

FREE OR DIRECTED RESEARCH

1. A large proportion of research is applied research. Inevitably this is directed research both in its objectives as well as its conduct. I restrict my remarks to the so called pure or basic research in natural sciences.

2. The distinction between applied and pure research is clearly arbitrary. Pure research is certainly not 'not applied' or inapplicable. Its objective as a rule is not a product or a technology but a new fact or a principle. Applied research may achieve the same objectives, although that would be incidental to its purpose.

3. A great deal of pure research is also directed. Funding agencies fix priorities and allocate money accordingly. In many areas (high energy physics) experiments involve building very large and expensive equipment. A large part of research effort has to be devoted to this 'building activity'. Even where equipment building does not constitute the main part of the research effort, more and more of research tends to be done by large groups where the work of individual researcher has to fit into the overall objectives of the group.

4. The trend towards greater 'directedness' is thus strong and largely inevitable. It stems partly from increased social ramifications of scientific research and partly from the nature of modern science itself.

5. It is therefore becoming increasingly important to ensure that direction and organisation of research do not cripple the basic instincts of science, originality and creativity.
6. There remain many areas of science where success does not depend upon big equipment and organisation. These are mostly frontier areas. A good example is molecular biology (I call it inexpensive only in a relative sense, say compared to high energy physics). A large part of research in this field is (and has to be) exploratory. The researcher does not quite know what he wants. He is guided by his intuition and hunches. Once in a while he is successful and his success opens up entirely new approaches; a lot of effort is then put into this new direction. To a great extent this is possible because the distance between an idea and its realisation is not too great. Once a new theory or a new approach is conceived it does not take too long to test it. Perhaps this state cannot last indefinitely and as the field develops it will inevitably settle down to systematic and organised work. It will then cease to be a frontier area. I merely wish to emphasise that the scope of directed research in such areas is very limited.
7. Lastly I should point out a danger to freedom in research which does not come from overt sources such as financial support or direction of policy. Scientists are greatly influenced by the ideas of other scientists specially the successful ones. This generates strong psychological pressures that have been described as 'the bandwagon effect'. Those who are not with the stream of

currently acceptable ideas are ignored. The weak (and one has to admit the majority of scientists belong to this category) give in. This subtle pressure of 'scientific opinion' is a serious impediment to originality.