tive temperatures are slightly above 2,000° C. at maximum." Stars cooler than this are not known, though present observational methods are apparently competent to reveal them if they exist. "The fact that the coolest stars we know are all long-period variables may indicate a region of instability as the temperature approaches a limit set by some physical law."

In investigating the relationship of spectral type to period among variable stars, on the basis of a study of some 60 variables with the 100-inch telescope, Adams and Joy find, first, that "a large majority of the Cepheids, including all of the brightest and best known stars, show a very nearly linear relationship between spectral type and logarithm of the period." This relationship had been known before, in a general way, though no exact correlation had been established. The "rather surprising result" of extending the investigation to the short-period cluster-type stars and the long-period red variables is that, "on the average, these two classes fall close to the curve derived from the Cepheids.—The conclusion seems to be justified that the physical cause of the variation in light of these different classes of variable stars is similar and probably is to be ascribed to a periodic variation in size."

The paper by Leuschner and Thiele giving a progress report on the research surveys of minor planets was presented by the senior author and showed in striking manner how incomplete our knowledge of the minor planets still is. Ordinarily, it is stated that between 1,100 and 1,200 of these bodies are known. If every discovery is of a different object, the actual number of those that have been observed is more nearly 2,600, but the majority were so poorly or incompletely observed that they have been "lost"; even of those regarded as known only a small fraction have orbits sufficiently well determined to warrant the publication of observing ephemerides; and the number for which thorough orbital investigations are available is small indeed. Cooperative research, under the auspices of the appropriate committee of the International Astronomical Union, is now in progress, and in this Professor Leuschner and his colleagues at the Students' Observatory are taking a leading part.

A magnetometer for recording the range in the horizontal component of the earth's magnetic field was installed at the Mount Wilson Observatory in August, 1926. Miss Losh has compared the records of magnetic storms with the observation of sunspot groups and other evidences of great solar activity and finds the usual close correlation. For example, one of the largest complex sunspot groups of the year came round the east limb of the sun on September 12, 1926; a marked magnetic storm began on September 14 and continued until this group passed around the west limb. When the disturbed area on the sun reappeared, as the result of the solar rotation, a second and even greater magnetic storm occurred on the earth on October 13.

Space limits forbid further comment on these and the many other interesting papers presented. All the research observatories in the Pacific area, from Victoria to Flagstaff, have obviously had a successful year.

Members of the society participated in the general sessions of the division on Wednesday and Thursday, Dr. W. S. Adams, director of the Mount Wilson Observatory being one of the speakers at the "Research Announcements" luncheon on Thursday.

W. W. SARGEANT,
Secretary

(*To be continued*)

THE EMERGENCE OF THE BIOLOGY OF FOREST AND RANGE

THE rapid rise of interest in the biology of forest and range is an outstanding sign of the scientific times. While it is true that during the past two or three decades a few writers have called pointed attention to certain phases of the problems involved, most silviculturists, biologists and range research men have overlooked them. Of necessity, since the many partial problems merge into one big bio-ecological unit, the union of biology and forestry must be something more than a companionate marriage. It must be an old-fashioned and enduring alliance. The case is the same with biology and range research.

PRESENT TRENDS

The emergence of the biology of forest and range is associated with a new interest in all phases of the environmental relations of organisms. It is increasingly realized by biologists that these environmental relations are worthy of as close, consistent, prolonged, and quantitative attention as the phases of genetics and heredity which have been examined of late years with such illuminating and valuable results.

The following events may be cited as among those which seem to show a movement of interest and attention in the right direction:

The organization and activity of the Ecological Society of America, and the noteworthy success (at least along technical lines) of its official organ, *Ecology*.

Increased recognition by the United States Department of Agriculture, especially through the Bureaus of Biological Survey, Entomology, Plant Industry and the Forest Service, of the significance and im-

portance of forest and range biology. The work and writings of certain leaders among the scientists in and out of the department, including, among others, F. E. Clements, F. C. Craighead, E. P. Farrow, J. Hoffmann, E. A. Goldman, J. Grinnell, C. F. Korstian, Aldo Leopold, W. L. McAtee, E. N. Munns, Edward W. Nelson, G. A. Pearson, V. E. Shelford, J. W. Toumey, I. Traghardh.

The publication of Jennings' "Prometheus."

The contributions of the Roosevelt Wild Life Forest Experiment Station, Syracuse University, New York, under the direction of its former head, Chas. C. Adams, and his associates.

The activities of the President's Conference on Outdoor Recreation.

The outstanding work of the special committee on forest research of the Washington Section of the Society of American Foresters, which resulted in the publication of "A National Program of Forest Research" (American Tree Association, November, 1926; by E. H. Clapp). This is unquestionably the most valuable survey of the field of forest research that has been made in this country to date. The biological side of forestry is clearly outlined, although the biological features of range research do not seem to have been so clearly appreciated.

The introduction, March 3, 1927, in the Sixty-ninth Congress, of the McSweeney Bill, providing for a more adequate forest and range research program in the United States Department of Agriculture.

The appointment of Paul G. Redington, formerly of the Forest Service, United States Department of Agriculture, as chief of the Bureau of Biological Survey.

The success of and obvious interest in the symposium on "The Forest and Forage Crops in the Southwest," held at the meeting of the Southwestern Division, American Association for the Advancement of Science, Santa Fé, New Mexico, April 13, 1927. Different aspects of the biology of forest and forage production were stressed by several of the speakers.

FOREST PATHOLOGY

The important effects of parasitic plants and of wood-rotting fungi in relation to the maintenance and administration of the forest have been obvious for a considerable period to the experts of the Bureau of Plant Industry, the New York Botanical Garden, the Forest Service and a few other agencies. Indeed, forest pathology may be regarded as a relatively early emergent in the province of the biology of the forest. One has only to recall the importance of such studies as those on the chestnut blight and white pine blister rust to recognize and appreciate the far-reaching, continuing and increasing significance of forest pathology. The names of Robert Hartig, of Germany, father of plant pathology, and his disciple, F. W. Neger, and of the following American workers come to mind among those who have made notable contributions: E. P. Meinecke, W. H. Long, J. R. Wier, R. C. Colley, F. D. Heald. While *forest* pathology has developed to a considerable extent, *forage* pathology, undoubtedly an important field, has apparently received little attention.

On the whole there has been a much clearer appreciation of the plant side of forest biology—as in the development of forest pathology—than of the animal side. It is to the animal side of the biology of forest and range, therefore, that the chief attention is here addressed.

THE PROTECTION OF FOREST AND FORAGE FROM ANIMAL PESTS

Far-sighted administrative officials, especially those on the ground, as well as progressive private users of range and of forest, have long been impressed with the damage done by animal pests. The destructive effects of bark-beetles and other insects, and of certain rodents, as the porcupine, in the woods, and of such animals as the prairie-dog and jack-rabbit on the open range, have been obvious to many. While this phase of animal relations to forest and range, referred to as "Protection," does not, even yet, receive sufficient consideration in many places, it does come nearer than any other to getting adequate attention. Indeed, it is often the only aspect of the zoology of forest and range receiving any notice at all.

POSSIBLE BENEFICIAL ACTIVITIES OF ANIMALS ON FOREST AND RANGE LANDS

The beneficent rôle of insectivorous birds in farming districts has been emphasized by the thorough studies of the subject made by the Biological Survey. This function of birds is widely recognized. That birds exercise a similarly beneficial service to forest trees, browse, and even forage grasses is sometimes not kept in mind. Other possible benefits by animals include the cultivation of the soil of range and forest by earthworms and burrowing rodents, the caching and planting by birds and mammals of the seeds of trees and other plants with consequent assistance to the maintenance and even extension of the vegetation, the nitrifying of the soil through the wastes and remains of the animal body, the activity of predatory insects, amphibians, reptiles, birds and mammals in destroying various other species of insects, rodents, or other forms of animals that prey on

vegetation, the serving as food for game fishes or other valuable species.

SOME BIO-ECOLOGICAL RELATIONS

Even moderate use by man of the timber and forage is almost sure to upset the balance between the plants and animals and their environment on forest and range lands. Clear cutting, over-grazing and burning bring about profound and often catastrophic changes, involving not only the physical but also the biotic factors of site. The removal of the plant-cover promotes destructive erosion, injures the watershed value of an area, affects for the worse the welfare of near-by farming sections and cities and often promotes disastrous floods. As Jones has pointed out, "It was destructive erosion and not war that destroyed Assyria and Babylonia" ("Watershed Handbook," U. S. Forest Service, Southwestern District, December, 1923, mimeographed). Successful natural reproduction of forest, reforestation by either seeding or planting, maintenance of desirable forage cover, all depend on adequate attention to bio-ecological problems, as does also the effective protection of game mammals, birds and fishes.

SOME GENERAL VALUES OF WILD LIFE

Edward W. Nelson, T. S. Palmer, Chas. C. Adams and others have pointed out the educational, recreational and financial value of wild life. Adams's recent detailed study and demonstration ("Importance of Animals in Forestry," *Roosevelt Wild Life Bulletin*, Vol. 3, no. 4, October, 1926) of the important place occupied by animals in the economics of the community is convincing and impressive. It is believed that few technical men, not to mention state and even federal administrators, fully appreciate the value of wild life. Adams very properly stresses the unity of the forest resources. To realize fully on these resources they must be intelligently managed, with the object of making each area produce the largest contribution to the people's welfare, having regard to its varied products in forage, forest and wild life.

CONCLUSIONS

Whereas, in most lines of agriculture over-production is so outstanding a phenomenon that curtailment is widely recommended by economists, precisely the opposite is the case in silviculture and forage production. America's wild crop of timber and of feed for livestock falls far short of the demand. Careful attention must be given to all the conditions surrounding the growth of these crops. Among the factors of major importance are the native animals of forest and range lands. Some are pests; others are beneficial. Most play mixed rôles. Efficient production of trees and forage necessitates thoroughgoing study of the life histories and ecology of all the predominants, both plants and animals. Many animals, especially fishes, birds and mammals, are themselves of extraordinary value for recreation, study, and as a source of income. In some instances the value of the animals on a given area may exceed that of forage or trees. The production of wild life should be more than an incident or by-product of forest and range management. The objective should be maximum continuing values from each area. Attainment of this objective necessitates additional information and increasingly enlightened administration. Research is the foundation of our present prosperity. It must be the corner-stone of future advance. "The application of traditional methods will no longer suffice." Biology must participate fully in the solution of the many problems involved.

WALTER P. TAYLOR

TUCSON, ARIZONA

SCIENTIFIC EVENTS

THE FIFTH INTERNATIONAL BOTANICAL CONGRESS

AT the International Congress of Plant Sciences (Fourth International Botanical Congress) held at Ithaca, New York, in August, 1926, an invitation was conveyed from British botanists for the Fifth International Botanical Congress to be held in England in 1930. The invitation was accepted by the botanists assembled at Ithaca, and arrangements are now being made for the congress to be held at Cambridge about the middle of August, 1930.

An executive committee has been formed to make arrangements for the congress, consisting of Dr. F. F. Blackman, Professor V. H. Blackman, Dr. E. J. Butler, Professor Sir John Farmer, Professor F. E. Fritsch, Professor Dame Helen Gwynne-Vaughan, Dr. A. W. Hill, Professor W. Neilson Jones, Sir David Prain, Dr. A. B. Rendle (treasurer), Professor A. C. Seward (chairman), Professor W. Stiles and Professor A. G. Tansley.

It has been decided to organize the congress in the following seven sections: Morphology (including Anatomy), Paleobotany, Plant Geography and Ecology, Taxonomy and Nomenclature, Genetics and Cytology, Physiology and Mycology and Plant Pathology.

Mr. F. T. Brooks, the Botany School, University of Cambridge, England, and Dr. T. F. Chipp, Royal Botanic Gardens, Kew, England, have been appointed honorary secretaries of the congress, and any com-