SCIENCE

FRIDAY, FEBRUARY 26, 1915

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

THE FORTHCOMING SITUATION IN AGRICULTURAL WORK[1]

THE American Association for the Advancement of Science represents the recognized and organized sciences. One by one new groups have been added to it, as those groups have won public recognition and have demonstrated that they are interested broadly in the enlargement of human knowledge. Half the letters of the alphabet are required to designate these groups represented in organized sections, indicating the breadth and vitality of our scientific inquiry. The last of these sections is agriculture—not the occupation agriculture, but the assembly of scientific research that deals with the problems of the occupation and of the living resulting from the occupation. We begin the work of this section to-day. It means much, I think, for this work that it has now been recognized as worthy to occupy a place on the programs with the older and the better standardized groups. I hope that we shall be worthy of the fellowship; and I trust that the Association itself will gain something by what we and our successors may bring to it in the future.

There is no field of scientific research that belongs exclusively to agriculture and not to other groups. The peculiarity of the research in this field lies in its association for the purpose of improving a great industry and of making a particular contribution thereby to the national life. The

[1] Address of the Vice-president and Chairman of Section L, American Association for the Advancement of Science, Philadelphia, December, 1915.

analysis of normal markworlds, we may expect significant results in a field which needs them perhaps more than any other among the biological substations.

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SCIENTIFIC JOURNALS AND ARTICLES

THE closing (October) number of Volume 15 of the *Transactions of the American Mathematical Society* contains the following papers:

R. A. Johnson: "The conic as a space element."

G. A. Bliss: "The Weierstrass *E*-function for problems of the calculus of variations in space."

H. H. Mitchell: "The subgroups of the quaternary abelian linear group."

L. P. Eisenhart: "Transformations of conjugate systems with equal point invariants."

F. B. Wiley: "Proof of the finiteness of the modular covariants of a system of binary forms and cogredient points."

Dunham Jackson: "On the degree of convergence of Sturm-Liouville series."

C. E. Love: "Singular integral equations of the Volterra type."

G. C. Evans: "On the reduction of integro-differential equations."

L. E. Dickson: "Invariants in the theory of numbers."

Also addenda and errata of volumes 11 and 14 and general index of volumes 11–15.

THE November number (Vol. 21, No. 2) of the *Bulletin of the American Mathematical Society* contains: Report of the twenty-first summer meeting of the Society, by F. N. Cole; "Infinite regions in geometry," by E. B. Wilson; "Famous problems of geometry" (review of Hobson's Squaring the Circle, A History of the Problem), by R. C. Archibald; Shorter notices: Smith and Gale's New Analytic Geometry, by E. R. Smith; Marsh's Technical Trigonometry, by F. M. Morgan; Fite's College Algebra, by J. E. Rowe; Mitzscherling's Problem der Kreisteilung, by R. D. Carmichael; Kommerell's Allgemeine Theorie der Raumkurven und Flächen, by R. C. Archibald; Neumann's Fragen der höheren Potentialtheorie, by T. H. Gronwall; Kaye and Laby's Physical and Chemical Constants, by H. B. Phillips; "Notes"; and "New Publications."

THE December number of the *Bulletin* contains: "On a generalization of a theorem of Dini on sequences of continuous functions," by T. H. Hildebrandt; "Note on removable singularities," by W. E. Milne; "Concerning a certain totally discontinuous function," by K. P. Williams; "Proof of the convergence of Poisson's integral for non-absolutely integrable functions," by W. W. Küstermann; "The Napier tercentenary celebration," by D. E. Smith; "An appeal to producing mathematicians," by George Paaswell; Shorter notices: Zeuthen's Mathematik im Altertum und Mittelalter, by D. E. Smith; Minkowski's Geometrie der Zahlen, by L. E. Dickson; Elliott's Algebra of Quantics, by D. D. Leib; Fabry's Problèmes d'Analyse mathématique, by E. W. Ponzer; Demartres' Cours de Géométrie infinitésimale, by E. W. Ponzer; Engelhardt's Probleme im Schlusswort des Lies'chen Geometrie der Berührungstransformationen, by O. E. Glenn; Whiteford's Trisection of an Angle, by E. B. Lytle; Collins' Practical Algebra, by E. B. Lytle; Van Tuyl's Complete Business Arithmetic, by D. E. Smith; Martin's Text-book of Mechanics, by F. L. Griffin; Ott's Angewandte Mathematik an den Deutschen mittleren Fachschulen der Maschinenindustrie, by E. W. Ponzer; Jacoby's Astronomy, by K. P. Williams; "Notes"; and "New Publications."

THE January number of the *Bulletin* contains: Report of the October meeting of the Society, by F. N. Cole; Report of the twenty-sixth meeting of the San Francisco Section, by Thomas Buck; "Modular invariant processes," by O. E. Glenn; "Invariants, seminvariants, and covariants of the ternary and quaternary quadratic form modulo 2," by L. E. Dickson; "The converse of the Heine-Borel theorem in a Riesz domain," by E. W. Chittenden; "Complete existential theory of Sheffer's postulates for Boolean algebras," by L. L. Dines; "On the characteristics of the principal manuals of elementary geometry

published in Italy in the course of the last fifty years," by Mario Vecchi; "Mathematical methods in physics" (review of Volterra's Sur quelques Progrès récents de la Physique mathématique, Drei Vorlesungen über neuere Fortschritte der mathematischen Physik, and Leçons sur l'Intégration des Equations aux Dérivées partielles), by J. B. Shaw; Shorter notices: Berkeley's Mysticism in Mathematics, by C. J. Keyser; Aubert and Papelier's Exercices de Géométrie analytique, by F. M. Morgan; Hardy's Orders of Infinity, by W. A. Hurwitz; Smith and Karpinski's Hindu-Arabic Numerals, by J. V. McKelvey; Dalwigk's Darstellende Geometrie, by J. V. McKelvey; Schmid's Darstellende Geometrie, by Virgil Snyder; Auerbach's Graphische Darstellung, by Virgil Snyder; Meyer's Differential- und Integralrechnung, by Virgil Snyder; Note on "The discovery of inversion," by Arnold Emch; Correction; "Notes"; and "New Publications."

SPECIAL ARTICLES

THE IDENTITY OF HELIOTROPISM IN ANIMALS AND PLANTS. SECOND NOTE [1]

Paul Bert had shown in 1869 that if the small fresh-water crustacean *Daphnia* is exposed to a solar spectrum it goes towards the source of light in all parts of the visible spectrum, but most rapidly in the yellow or green.

Il fut facile de remarquer qu'elles accouraient beaucoup plus rapidement au jaune ou au vert qu'à toute autre couleur.[2]

The fact of the predominance of the heliotropic efficiency of the yellowish-green in these and some other animals led the ophthalmologist Hess to two assumptions, first that they are totally color-blind (since the yellowish-green part of the spectrum is the brightest for the eye of the totally color-blind human) and second, that the sensation of brightness is the cause of the heliotropic reaction of animals. It is obvious that these conclusions go beyond the facts, since we have no proof for the assumption that the heliotropic effects of light in lower animals are accompanied or determined by any sensations of brightness and since totally color-blind humans do not show any positive heliotropism. In consequence of his two arbitrary assumptions, Hess is forced to the further conclusion that the heliotropic reactions in animals and plants can not be identical, since he does not seem ready to discuss the light and color sensations of plants, and he tries to support this conclusion by the statement that heliotropic plants and animals are sensitive to different parts of the spectrum, all animals to the yellowish-green, all plants to the blue. We have already pointed out in our previous note[3] that this latter statement is not correct, since we were able to show that for the positively heliotropic animal, *Eudendrium*, the most efficient part of the spectrum lies in a carbon arc spectrum in the blue near the region $\lambda = 474\ \mu\mu$, where it also lies, according to Blaauw, for the seedlings of oats.

It seemed of interest to find out whether for different motile unicellular organisms which contain chlorophyll and which are on the border line between plants and animals the most efficient part of the spectrum for the production of heliotropic reaction lies always in the same region. We investigated the reactions of *Chlamydomonas pisiformis* and of *Euglena viridis* in a carbon arc spectrum. The investigation of the behavior of these organisms in the spectrum showed a marked difference. *Euglena* gather in the blue part of the spectrum, usually in the region between $\lambda = 438$ and $\lambda = 510\ \mu\mu$. The densest gathering was generally in the region of $\lambda = 475\ \mu\mu$. In the case of *Chlamydomonas* the gathering always went much farther towards the yellow, usually having its limit in the region of about $\lambda = 560$ or $\lambda = 570\ \mu\mu$. It was in most cases not easy, however, to ascertain the region of maximal gathering, though in many cases it seemed to be about $\lambda = 520\ \mu\mu$. The most remarkable difference between the behavior of the two forms in the spectrum was therefore the fact that *Chlamydomonas* was sensitive to longer waves than *Euglena*.

It soon became obvious that this method of procedure does not permit the decision of the

[1] Loeb and Wasteneys, *Proc. Nat. Acad. Sc.*, I., p. 44, 1915.

[2] Paul Bert, *Arch. de Physiol.*, II., p. 547, 1869.

[3] Loeb and Wasteneys, *Proc. Nat. Acad. Sc.*, I., p. 44, 1915.