

MANAGING LARGE LABORATORIES

THE ORGANIZATION OF RESEARCH ESTABLISHMENTS, Sir John Cockcroft, ed. 275 pp. Cambridge University Press, Cambridge England, 1965. \$11.50.

by Alvin Weinberg

Sir John Cockcroft tells us in the introduction to *The Organization of Research Establishments* that "The general organization of the Cavendish Laboratory was very simple. There were no committees, but responsibility for different parts of the laboratory work was delegated; Chadwick being responsible for seeing that research equipment was provided, whilst I was responsible for buildings and services, and others for teaching and finance. Rutherford had a system of . . . consulting senior staff members individually on important new issues. Decisions were not therefore taken over their heads."

How quaintly archaic the organization of the Cavendish seems in this day of the Big Scientific Institution. One would hardly need more than a paragraph to describe how the Cavendish was organized: Today 275 pages of essays written by 15 distinguished research directors can do only partial justice to the organizational complexities of 11 British research establishments, the Bell Laboratories, and CERN. There seems to be a law that research organizations become complicated even faster than their budgets grow, and this in spite of the stoutly stated warning of T. G. Pickavance, writing about the Rutherford High Energy Physics Laboratory, that "in research and development, it is easy to organize the life out of the establishment."

The research organizations whose structures are described in this book vary greatly. There are the huge mission-oriented laboratories such as Harwell, the Royal Aircraft Establishment,

the Bell Laboratories, and the National Physical Laboratory. There are the high-energy laboratories like Rutherford and CERN. There are the biomedical and agricultural laboratories: the National Institute for Medical Research, the Medical Research Council Social Psychiatry Unit, the Animal Physiology Unit at Brabingham, and the Glaxo Pharmaceutical Research Organization. And, finally, there are establishments that are as much research associations as they are research laboratories: the British Iron and Steel Research Association, the Research Department of the British Railways, and the Empire Cotton Growing Corporation's Organization for Research.

One would hardly expect to find many common threads in descriptions of organizations as different as CERN and the Glaxo Laboratories, or the Royal Aircraft Establishment and the Social Psychiatry Research Unit. As Sir Edwin Bullard points out in the final chapter, "What Makes A Good Research Establishment?": "The ac-

counts of the smaller organizations concentrate mostly on the work done and say little of the organization; in the large organizations, employing several thousand people, the organizational problems loom much larger and become the main concern of management." Yet certain recurring themes reappear in most of the essays. These themes serve to define "the main concern of management" of a modern research institution.

The research institution, in contrast to the university, should be more than the community of scholars reminiscent, as J. B. Adams of CERN puts it, of the monastic system from which many universities are derived. The research institution must have a purpose that transcends the individual purposes and aspirations of the scientists in the institution. The research institution can fulfill its purpose only insofar as the separate disciplines and techniques interact with each other to produce more than they could achieve working in monastic isolation. As Sir



A LARGE LABORATORY is a complicated physical entity providing space for many activities (note baseball fields). Bell Telephone Laboratories at Murray Hill, N.J.

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PEOPLE in a large laboratory are engaged in complexly interrelated activities which must be held together by efforts of laboratory managers. Checking magnetic memory cores at Bell Telephone Laboratories in Murray Hill, N.J.

Charles Harington, writing of the National Institute for Medical Research says, "the only justification for the existence of a research institution is that it should constitute a scientific instrument as a whole more effective than would be the sum of its separate parts." This view seems to underlie, either explicitly or implicitly, most of the other essays, whether the organization being described consists of 15 scientists working on social psychiatry or 8500 working on the technology of aircraft and missiles.

Thus one main concern of management of a research institution, and one of the ends of the organizational structures set up by management is to ensure that the different parts of the establishment interact properly with each other. This is achieved typically in the large project institutions by superimposing a temporary organization by project or system upon a permanent organization by discipline (or technique, as M. J. Lighthill of RAE calls it). In some cases, as at the Bell Laboratories, or at RAE, the requirements for systems development are sufficiently broad and long-term that organization by systems exists in its own right as well as coexisting with

the organization by discipline. At an atomic-energy laboratory where a reactor project has a finite lifetime, the project organization may not show on paper, though it often wields more power than does the disciplinary divisional organization.

The mission-discipline duality I have described is most evident in the project-oriented, applied laboratory. Yet the same duality, and with it an intrinsic conflict, exists in every research institution, even the institution devoted to basic research. A good part of the conflict arises because each individual scientist has his own aspirations and desires, and these are not necessarily congruent with the aims of the research institution. Moreover, he belongs to a guild of his peers to whom he owes some allegiance, and which judges him by the standards of the guild, not by the standards of the institution from which he receives his salary. The organizational devices discussed in all the essays are in many respects aimed at strengthening the individual's sense of identification with his research institution so that he indeed pulls his weight in converting a community of scholars into a research institute.

I was puzzled, in reading through these essays, to find no research director who admitted to having failed in any degree in overcoming this intrinsic conflict. Perhaps the British experience and tradition is very different from the American: I would guess that most American research directors would consider the resolution of the mission-discipline conflict as being stickier than do their British counterparts.

A second recurrent theme, which further illuminates the "main concern of management," is what I call the problem of mission: how does one decide in the first place what a research institution's purpose is, and how does one renew and strengthen that purpose as the years go by and old problems are either solved or by-passed? As James Fisk says in his excellent essay on the Bell Laboratories, "The broad objective of the Bell System—to provide better and cheaper communication services—defines a channel for research activity of considerable breadth and scope, touching on many sciences, yet with sufficient unity of purpose to give a sense of mission to those engaged. This is felt to be essential to a successful long-range research programme. For without such a mission, an industrial research organization is at best only a community of scholars, capable, to be sure, of productive research for a period of time if wisely led, yet lacking the unifying influence of a university with its traditions and its educational responsibilities to give it long-term stability." Yet as I read between the lines of at least some of the more thoughtful essays I detect a concern with the validity of overall purpose: this concern is to my mind a *sine qua non* of good research management.

The question of mission bears on one of the criteria Sir Edwin Bullard proposes for judging the merit of a good research establishment. Sir Edwin holds that the best laboratories "are usually newly formed ones, or ones that are expanding." This is not a reassuring view to those of us who have spent 25 years of our lives in a single laboratory; nor do I believe it is wholly acceptable. Certainly Fisk's Bell Laboratories are one of the world's best, and oldest, research estab-

lishments. Rather, I would argue that the best laboratories are those that are able to maintain a sense of urgent mission. A new laboratory generally has a sense of urgent mission. It becomes old only when its mission has become rusty and when its management has too little imagination or energy to redeploy and revitalize its mission. A laboratory might be old chronologically and its division leaders may be in their late 50's; yet if the laboratory is fired by a new and exciting mission, it is young in Sir Edwin's sense.

The question of missions is strongly involved in the relation between a research establishment and the governmental or industrial agency that supports it: and in every one of the essays attention is devoted to the relation between the laboratory and its supporting agency. In one respect, the point at issue finally is "Who runs the laboratory—the laboratory management or the staff of the agency that supports the laboratory?" I suspect that every one of the British research directors would answer unequivocally, the laboratory management, of course. American research directors, especially those involved in contract research for the government, would surely be less positive. For with the elaboration and strengthening of Washington staffs, the inevitable tension between laboratory management and headquarters staff as to how things should be done tends to become a dominant issue. Since the project office in Washington finally controls the funding of a project, what the laboratory director can do is always constrained by the project officer's power to provide funds or not to provide funds. The laboratory management must steer a somewhat precarious course that is influenced in substantial degree by the headquarters staff, with their ultimate fiscal power. Who finally prevails depends upon such intangibles as the management's prestige and competence, its skill in maneuvering, and the confidence the laboratory and its management enjoy at the highest levels of the agency for which the laboratory works.

To balance the inevitable growth of the scientific agency staffs American

laboratories often establish intermediate hierarchies that serve as counterweights to the headquarters staff. This layer of administrators frees the working scientist of the necessity for sparring directly with the funding agency, and it gives the highest level of laboratory management the time and energy to occupy itself with the "main concerns of management"—establishing the laboratory's sense of mission, maintaining its scientific tone and excellence, and counteracting the inherent centrifugal forces that thwart the achievement of the mission. Actually I suspect that the British situation is not so very much simpler than is the American (though the UK has the advantage of being smaller, and the American contractor system accentuates the separation between laboratory management and headquarters staff). And from the one essay dealing with a defense establishment, RAE, I gathered that the relations between headquarters staff and laboratory staff must involve a good deal of the give-and-take that we Americans have come to take for granted.

Though the book is largely devoted to research performed outside the university, many of the authors speak of the connection between their institutions and the universities. The matter has acquired an urgency in recent years as the universities and the laboratories find that they are competing for the same funds. Adams, in describing the relation between CERN, the national laboratories, and the universities, urges a strong flow between these institutions, but urges that each must retain its identity and strength: "if . . . national and international laboratories took over the teaching functions of the universities, or if one of the three types of institutions is starved of resources, then the whole pyramid will crumble." By contrast, Sir Gordon Sutherland of NPL comments, "There is a great unused teaching potential in the National Physical Laboratory. . . . The NPL might even become the nucleus of a postgraduate technological university with associated research institutes." I suppose I find these two views curiously reversed: an institution such as CERN devoted to basic research could much more readily tol-

erate the university, discipline-oriented, and individualistic organization than could a mission-oriented institution such as NPL. Or does Sir Gordon visualize only the more basic parts of the National Physical Laboratory as forming the nucleus of his new technological university?

The essays in *The Organization of Research Establishments* are rewarding reading, especially to a research administrator who learns from these essays that his problems are not unique. They would perhaps have been more useful if the Research Directors had let their hair down more. But this is asking too much: there is a kind of etiquette that forbids a research director from admitting publicly that anything is going badly, or that his agency is behaving unreasonably.

Yet some of the essays, notably the ones by Fisk, Adams, Vick, and Lewis, I found to have an openness and sparkle that reflect well not only upon the research director who wrote the piece, but also upon the institution that he directs. Surely CERN must have prospered under a man who, in speaking of language difficulties, writes "The language problem resolved itself quite simply. It was soon discovered that an inability to express oneself forcibly in another language lowered the tensions normally experienced in a research laboratory. In any case, the real difficulty lies not in understanding what somebody else is saying, but in forgiving him for saying it, and this has little to do with language difference." The author of this gem is J. B. Adams, who now heads the fusion laboratory at Culham. Does anyone want to make book on how the British will do in the thermonuclear sweepstakes?

Philosophy and physics

CONCEPTIONS DE LA PHYSIQUE CONTEMPORAINE. Les interprétations de la mécanique quantique et de la mesure. By Bernard d'Espagnat. 154 pp. Hermann, Paris, 1965. 24F.

by R. B. Lindsay

It is generally taken for granted that in order to pursue successfully the