the nervous system, including the brain, is describable in terms of physicochemical processes, and that the principles or modes of mental activity are in some manner closely related to the modes of neural activity. Even the radical behaviorist, in denying the scientific character of the "mental," merely emphasizes the supremacy of "natural law." To McDougall, on the other hand, mental activity belongs to a distinctly different type from inorganic activity. Organic behavior does not follow the resultant of forces—it pictures the future and operates to attain a desired end.

The teleological theory offered in this book is closely related to the vitalistic theory in biology. Each assumes a mode of activity distinct from the strictly causal sequence of events—a factor which somehow guides the flow of energy and determines the outcome. It is precisely at this point that the teleological conception is open to challenge. The arguments of Driesch for an organic entelechy have been seriously questioned by leading biologists. Similarly, Professor McDougall's colleagues will question his teleological interpretation of response. The present volume offers no suggestion as to the *manner* in which the hormic activity works. The author merely states that the end is foreseen and that the activity proceeds till the purpose in view is accomplished. But is this true? Certainly the adult who has endeavored to twitch his ears without prior training finds that the purpose to accomplish this result does *not* attain the appropriate goal, no matter how intense or prolonged the striving. And so with the lower types of behavior. "Instinctive activity," says McDougall, "strives toward a goal, a change of situation of a particular kind, which alone can satisfy the impulse and allay the appetite and unrest of the organism" (p. 119). In pre-Darwinian days the instincts might well have been defined in these teleological terms, but natural selection indicates an alternative explanation —evolution of traits by racial "trial and error"— which seems both intelligible and plausible. Such questions of fact and interpretation will have to be thoroughly threshed out before the real value of McDougall's work can be determined.

Perhaps the weakest point in the present volume is the author's vagueness in defining his fundamental concepts. The reader will ask for a more lucid description of *striving, conation* and *foresight* than is given. There is also throughout the book a certain dogmatic insistence upon the cardinal doctrine of teleology, coupled with an all too frequent use of the adjectival method of refuting opponents. ("Loftily assert," p. 28; "impossible," "obviously absurd," p. 84; "fantastic theories," p. 128; "lofty attitude," p. 194; "the extravagant behaviorist doctrine," p. 289.)

On the other hand, the evidence for non-mechanistic activity is ably presented and deserves careful and unprejudiced study on the part of investigators, to whatever school they may belong. Professor McDougall's formulation of the hormic theory (p. 71–3) raises teleology from metaphysical speculation to a real psychological problem, and his explanation of the nature of free-will (p. 46–8) gives that time-worn theory a new meaning.

Of special interest is the discussion of the seven marks which the author believes distinguish the behavior of organisms from the physicochemical activities of inorganic matter (pp. 44–46, 56). These are: (1) spontaneity of movement; (2) persistence of activity; (3) variation of direction of persistent movements; (4) termination of the activity when a particular change in situation is brought about; (5) preparation for the new situation; (6) improvement in the effectiveness of behavior; and finally (7) the fact that "purposive action is a total reaction of the organism," rather than a specific reflex or group of reflexes. These characteristics, taken together, afford perhaps the best synthetic view of the teleological conception of behavior.

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Historia de la Influencia Extranjera en el desenvolvimiento Educacional y Cientifico de Costa Rica. Por LUIS FELIPE GONZALEZ. Imprenta Nacional, San José de Costa Rica, 1921. 8vo, pp. (6) + XI + 320, 24 plates, each containing four portraits.

THE title of this clearly printed volume accurately describes its contents, which are concerned with the rôles played by various European and American nations in the educational and scientific development of the most liberal and progressive of the Central American republics—Costa Rica. It is a centenary volume, issued in the year when these republics celebrated the hundredth anniversary of their independence of Spain. It is divided into two parts.

The first part comprises eight chapters, 61 pages and, in the words of the author, analyzes the different factors which have determined the national culture during the first two thirds of the century of separate existence.

The universities of Spanish colonial America were those of Mexico, Guatemala, León, Santa Fé de Bogota, Lima and Cordoba. They possessed the same medieval culture peculiar to those of the mother country. Essentially conservative, they gave preeminence to ecclesiastical studies and scholastic philosophy, that mistress of theocratic Spain, with her bookish and memorizing systems, narrowness of spirit, filled with preoccupation and routine that offered not the least impulse to scientific investigation.

Their knowledge crystalized in traditional formulae, with essentially mnemotechnical methods of the purest scholasticism, with the order of cyclical teaching and the dogmatism of the peninsular cloisters. Under such conditions the Hispano-American university lived without the stimulus of philosophic and scientific culture which culminated in the teaching institutions of other countries, due to European investigation.

In the early years of the 19th century members of influential families of Costa Rica attended the University of León (Nicaragua), as the nearest institution of higher learning, and through them and other graduates who went to Costa Rica to take part in the political organization of the latter country, after its independence was proclaimed in September, 1921, the Nicaraguan institution exercised great influence on the intellectual and educational development of the neighbor to the south. One of the Leonese alumni was Rafael Francisco Osejo, called in 1814 by the municipality of San José (Costa Rica) to direct the House of Teaching of St. Thomas (*Casa de Ensenanza de Santo Tomas*). Here in 1825, or soon thereafter, modern foreign languages, English and French, were for the first time taught in Costa Rica. Professor Osejo, in his character as a deputy in the Ordinary Assembly, was the author of the first law of public instruction in Costa Rica, promulgated in May, 1832, according to which the municipal bodies were required to oblige fathers of families to procure for their children between the ages of eight and fourteen years instruction in Christian doctrine, reading, writing and numeration, and imposing a fine of 3 pesos per year on those who did not fulfil this obligation.

From about 1840 the influence of the University of San Carlos at Guatemala, with the more liberal tendencies in its organization, began to supplant that of San Ramón de León, especially in law and in medicine.

Immigration from Europe, South America and the other Central American countries followed the establishment of independence and tended to increase the elements of and desire for culture. The first Costa Rican youth to seek an education in Europe, José Maria Montealegre, left his native land in 1826, at the age of eleven, passed through High Gate School in London, obtained the medical degree in Edinburgh and returned home early in 1840. Not until 1863 did Costa Ricans come to the United States to study medicine.

The increasing production of coffee, the establishment of a regular port of call at Puntarenas by steamships of the Pacific Mail in 1856, the arrival and prolonged residence of distinguished German engineers and scientific men like Rohrmoser, Frantzius and Hoffmann, constituted additional factors in the increasing enterprise and development of the country.

In 1848–1850, treaties of amity and commerce were made with Great Britain, France, the Hanseatic cities, Spain and the United States, and accredited representatives of these countries soon began to function in Costa Rica.

The influence of the other Central American states declined with these events in proportion as that of Europe and the United States increased. Nevertheless, the foundation of the Liceo de Costa Rica at San José in 1864 was largely due to Maximo Jerez, a native of León, proscribed by his own country and who, as a result, dwelt in Costa Rica from 1863 to 1868.

A Guatemalan, Felipe Molina, was the first minister plenipotentiary from Costa Rica to the United States, dying in Washington February 1, 1855, while discharging that function. He was the author of the first historical and geographical sketch of Costa Rica, a work which did good service in acquainting foreigners with the possibilities and beauties of the country and which long served as a text-book in the schools and colleges of Costa Rica itself.

A railroad from the Atlantic port of Limon to the capital, San José, was completed in 1891, while that on the Pacific side halted between Orotina and Esparta for some time and was finally extended to Puntarenas in 1910.

All of the movements of which the events mentioned above were the visible signs are duly considered with reference to the intellectual development of Costa Rica.

Beginning in 1869 the Costa Rican government entered into contracts with teachers in various European countries to instruct the youth of the republic. The first of these instructors was Professor Valeriano Fernandez Ferraz, who had occupied chairs in Greek and in Arabic in the universities of Seville and Madrid, and who on reaching Costa Rica organized, and for three years directed, the College of San Luis Gonzaga at Cartago. He was followed to Costa Rica by his two brothers, one of whom, Juan Fernandez Ferraz, became Director of the Museo Nacional in 1898 and served the state in many other capacities.

Others who went to Costa Rica under similar arrangements were the botanist Helmut Polakowsky (1875), and a notable group of young Swiss scientific men, Paul Biolley (1886), Henri Pittier (1887), Gustave Michaud and Jean Rudin (1889), all of whom remained for many years in the country and added greatly to the development of science by teaching and by research.

The second and larger part of the book traces the influence derived from each country to which Costa

Rica has been indebted for her educational and scientific life. One or more chapters are devoted to Germany, Argentina, Belgium, Colombia, Cuba, Chile, Spain, the United States, France, England, Italy, Mexico and Switzerland. The individuals of these countries who have visited and studied in Costa Rica, or who have described her natural productions, are discussed biographically and lists of their publications relating to the country are given. Pedagogical theories and methods proceeding from these different sources are considered with respect to Costa Rican schools and teaching. Four chapters (nearly 100 pages) are devoted to the United States, wherein 103 authors and travelers are named or discussed. The data on books and publications given in this volume constitute a fairly complete bibliography of foreign authors on Costa Rican pedagogy and natural science.

Senor Gonzalez's history is surely of great value to Americanists, Pan-Americans, naturalists and historians of science.

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SPECIAL ARTICLES

NOTES BY N. M. STEVENS ON CHROMOSOMES OF THE DOMESTIC CHICKEN

RECENTLY, in looking over a file of old research notes I came across a package of rough notes and drawings by Miss Stevens on the chromosomes of the domestic chicken, which had been given to me after her death. She had been working at this problem at odd times at the same time that Dr. Pearl and I had in 1914. We had sent her adult testis material from the Maine Agricultural Station, and she had also worked on embryos. The present interest in these notes lies in their bearing on T. S. Painter's paper on Reptilian Spermatogenesis (*Jour. Exp. Zool.*, 34, 281–327). Painter says that one object of his study was "to determine what light a study of reptilian spermatogenesis would throw on the spermatogenesis of birds since reptiles and birds are closely related phylogenetically." No one as yet has published any satisfactory results on bird chromosomes. The outstanding feature in the lizard spermatogenesis seems to be the arrangement of the chromosomes in the equatorial plate, a definite number of large chromosomes in a ring around a center group of small chromosomes, the number of which is sometimes difficult to determine. Miss Stevens's drawings show equatorial plates which exhibit a striking resemblance to those drawn from the lizard by Painter. She suggests that there may be a nebula of small chromosomes at the center of the group which clump readily in poor fixation and therefore have often been taken for several large chromosomes.

Her drawings show 12 large chromosomes forming the outer circle in the spermatogonia and usually 6 (occasionally 5 or 7) in the spermatocyte. The number of small chromosomes figured in the center varies, being usually 12 or 14 in the spermatocyte where they are of course easier to identify than in the spermatogonium. I include copies of six of her drawings. They were camera lucida drawings, but had not been finished as these were only fragmentary notes at the beginning of a study. Figures 1 and 2 are spermatogonia, each with 6 pairs of large chromosomes and a mass of small chromosomes. Figure 1 was marked "question as to how many small ones—too thick together." Figure 2 was marked "all rather mixed in the center." Figures 3 and 4 are prophases of the first spermatocyte division. Each shows 6 large chromosomes. Figure 3 has 14 small chromosomes, while Figure 4 has 16. Figures 5 and 6 are equatorial plates of the first spermatocyte division. Here we find 6 large chromosomes; in Figure 5, 14 small, while in Figure 6 there seem to be only 12 small. Some other drawings bear the following comments

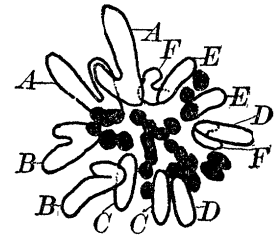

Fig. 1


Fig. 2

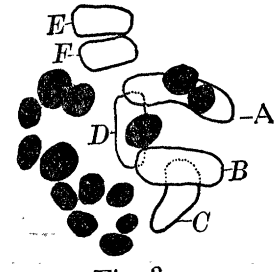

Fig. 3

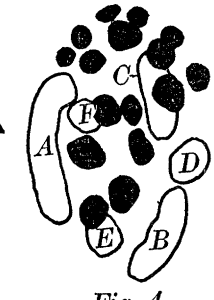

Fig. 4

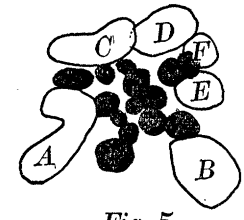

Fig. 5

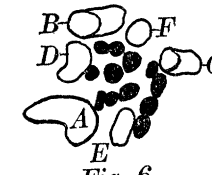

Fig. 6