to be a great engineer. I didn’t know that you liked tools so much”. Bless my poor soul, I was still figuring out whether the fans would go inside or outside the fuselage and here I had the degree already confirmed.

“Engineers,” was too difficult a word to say and so the next time I had my birthday party, I passed the word down that I was going to be a motor mechanic. I guess that was the only profession I knew. “Why not an engineer or scientist, son ? Why a mechanic ?” You see, John, the neighbour’s son, his dad is a mechanic and he can drive everything. Yesterday he was sitting on that small machine which cut his grass faster than our mower.

* (1960-65 B. Tech. Electrical Engineering L.C., M.S.)

“Dad, why don’t we have one of those things?”

“You see, my dear boy, our lawn isn’t as big as John’s and we like doing a bit of exercise.” “Mom, don’t you think that if we had a bigger lawn, Dad would get a bit more experience?” Quite a legitimate point, but we never happened to acquire one of those strange looking devices and the crave for being a mechanic started dying down.

Incidentally, I was the eldest son in the family, and quite handy at doing men’s jobs. I could fix a leaky tap, mainly because I knew where the main valve was, hang a picture, I knew all the spots where a nail could go, mostly because I used to play ball against the walls, and knew the weak spots, and odd jobs like fixing the stove or fridge by kicking them. Modestly speaking, I had the engineer’s temperament.

Then came the end of school and a big decision to make. The principal suggested that I would make a good public speaker, may be he had Hyde Park in mind. I still wonder how he ever thought of it but my dad, an obstinate old man, had seen me at work that day. No, sir, his son would make a great engineer.

“You don’t know my son : he has been practically running the household. We haven’t needed a mechanic for the past five years”.

Surely not because things used to get into such a mess that a new one would be better than a repaired one. Remember that night when I opened the back of our radio, an antique. I was always afraid playing with this music box but curiosity gets the best of you sometimes, and even the best dealer in town didn’t have the slightest idea how to get the sound back into the system. The project was called off and my dad who gave in for experience at any time laughed if off by saying “Son, you learn by your mistakes.” Surely I did not want to make another mistake by joining the technical school but as a young man I had no say in the matter. Left to me I would have been a great business man but the intricacies of Machine Design, Superhetrodyne receivers, the modulation at carrier frequencies, the acoustics of recording rooms and the Logic of Boolean Algebra had me down for all these years. There was not a moment to lift my head and question my decisions. To my surprise I showed reasonable progress except for the supplementaries which brought my academic year every time to full twelve months and 365 days.

Somehow the end seemed in sight and the realization of a dream which was partly subjective. The results were in the paper. I had a fruitful ending, a first class in my Bachelor’s degree. Incidentally, I had majored in Electronics mainly because the electrons in orbits always intrigued me and somehow still do.

It was time for every body, my parents, teachers, brothers, sisters, to see my knowledge at work. That was a big day when I was called for the interview. Dressed in my graduation suit, adjusting the tie knot every ten yards I entered the committee room. It gave me shivers but the principal was after all allright, I impressed them with my answers. I think they were relevant enough. Then came the hundred dollar question, a bombshell, “Any experience?” “No, sir, I just graduated this year, as a matter of fact this month.”

They had their eyebrows up, and quickly held a conference. “Well, you see youngman, we are looking for a man who has worked in this field for a couple of years. We have a job for apprenticeship but I think we would wait till we are through with the rest of the candidates. It went on and on from one firm to another, one city to another. Hope sustains life but not the shine of my suit.

This was in that coffee house where the Beatniks and the Beatles meet. I bumped into an old pal of mine. “Well! Well! how are you engineer sahib? Don’t see you around these

days. Must be loaded with dough. Why should you look on people like us any more? Let me buy you a cup of coffee, at least you might then appoint me as your secretary." I felt like wringing his neck and see him gaping for breath but sometimes a brilliant man is born amongst ruins and during our conversation he kidded me into going for another degree, I guess, he considered us some kind of nuts. If the present degree couldn't fetch me a decent job, I had my doubts if another one would help and in any case I would still be without any experience. But why waste time in coffee house and taverns? With my marks I could be easily considered for graduate study. Things soon started shaping up and I took off for Canada for another degree, much to the amazement of my parents, who had another dream of their own.

And here I am friends, still trying to figure out why two and two make four.

N.B. While I was preparing the text for this, I happened to run into another definition of an Engineer which I produce here for my Engineer friends.

An Engineer

An Engineer is one who passes as an exacting expert on the strength of being able to turn out, with prolific and amazing fortitude, strings of incomprehensible formulae calculated with micrometric precision from extremely vague assumptions based upon debatable figures obtained from inconclusive tests and quite incomplete experiments carried out with the instruments of problematic accuracy and by *persons of rather dubious mentality*, with the particular anticipation of disconcerting and annoying a group of hopelessly chimerical fanatics altogether too frequently described as the corporate staff.

On Teaching Methods

DR. T. GOPICHAND*

Teaching and learning are mainly the problems of communication between two persons, the teacher and the taught. Wherever human behaviour is involved, it is necessary to define the objectives and ideal conditions, then only, any discussion is meaningful. Besides definitions and discussions, a matter of equal importance is how any method works in a real situation and what corrective action is necessary to attain the objectives. The latter could only be arrived at by a critical assessment of behaviour of a given real system. However good a teaching method may be, a given combination of a teacher and student may not be benefited by it. Whatever may be the method of teaching employed, a given combination of teacher and student may learn. This is, however, an extreme condition, where the will of uncompromising individuals dominates and surpasses every material tenet. This essay is devoted to laying down certain ideal conditions and discussing a few suggestions for practice.

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Teaching is an art. Learning is the fulfilment of an innate desire to know. For a perfect result of teaching and learning, the two persons—the teacher and the taught—should be personally aware of their responsibilities and should have faith in their ability to achieve their aims. A teaching method can only provide a stimulus to attain a good result but does not guarantee it.

A teacher is not a text-book. He is not just a widely read person. He is not a machine to give correct answers to set questions. This negative way of starting a definition is deliberately chosen to eliminate some popular misconceptions of a good teacher. A teacher should be an individualist. He should have his own style of teaching. George Bernard Shaw once stated, that if a person has something to say (his own), he sets his own style. So a teaching method, if the above definitions of teacher and teaching are accepted, is a property of a teacher—nay, it is at the core of all creative work of a teacher.

The above set of definitions is stated to recognise certain limitations to the extent to which a desired result can be achieved, for a prescribed teaching method. In so far, they also help to arrive at corrective actions for any prescribed scheme.

Before any suggestions are made to deal with real situations it is necessary to distinguish between teaching basic principles of a subject to a large number of students, for example, in undergraduate teaching and teaching at graduate level, where the teacher-to-student ratio is high.

It is necessary to recognise that certain pre-requisites and accepted objectives to be attained are to be set forth before recommending a teaching method. So, in what follows, some useful teaching methods for undergraduate and graduate studies are presented.

Undergraduate Teaching

The principal objectives can be stated as to teach the most basic principles of the subject and to inculcate into the mind of the students to make it a habit to think and to make the subject a part and parcel of his mental outfit. There are two basic ingredients in the above objective, *i.e.*, to inspire a student to love his subject and to provide him with the most basic principles. To inspire a student is not necessary, if the student comes to learn and with a love towards the subject. However, this is the exception rather than the rule in our country. Both the above mentioned objectives are challenging problems to a teacher.

The following practice may be helpful to achieve the above objectives :—

1. The seniormost member of the department should organise and teach the first course in any subject.
2. Demonstration lectures in pure sciences are very helpful in inspiring students to learn.
3. Intensive viva-voce in practical classes. A lot of experience is necessary, if the viva has to be of any teaching value. A questioning method will teach a student only if the questions are put to provoke or prod a person to think and not if they are of a vindictive nature.

It takes a very, very long time to teach students by ridiculing them or by teasing them about what they do not know.

4. A well organised tutorial system where most of the talking is to be done by students to present their doubts.

5. Finally, a teacher must be made available for every two or three students for bringing up their problems or doubts once a week. This should be done purely on humanitarian grounds and can be outside the college hours.

There are two major prerequisites for the teaching methods proposed above. Firstly, courses of a descriptive nature are to be avoided. It is unjust to ask a teacher and a student to do a painstaking job when a course is of purely descriptive nature and as such may or may not require a teacher. For all such courses, it is more beneficial and proper to educate a student by

1. providing a museum of articles or equipment or anything which is described in the course,
2. taking advantage of audio-visual educational methods like motion pictures and slides,
3. taking students for a tour.

The second prerequisite is that a good supply of cheap text-books should be available. It would be possible for the teacher, then, to devote his lecture to explain the fundamentals.

Graduate Teaching

While the teaching at undergraduate level is to initiate a student, at the graduate level the emphasis should be on making him a mature individual. He should be taught to tackle problems of more and more difficult nature and as the problems become more difficult, the teacher slowly fades out into the background and will be of help, when it is absolutely necessary.

If such is the objective, the following teaching methods may be helpful :

1. The lectures should be such as to promote discussion. If students in graduate classes do not ask logical questions, the classes are bound to be un-educative.
2. To allot topics on recent advances and initiate study and discussion in the class room.
3. Work involving experimentation should initiate the individual into the art of getting useful information and logical interpretation.
4. To allot project work where a student should develop independent ability to organise himself to present a problem and to undertake investigation or in short to develop the thinking faculty to its fullest extent.

There is one prerequisite for the above methods. They are useful if the programme of study is designed to be intensive in nature rather than extensive. Studies of intensive nature only are in conformity with the objectives stated (in the first para of this sub-section). To try to cram a little of every conceivable subject at the graduate level would be very harmful to a group of intelligent students.

It is very desirable to note at this juncture, that if graduate studies are to be exciting for the students and teachers, the teacher should have the courage to learn from the students, whenever the situation demands. Everyone, whether he be a student or teacher, should be confident of what he knows and should avoid at all costs to be an introvert trying to worry about what he does not know. Only the supreme authority of a logical argument need be respected.

Summary

An attempt is made to lay down certain ideal conditions and objectives for teaching in general. Certain teaching methods are recommended to fulfill specific objectives for graduate and undergraduate studies against a given background of prerequisites.

Finally in concluding this essay, it is but necessary to mention the status of examination in the above scheme. It is only permitted as a tool for the teacher to assess how much of what he has taught is assimilated by the student. Any other aspect of a given examination system falls outside the scope of this essay.

Research Worker an Asset or a Liability?

K. S. KRISHNAMURTHY*

In spite of Ramans, Krishnans, Bhabhas and Ramanujams, the present conditions prevalent in our country will confuse the common man. These are cries for better prospects from the Scientists and Engineers on the one hand; at the same time one reads about the decision of the 'Pool' to evict the 'foreign returned's who have chosen to follow the notorious 'sons-in-law' of olden days in being reluctant to refuse the hospitality extended to them.

My intention is to discuss the worth of a Researcher, irrespective of whether he has enlarged(!) his information in an "advanced" country or has been struggling for recognition in his own motherland.

Let me answer the question appearing in the title which is: 1. definitely an asset, 2. could be a liability.

On analysis of the statistics taken by the "advanced" countries, Research and Development have paid rich dividends in the long run. It is one of those departments where one cannot see immediate results. It takes ten months for a child to come out of the womb. The amount spent on Research in the "advanced" countries has been on the increase every year.

I am writing from my own experience as a Development Engineer for a year. I hope it will prove of help to my colleagues and friends who choose to woo a career of Research. It is not my intention to give advice or suggestions to the authorities on how to encourage research in our country. Let me skip over to the second part of my question that is "How a Researcher could be a liability and how best to avoid becoming one."

The first and foremost question one should ask himself before choosing a particular field of research is “Does my country need research in this field”? and secondly, “Will there be facilities for continued research?”. These questions are almost always coupled with the interest and fascination one has for a particular discipline in which he seeks a research career. Once a decision is made, I do not see any reason in blaming others for lack of facilities. If one is really interested in his subject of study, he can find a country that has facilities for work. A developing country is like a child which can consume only as much as its belly can hold. One should also bear in mind that only very rarely does one come across a job which is after his heart as well as paying.

Having taken up a job one should realise that the problems do not end there. It is only the beginning. One should always be on the look out for things of interest in order to widen the horizon of his knowledge, be constantly in touch with the latest developments in his field of study. One should be willing to learn from others.

Never underestimate any person—he might possess some information you need. Be frank in your discussions with others. It always helps to admit what you don't know, rather than to pretend knowledge.

Last, but not least, is the developing of one's ability to adapt whatever one has gathered to the conditions prevalent in one's own country.

To sum up, the successful researcher, as I see him, is industrious, alert, inquisitive and frank, apart from being intelligent. He will never be a liability to his country.

Applied Engineering

PRADEEP MALLICK*

Thoughts of going abroad begin to take shape in the final year of one's University education and become, for some, an obsession by the time they are through it. This was definitely true of my class-mates and unless someone has been sending home rather dark and dismal descriptions of higher education abroad—I am sure the same trend continues. Such obsessions are indeed magnificent, for, the experience—and the technical aspect is only part of it!—and knowledge to be gained abroad are absolute assets and perhaps the oft-quoted “widening of one's outlook” jazz is not entirely a myth.

This by no means applies to all, but, by and large, at or about the time of our graduation, we in India lack a practical knowledge of engineering problems. I could even go a step

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further and say that we lack the basic understanding of the fundamental concepts on which engineering is based. Whereas, one should endeavour to understand the fundamental concepts and allow advanced learning to follow on its own, based on that understanding, we, on the contrary, learn—nay, study—refrigeration with only a vague notion of the meaning of enthalpy. Soon after the Convocation, as if by sudden transition, we find we are engineers and wonder whether we should now be capable of solving all problems that pertain, even if only remotely, to engineering. Uncertainty and a lack of confidence account for our attempts to shy away from simple day-to-day engineering problems. The word 'engineer' becomes frightful. But first what is an engineer? Is he the business-suited executive who clinches deals over business-lunches? Is he the impatient, eager enthusiast who was responsible for the turbo-jet? Or, is he the one who, in overalls, helps build power-stations? Perhaps, all three are engineers, each in his own light; basically, as one American put it, "an engineer is one who can do with one dollar what any blundering fool can do after a fashion with two". And this comes with experience. Becoming an engineer is no transition; it is a maturing process, an evolution. It is my contention, however, that the earlier one is "broken in" the better grasp one has of the practical aspect of engineering, and this definitely results in a far greater interest in and appreciation of the subjects taught at college.

We have, for so long now, been crying out for the dire need for a closer and more intimate relationship between technical institutions and industry. Perhaps the appreciation of the idea itself takes considerable time to mature, and then again its execution must of necessity take longer, in view of the obvious expense involved in evolving schemes for training. I do, however, sincerely hope that this marriage between institution and industry is arranged speedily, so that we in India have capable engineers with a greater insight into what makes things tick, an inborn inquisitiveness rather than indifference, curiosity rather than nonchalance. This applies to all, be they men in research, development or applications. Such of those who do intend becoming 'applications engineers' have got to know about the practical on-site problems of installation and commissioning as well as about operation in addition to some of the raw design features taught in the class room.

It must not be implied from what I have said, that engineers in this country are to be regarded as demi-gods; nor are they basically superior. Quite on the contrary, our budding engineers often exhibit a genius that matches that of any other engineer anywhere, and post-graduate students from home rarely fail to shine in Universities abroad. Engineers here, however, have the great advantage of having received industrial training, even when still studying. During their holidays, University students often take up some sort of training with firms. Although the primary reason for this might be monetary rather than an absolute thirst for knowledge, such training never fails to do some good. The degree of benefit is undoubtedly greater for foreigners, who come for a specific purpose and have, therefore, only a short time to learn so much.

Training in this country may take one of a multitude of forms, but the feature they all have in common is the time spent on the shop-floor, where the apprentices are encouraged to 'use their hands'. But whether they do so or not, they absorb (even, perhaps, oblivious of the osmosis) a lot of the manufacturing problems encountered and their subsequent solution. The reasons for delays in promised-delivery dates, which somehow seem so inevitable and which one tends to accept as a foregone conclusion, are now understood. Thus, consciously or unconsciously, one widens one's knowledge; one learns. Only, one cannot, at the end of such a training, tick off certain items as having acquired full knowledge in them; only when put to test can one gauge the depth and degree of absorption.

One might wonder, after all this, at the need to go abroad to absorb practices on a foreign shop-floor, and whether one might not absorb as much on shop-floors in the industries in one's own home. Indeed! The technical knowledge that one might gain abroad might not be far greater than that proffered at home, but since when has 'learning' and 'experience' been confined to technical knowledge alone? The technical knowledge that a post-graduate apprentice acquires abroad is small in comparison to the overall knowledge he gains. This is nothing to feel sorry about; for success does not depend solely on one's ability to read Mother's Charts; it also depends to a large extent on gaining experience. And mere living abroad is an experience in itself. You now look back and 'see' for the first time, the things which, at home, you had taken for granted, things which had been around you all these years, but which somehow appear different now that they are viewed in a different light, in a different perspective. You begin to realise that poverty, squalor, hunger, disease and illiteracy are not our birthrights, that they must go. And this awareness, this awakening too are important, for they are education in themselves.

On "Why?" and "How?"

Dr. T GOPI CHAND*

I have promised a good friend of mine, in the Alumni Association, to write an article for the annual number. When I resolved, I should snatch a few moments of respite, sit down and write something, the first question I faced was, "Why should I write an Essay?" I know I cannot answer this question, precisely, I shrugged my shoulders and asked the next logical question, "How should I write it?". Had I not chosen this path I know the plethora of other questions, which the former query "Why should I write an essay?" will lead to. For instance, "Do I have a topic to write about?"; "Can I exploit the indulgence of my friends to patiently read about whatever I feel I have suffered and learnt?" etc.

It occurred to me that it might be worth while to put in the form of an essay some of my experiences with these twin questions "Why?" and "How?".

I had asked one of my friends in college days, who later was dabbling in novels and poetry as a pastime, "Why should you write novels or poetry?". This gentleman being a very sensitive person, and who feels that art should either trigger or sustain the values of what can be called civilized existence for homosapiens, promptly answered that when certain actions of human beings make him suffer, he feels he should tell others: depict the depth of human interactions in society. I then asked him "Why write stories with fictitious names and situations? Why not

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straight away say what you want to say in plain language?”. I could see the pain on his face, because every artist loves his creative instinct more than the despicable and ever elusive “truth”, Fortunately or otherwise, I never had to ask myself “How should I write a novel?”. However, I should admit that I am sometimes moved during my daily life, to write poetry occasionally without caring for “truth”.

The twin questions “Why?” and “How?” are almost unavoidable. If a man does anything automatically, like a machine, of course, these questions never arise. For instance, if you go to a railway station and stand in a queue, you don’t ask yourself any questions. You simply do what others do. But for an action about which a man has to think, he faces these questions invariably.

A funny feature of these twin questions is that the order in which one faces them decides the nature of what he is going to do. To further elaborate, if he starts with asking “Why should I do it?”, his action is going to be positive. By positive, I mean, his actions are going to be useful to him and if it pertains to a larger domain, they are going to be beneficial to his society.

On the other hand, if he asks “How should I do it?” and gets bogged down in methodology and comes up with “Why should I do it?”, he is led to either inaction or action of a negative type. By negative type, I mean, actions which are not going to be useful either to him or to others and eventually lead to frustration of the individual.

I might extend this latter hypothesis of “order in which the twin questions are invoked” to our present national situation and the dilemma faced by “intellectuals”—(the term intellectuals being used in a colloquial sense). There is a good number of patriotic, intelligent, normal, healthy persons in our country, but the progress that is being achieved in any aspect of our society is really small. It is my personal feeling that most of them conscientiously ask the question “How should I be useful to my country?”. The answers they try to formulate are so disordered that more often, they feel compelled to ask “Why should I be a lone figure in trying to be useful to my country?”. This situation is not new to our country. Till Gandhiji vitalised and toned up the national feelings “to help ourselves to improve our lot”, all good natured souls in the first half of twentieth century in our country were in the same dilemma.

I, for one, feel optimistic that this trend of questioning will be reversed and that our country will progress.

I might close this short glimpse at these twin questions with a poem by Kipling :

“ I keep six honest serving-men ;
 (They taught me all I knew)
 Their names are WHAT and WHY and
 WHEN and HOW and WHERE and WHO. ”

The Basic Problem

G. N. SHARMA*

Discarding the topic "student life in the U.S.A.", though it may be more appropriate I wish to write about the most gigantic problem that our country faces: the population explosion. The following estimate indicates the magnitude of the problem. To-day there are 2.2 billion people in the under-developed nations, and one billion in the developed nations. At the present rate of growth, it is estimated that by 2,000 A.D. (which is not far off) there will be roughly 5.0 billions in the (present) under-developed nations and only 1.5 billions in the developed ones. The population of India, at the present rate, would exceed one billion by 2000 A.D.! It should be noted that the developed countries are conscious of the problem, several have solved it, and some, with valid reasons, think it is not urgent enough for them to take additional measures towards population control. Unfortunately, it is the backward countries that are going to be hard hit by the population explosion in the next 20 years. My objective in writing this article is to indicate how wise and fruitful it would be if the various political, social groups and the educational institutions in our country took a rational view of the problem and showed interest in solving it; to show that a basic change is needed in our society; and to make it clear that the question of whether we progress, or plunge into a chaotic deterioration of our economy, is critically dependent on how well we subdue the population growth in the next 20 or 30 years.

First, I wish to present the views of some of the developed nations on birth control and related topics, as revealed in their reports to the U.N.

Sweden is one of those countries where people have been mindful of birth control for a long time. There, it seems, the family planning ideas found their way to the people through the popular educational organisations and through the leaders of the labour movement, which had its break-through at the turn of the century. As a result of the birth control measures adopted by her people, Sweden reports, not only has the population levelled off, but also the appreciable reduction in the number of large families has made it necessary to close down small agricultural units and hence has made rationalisation of agriculture easier. (The converse: As discussed later in this article, the effect of rationalisation of agriculture on family planning by the villagers can be very significant). Excellent health services are provided and there is legalised abortion.

Denmark, Yugoslavia, Austria, France and Canada have rates of growth of population of less than 1% and so do not see any population problem, in the near future. Italy considers that high cost of living and the financial and psychological cost of bringing up children is sufficient obstacle to unchecked procreation. The U.S.A., the richest country, has a high rate of growth of population, almost comparable to that of under-developed nations. However, the

U.S. does not see any need for population control in the near future, for obvious reasons. Eventually, however, they too will have to face the problem.

The U.S.S.R. faced population problems in the early years of communism, but the enormous economic growth that followed did not necessitate population control: in the period 1913 to 1963, the population increased by 41% but the national income increased by 2700%, thus increasing the income per head by 1900%.' Perhaps because of the fantastic success the Soviets scored on the economic front, they contend that the socio-economic problems should not be attempted by population control, but by changes in the social structure, i.e., by socialist reforms. The Soviet view, which implies that all socialist countries should not be confronted with severe population problems, stands to question: (Red) China, for example, has been struggling under the enormous pressure of a rapidly growing population and it is only recently that they have taken concrete steps to reduce the population growth, by birth control techniques.

From the above, it is clear that as far as the population problem is concerned, the developed nations have every reason to take it easy over the next few decades. The backward countries in South America and Asia will have to move fast to solve the problem. (The African nations do not have any population problems). India and China, because of their large populations, can expect to be worst hit by the population "explosion", which is already under way, though few recognise it. The problem is ours and the burden of solving it rests squarely on our shoulders. We have to investigate the socio-economic conditions and changes (apart from education and medical facilities) that will lead to, and result from, a wide-spread use of birth control measures and family planning.

At this point, I should explain the socio-economic conditions that I have been referring to, and I will do so with an example. Let us consider the economic conditions of the farmer. The farmer wants to have at least two sons, to help him on his small farmland, and to support him when he reaches old age. In the process of getting two sons, he ends up with a family of at least four or five children. Such a behaviour on the part of the farmer is not surprising, (an average of two children per family would ensure a sufficiently low population growth) and is quite reasonable. (This important view was expressed and substantiated with facts in the report from Pakistan, where the problem is similar to ours.) Even if we educate the farmer in the methods of birth control, and provide adequate medical facilities, he would be forced by the economic conditions mentioned above to have a large family. This would be true not only of the farmer but also of all those people who do not have a "security" or a means of subsistence to fall back on when they reach old age. In our country, most of the workers, and all the poor people, that constitute the bulk of the population, fall into this category. Hence, it seems to me that apart from educating the masses about birth control and providing the required medical facilities, we should work out a scheme by which practically everyone, including the workers and the farmers, is assured of certain amount of security (by way of pension, etc.) when he reaches old age. Though this may seem costly at first sight, it would be profitable in view of the reduction in population it would lead to and the allied national welfare. Besides, there is a certain amount of social justice involved. In our country, unfortunately, the social security of a person is often closely linked to his own family. We should change our social structure in such a way that a person's social security is independent of his family structure. In other words, the individual, and not the family, should be unit of the society.

For example, collective farming could enable the farmer to work in a big farm and draw pension from the same farm when he reaches old age. This would remove his necessity to have

sons. If we pause for a moment and think there are scores of such conditions in our society that need attention. All these necessitate a change in our way of life. We should not hesitate to make these changes if these are necessary for effective use of family planning, since the alternative is disaster.

Whatever steps we take to effectively reduce the population growth, we have to do so as early as possible, within the next few years. The consequences of an uncontrolled population growth or an insufficiently controlled population level or delayed action are very clear :

- (i) repeated food shortages even under normal natural conditions, which will reach a stage when even the massive U.S. food aid will not help. In fact, the U.S. will have just enough people in the U.S. itself to worry about;
- (ii) we will find it impossible to provide the basic living conditions for the enormous population. The result will be unrest which may lead to violent revolution and
- (iii) when the era of executing industrial plans with foreign aid is over we will find it more difficult to match the economic growth with the population growth and as a result the "progress", which has always been eluding us, will never become a reality.

(I am not pessimistic in making the above observations. Think of the situation just twenty years from now when the population of our country will be 50% more than what it is to-day, at the present rate of 2.2% a year, and 2,000 A.D. when it will be double what it is today !)

Considering the magnitude and the urgency of the problem, it is distressing to note that the educational organisations and the various political and social groups in our country seldom discuss the problem and suggest the means to a quick and effective solution. It is foolish to expect the government to make the entire effort. Certainly, a successful family planning programme, which avoids a possible 50 to 100% growth in the population in the next 20 to 30 years is as valuable as several big five year plans put together. Here is the secret of a possible success of all our development plans ! It is needless to say that this needs as much attention as our five year plans are getting at the hands of economists and engineers !

The educational aspect of the family planning scheme and the medical aspect of it are rather well defined and our objective is to make them used as extensively as possible. I do not propose to elaborate on these and my objective has only been to bring out some hidden, but very significant, sociological aspects of the problem. There are several other facets of the problem which deserve attention. It would be interesting, for example, to investigate the possible effectiveness of different ways of enforcing family planning. One simple but effective way to curb population growth is to encourage late marriages. (They are trying this, I believe, in mainland China).

At first sight, the population problem appeared to me as a typical control problem; we have the various techniques of birth control and other population control measures including many legal sanctions which constitute the variables at our disposal to control the population level; and our objective would be to select that combination of these variables which would, over a reasonable period of time, maximise some "performance index" of the society. But I was told by the demographers that the system (the society) is very difficult to identify (i.e., it is difficult to predict its response reasonably well) and also it may vary with time in an unpredictable way. Besides, for our country, we do not need any optimisation theory to tell us what to do; we simply have to apply brakes on the population growth as quickly and effectively as possible.

If I have succeeded in getting the brilliant minds of the I.I.T.ians to think about this very important problem, one should not mind the length of this article. Thinking about our population problem, one cannot help feeling very sad, even desperate, but the truth is often very ugly!

I am extremely thankful for the help Mr. David Radel of the Ford Foundations Population Programme gave me in acquiring some valuable information.

A Garland of Memories

R. NATARAJAN*

Padma Vibhushan Dr. Mudaliar, Professor and Mrs. Sengupto, Prof. Krishnamurthi, Mr. Ramaswamy, staff-colleagues, students, friends, ladies and gentlemen.

Even at the outset, before I say something, by way of reply, I must plead not guilty to the compliments, mostly imaginary, that have been paid to me. These are, usually, not excusable at all, but having reference to the day that we have assembled on—1st April—I think this becomes a little pardonable,

‘I cannot sing the old songs,
I sang long years ago
For heart and voice would fail me
And foolish tears will flow’

said Charlotte Bernard on a farewell occasion similar to this. To try to recapture the fleeting loneliness of the fond hours and years that I have spent at this Institute, or to ransom the many sweet memories I have gathered during the last six years that I have been with you is bound to land me in a similar predicament. But I have the high authority of George Santayana, that life is not a spectacle or a feast, it is a predicament. Under such circumstances, I will have to go through this predicament which I shall, presently.

“The sun’s rim dips: the stars rush out, at one side comes the dark” wrote the poet Coleridge when once describing the sudden descent of darkness on the scene. Without any pretences to being a poet myself, I must confess to a feeling, of mental darkness as the day of my departure from this Institute draws dangerously near—the dreadful day when I have to

(I.A.S., Former Registrar, I.I.T. Madras. Speech delivered on the occasion of his laying down office.)

exchange my dear office room for the visitors' room—I am referring to the morning of the 5th April. Some might ask me what was the silken bond between me and the Institute—that strange and deep affection. They would say that it is the lot of Government servants to leave sweet scenes and familiar faces once in two or three years, for

“ Theirs is not to make reply
Theirs is not to reason why
Theirs is but to do and sigh.”

(with apologies to Lord Tennyson for the alteration in the last word)

But my defence and explanation is that you cannot find a pleasanter place or more congenial work spot than our Campus. I have not seen a place which compares even favourably with this. The famous lines of Lord Byron

“ There is a pleasure in the painless woods,
There is a rapture on the lonely shore,
There is society where none inside
By the deep sea and music in its roar
I love not man the less, but Nature more
From these our interviews.”

You are all very well aware that I am referring to the Institute campus and the warm waters of the Elliots Beach nearby.

It was the poet Shelley who once wrote, “ Life, like a dam of many coloured glass, stains nor writes radiance of eternity”. True, life leaves many memories behind—both good and bad—sometimes sweet, sometimes sour. But my six years stay at this Institute, I must say, has been a garland of golden memories which, I am sure, has been due to my humble and lucky associations with great minds like those of Dr. Mudaliar, our respected Chairman of the Board of Governors, Prof. Sengupto, our Director, my good friend Mr. Ramaswamy, the members of the academic staff and members of the administrative staff.

As I felt and said on the last Institute Day, to work with you, Sir (Dr. Mudaliar) is a liberal education by itself. Dr. Mudaliar has placed me under a very deep debt of gratitude. I cannot do better than by describing him in the words of the Old Testament. ‘As a lamb unto my feet and the light unto my path.’ As for Prof. Sengupto, I do not really know what to say. It was Louis XIV of France who once said, ‘I am the State’. With far greater justification but for his own innate humility Prof. Sengupto might well say, ‘I am the Institute’. He has done so much for the Institute.

I have always received the most excellent cooperation from the successive German Consuls at Madras, the German members of the staff at this Institute, the Directors of the Central Leather Research Institute and the A. C. College of Technology and the staff of more institutions as also from the Principal and members of the staff of the Guindy Engineering College.

I cannot forget my friend and colleague, the Superintending Engineer. Alladin had at least a lamp to work wonders with. Ramaswamy has been doing them without it. I leave you to judge who is the better of the two. As for my friends, the Professors here, they have always (right from the dynamic and 68 years young Prof. Krishnamurthi and the jovial Dr. Koch to the junior most of the Junior Technical Assistants) bucked me and backed me up at every step.

Professors like Valluri or Sampath, Nigam or Shastri are crazy after research, if I may use a slightly unparliamentary word. The future of research at this Institute is indeed safe in their hands. I, of course, cannot forget my old friends of administrations, distributed among the academic, the stores, the accounts, the security, the auditor and the cash sections. I hope I have not forgotten any one. Their devotion to me has been most exemplary.

Administration is an one man melody. It is a tune of harmony which has to be sung by people acting together, if it is to be effective. If anything has come out of it, quite a big chunk has been due to the wholehearted and excellent cooperation that I have been able to receive from my colleagues in the administration.

I always like to remember my friends—the student pals of mine. As with friends, we can surely say 'Tell me who your students are? I will tell you what your Institution is.' I have not met a better and more intelligent set of students anywhere. They have always done their best for their Institute. I would only request them to follow knowledge like a sinking star, for knowledge is the only instrument of production, which is not subjected to the law of diminishing returns. I am sure you will take pride in this Institute; for if we, the staff and students are not proud of our Institute, the others will have neither the time nor the patience to be proud of our Institute.

Before I conclude I must say this. Having missed the opportunity of being enrolled as a student of this Institute in this birth of mine, it is my wish that I should at least in my rebirth become a student of this Institute, preferably without a Joint Entrance Examination. I also wish I must go through the hands of the academic staff members who will all, I expect, be given an opportunity to become staff members again, of course in their own respective re-incarnations. I know some of them like Dr. Klein, Kuriacose or Khader do not believe in re-incarnations. But it is my prayer to God that they should be given one each, as a special case.

Higher Education & Research in Canada

PROF. M. V. C. SASTRI

Every year, an increasing number of Indian students and scholars seek admission to Canadian universities for post-graduate studies and research. Some impressions formed during my recent assignment as a Visiting Professor in that country may be of interest in this context.

Among the many Universities in Canada, those most reputed for their generally high standards are: McGill, Toronto, McMaster and British Columbia. However, none of these can claim to be equally good in all disciplines. There are particular areas in which each of them excels, but these also will vary from time to time on account of changes that occur in the senior faculty

positions. Further, in certain specialised areas some of the less well-known universities do outstanding work because of the Professors in charge of them. At the present time, none of the Canadian universities can claim to have attained the high standards of the best known American universities such as Berkeley, Stanford, Harvard, M. I. T., 'Caltech', Princeton and Yale. However, with the intensive efforts now being made by the Canadian Government, which has planned to 'invest' enormous sums of money on education at all levels from elementary school to advanced research, at least some of their Universities can be expected to peer the U. S. A. giants in the course of a few years.

Many of our students seem to think that it is relatively easy to get admission to Canadian universities. This is an erroneous impression which needs to be corrected promptly, for it has unfortunately led to large numbers of our students with indifferent backgrounds applying to Canadian universities; the poor performance of most of these students has caused considerable damage to the image of Indian university standards. Indian students seeking to go to Canada for higher studies will do well to remember that they have to meet with rather severe competition from other countries, notably Great Britain and Continental Europe. Admission standards of Canadian universities are quite stiff. Nor have the widely varying standards attained in Indian universities failed to be noticed and even recorded in Canada as elsewhere. In the University of Toronto, for instance, well indexed records are kept of the performances of students drawn from various Indian universities. Indian students are no doubt known to be cooperative and hard-working, but backward in basic fundamental subjects such as mathematics and physical sciences. Many Canadian and American Professors were appalled by the antiquity of the syllabi followed in these subjects in most Indian universities and wondered if this was not indicative of the apathy of our educational authorities towards basic sciences, particularly mathematics, on account of over emphasis on technology. Lack of familiarity with modern instruments and generally inadequate training in laboratory work is another strong deficiency found among many Indian students. I found it hard to correct this impression, because the resistance in our country against modern instrumentation is only too well known in the outside world. I also felt somewhat ashamed to hear that the references given by Indian professors about their students generally failed to serve their purpose, because of the tendency to lavish superlatives on students who should at best have been only mildly recommended. It is small wonder then that many American and Canadian universities have now started insisting on our students appearing for the Graduate Record Examinations conducted in many parts of the world, including India, by the Princeton and Michigan Universities. Against this dismal picture, it was indeed very heartening for me personally to find that students from the I. I. T.'s have fared uniformly very well wherever they went. This observation was heard spontaneously at nearly all the universities that I visited. I took the opportunity to explain the "strictly-on-merit" basis of admissions to the I. I. T.'s., the generally superior standards of our faculty and equipment and our method of evaluation of students' performance through assessment of term-work and periodical tests. I have ventured to make these comments not with any intention to disparage students from Indian universities, but rather with a view to warn them against thinking too lightly of Canadian university standards and going there without adequate preparation at home.

Although Canada is a Dominion in the British Commonwealth and many Britons are in senior faculty positions in Canadian universities, the curricular contents and administrative regulations pertaining to the various degrees follow more closely those of American universities. One point of difference is that admissions to Canadian universities are made only once a year, that is, in September, whereas in American universities one can join alternatively in February also, as many of their courses are repeated in both the Fall and Spring semesters. Otherwise,

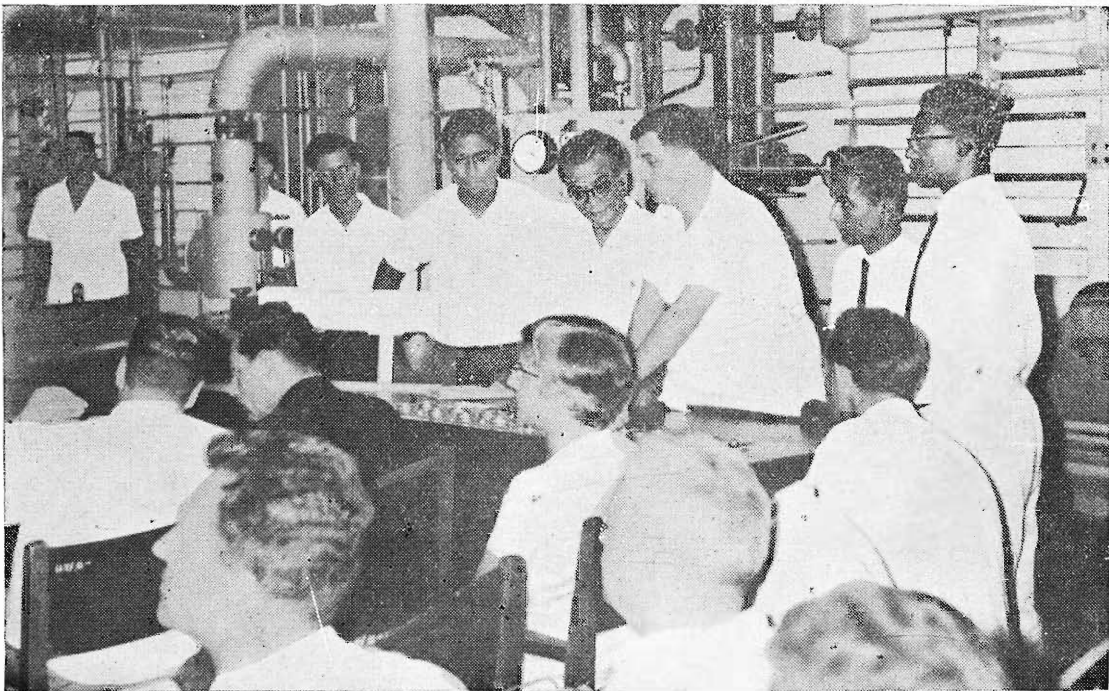
there is considerable similarity in the instructional techniques. As in U.S.A., in Canada also the students (particularly those in post-graduate classes) are encouraged to think freely for themselves and "coaching" is reduced to the minimum. Their extensive use of seminars and group discussions for instructional purposes is indeed worthy of emulation. The merit of a teacher is recognised not so much by the rhetoric content of his lectures, but by the quality of the work that he gets done independently by the students. At advanced (post) graduate levels, it is fairly common to find a group of students arrive at different solutions for a given problem. The answers are rated dispassionately according to the method of reasoning used and no student suffers for holding views different from the teacher's. To put it more bluntly, students are not used as repeaters of teachers' notes. The result: initiative develops at the prime creative age and original research proliferates.

Turning to scientific and engineering research, Canadian universities and research laboratories are generally well-equipped though not lavishly or glamorously as American universities. Generally, the emphasis is more on physical plant services, utilities and fabricating facilities than on ready made equipment. The tendency to conserve funds and to use them judiciously is evident even in the biggest Canadian universities.

Scientific research in Canada is financed almost entirely by the National Research Council, a Government sponsored body which is analogous to our C.S.I.R. The main group of N.R.C.'s research laboratories is located in Ottawa. These cover nearly all disciplines of science and engineering and are superbly equipped for almost any kind of research. In addition, the N.R.C. has subsidiary research laboratories at Halifax, Saskatoon, Chalk River and a few other places, where research activity is restricted to a few special fields, such as marine biology, radiation chemistry, agricultural science, etc. The N.R.C. also provides universities with substantial research grants and fellowships for specific research projects. What struck me most about the N.R.C. is the complete absence of any kind of Governmental pressure, directly or indirectly, on the type of research work carried out either in its own laboratories or with its financing in the universities. This is remarkable particularly when we consider the fact that the enormous research funds of the N.R.C. are drawn almost entirely from the national exchequer. To quote Dr. Puddington, the distinguished Director of N.R.C.'s Applied Chemistry Division, the principal aim and purpose of the Council is to promote scientific research and thereby to breed scientific intellect in the country. "We attract good men and leave them free with facilities to do what they please", he said. Government research projects are carried out mainly in a separate chain of research laboratories, which are directly administered by the respective ministries and departments of the Government. These too are very extensive in size and scope and are well equipped and provided with expert staff.



The Executive Committee of the Alumni Association for the year 1964-65.
Standing (L. to R.) B. S. Sudhir Chandra, S. Parthasarathy, S. Gopalakrishnan, R. Sridhar.
Sitting : (L. to R.) A. T. Santhanam, Prof. M. V. C. Sastri, Dr. Ing. B. V. A. Rao.



Steam Laboratory being inaugurated.



Registrar and Director, with Prof. Dr. P. Hilbig, Pro-Rector, Technical University, Berlin, and Prof. Westphal, Director, Academic foreign Relations Office. They were at I.I.T., Madras between 8th and 11th Dec. 1965.



Prof. Dr. K. Gerke, Rector, Technical University, Brunswick, standing on left. He visited the Institute between 13th and 18th Feb. 1966.

Faculty Association

As you are aware the Faculty Association of our Institute, comprising of all academic staff and some other instructional staff as well, has been in existence since the inception of our Institute. This association has been dealing with the social and recreational activities of the staff till the year 1965, and thereon, with the coming-up of the other associations like the Staff Club, etc. with specified sectors of activities, this association has been mainly concentrating upon matters pertaining to the academic activities of the Institute. The high-light of this year was the seminar on 'A suitable scheme of examination for the undergraduate course'. The consensus of opinion was that the year has to be divided into two terms, there being one terminal examination at the end of each term, one mid-term examination and one periodical examination. This scheme takes into account the proper appreciation of the knowledge gained by the student, the proper evaluation of the teaching standard and a reduction in the existing number of periodical and other examinations actually in force at present. The Association hopes to take up similar problems and bestow its attention on them.

There have been distinguished visitors entertained by the Faculty, like Dr. Burks of the University of Michigan from the United States, Dr. Taraev and Dr. Butaev from Moscow, Dr. Hilbig of the Technical University of Berlin from West Germany and Shri M. C. Chagla, our Union Education Minister.

In order to make the deliberations and activities of the association more effective, particularly in the scheme of instruction as well as in the inculcation of professional sense into our boys, suggestions are most welcome from our old boys who may be engaged in different spheres of activities all over the country and abroad.

The Gymkhana

The Gymkhana has been, for the past year, as active as ever. The Institute teams have, as usual, bagged most of the quiz and debating trophies in the city. It looks as though there will never be a lack of talent here and the Alumni, wherever they are, can be sure that their successors are as good as they were. Not content with winning the usual trophies, the Gymkhana has initiated what they call "Social Service and External Relations" which, whatever they might mean, have started making a lot of noise under the first Secretary, Madhusudhan Menon.

The Rowing Team did it again, they beat the Madras University. Another field where I.I.T. Gymkhana has made its mark is music. Yes, music! Our Institute Orchestra, the Beat-x (naturally), beat all corners in a music competition in the city. This has led to the sprouting of another strong music group which is slowly gaining popularity.

All in all the Gymkhana had a glorious year—as usual.

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