of the past few years. Patient, systematic exploration, by routes of which the initial sections were already mapped in the early days of chemotherapy, has in these recent years again led to results of major importance, both for practical therapeutics and for the theoretical basis of future advance. That the original theoretical framework begins to show itself inadequate for the expanding fabric is good reason for its reconstruction; but we may well beware of hasty and wholesale rejection, remembering that it served the early builders well. I think that it is especially encouraging to note that, though, in the action of almost every remedy which has proved its value in the specific cure of infection, there are features which can not be interpreted by a strict application of Ehrlich's distribution hypothesis, the discrepancies begin to show a new congruity among themselves. Repeatedly we find phenomena which point to the need of modifying the theoretical structure in the same direction. The conception of a remedy not killing the parasites immediately, but modifying their virulence, or lowering their resistance to the body's natural defences; of a remedy not acting as such, but in virtue of the formation from it in the body of some directly toxic product, either by a modification of its structure or by its union with some tissue constituent; of an affinity of the remedy for certain cells of the host's body, leading to the formation of a depot from which, in long persistent, never dangerous concentration, the curative substance is slowly released; all these conceptions present themselves, again and again, as necessary for our present rationalization of the effects observed. It can hardly be doubted that they will potently influence the methods by which, in the immediate future, new and still better specific remedies are sought. But though our practical aim, in relation to the affinities of a remedy for the parasite and for the host's tissues, may be radically changed, the meaning of these specific affinities, so delicately adjusted to a precise molecular pattern, remains dark. Ehrlich's chemoreceptors may no longer satisfy us, but we have nothing equally definite to replace them. I have endeavored to indicate what seem to me hopeful signs of new contacts between biochemistry and chemotherapy. There is promise, in another direction, that at least some aspects of the problem of immune specificity are being brought within the scope of strictly chemical investigation, as in the recent work of Avery and Heidelberger, on the constituent of a pneumococcus which combines with the specific precipitin. As in Ehrlich's pioneer work in chemotherapy, it can hardly be doubted that an increased understanding of the meaning of immune specificity, which but a short while ago might have seemed hopelessly beyond the range of attack by chemical weapons, will still influence ideas and help to shape the course of further investigations on the chemotherapeutic process. As the biological complexity of the problem is realized, it becomes increasingly a matter for wonder and admiration that so much of practical value has already been achieved—the treatment of the spirochetal infections, syphilis, yaws and relapsing fever, revolutionized; Leishmania infections, kala-azar and Baghdad boil and Bilharzia infections which crippled the health of whole populations in countries such as Egypt, now made definitely curable; trypanosome infections, such as the deadly African sleeping-sickness, after years of alternating promise and disappointments, brought now at last within the range of effective treatment. And if such results have already been attained, in a period during which practice has often and inevitably outrun theory, we may well be hopeful for a future in which fuller understanding should make for more orderly progress.

H. H. DALE

DEVONIAN PALEONTOLOGY OF BOLIVIA

No geological system in South America has been so well explored as has the Devonian. The bead-roll of eminent contributors to the elucidation of South American Devonian paleontology commences with the name of d'Orbigny in 1842 and includes longer or shorter contributions by Salter (1861), Rathbun (1874, 1878), Hartt (1875), A. Ulrich (1893), von Ammon (1893), Katzer (1896–1898), Kayser (1897, 1900), Haug (1905), Thomas (1905), Newton (1906), and Knod (1908). John M. Clarke, whose labors in this field cover nearly a quarter of a century (1890–1913), and culminated in his magnificent monograph published in 1913, in which the whole field was covered in his characteristic masterly way, has contributed more than any one else to this subject.

The eastern South American Devonian has, on the whole, received more attention and more thorough treatment than that of the Andean region, although Devonian beds outcrop for hundreds of miles along the medial extent of the Andean system. The Devonian is well represented and fairly fossiliferous in Bolivia, in which general region d'Orbigny first collected Devonian fossils in South America, but these Devonian faunas have not heretofore received the exhaustive treatment that has been devoted to those of Brazil.

Last year there appeared in the Annales de Paléontologie a monograph of the Devonian of Bolivia by Roman Kozlowski,[1] who spent six years in Bolivia, first as a professor and subsequently as director of the School of Mines at Oruro. In this work there are described 138 different forms, making the Bolivian

[1] Kozlowski, R., "Faune Dévonienne de bolivie." Ann. Paléont., tome xii, 112 pp., 10 pls., 1923.

fauna the largest known from South America, that from Paraná, for example, consisting of 73 species. This fauna comprises 33 trilobites, 9 cephalopods, 5 conularias, 7 pterapods, 15 gastropods, 26 pelecypods, 33 brachiopods, 3 echinoderms, 3 bryozoa and 4 corals. The few corals, bryozoa and crinoids; the reduced number of brachiopods, and the great abundance of pelecypods emphasize the prevailing muddy environment during Devonian time in Bolivia.

The sub-divisions of the Bolivian Devonian are geographic rather than stratigraphic, although Kozlowski believes the succession given below as probable: At the base are the shales of the Cordillera Real, as at Araca, and these are correlated with the North American Helderberg. Above this lies the Icla formation, consisting of the *Rensselaria knodi* sandstone, the Conularia shales and the Huamampampa sandstone. These are collectively correlated with the Oriskany of North America, the Maecurú sandstone of Pará, the Devonian of Paraná, Matto Grosso, the Argentina, Falkland Islands and the Bokkeveld beds of Africa.

Above the Icla formation is the Sicasica formation of the Altaplanicie, which consists of the lower fossiliferous shales, the *Homalonotus dekayi* shales and the upper barren sandstone. These are correlated with the Ereré sandstone of Pará, and with the middle Devonian of North America, and possibly extending upward into the upper Devonian.

The austral character of the Devonian faunas of South America, emphasized by Clarke, are, in Bolivia, shown chiefly by the Phacopidae. Paraná and Africa show the largest number of identical forms, and Africa has twice as many as Pará. Kozlowski is inclined to think that the barrier that prevented intercommunication between Bolivia and Pará was water too deep to permit the interchange of shallow water faunas rather than a land barrier, and this implies that such a deep water barrier was lacking at that time between South Africa and Bolivia.

Kozlowski identifies a considerable number of North American species in the Bolivian Devonian. These occur for the most part in the supposed younger Devonian Sicasica formation, and include such forms as *Homalonotus dekayi, Orthoceras constrictum, Nuculites oblongatus, Tropidoleptus carinatus, Vitulina pustulosa;* and closely related forms of Lophospira, Ambocoelia, Liorhynchus and Spirifer. From this he concludes that the means of intercommunication between North America and Bolivia were easier at that time than in the earlier Devonian. We have compared these with material in the Hopkins collections from Bolivia, and with North American specimens, and believe that such an identity is not established in all cases, but this is a question to be decided by more material and by someone better versed in Devonian paleontology than the reviewer.

Kozlowski's memoir is a most complete and scholarly contribution. His adequate and well-executed illustrations amply supply the deficient and poor illustrations of Bolivian material in the works of Ulrich and Knod. The work is a most welcome contribution to the paleontology of South America, and lays a secure basis for future studies of the Andean Devonian.

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AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

PREPARATIONS FOR THE FIFTH WASHINGTON MEETING AND ASSOCIATED ORGANIZATIONS

THE local committees in charge of preparations for the approaching Washington meeting of scientists (December 29, 1924, to January 3, 1925) have been organized as follows:

The Local Committee for the Fifth Washington Meeting

William Mather Lewis, president of George Washington University, *chairman.*

C. G. Abbot, assistant secretary, Smithsonian Institution.

Gilbert H. Grosvenor, president of the National Geographic Society.

Vernon Kellogg, permanent secretary of the National Research Council.

John C. Merriam, president of the Carnegie Institution of Washington.

David White, home secretary of the National Academy of Sciences, and senior geologist, U. S. Geological Survey.

The Committee on Special Arrangements for the Fifth Washington Meeting

Walter M. Gilbert, administrative secretary, Carnegie Institution of Washington, *chairman.*

Albert L. Barrows, assistant secretary, National Research Council.

Paul Brockett, assistant secretary, National Academy of Sciences.

Austin H. Clark, curator, Division of Echinoderms, U. S. National Museum.

Hugh Miller, dean of engineering, George Washington University.

W. J. Showalter, associate editor, National Geographic Society.

Chairmen of Subcommittees

Albert L. Barrows, Hotels.

Paul Brockett, Transportation.