

## **TOWARD A PROPER ROLE FOR SCIENCE AND SCIENTIST: AN OUTLINE FOR ANZAAS PAPER 1973, PERTH**

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1. Since at least the late 1930s we have been faced with the increasing escalation of science-based industry and the part of research and development in economic growth. With the revolution in information technology and the burgeoning of the social sciences these trends have spilled over to most areas of organized social activity. It no longer shocks us that such a venerable organization as the Papacy might call on the services of McKinsey'.
2. This rapid growth in the use of science and scientist has taken place in the context of the growth in the size and bureaucratization of organizations. And this applies to both sides of the growth – the utilization of scientists and the production of scientists. This CSIRO, Shell Research Laboratories, Cal-Tech have long ceased to be the sorts of places that Faraday, Cavendish and Edison worked in: the University of N.S.W. can no longer provide the close staff-student relation that Bayliss could in the University of W.A. in the early forties. The processing of masses of students has meant the replacement of personal relations by impersonal rules.
3. The gross and dangerous inefficiencies of bureaucratic organization in a turbulent social environment have been recognized (O'Toole, 1973). There seems little doubt that one of the major items on the agenda of the western societies is the de-bureaucratization of their organizations, public and private. As a matter of course this social movement will affect both the way we produce scientists and the way we use them. I suggest that the matter is not as simple as that and there are special reasons for scientists, no matter what their discipline, being leaders, not recipients, in these social changes.
4. Whilst I accept Sommerhoff's argument that engineering is basically a more creative discipline than science I do not think that science can be a socially

justifiable occupation unless it is creative. The analytical chemist monitoring qualities in a brickwork or a flour-mill is a thing of the past (although in the 1940s it was still a very real career prospect). Creativity, and professional growth, are going to be stifled if we recruit scientific talent into organizations that are bureaucratically arranged. I know that the managers of research establishments, themselves scientists of repute, are apt to wax enthusiastically about the open creative climate of their labs, compared with the rest of their organization. I also know from personal study of science labs in four countries that such enthusiasm is usually unwarranted. Despite fringe allowances for the 'long-haired' and 'egg-heads' the bureaucratic pattern is nearly universal. The consequences are general. Research gets carved up into one-man units, the interface between the research and its users gets located upstairs with some one who understands neither, the 'blue-eyed boy' becomes a mandarin and a new interface develops between fundamental and applied research, the scientist who shows a real capability in some particular task becomes over-specialized as he becomes defined as the best answer to urgent and insistent demands for service from outside bodies.

5. The pressure toward proper utilization of scientific potential in the U.S. space program led to government contracts stipulating that a non-bureaucratic 'project management' be specified by any would be contractor. Lockheed Corporation, amongst others, went beyond this requirement to develop matrix type organizations. Soviet defence industries had to move in the same direction. These moves encountered problems. The new forms of organization about the work-face were still embedded within organizations that were bureaucratically organized. There does not, however, seem any way back. Scientific problems cannot be carved up into one-man tasks without grave danger of missing the point; scientific personnel cannot be expected to constitute creative teams unless they are guaranteed the minimum conditions of 'selective interdependence', and an adequate degree of autonomy. The Commonwealth Department of Works has for some years been exploring methods of 'project management'. Unless this matter receives wider attention I do not think we will realize the potential of our current scientific personnel, nor do I think we can hope to reverse the trend of our best young minds away from scientific occupations.
6. Our methods for producing scientists ought to give us reason to pause and think. Once these were the paths to elitist positions. That no longer represents the way they feel. However, the point I wish to make is that those in training to be scientists ought to be trained in ways that are appropriate to the 'project' and 'matrix' forms in which they can be expected to be employed. I do not believe that it is beyond the ingenuity of universities to devise syndicate methods of learning and even team research for Ph.D.s that still would enable individual evaluation. The 'master-apprentice' model that persists in the Ph.D. training does

no good to the student or subsequently to the society. The good it does to the 'master' is pernicious to the purposes of science.

7. I do not think that what have said above comes anywhere near the redefinition of the role of science in the society that is now emerging. To my mind two fundamental changes are occurring. The problems of man-man relations are displacing the man-nature problems from the stage of public concern. This has even got to the stage where the man-man relation is more sensibly defined as the man-woman relation (statistically women tend to be about fifty per cent of a human population). The man-nature relation has already been effectively redefined since Rachael Carson rubbished the test-tube cause effect relations of the test tube chemist. A great deal of the esoteric skills of the scientist (or the engineer) can be programmed for a computer, and there is little economic sense in building these programs into science students. I do not know what this means but I have a strong suspicion that we will not get the sort of scientists our society needs unless we have something more to offer than we can program onto a computer and most of their first names are of the class of first names of which 'Rachael' is a member. The second fundamental change is the erosion of the special role of the 'expert'. This is a matter in which I have been directly involved. What stands out is that in science-based industries the interfaces with management and workers is quite inappropriate. Science graduates must accept that they are going to spend time at the work-face; managers are going to have to accept that the work-face is where experimentation (E.V.O.P.s) is the norm, and promotion to managing sociotechnical systems is going to require an education in human needs that goes beyond the original B.Sc.

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