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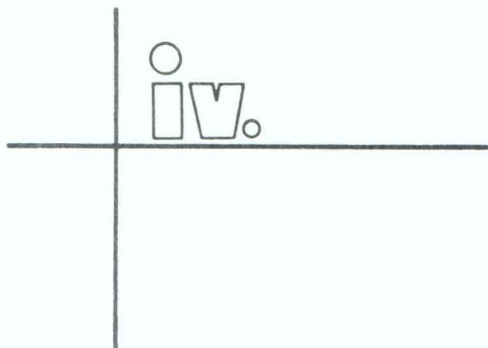
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# A PROGRAM FOR THE DEVELOPMENT OF LIBERAL STUDIES IN SCIENCE

James L. Goatley

## *Introduction*

Most academic disciplines have a clear relationship between the research that is done and the content of courses that are taught. In the area of general education and liberal studies, however, the reciprocal relationships between teaching and scholarly investigation are much less well understood. (In this paper general education refers to courses that are taught and liberal studies to the scholarship related to this course work.) The author believes that there is difficulty because the domains of general education and related liberal studies have been poorly articulated. The problem is particularly acute in general education and liberal studies in science.

The lack of clear definition and an understood reciprocity between research and teaching presents two problems. One is that there is no adequate agreement on material appropriate for general education science courses. The other is that there are no general guidelines for scholarly development and evaluation of general education faculty.

## *Curriculum*

In countless faculty and committee meetings conceptual difficulties occur which center around the meaning of general education. It is clear that most university faculty view general education as a sampling of traditional disciplines. College catalogues and the literature on general education offer innumerable permutations of the facts and ideas of science as the best combination for general education. Yet most faculty with experience in liberal studies view general education as something quite different. The latter see many inadequacies in a simple survey approach to science.

Part of the problem lies in the history of development of general education science. The liberal/general idea of education has a long history, going back, of course, to the ancient trivium and quadrivium. In the present century the principal justification for general/

liberal education is that too specialized an education results in a constricted intellectual perspective. Despite difficulties and often failures in various ways of liberalizing higher education, the need is perhaps more significant than ever. The two chief ways of responding to the need have been distribution requirements and the development of general education courses. For the most part general education science courses have taken the form of representative highlights from a variety of scientific disciplines.

Many general education faculty have found the idea of simply assembling some areas of knowledge from the traditional disciplines to be an inadequate and unsatisfactory view of liberal education. They have come to recognize that teaching general education science involves orders of generalization and interrelations that are not a part of the regular scientific disciplines.

### *Faculty*

General education science requires a specially trained (or trainable) professor. While much debate has been given to the content of courses, little attention has been paid to the education of professors to teach those courses or to their appropriate development as scholars. This has significance in evaluating general education faculty. In most university departments, a faculty member is judged by his general scholarly preparation, his knowledge and productivity in his scholarly specialty, and his teaching effectiveness. The latter includes both mastery of the material and the ability to engage students in it.

In evaluating general education science faculty (indeed, most general education faculty) teaching effectiveness is heavily considered, scholarly productivity is observed, but general scholarly preparation is seldom examined systematically. Even scholarly productivity is sometimes measured only in terms of the traditional disciplines. In some institutions faculty must live with a variety of blind prejudices about the nature and quality of the scholarship in which they are engaged. Yet these faculty are part of an important tradition of scholarship.

Unfortunately, the academic structures of colleges and universities fail to recognize this. In some schools teaching faculty for general education are drawn on a part-time basis from regular science departments. Their rewards are not for development as generalists in liberal studies but as specialists in their traditional discipline. In other cases there are separate general education departments, but their role in the university is viewed as almost exclusively teaching. Because of that, and since the most widely held view of general education is that it is a presentation of elementary disciplines, little recognition is given to the considerable scholarship that goes into the development of the modern general education course. In fact, unlike some disciplinary areas where course preparation involves assembling an appropriate grouping of existing knowledge in the area, developing a good general education course often involves considerable scholarly creativity in the process. This scholarship often goes unrecognized because of the lack of understanding of general education.

The faculty development and evaluation problem has the same roots as the curriculum structure problem: There is no clear articulation of that body of knowledge or area of scholarly exploration appropriate for such faculty.

### *Liberal Studies in Science*

In recent decades there has been a great growth in scholarly fields which are rooted in science, but which go beyond the basic science disciplines. Collectively these constitute an area often called liberal studies in science. This scholarly area has general education as its teaching counterpart. The area provides social, historical, and philosophical dimen-

sions that are much needed in understanding the role of science in human affairs.

While the area of liberal studies in science is vigorous and productive, little specific attention has been given to the development of a descriptive classification for it. Yet a clear understanding of its structure is necessary in order to judge and guide curricular structure in general education and to measure and direct faculty development. The next section of this paper suggests such a classification, covering the scope of liberal studies in science and, therefore, the source of much of the material for general education teaching in science.

### *A Classification of Liberal Studies in Science*

To understand liberal studies in science as a separate academic area is to recognize that there exist important ideas and areas of knowledge related to science which are not dealt with by the traditional scientific disciplines, or which need to be integrated in new ways. They are so all-encompassing or broadly interdisciplinary that the traditional disciplines cannot cover them. Investigating these areas is the domain of the liberal studies scholar and teaching about the nature of the questions investigated, and the accepted or provisional answers, is the domain of the general education science teacher.

It will be obvious in the following classification that there is considerable overlap in the categories, but that is necessary in searching for general relations.

#### *I. The Organization of Scientific Information*

- A. The content of the disciplines
  - 1. empirical content (classes of facts)
  - 2. major concepts and theories
  - 3. reciprocal relationships between facts and concepts

Although this paper argues that liberal studies science is more than the traditional disciplines, these studies are nonetheless science based. Both teaching and research must recognize the central core of science that is being examined.

- B. The disciplinary organization of science

This area concerns itself with the way the major questions and classes of facts in the sciences are divided. In its simplest form it would be a cataloging of the disciplines of science. More importantly, this area deals with the reasons for and values of particular ways of separating the disciplines.

- C. The interconnections of the disciplines

This area deals with the ways in which the questions asked in various disciplines interrelate and the ways in which advances in various areas catalyze or otherwise interact with other areas.

- D. Current trends and innovations

Liberal studies in science must have a particular sensitivity to current activities in order to interpret them in the larger context of the history of science and its social role.

#### *II. The Intellectual Context of Science*

- A. The history of science

History of science is, of course, a respected intellectual discipline in itself, but the more general facets of the area are of particular value for the liberal studies scholar.



B. Interpretations of the history of science

It is one thing to report the history of science. It is another to interpret that history in general frameworks. The efforts of Kuhn, Toulmin, and others in that direction are highly significant to liberal studies in science.

C. Scientific biography

Biographical studies are of value in liberal studies since they may reveal much about the actual practice of science, and the character of the people who participate in it.

D. The relation of ideas in science to the general history of ideas

It is self-evident that science has played an important role in the history of ideas. Unfortunately the dimensions of its influences have often been sketchily or inaccurately reported.

E. Methods in science

Epistemology is a legitimate concern of the scientific generalist as well as the philosophical specialist.

F. Science and world views

Science has shaped and been shaped by shifting world views. These interrelations are an important area of concern to the generalist.

G. Other aspects of the philosophy of science

Epistemology and metaphysics have been areas of such special interest to the scientific generalist that they are indicated in separate categories. The importance of the philosophy of science as a whole to the generalist can hardly be overestimated.

H. Creativity and science

The nature of the creative process in science is intriguing and significant to the liberal studies scholar.

I. Science and particular other disciplines or human concerns

Many generalists find themselves involved in studying the relationship of science and particular other disciplinary areas or scholarly or artistic activities. For example, there is rich literature on the relations of science and religion. There is a growing literature on the influences of science on literature.

### III. *The Social Organization of Science*

A. Scientific organizations and their role

B. Science as a social structure

Interaction of scientists individually and in groups.

C. The interaction of the governmental, academic, and private sectors in science

D. Communications in science

Role of meetings, research literature, reviews, and other secondary literature, informal communication and public popular forms of communication.

E. The interaction of "basic" and "applied" science

F. The individual and the practice of science

This concerns itself with the problems of intellectual capabilities, rewards, social pressures, etc., that motivate, discourage, enhance, or restrict the individual in the practice of science.

### IV. *The Social Milieu of Science*

A. The social context of support for science

For what interests or purposes do the public or special interest groups support scientific activity?

B. Funding of science

For what purposes or interests will the public or special interest groups fund scientific activity?

C. The social impact of scientific information

What effect will the technological implications of scientific findings have on social structures?

D. The ethical implications of scientific findings

In terms of public awareness of science, nothing is of more concern than the ethical questions arising out of new technologies, especially in bio-medical areas.

*Use of the Classification in General/Liberal Education Curricula*

The taxonomy proposed argues against any view of general education in science that limits it to samples of the traditional disciplines. This holds true if the sampling takes place in integrated "natural science" courses or by elected introductory courses in a variety of traditional disciplines. It by no means excludes, and in fact even demands, the use of the information contained in the scientific disciplines. But it attempts to relate this information to larger questions.

It is apparent in looking over the taxonomy that no reasonable number of general education courses could cover the range of areas in the list. Therefore, selection must take place. Less apparent, but no less true, is that there is no easily selected group of concerns that "must" be in general education.

If staff and budget allow, a variety of courses emphasizing one or more facets of the described domain would be offered, with students selecting courses that range from the more scientifically technical to the more socially, historically, or philosophically reflective. If only a restricted number of courses can be offered, then the best route is to design courses which expose a number of points on the list, but do not attempt too much.

*Use of the Classification in Faculty Development*

There is no such thing as a Ph.D. in liberal studies in science. All traditional science training emphasizes the facts and ideas of a particular discipline. Unfortunately, it seldom gives attention to the more general questions of the nature of science and its social role. Advanced degrees in the history or philosophy of science have dimensions that basic science degrees lack, but often leave the graduate with little acquisition of the basic subject matter in any of the sciences. Degrees in science education give the graduate a valuable advantage in the techniques of teaching effectively, but general preparation in the sciences or in the history and philosophy of science may be weak.

Given that no degree is the "right" degree to begin a career in general studies in science, faculty growth and development on the job become extremely important. The problem is on what basis to encourage, measure, and reward this development. In circumstances where general education faculty are attached to regular science departments, the evaluation of the faculty is done on the same basis as within the established disciplines, thus making general education contributions an unrewarded adjunct. But even in cases where general education faculty have their own department, evaluations are too often made with inadequate attention to scholarly growth as a generalist. The proposed taxonomy could be used as a standard against which to measure such growth.

With any criterion of faculty performance there are difficulties in measuring development along the lines indicated. But there are some measures. Publications are obviously one, with the range of publication an indication of extent of growth. Other measures are use of professional time uncommitted to routine duties, contributions to course and

curriculum development, course material development, and breadth of scholarship as indicated in intellectual exchanges with colleagues.

It is obvious, of course, that a given faculty member can have a scholar's understanding of only a part of the domain of liberal studies in science. But this is no different from any other major academic area. A synthetic organic chemist may know little of the special areas of the physical chemist, even though both are legitimately called chemists. Liberal studies teacher-scholars would have their areas of specialty. These scholars should, however, recognize the range of key problems with which the generalist in science concerns himself, just as the specialist in an area of chemistry has some understanding of the general domain of chemistry.

Besides the range of scholarly specialization that is tabulated in the taxonomy, the roles of scholar and educator can be combined in the following ways:

I. Development of educational literature

Suitable texts for general education teaching are nowhere near the state of development of texts for traditional disciplinary courses. The liberal studies teacher/scholar has an open field for contribution here.

II. Curriculum Development

The educator/generalist may develop courses and curriculum for teaching the ideas of liberal studies in science.

III. Interpretation of science

The generalist in his educational role may deal with how to put scientific ideas in forms understandable to the layman, but with minimum distortion.

IV. Popular literature

In a role as educator, the scientific generalist may be concerned with the nature and production of popular literature in science.

*General Studies and the Organization of the University*

As indicated above, it has been the case all too often that scholarship in liberal studies science lacks institutional identity and is considered a separate function from general education teaching within the university. This is, of course, a generalization to which exceptions are found. Despite these exceptions, most institutions could use a new kind of organization. The taxonomy of liberal studies science given above could serve as an organizational tool for the formation of a true general studies department, combining both the scholarly and educational components.

It might be argued that the activities of the generalist could be subsumed into existing academic departments. The rigidity of the academic disciplines is too well documented to suppose that this could be successful. The best arrangements are in those institutions where separate general education departments exist. There, liberal studies scholars-teachers can be brought together, vigorous interaction of scholarly thought can take place, and appropriate curricula can be derived. The often isolated general studies scholars can have greater interaction with each other, and are in a better position to contribute to effective teaching. The general education teacher has a greater opportunity for scholarly recognition and activity.