Book Reviews

A History of Technology. vol. 4, *The Industrial Revolution, c 1750 to c 1850.* xxxiii + 728 pp. Illus. + plates. vol. 5, *The Late Nineteenth Century, c 1850 to c 1900.* xxxviii + 888 pp. Illus. + plates. Charles Singer, E. J. Holmyard, A. R. Hall, Trevor I. Williams, Eds. Oxford University Press, New York, 1958. $26.90 each.

Readers of the first three volumes of this immensely successful cooperative venture among scholars will not be disappointed in these, the concluding, volumes. Even though as the editors point out, limitations of space increased tremendously the writers' and the editors' problems in dealing with the more recent technology, these volumes exhibit the same outstanding scholarship and competent judgment that we have come to know in the earlier volumes. It is inevitable that the history of "modern" technology—from approximately the beginning of the 19th century to the present—proliferating as it does in conelike fashion, should present especially difficult problems for the historian. The data are infinitely more numerous than for earlier periods, and thus critical problems of selection are presented, if the data cited are to be representative. Moreover, for a variety of reasons, the history of modern technology has been studied less by professional historians of technology than the earlier history. In short, the "rapidly increasing complexity of the subject" forced the editors to be more and more selective in their choice of subject matter. And yet, despite this apparent disadvantage, the result is a cogent and convincing documentation of the technological revolution which led, without respite, to present-day Western civilization.

The period covered in volume 4, roughly 1750 to 1850, is generally identified as that of the Industrial Revolution. That the events of an entire century should have come to be known as a "revolution," rather than merely an "evolution," may seem paradoxical, and yet the true revolutionary character of these events is clearly discernible in this study. The events of this century completely revolutionized man's attitude toward his environment and, coincidentally, enabled him to utilize as never before, almost all natural resources. Developments in technology during this century literally redefined Western civilization. The shock wave of new inventions and technical processes struck first in England, then on the Continent and in North America. With it came radical economic, agricultural, and mercantile changes, which led eventually to the notion of the modern industrial state.

The editors have treated this period in terms of six broad fields of classification: (i) "Primary production" (foods, metals, and coal); (ii) "Forms of energy" (the production of power in general, the early development of the steam engine and the water mill); (iii) "Manufacture" (the chemical industry, gas production, textiles, ceramics, glass, precision machines, and machine tools); (iv) "Static engineering" (civil and sanitary engineering); (v) "Communications" (roads, canals, shipbuilding, cartography, dredging, and early telegraphy); (vi) "Scientific basis of technology."

This final chapter will be especially interesting to historians of science, for the period of the Industrial Revolution marks the beginning of the permeation of technology by science—"the beginnings of the change from craft mystery to science as a basis for technology." The deliberate shift from secrecy to scientific openness was perhaps the most important single step in the development of modern technology. The story of this movement is exciting as well as important. Institutions such as the Royal Society of London and the much younger British Association for the Advancement of Science played a role no less vital than that of the great individual scientists and engineers, among them Joseph Black, Antoine Lavoisier, Michael Faraday, Lord Kelvin, Count Rumford, Denis Papin, Thomas Newcomen, and James Watt, to mention but a few. In France, one of the greatest systematizing influences on contemporary technology was the famous *Dictionnaire raisonné des sciences des arts et des métiers,* edited by Denis Diderot and Jean d'Alembert. Works such as this helped to generate the surging enthusiasm of the late 18th and early 19th centuries over the power of applied science as a means of bettering man's lot.

In volume 5 we are given a continuation of this *History,* through the second half of the 19th century. The broad organizational scheme is modified slightly. Part 1 treats of "Primary production"; under this heading again come foods and metals but, significantly, a chapter on the production and uses of petroleum has been added. Part 2 deals with "Prime movers": the stationary steam engine, the marine steam engine, and internal combustion engines. It may surprise readers to learn that the idea of the internal-combustion engine antedates that of the piston steam engine. As early as the latter part of the 17th century Christian Huygens experimented with the gunpowder engine. In part 3 we read of the "Rise of the electrical industry," and of the generation, distribution, and utilization of electricity. Part 4 treats of the chemical industry. Part 5 deals with transportation, including early aeronautics. Part 6 is concerned with civil engineering. Part 7 discusses all aspects of manufacturing, including newly developed areas of technology such as photography. The eighth and final part of volume 5 is entitled, "The threshold of the twentieth century." Here are treated, in broad but significant fashion, the problems of education, industrial organization, and the social consequences of technology. These aspects of the modern industrial state will perhaps be more familiar than some of the others to the average reader of this *History,* but this presentation is both authoritative and fresh.

Thus, this work brings the history of technology down to approximately the beginning of our own century. This terminal date is both convenient and symbolic. From the beginning, when this work was in the planning stage, the editors realized that it would be impractical to carry it on to the present time, despite the obvious attractiveness of such an objective. The amount of space needed to describe the technological progress of the past half-century alone would have made the project unfeasible. In addition, technology today is relatively so complex and so technical that adequate descriptions would, of neces-

sity, have involved the use of much more technical language than was required in the present five volumes. Moreover, the beginning of the 20th century signalized a new technological revolution—hence, an essentially new story. It marked the beginnings of modern transport, by land and air; the great development of the electrical and eventually of the electronics industries; and, finally, the revolution that is stemming from control of the atom, of a magnitude not yet fully realized.

For this and similar reasons it was wise to end this huge project at the beginning of our own era. We must simply be grateful to the editors and the many writers for having so expertly and attractively produced these five outstanding volumes. Finally, a special vote of thanks must be extended to the Imperial Chemical Industries Limited, without whose thoughtful foresight and support this *History* would never have been written.

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East and West in India's Development. Wilfred Malenbaum. National Planning Association Washington, D.C., 1959. xi + 67 pp. $1.75.

The National Planning Association's project on the economics of coexistence was initiated in 1956 to investigate Soviet trade-and-aid programs in uncommitted countries of Asia and the Middle East and to evaluate, if possible, both the impact of this Soviet "competitive coexistence" drive and the capability of the Communist bloc for further expansion. As a preliminary to the preparation of a more general analysis, the project commissioned a series of studies of countries and areas, of which this one on India is the third to be published.

The crux of the Indian problem, according to Malenbaum, is whether or not the country can modernize itself by democratic means—in contrast to the totalitarian techniques used by the Soviet Union and China—and thus not only preserve its own form of government but also set an example for the rest of the underdeveloped world. To date, Malenbaum points out, the results have been mixed: progress during the first Five Year Plan was encouraging, but the country's financial resources were insufficient for the ambitious targets of the Second Plan period that began in 1956. Despite stepped-up aid from the West, the plan targets had to be cut back to a hard core. Now the question is whether this limited success, achieved with great effort, is the best that can be hoped for, and whether it is perhaps a Pyrrhic victory.

The Soviet Union, appearing on the scene in India at a critical moment with its own "trade-and-aid" program, emphasized what underdeveloped countries consider to be the hard prerequisite for rapid industrialization: steel, and other heavy industry, in addition to exploration of resources. This accent on hard prerequisites, according to Malenbaum, may warp the pattern of future development in India in two ways: by lessening the emphasis on greater productivity and by letting the effects of the exchange shortage fall most heavily on private industry, which has surprised the planners by a rigorous initiative that exceeded expectations and targets.

What is at stake, then, is not simply a minimal success but also the long-run prospects for economic development in India. The Soviet bloc might well benefit either from total failure in India or from resort to more authoritarian methods during a successful drive toward modernization. The West, on the other hand, can benefit only if a balance is maintained between economic achievement and democratic method.

Under these circumstances, Malenbaum feels, it would be highly desirable for the West to initiate, with India, a coordinated effort for ensuring a broad balance of development, both within the Second Five Year Plan and within the design for the forthcoming Third Five Year Plan. This is an argument which, in its own interests, the West cannot afford to ignore.

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Excursion Flora of the British Isles. A. R. Clapham, T. G. Tutin, E. F. Warburg. Cambridge University Press, New York, 1959. xxxiii + 579 pp. $4.50.

This is a condensation of the same authors' *Flora of the British Isles,* and, like that excellent volume, this one has already found an enthusiastic audience.

Artificial keys to family groups, keys to genera and to species, short descriptions of "all species that are generally common in lowland districts of the British Isles," a glossary, and an index make up the contents. Omitted from the *Flora* are text figures and descriptions of the less common species, as well as data of interest principally to the professional botanist.

The typography is exceptionally clear, and because of the light-weight paper used, this is a very small volume which will easily fit into the field packs and knapsacks of the astonishingly large number of amateur field botanists who study Britain's flora.

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Program for College Preparatory Mathematics. Report of the Commission on Mathematics. College Entrance Examination Board, Princeton, N.J., 1959. 63 pp. + *Appendices* (bound separately). 231 pp. $1 each.

The Commission on Mathematics was established by the College Entrance Examination Board in 1955 because "it felt that curricular reform in secondary school mathematics was long overdue, and that the Board, as an agency representing both colleges and secondary schools, could and should use its influence to improve the current situation." Accordingly, the commission, composed of representatives from universities and secondary schools and with the financial support of the Carnegie Corporation, presents, after intensive scrutiny and study, a proposed new program for secondary-school mathematics.

The commission does not claim that this is *the* new program, nor does it believe that a sudden change is either practicable or desirable. But this report does indicate the lines along which the commission feels progress should be made.

After describing the urgent need for curricular revision and stating the premises, the commission's report outlines the prerequisite mathematics assumed, gives proposed sequences for grades 9 through 12, and discusses the vital role of teacher education and the articulation of school and college mathematics.

In brief, they summarize their proposed program as follows: "1. Strong preparation, *both* in concepts *and* in skills, for college mathematics at the level of calculus and analytic geometry 2. Understanding of the nature and role of deductive reasoning—in algebra as well as in geometry 3. Appreciation of