wards and permeate English society, until, in the remote future, there shall be no member of the legislature who does not know as much of science as an elementary schoolboy.

. . . the great aim should be to teach only so much science as can be taught thoroughly; and to ground in principles and methods rather than to attempt to cover a large surface of details.

. . . in the actual condition of the nation . . . I cannot doubt the wisdom of enforcing the teaching of science upon the public schools by positive enactment.

If individuality has no play, society does not advance; if individuality breaks out of all bounds, society perishes.

No personal habit more surely degrades the conscience and the intellect than blind and unhesitating obedience to unlimited authority. Undoubtedly, harlotry and intemperance are sore evils, and starvation is hard to bear, or even to know of; but the prostitution of the mind, the soddening of the conscience, the dwarfing of manhood are worse calamities.

Let the reader decide which of these sayings are relevant to our own times and our present national condition.

Huxley's New World

The last chapter of the book is entitled "To the New World," but it includes more than a discussion of Huxley's trip to the United States and his address upon the occasion of the founding of the Johns Hopkins University. The chapter concludes with a broader consideration of the really "new world" which Huxley always had in mind as the fruition of his hopes and the goal of his efforts, a "new world" in which the scientific method would be supreme.

"We are in the case of Tarpeia," he declared on one occasion, "who opened the gates of the Roman citadel to the Sabines and was crushed by the weight of the reward bestowed upon her. It has become impossible for any man to keep pace with the progress of the whole of any important branch of science. It looks as if the scientific, like other revolutions, meant to devour its own children; as if the growth of science tended to overwhelm its votaries; as if the man of science of the future were condemned to diminish into a narrow specialist as time goes on."

Only by sharing the rewards might we escape Tarpeia's fate, only by so organizing and extending scientific education that breadth of culture might be secured without superficiality, depth and precision of knowledge without narrowness. To achieve this remains today, as in Huxley's time, the major task of education. What Huxley foresaw so clearly a century ago, we may all see clearly today as the imminent threat to further progress. Before addressing ourselves to this task, we might well reread Huxley on education, or, in lieu of that, peruse this farsighted, spirited book which for the first time treats adequately Huxley's dedication to science in education, and to education in science.

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Physics of the Upper Atmosphere. John A. Ratcliffe, Ed. Academic Press, New York, 1960. 586 pp. Illus. $14.50.

In the past 10 years our knowledge of the earth's upper atmosphere has gone forward to an extent unparalleled during any previous period. The subject matter has expanded greatly and now includes for the first time, information about the nature of the solar radiation that provides the driving force for so many atmospheric phenomena. The names of the topics are very much the same as they are in the classic treatise by Mitra, but the content is remarkably different. This is evidenced at once by the introduction by Sydney Chapman, a man who has contributed so outstandingly to every facet of the physics of the upper atmosphere, not to mention his many other contributions to pure physics. Here he views the problem of the interaction between the solar corona and the earth's outer atmosphere (the exosphere, and its ionized portion, the protosphere).

M. Nicolet of Belgium addresses himself to the problem of the distribution of atmospheric constituents in the ionospheric region. He gives an excellent general review of the whole atmosphere but then concentrates on such topics as the dissociation of molecular oxygen and the problem of diffusion. There is a particularly detailed discussion of the problem of heat flow in the upper atmosphere. Finally, satellite data are used to give information on the structure of the atmosphere up to about 700 kilometers.

The next chapter, by Homer E. Newell, Jr., is an authoritative review of data on the upper atmosphere obtained by rockets and satellites. The emphasis is on rockets, and most of the information deals with atmospheric structure, winds, and density of ionization. It is extremely useful to have this review which also incorporates data obtained during the International Geophysical Year.

In contrast to the wide scope of the previous chapter, Herbert Friedman's discussion of the sun's ionizing radiations is a detailed account of the state of our present knowledge of x-ray and ultraviolet radiation from the sun and of its interaction with the atmosphere. Most of the important research findings in this area have been made by Friedman and his colleagues at the Naval Research Laboratory.

The next three chapters, dealing with airglow and aurora, are written by David R. Bates of Belfast. The discussion is brief but quite complete. The spectrum intensities and excitation processes are discussed for the nightglow, the twilight glow, and some indication is given of the possibility of a day airglow. The chapters on the aurora again are brief but meaty. The auroral forms are classified; their geographic and temporal distribution is described, and their relation to other geophysical phenomena is shown. It is in the discussion of the auroral spectrum, however, that the author contributes important detail and much new material. The aurora is also described from the point of view of radar, with particular emphasis on the motions associated with auroral echoes, by Henry G. Booker.

The longest and most detailed chapter (318 references), by J. A. Ratcliffe and K. Weekes, discusses all phases of ionospheric physics. Only the subheadings need to be given, "Theory of the origin and shape of layers of electrons," "The ionosphere as a dynamo and a motor," "Theory of wave propagation through the ionosphere," "Undisturbed D-region," "Undisturbed E-layer," "Undisturbed F1-layer," "Undisturbed F2-layer," "The collision frequency of electrons," "Horizontal irregularities and movements," and finally "Disturbances and storms in the ionosphere."

Closely related is the chapter on upper atmosphere and geomagnetism by E. H. Vestine. Here the subject matter has not advanced as rapidly in the last few years. Much of our knowledge of the daily solar variation, and the daily lunar variation is as it was before the IGY. Magnetic storms have been better studied, however, and the subject of magnetic pulsations has come to the foreground. The puzzling

feature of the equatorial electrojet is now understood, and is in harmony with the dynamo theory. The brief chapter on the upper atmosphere and meteors, contributed by J. S. Greenhow and A. C. B. Lovell, deals mainly with radar observations of meteor trails.

A final chapter is supposed to give the advances made during the IGY, and provides something of a catch-all to relate recent results. Except for a discussion of the detailed shape of the solar Lyman-alpha line, this chapter is somewhat disappointing. The rapid pace of development is shown by the fact that the exosphere is still described as an isothermal region. More recent work has shown that this concept is not justified and that the distribution of density in the exosphere varies considerably from that of a gas at constant temperature and in thermodynamic equilibrium.

Except for such rather minor shortcomings, the book constitutes a most useful and up-to-date compendium on upper atmosphere physics. It is a must for the specialist, but is written so that the nonspecialist or student can inform himself authoritatively of the state of this important subject.

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The Policy Machine. The Department of State and American foreign policy. Robert E. Elder. Syracuse University Press, Syracuse, N.Y., 1960. 238 pp. $4.50.

In *The Policy Machine*, Robert Elder examines the structure and procedure by which American foreign policy is made and administered. The "policy machine," he says, "which grinds out American Foreign Policy is one of the most intricate and complex mechanisms of modern democratic government." Not so long ago the Department of State was a relatively modest agency in which sons of "good families," trained at Ivy League colleges and ignorant alike of their own country and the world at large, could carve out fashionable careers in Washington or abroad. Today this same agency is a bureaucratic behemoth among behemoths. With over 6500 employees in Washington and New York, it operates 277 overseas posts, staffed by over 6000 American citizens and nearly 10,000 alien employees. It is a vastly complex communication center which on an average day receives over 1200 telegrams, dispatches, and operation memoranda and sends more than 1500 communications by telegraph and diplomatic pouch. "During the fiscal year of 1958, a quiet one diplomatically, 7,500,000 words a month flowed in and out of the Department's telegraph room. Some 80% of this communication flow is classified for official eyes only."

Nor is foreign policy contained wholly within the Department of State. The International Cooperation Administration, the Export-Import Bank, the Development Loan Fund, and the United States Information Agency are independent or semiautonomous cogs in the vast foreign policy machine of the United States. So, too, are the overseas representatives of the departments of Agriculture and Treasury, Commerce and Labor. At the summit of this structure, the President, as the sole constitutional voice of the United States in its international relations, must somehow shape, coordinate, and direct people, policies, and programs.

In the conduct of foreign relations, as in other areas of his responsibility, the President must make a kind of Hobson's choice between a manageable number of unmanageable agencies, or an unmanageable number of manageable ones. Even the President's "span of control" has outer limits, and in striving to keep on top of the vast policy machine over which he presides, he must rely on, not one, but a hierarchy of coordinating agencies which stand between him and his agents at the level of operations. His communication with our major diplomatic missions, consular offices, and delegations to international organizations carried on through the Secretary of State, is reasonably direct and, in emergency, can be swift and sure. But for the most part the President's knowledge of events in the field is filtered through an elaborate sieve.

The "low men on this totem pole," if I may mix a metaphor, are the 114 country desk-officers in the State Department, who are "the eyes and ears, the brain and voice of America in a troubled world." Standing between these officers and the President is a veritable wilderness of coordinating agencies and officials including assistant secretaries in charge of African, Inter-American, European, Far Eastern, Near Eastern, and South Asian affairs and bureaus of International Organization, Economic Affairs, International Cultural Relations, Intelligence and Research, Public Affairs, Administration, and Consular Affairs. There are also assistant secretaries responsible for policy planning and Congressional relations. At the apex of this structure is, of course, the official on whom the President must mainly depend, the Secretary of State, with his undersecretaries and deputy undersecretaries for political affairs and administration, who, with the directors of the ICA and the Foreign Service, make up the high command of the Department of State.

But since foreign policy is no longer the exclusive prerogative of the State Department, other interdepartmental agencies of coordination have emerged. Most important of these are the National Security Council, the National Security Council Planning Board, the Central Intelligence Agency, the United States Intelligence Board, and an Operations Coordinating Board. Under President Eisenhower the National Security Council became a kind of supercabinet in which major problems of both foreign and domestic policy were discussed. Included in this body, either by law or invitation, are the President, the Vice President, the secretaries of State, Defense, and Treasury, the directors of Defense Mobilization, the Bureau of the Budget, the U.S. Information Agency, and the Central Intelligence Agency, and the chairman of the Joint Chiefs of Staff.

This, in rough outline, is the policy machine which Elder strives to describe and to evaluate. Although Elder knows that our foreign policy is a complex of diplomatic, economic, military, and cultural relations, his major concern in this volume is with its diplomatic and cultural aspects. His book is more than a study of structure and organization, although its main emphasis is on problems of administration and personnel. But in dealing with these problems, Elder takes us behind the scenes to look with a friendly but critical eye at some of the more dynamic aspects of politics and administration as they affect our foreign policy. His analysis of the role of public information officers, public opinion analysts, and legislative liaison specialists in the foreign policy machine is informative and perceptive. All students of public administration will find the author's chapter on personnel management of particular interest, since he does not hesitate to grasp the Wriston nettle with a firm hand.