same for the dry steppes of the northern and middle Kalahari region in South Africa. The contrast between the two regions covered by these two Heften is most striking. The illustrations continue to maintain the high standard of excellence which they have shown from the beginning of the series.

Professor Hansen's bulletin on "The Wild Alfalfas and Clovers of Siberia, with a Perspective View of the Alfalfas of the World" (Bull. 150, Bureau of Plant Industry, U. S. Department of Agriculture) tells, first, of his several journeys into parts of Siberia, and then discusses quite particularly three Siberian alfalfas, viz., *Medicago falcata, M. platycarpa* and *M. ruthenica,* all of which are cultivated. Common alfalfa, *M. sativa,* and sand lucerne, *M. media,* are grown also, as are *M. glutinosa* and *M. arborea* (often 10 feet high) to a very limited extent.

Professor Gates attempts to make an analytical key to some of the segregates of *Oenothera* (Twentieth Annual Report of Mo. Bot. Garden), and succeeds in designating no less than twenty-two "species," beginning with *Oenothera biennis* of Linnaeus. The author finds it necessary to add one new species, *O. rubricalyx* which "originated as a mutant from *O. rubrinervis* two years ago." Surely we are making progress in regard to a practical acceptance of evolution!

"Some Unsolved Problems of the Prairies" are discussed, by Professor H. A. Gleason, in the *Torrey Bulletin* for June, 1909. He confines himself to the Illinois prairies where they "were converted into cornfields long before the development of ecology and phytogeography in America, thus forever prohibiting the satisfactory investigation of some questions of the most absorbing interest." The sources of information still available are enumerated, and then he discusses eight problems which have hitherto remained unsolved.

Allied to the last is Professor C. H. Shaw's paper on "Present Problems in Plant Ecology" in the *American Naturalist* for July, 1909, dealing very largely with those problems that develop in the study of alpine vegetation, including heat, precipitation, length of season, light and evaporation. Little more is attempted than the setting forth of the problems in a distinct form. At the close the author expresses the wish which every botanist will echo, "that some one whose knowledge of physics and physiology fits him for such a task should overhaul and scrutinize our ideas and methods," and a little later says "there can be no question that ecology at the present time contains not a little of discernible error." And to the latter there is a chorus of "amens" from scientific botanists everywhere.

The same author shows (in *Plant World,* August, 1909) that "timber-line" on high mountains is often due to the action of the snow.

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SPECIAL ARTICLES

ARTIFICIAL PRODUCTION OF MULTIVOLTINE RACES OF SILKWORMS

The domesticated moths known as silkworms have been the subject of much interesting observation and experiment in recent years. The work of Toyama,[1] Coutagne[2] and particularly that of Kellogg[3] in this country, has added much to our knowledge of the hereditary processes revealed by the manifold varieties of this insect. In a recent study Miss McCracken,[4] continuing the previous work in Professor Kellogg's laboratory, has studied the heredity of the race characters, bivoltism and univoltism, in the silkworm. By the former term is meant the condition by virtue of which two broods are produced annually, whereas in the univoltine form, but one brood is reared, the eggs laid in the spring wintering over and hatching out the following spring. This racial character being a physiological rather than a morphological one, is of peculiar interest in heredity.

The elaborate breeding experiments of Miss

[1] *Bull. Agricultural Coll.,* Tokyo Imp. Univ., VII., 1906.

[2] *Bull. Scient. de la France,* XXXVII., 1903.

[3] "Inheritance in Silkworms," *L. S. Jr. Univ. Pub.,* 1908.

[4] *Jour. Exp. Zool.,* 1909, VII., 747.

McCracken extending over a period of five years seem to indicate that the character does not follow out the Mendelian ratio in hybridizing, but rather that the bivoltine character shows an increasing prepotence over the univoltine character in consecutive generations. Miss McCracken interprets this as a reversion to an ancestral condition.

One of the most significant results obtained by Tower in his work with *Leptinotarsa*,[5] consisted in so altering the nature of the germ plasm of his developing beetles by certain "stimuli" that a normally two-brooded form became five-brooded—a condition that was perpetuated in succeeding generations.

Somewhat along the same line, certain experiments carried out in Japan and recorded in an obscure journal[6] would seem to deserve recognition, if only because of their interest in connection with the above-mentioned work of Tower and Miss McCracken. As it is unlikely that this paper is either accessible or intelligible to the majority of occidental biologists, it may be worth while to give a brief abstract of it, in the hope that some one may be induced to repeat the rather uncritical experiments of the Japanese and thereby throw more light on the interesting phenomena of alteration of brood habit.

The article is entitled "The Artificial Production of Trivoltine Silkworms from Bivoltine," and the writer, Mr. K. Tsukai, begins by relating how an experienced silkworm grower named Matsumoto, living in a town of Shizuoka-ken, called Uragawa, brought some bivoltine silkworm eggs of a dealer some twenty miles to the north, intending to keep them over the winter and rear them the following spring. To his astonishment, after a few weeks, the eggs began to hatch. He thought at first that he had been tricked in his purchase, but on recollecting that the climate of his own town and that from which his eggs had come is quite different, he resolved to suspend judgment pending investigation. He found, indeed, that there was a difference of five or six days in the hatching interval in the two places, the worms which issue in twelve to thirteen days ordinarily, requiring there some eighteen days. Conceiving that a sudden temperature change might have occasioned this alteration in the physiological habit of his silkworms, he decided to experiment.

Near Takizawa is a famous cavern, the temperature of which varies little from 60° [Fahrenheit?] the year round. Within this cave he placed some eggs of the first brood of a bivoltine race, intending to delay their hatching until the eighteenth day. Eggs placed in the cave three days after laying and kept there nine days, on being removed, hatched out three days later, apparently unaltered by their stay in the cave. Next year (1903) he took up the matter again. Some bivoltine eggs were divided into two lots. The first were "brushed down" (first instar), March 31, pupated May 17 and emerged June 7. The eggs of these moths after a two-day interval were placed in the cave (March 24). After 13 days, *i. e.*, June 6, they were taken out. Six days later (June 12) they hatched. In rearing them, it was found that the cocoons were inferior to those of the second brood. The average cocoons of the second brood run about 270 to the *sho* (1.8 liters). These ran about 308. Of these only four or five revealed the trivoltine character.

The first brood of the second lot were "brushed down" April 15, pupated May 17 and emerged June 7. The eggs from these after a two-day interval were placed in the cave. After a stay of nineteen days (June 27) they began to hatch in the cave. The worms were "brushed down" and reared, but were very thin and "thread-like." Larvæ in the second moult average about 15.4 g. in weight. These did not exceed 10.5 g. They pupated July 23. The cocoons were very light and small, 358 of them bulking the same as 255 of the ordinary second brood.

Nevertheless, these all hatched out as trivoltine moths. Thus the experimenter's aim had been accomplished.

It is to be regretted that the Japanese writer does not give more explicit information as to

[5] Carnegie Pub., No. 48, 1906, p. 289.

[6] *Dai Nihon San Shu Kwai Ho* (Rept. of the Sericultural Assoc. of Japan), No. 171, p. 5, 1906.

the details of the third metamorphosis. Some of the specimens were given to the local sericultural school for experimental breeding, and by it distributed so that a number of silk growers in the vicinity are now rearing the trivoltine form.

The cave is described as lying in the south side of a mountain leading downward about 350 yards. The interior is moist and dripping. The temperature as mentioned before is 60°.

The larvæ were placed in a corner of the cave on the top of a "coal oil box" and enclosed in a double packing box (such as is used for storing treasures in go-downs). This box measured externally two feet square by one and a half feet high. The inner wall, one foot two inches square by about one foot high. The space between was filled with sawdust. (Apparently no record was made of the temperature of the interior of the box.)

In concluding, Mr. Tsukai remarks that some successful results have been recently reported in changing a trivoltine race into a quadrivoltine, presumably by the same method. He attributes the change to an inhibition of development through a lowering of the temperature. If so, it should be easy to reproduce the results described.

If it is true that the bivoltine races can be converted into trivoltine so easily, it would seem unlikely that the condition of bivoltism can be explained as a case of reversion.

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The American Association for the Advancement of Science
Section B—Physics

The annual meeting of the American Association for the Advancement of Science, Section B, was held in Boston, beginning Tuesday morning, December 28, and closing Friday noon, December 31, with two sessions daily. All sessions except that on the closing day were joint sessions with the American Physical Society. That on Tuesday afternoon was participated in also by Section A, and that on Friday was a joint session with Section L. The presiding officers were Vice-president Bauer, of Section B, and President Crew, of the American Physical Society. All the meetings were held in the physics lecture room of Walker Building, Massachusetts Institute of Technology, except on Wednesday, when both sessions were held in Cambridge at the Jefferson Laboratory of Harvard University. The attendance was uniformly good, varying from one hundred to two hundred. Fifty-nine papers and addresses were presented at the meeting.

On Wednesday evening there was an informal dinner for physicists at the Hotel Vendome and on Thursday afternoon a reception was given to all visiting physicists and their ladies by President and Mrs. Maclaurin of the Massachusetts Institute of Technology, at their home. Both of these were well attended and greatly enjoyed. An informal dinner and conference of the officers of Section B and of the American Physical Society on Tuesday evening led to a satisfactory plan for a more complete cooperation of the two organizations and a better agreement with respect to the range of activity of each.

A short business session on Tuesday resulted in the selection of the following officers for the meeting next Christmas at Minneapolis:

Vice-president and Chairman of Section—E. B. Rosa, Washington, D. C.

Secretary—A. D. Cole, Columbus, O.

Member of Council—W. S. Franklin.

Sectional Committee—L. A. Bauer, E. B. Rosa, A. D. Cole, A. Trowbridge, A. P. Carman, G. F. Hull and E. L. Nichols.

Member of General Committee—F. P. Whitman.

Several new members were added to the section and fifty members were made fellows of the association.

At the joint sessions on Tuesday afternoon and Friday morning an effort was made to provide programs that would be of interest to others than physicists. The papers presented were wholly by invitation. The large audiences—approximately two hundred in each case—and the interest shown demonstrated the success of this effort and led to a decision to adopt the "general-interest session" as a permanent policy. The program on Tuesday was presented by Sections A and B jointly and that on Friday by Section B. These programs follow.

Tuesday Afternoon, December 28

Some Reforms needed in the Teaching of Physics (vice-presidential address of Section B): Professor Karl E. Guthe, of the University of Michigan.