HYDRAULICS DIVISION

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WORKSHOP ON SCIENCE POLICY

Strathmere House -

Jan. 31 - Feb. 2, 1984

Comments on Science and Policy

1. The comments which follow are adapted from an address made at the workshop and written here in a non-colloquial form.

2. Forecasting the future has always been difficult and since Robert Burns has recently been in the news, it's appropriate to recall some of his views:

> "But, Mousie, thou are no thy lane (alone)
> In proving foresight may be vain;
> The best laid schemes o' mice and men
> Gang aft a-gley (awry)
> And lea'e us nought but grief and pain
> For promised joy.
>
> Still thou are blest compar'd wi' me
> The present only toucheth thee.
> But oh' I backward cast my e'e (eye)
> On prospects drear,
> An' forward tho' I canna see,
> I guess an' fear."
>
> R. Burns, 1785

Science policy is an elusive idea - one not easily drafted in a coherent form.

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There have been numerous documents on various aspects of science and technology in government and in the Department. In fact, the volume of this material is astounding and reflects some basic and underlying concern. The more recent of these - the review of Dr. Roots on science in DOE - is quite comprehensive and describes the situation very well.

The problems and attitudes described by Roots have parallels in a paper in SCIENCE by E. Brown and Radford Byerly on research in E.P.A., written in 1981. Some examples of their remarks are:

> "....scientists seem to perceive the program offices as demanding 'response to crises', whereas the program offices see the scientists as wanting to follow their research where it leads them, without regard to agency missions and deadlines. Although not logical opposites, these two views are sufficiently different to cause major difficulties in planning, managing, and evaluating the research program of the agency.
>
> The disturbing lesson of the hearings seems to be that the customers do not understand what to expect from a research program. Perhaps they do not pose the right questions; and if their questions are invalid, the answers will be also. In comments surprisingly applicable to EPS research, Henry Kissinger has described the general difficulty the intellectual has with the policy-maker:
>
> > The contribution of the intellectual to policy is therefore in terms of criteria that he has played a minor role in establishing. He is rarely given the opportunity to point out that a query delimits a range of possible solutions, or that an issue is posed in irrelevant terms. He is asked to solve problems, not to contribute to the definition of goals... In short, all too often what the policy maker wants from the intellectural is not ideas but endorsement...The policy maker sincerely wants help. His problem is that he does not know the nature of the help he requires. And he generally does not

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become aware of the need until the problem is already critical.... Of necessity, the bureaucracy gears the intellectual effort to its own requirements and its own pace; the deadlines are inevitably those of the policy maker and all too often they demand a premature disclosure of ideas which are then dissected before they are fully developed. The administrative approach to intellectual effort tends to destroy the environment from which innovation grows. Its insistence on 'results' discourages the intellectual climate that might produce important ideas whether or not the bureaucracy feels it needs them.'

It is clear that senior EPA officials see ORD (Office of Research and Development) in much this way, and that they do not like to be told that they are not posing the right questions, that a 'query delimits a range of possible solutions'.

Thus many forces now at work in EPA push its research program in a direction that could be characterized as short-term, limited in scope, routine, and lacking in the stimulation needed to sustain high-grade work. A review of the hearings suggests the following as epitome: 'The fact that the need for excellence is constantly invoked is no guarantee that its nature will be understood'."

The conclusions reached by Byerly and Brown on the policy which should be adopted by EPA in conducting their R and D was:

"... the authors conclude that the agency give more support to the accumulation of the scientific 'intellectual capital' needed for managing the environment in the long run."

In view of the parallels in the scientific needs of DOE and EPA, this conclusion is an interesting one.

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3. Science Policy is an abstraction which is difficult to contemplate and does not have a high profile at the working level. In recent days raising science policy in DOE as a topic of conversation with scientific staff evoked derision and cynicism. If the subject was pursued views were expressed that the paper work and administrative rules had taken over - trenchantly implied in the comment, "Does anyone care if we produce anything?"

4. Selecting scientific topics for research is not done on a whim. Competent scientists and their managers are very conscious of the context within which projects are selected.

   Scientific projects are based on real gaps in knowledge and once a decision is made to follow certain areas of research such as aquatic ecology, environmental contaminants, or hydraulics, then the priorities almost automatically follow within the themes applicable to DOE mandates. These topics exist no matter what processes or priorities are of current popularity.

   There is a feeling of dissatisfaction with research work output which is manifested by having a lot of attention paid to the process of selection. Some of the documents produced are based on simplistic models of management and on occasion tend to be presumptuous in their implied assumption of the lack of competence of scientific staff. Most of this material is not considered when decisions are made. After the scientific problem is identified, then the necessary documents are generated. It must therefore be noted that bureaucratic actions will not change the basic selection of scientific unknowns which should be investigated.

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5. Controls on scientific management appear to have increased because it seems the blame for the perceived inappropriateness of the scientific product has been assigned to the scientific staff. The most recent imposition is the identification of "sponsors" for research studies. Research managers are continually being asked to explain their projects and to defend decisions based on scientific perceptions which are being judged on non-scientific criteria. Far too much time is spent on this non-productive activity.

6. Departmental priorities reflect political, socio-economic, and regional needs. In that context they are sound but as they tend to be short lived and not science-based, they must be interpreted liberally before designing research programs. There are other features of priorities:

   a) Chicken and Egg. Some priorities of the Department, such as Toxics and LRTAP, are the result of scientific endeavours. Making the topic a Departmental priority does not change the scientific priority nor does it materially affect the rate of progress. That depends on the rate at which one can think. Dollars are a necessity but they bring more pressures from management to get results. They may only accelerate progress in the wrong direction.

   b) Confrontation always exists between scientists and management. Management wants results; scientists want to understand. Once a scientific subject is a political issue it cannot he addressed effectively by scientific staff without assistance from non-scientific staff.

      The action must shift to mobilizing the existing knowledge and expertise of scientific staff. Non-research staff use information, theories, and data garnered by others to prepare

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position papers. In this process scientific staff may be piqued because they are sidelined and ignored. Of course, this is usually justified because the skills and time necessary to prepare position papers are not skills or occupations of research staff. Nevertheless, more recognition would sometimes be appreciated.

c) Some problems have only a small portion which is resolveable by research activities; the remainder may be assessed by existing knowledge. There is, therefore, a problem of integrating research and non-research activity.

d) The time scale for research is different than for operational needs. If the problem was easy it would have been solved long ago. Science projects have certain characteristics. They are:

1) It takes time to establish a knowledge base on any subject.

2) It takes time to develop enough knowledge and reputation in order to communicate effectively and to collaborate with other research scientists and institutes.

3) It takes time to collect data, design experiments, and to undertake analysis and to confirm hypotheses.

Priorities of DOE are valid in context but do not necessarily reflect the scientific problems which require action within the general mandate of DOE and its objectives.

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7. Connections between science projects and programs are accomplished by research managers, not by scientists. For example, research on ice jams may be related to:

1. Flooding
2. Energy
3. Dredging
4. Diversion
5. Navigation

Scientists in general do not plan ahead in detail. The current requirements for detailed five-year plans are the product of management who will have greater or lesser success in predicting correctly. Five year plans for non-scientific projects are relatively easy to do but the detail demanded for such plans in science should be abandoned.

8. Feed back on scientific output from management and non-research units tends to be poor. There is obviously a communication difficulty. The reasons for the lack of response are obscure but may be connected to the following:

1. The report is incomprehensible to the reader (Probably true for some reports).

2. Its relevance to the operational needs is not recognized. (Probably true. There is also some research attempted by operational groups).

3. The recipient is too busy to read the report. (He lacks the expertise to absorb it without background)

4. Its not in French - possibly a factor in Quebec.

The lack of response is disappointing but does not erode the confidence of the research group in selecting subjects to investigate. It does mean, however, that streaming research reports directly to management is

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probably not effective, Management is not equipped to deal with the results which are produced in an eclectic and haphazard fashion. Management, in fact, needs integrated summaries of scientific opinion and know-how on selected issues.

9. Classification of managers by research in the SM category is a long term threat to science programs. No research scientst who is really competent will enter this category because of the salary scale and because it's equated to non-research jobs of low prestige.

The science policy must eventually address this issue. It's a time-bomb which will inevitably produce third rate managers followed by third rate science. If the science to be done is not the best, then it's not worth funding.

10. Principles for Policy

Analysis can lead to paralysis. Ideas and policies to be effective must be simple and direct.

The first major feature of DOE is that it has a large sphere of influence but only a small sector which is managed directly. It is therefore self-evident that DOE and ECS obtain their objectives by lateral methods, by influencing others. This influence is implemented through

1. Political acts.

2. Agreements with Provinces who share constitutional management responsibilities.

3. Diffusion of technical and scientific information and knowledge of the environment.

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Organizationally, the Department has concentrated on the first two methods and tried to use R&D through line management and bureaucratic channels. This is very difficult to do without introducing interpreters. And soon the interpreters are the science authority. The research teams have also been disseminating R&D results and data directly to engineers, planners, and other scientists and specialists in the world at large. Policies should reflect the real situation. A basic strategy in reorganizing is to discover how things really get done and then organize that way.

Principle One

The distribution and dissemination of knowledge and data should be adopted as a basic method to influence others. Marketing this knowledge should be emphasized but, in order to be effective, DOE must be recognized as being an authority. Research centres and data centres must be seen as sources of knowledge. To do that the customer must be convinced to seek information from DOE and rely upon it.

Doing this will not change basic internal flow of R&D results to management. Management, however, should recognize that the production of data and research results which go directly to technical staff are a real but officially unrecognized DOE output. Consolidation of research opinion on issues prepared for management should be done in the Institute, not elsewhere.

Principle Two

Only the best will do. Third class work is a waste of time and money and is self-defeating.

Science institutes should be required to develop identifiable national and international reputations. If they are buried in the

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DOE organization this is difficult to do. Therefore, there is a need to organize so that centres for data and for research are readily identified by the public and especially by the scientific and engineering communities.

At the outset CCIW was correctly constituted. However, successive decisions or reorganization have greatly blunted its impact.

Research directors need a much higher profile and should be required to develop it. Where views or scientific issues depend very much on reputation it is obvious that, in order to be effective, reputation and prestige must be developed. Opinions obtain weight from prestige, not just from technical content.

More freedom to develop the necessary reservoir of expertise, knowledge, and data is fundamental and requires, for research institutes, increased freedom to engage young scientists and organize scientific exchanges. With the correct funding and attitudes the institutes and data centres would create a reservoir of unimpeachable expertise on which management could draw for advice and assessment for operational and political problems.

A secondary aspect in this regard is the need to undertake studies on a broad front because the questions that will be asked are a priori not known.

Principle Three

There must be a policy of steadfastness. Research and data need time to ensure results and to develop the necessary reputations to ensure reciprocal connections with other scientists and institutes. In-house programs cannot do everything; therefore it is critical to establish national and international connections so that up-to-date information is readily assembled.

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Clearly allied to this is the need to accept travel and conferences as the cost of establishing contacts and ensuring that projects react to scientific developments elsewhere. Publications are not enough as the lag in time between existing knowledge and published knowledge is considerable.

Principle Four

Some projects could usefully be managed by research institutes and thereby provide more direct links with management. Exposure to operational projects can act as a stimulus and inspiration to R&D projects.

For example, it is conceivable that the R&D interest in the GLWQA could have been handled by NWRI. Some staff would be necessary but there would also be some efficiencies. A policy to more directly involve research groups in the management of certain projects or large parts of them should be considered.

Principle Five

Science in DOE includes R&D, data gathering, and analysis. Consideration must be given to the appropriate management of these scientific functions. Data gathered without due consideration of the use to which it may be put should be reviewed carefully as to its ultimate utility. Some research functions in operational groups should be considered for management by research managers in institutes. Some data gathering functions in R&D institutes should likewise be examined for appropriateness. DOE science policy should consider the entire scientific aspects of DOE programs and not just the R&D components.

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Conclusions

1. Perceived difficulties with science in DOE would be removed if scientific knowledge and expertise were seen as a product of the Department.

2. Research institutes need to be set free and challenged to become recognized centres of expertise, both nationally and internationally.

3. The Department's influence would be increased greatly if its scientific expertise and knowledge were properly advertised and promoted. Research institutes and data centres should have a high profile.

4. Interpretation of research as it pertains to issues defined by management should be done in research institutes and not elsewhere. Resources would be required.

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