tional organs/tissues. Successful completion of clinical trials will provide a basis for introduction of cell transplantation as a treatment option for people with various diseases like Type-1 diabetes, neurodegenerative disorders and cardiomyopathies.

(b) Basic research studies should look into the following questions and come up with appropriate solutions: (i) Would stem cells do the job we want them to do *in vivo*? (ii) Would the cells get immortalized, fail to undergo apoptosis and lead to malignancy? (iii) Are there other unknown risks? More basic research is needed in the area of embryonic stem cell isolation, culturing, maintenance and controlled fate selection by way of conditional differentiation protocols and modulation of gene expression.

(c) Establishment of repository cell lines for studying diabetes, heart and neuronal diseases should be encouraged.

(d) The National Academy of Sciences, USA has recommended that the terminology 'therapeutic cloning' should be appropriately replaced with 'nuclear transplantation' – to describe stem cells made for research in regenerative medicine using somatic cell nuclear transfer. It appears that this new terminology would clearly articulate the differences between stem cell research and human cloning. We hope that for many activist groups who want a ban on cloning, the term nuclear transplantation may be more acceptable.

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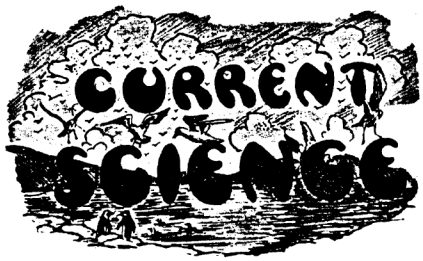
FROM THE ARCHIVES



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The changing outlook of engineering science*

As engineering knowledge and the requirements of industry are rapidly changing, planning of engineering education is necessary. Practical and academic sides of engineering should be regarded as one undivided whole. Engineering science is defined as the academic aspect of engineering and the author discusses it under three heads.

Teaching

Industrialists have lost their old time contempt for the engineering graduate but the qualities demanded now are new. The college curriculum tends to overcrowding, each enthusiast desiring to include a little more of his subject. The final result is a syllabus which the average student cannot assimilate. The industrialist now engages specialists for his special problems and demands from the graduate, ability to take wide views, to think, to negotiate and to control; qualities which can be developed only in their undergraduate years given sufficient leisure for original thinking. The knowledge of engineering principles required is such as an average student should be able to acquire and can be tested by easy papers. The timetable should not therefore be overcrowded. There is however need to co-ordinate the three years' college instruction with the two years practical training so as to form a connected five years' training carried out with a single objective.

Research

Engineering research has become specialised and a tendency is observed to leave everything to the pure scientist. The attitude of the engineer to his problems is however entirely different from that of the pure scientist. The latter requires ideal conditions and materials. He is free to choose his path or alter it at his will. His shapes are not dictated by constructional or manufacturing requirements; nor his materials by considerations of strength or cost. The engineer, on the other hand, has to solve a problem as it is presented and some solution he must have, even though it is only approximate. Engineering research requires the gift of visualisation and this must be fostered deliberately. The inevitable factor of safety must be reduced as improved methods are evolved. Owing to a margin of error being ever present in the engineer's data, he cannot copy exactly the scientist's methods, but must develop a method of his own. The 'Relaxation method' devised by the author has been able to solve many problems hitherto regarded as difficult. It is not to be imagined that engineering does not aim at accurate calculations. On the contrary, correct calculations are more important for them as the real check, viz. test to destruction, is both costly and dangerous. Engineering research should aim to point out the 'disturbing factors' in the scientist's solutions and to leave the scientists to solve the new problems thus presented.

Relations to community

The accusation is sometimes levelled against scientists and engineers that they are responsible for the modern wars and their horrors. This is entirely groundless. Wars have always been made by communities and not by engineers; nor is the horror peculiar to modern wars. By their search for knowledge, scientists and engineers have opened up vast sources of power. Knowledge is non-moral. Poisons and deadly weapons may be used for the happiness of a community in preventing disease, etc. It is not the fault of the scientist if these powers are used for evil objects. The engineer has been silent in the past. As a member of the community he has a duty to perform. He can instil into the mind of the public a clearer notion of the real aim of scientific work, which is to seek the truth, believing that the gifts of science hold potential good.

*Summary of address by R. V. Southwell, President, Section of Engineering, British Association for the Advancement of Science, Cambridge, 1938.