marks an important step forward in the scientific use of British Colonial resources. The recommendations have been adopted by the Colonial Conference, and ideas which have been in the air for some time have now become definite proposals. There is still, of course, a great deal to be done. The committee have worked under great pressure, and a further committee will have to be set up to work out details. The colonial governments have to give their consent and arrange their contributions to the central pool. But the main principles that there should be a chain of research stations, like Trinidad and Amami, throughout the Empire, with a central directing council in London, controlling a mobile reserve of men of science, and that there should be an Imperial Scientific Service transcending colonial boundaries, have been accepted by the spokesmen of five-and-twenty colonial governments.

The present plans are only for agricultural research. Medicine and forestry have been left to the recently constituted Medical Research Committee and to next year's Empire Forestry Conference. But this report has the added interest that its underlying principles apply to all branches of scientific work. It brings out three points that are very little appreciated—how small a sum the colonial governments spend at present on agricultural research as compared with other governments; how valuable the trade of the colonies is to Great Britain; and how closely the prosperity of that trade is dependent upon agricultural progress. It is perhaps not surprising to hear that the United States already spends on agricultural research over $21,000,000 a year, and that the figure is growing. It is more surprising to learn that, though entomology is one of the most important and most highly organized branches of science in the colonies, their combined expenditure on it is little more than half the £100,000 a year that the government of Egypt spends. Henceforth it is proposed that the Imperial government and the colonial governments between them shall find £175,000 a year for agricultural research. That is considerably more than is being spent in uncoordinated ways to-day. But the Empire Marketing Board has an appropriation for research, and the money found by the Imperial government is likely to prove an excellent investment for the taxpayers at home. The complementary character of the trade between Great Britain and the Crown colonies makes an increase in their purchasing power particularly advantageous to industry here. On the other hand the colonial governments stand to gain out of all proportion to their contributions, for, while these contributions will be based on their revenue, the services they will receive will be limited only by their needs and by the resources of the whole system. They will be able to command first-rate men of science without having to find their salaries, because, if the conditions of service envisaged by the committee are created, the varied and well-rewarded career which the Colonial Agricultural Research Service will offer will enable it to attract the finest talent. The advantage will be greatest to the poorest colonies, for there is no natural connection between a colony's financial strength and the urgency of its need for scientific help. Moreover work well done in one colony is more often than not of value to other colonies, and the arrangements for more efficient intelligence service will make this more than ever obvious. Thus both in the science of soils and in plant genetics—"where," says the committee, "no organization of any kind at present exists"—the gain of one colony is likely to prove the gain of all. For this reason, if for no others, the proposals are plainly of interest to those Dominion governments who have similar questions of their own; and there is every reason for believing that what is now being set on foot for the Crown colonies will come in time to cover the whole Empire.—*The London Times.*

SCIENTIFIC BOOKS

A Bibliography of American Natural History. The Pioneer Century, 1769–1865. By MAX MEISEL. Vol. II. Brooklyn, The Premier Publishing Company, xii + 741 pp.

THIS, the second volume of Mr. Max Meisel's interesting and valuable contributions to the bibliography of the natural sciences in the United States, is in reality a history of the rise and development of the biological sciences in the first half of the last century in this country. It includes also the earth sciences and the exploring expeditions which were often concerned with technical scientific matters as well as with geographical and military or naval affairs. The multiplication of organizations, such as scientific societies and academies, and of various enterprises, such as museums, botanical and zoological gardens, institutes, state surveys, and exploring expeditions, was remarkable in the various parts of the United States from 1800 to 1844. Whereas, from 1769 to 1800 only ten such enterprises were founded, in the period from 1800 to 1844 one hundred and twenty were started on their career. Of these, sixteen were U. S. Government Exploring Expeditions. State geological and natural history surveys followed with the rise of state consciousness. The first state geological survey was that established in North Carolina in 1823. Other states followed in rapid suc-

cession, South Carolina in 1824, Massachusetts in 1830, Tennessee in 1831, Maryland in 1833, Connecticut, New Jersey and Virginia in 1835, Georgia, Maine, New York and Pennsylvania in 1836, Delaware, Indiana, Michigan and Ohio in 1837, Rhode Island in 1838, New Hampshire, Iowa, Illinois and Wisconsin in 1839, and Vermont in 1844. Three botanical gardens were opened in the first decade of the last century. The major line of activity was, however, very largely the formation of local scientific societies, academies, institutes and museums. These were the natural outgrowth of local enterprise and ambition and were obviously the most practical type in a period when travel was both expensive and time-consuming.

While there are these marked developments of state and local enterprises, there is at the same time a noticeable absence of federal activities, aside from exploring expeditions which usually utilized the federal army or navy personnel and guidance; and of national societies. Two notable exceptions to this are the American Philosophical Society (1769) and the American Academy of Arts and Sciences (1780).

In the period from 1769 to 1844, and mainly after 1800, no less than 65 societies, lyceums, institutes, and the like, with state, county, city, or institutional designations in their names, were formed. Many of these were short-lived, a few now continue to function abreast of the times, and a number of others seem to have acquired the status of ancient and honorable desuetude. The close of this period saw the dawn of national solidarity in scientific matters with the formation of the Association of American Geologists and Naturalists (1840), out of which grew the American Association for the Advancement of Science and the National Institution for the Promotion of Science (1840), the predecessor of the Smithsonian Institution.

Scientific journals and publishing enterprises also multiplied in this period. Fourteen such serials, not professedly attached to institutions, were established between 1800 and 1844. Of these all but one, *The American Journal of Science,* have vanished, often after a brief career. They lacked the environing conditions and institutional continuity to enable them to survive in the struggle for pabulum and patronage.

The bibliographer and librarian will find in this volume a valuable record of the fugitive publications of the early expeditions, the state surveys and the ephemeral societies and lyceums which sprang up throughout the Republic in its early days from Portland to Little Rock. The investigator will find here accurate citations of all papers on subjects in natural history in practically all of the serials issued by the scientific agencies in the United States published prior to 1845. The historian of this scientific age will find here, in so far as names and titles can express it, an epitome of the pioneer days of American science.

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SPECIAL ARTICLES

EFFECT OF SHORT ALTERNATING PERIODS OF LIGHT AND DARKNESS ON PLANT GROWTH

IN earlier papers dating from 1920, it has been shown that the relative length of the day and night may profoundly affect the course of development of plants. With many species flowering and fruiting may be hastened or retarded by appropriate regulation of the daily period of illumination. In some plants flowering is favored by relatively short days, while in others reproductive activity is induced by long days. Thus it was found that plants normally flowering during the fall or winter may be readily caused to flower in midsummer by excluding the early morning or late afternoon light for a few hours each day. When, however, these plants were darkened for a like number of hours during the middle of the day the vegetative period was not materially shortened. In this respect the plants behaved about the same as if they had remained in the light throughout the day. It appears that with the same total number of hours of daily illumination two shorter periods of light do not produce the same effect as a single uninterrupted light period. The view has been previously expressed that the length of day effect is not due simply to the total quantity of light energy received by the plant and additional evidence in support of this view is seen in the results of recent experiments having to do with the response of plants to variations in the distribution of a given number of hours of illumination through the 24-hour period. Considerable work will be required to complete these studies but it seems desirable to report briefly at this time some of the results thus far obtained. It has been previously shown that in June plantings of the Biloxi variety of soybeans the normal vegetative period at Washington is 80 to 90 days while exposure to a daylight period of 8 to 12 hours may induce flowering in 20 to 25 days. Similar plantings were darkened daily from 10 a. m. to noon and from 2 to 4 p. m. As compared with the full length of day of summer this treatment not only failed to hasten flowering but actually delayed it by two weeks. On the other hand, when these and other plants of similar behavior were exposed to the full daylight period, but on alternate days only, the vegetative period was materially shortened, although not to the extent effected by a