exposed to light in the case of living leaves and the glass vessels of the laboratory. These quantities are about the same. Some plants produce more and others produce less than we are able to synthesize. This similarity may be emphasized, because surely Dame Nature in the living leaf has produced the best machine she could for her purpose of food production for her children of the vegetable kingdom.

There is yet another striking feature which is common to the two, photosynthesis *in vivo* and *in vitro*. The light must not be too strong in either, for if it is too strong then harmful results at once supervene. This is due to the poisoning of the surface by the oxygen which is set free. In both cases this poisoning slowly rights itself, and in both the synthesis must not proceed at a greater rate than that of the recovery of the surface from its poisoning.

In fine, so far as we have been able to carry the investigations, the processes in the living plant and in the laboratory show most striking resemblance, not only in the compounds which are formed, but in every feature which is characteristic of either of them.

For my own part I would go further than this, because I believe that these experimental results help us to gain some understanding of the chemistry of life, the chemistry which is so different from that of man's achievements with his test-tube, flask and beaker. Within the confines of vital chemistry reactions take place which are so far outside our own experimental experience that it came to be believed by many that they were under the control of a mysterious force, to which the name of *vis vitalis* was given. One of these processes has come within our purview to-night, the condensation of the simple sugars, glucose and fructose, to form cane sugar, starch and inulin. No one has yet succeeded in effecting these syntheses in his laboratory, but it would seem that something of that nature takes place in our photosynthesis. Why, then, is it that even this step forward has been gained?

The one lesson that we have gained from photosynthesis is that the definitive factor is the very large amount of energy which must be supplied to the carbonic acid before the synthesis of the simple sugars takes place. The means of supplying that energy do not concern the argument. The synthesis proceeds at an energy level which is far higher than is the case in the reactions of ordinary chemistry, and the sugars are formed at that high energy level. I myself believe that the condensation reactions to give the more complex carbohydrates are those which are characteristic of the simple sugars when they exist at the high energy level. The reason why no one has succeeded up till now in inducing these reactions to take place is because no one has hitherto been able to supply the large energy increment necessary.

I myself believe that we find in this the key which unlocks the door of vital chemistry, and that the chemistry of all life is one of high energy, our laboratory experience being confined to the chemistry of low energy. From this viewpoint I see a wondrous vista unfold itself, wherein new understanding, new hopes and new possibilities reveal themselves. Health and vitality must essentially depend on the high energy level being maintained; any lowering of that level will lead to poor health and weak vitality. Knowledge comes to us of the means whereby the high level may be kept unimpaired. The most important sources from which we can absorb high energy are fresh food and ultra-violet light. From the one we learn the necessity of the rapid distribution of our food supply before its high energy is lost, from the other we gain a real understanding of the benefits of ultra-violet light therapy, and, more important still, of the dangers of its misuse. We gain an insight into the chemistry of vitamins, which in the light of our new knowledge reveal themselves as stores of high energy, bottled sunshine so to speak, which yield their energy to restore and maintain the vitality of decadent tissues. A vision thus comes to us of a new chemistry with limits far flung beyond those which constrain our knowledge of to-day, a chemistry which will embrace and coordinate not only the properties of inanimate matter upon this earth, not only the wondrous mechanism of the life of man in health and in disease, but in addition the stupendous marvels of the birth and growth of the worlds outside our own. From those who would decry this as a mere speculation I beg forgiveness, and plead that speculation based on sure experimental fact is the life blood of true scientific research.

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MILLIONTH SCALE MAP OF HISPANIC AMERICA[1]

THE department of Hispanic-American research of the American Geographical Society has been engaged for the past seven years in the preparation of a new map of Hispanic America and the West Indies. An exhaustive search has been made for original surveys and other source material, and a completely new map is being compiled. The map follows the scheme of the International Map of the World on a scale of 1:1,000,000 and will consist of one hundred sheets,

[1] Résumé of a paper read at a recent meeting of the Federal Board of Surveys and Maps.

each four degrees of latitude by six of longitude. The work is now about half completed. Twenty sheets have been published, ten more are in the engravers' hands and a large number are in various stages of compilation and fair drawing.

The preparation of this map is a part of the program of geographical studies in Hispanic America which the American Geographical Society inaugurated in 1920. The purpose of the map is to provide as accurate a cartographic base as present knowledge will permit for use in the field, for study and for the plotting of distributions.

For many years to come maps of Hispanic America which cover any considerable extent of territory must be compiled maps, because, although many of the Hispanic-American countries are engaged on programs of systematic topographic surveys, progress on such programs is necessarily slow. However, a great deal of survey work of various types and various degrees of merit has been done in recent years in all the Hispanic-American countries. There are of course areas in which no surveys of any sort have yet been made. However, a sufficient number of surveys have been made to afford an excellent cartographic picture of the whole of Hispanic America, once they are assembled and incorporated in a critical compilation.

Much of this material has been published in scientific periodicals, books and sheet maps. It is, therefore, in a sense available for compilation, but it is scattered in many collections and there is no general catalogue of it, nor is there for the individual collections any analysis of the relative merits of their parts. To make thorough use of this source material is, therefore, beyond the scope of the individual compiler or the map concern that must sell its products at a profit. An even more important source of compilation material is the unpublished surveys in the archives of the Hispanic-American governments themselves and in the map departments of foreign and domestic development companies. Because of the confidential nature of these surveys they may well be said to be practically inaccessible to the commercial cartographer.

To compile a map of Hispanic America which will truly represent present cartographic knowledge of the whole region necessitates the assembling and critical study of all possible survey material. Even the best general maps of the Hispanic-American countries fall far short of such accuracy. They are in general practically valueless as a base for field work or for the detailed plotting of distributions. The explorer is handicapped by the fact that he has no maps upon which he can rely to indicate to him the extent and quality of his predecessors' work. The student who undertakes the study of any phase of Hispanic-American geography is balked by the lack of maps upon which to base his studies. He ought not to be obliged to preface his studies with a prolonged examination of cartographic sources and with map compilations for which he may have neither the time nor the technical training. He ought to be provided with maps on a scale sufficiently large for his needs, in which he is assured that the best surveys available have been critically compiled and on which he can readily distinguish between surveyed and unsurveyed areas.

It is in an attempt to supply this need that the American Geographical Society has undertaken to compile a new map of Hispanic America. The society has had most gratifying success in collecting source material. Libraries, scientific institutions, the various bureaus of the federal governments and individual explorers have given much assistance. The Hispanic-American governments have shown great interest in the map and have in many cases placed the entire contents of collections of official surveys at the society's disposal. Development companies have recognized the value to themselves of the type of map which the society is producing and have freely granted the use of their surveys once they have been assured of the integrity of the compilers in handling confidential material. As a result it is believed that for the sheets of the map so far completed use has been made of all the important surveys that have been made in the areas covered by the sheets. In all requests for compilation material the extent of territory to be covered by the map and the scope of the studies to be based on it have been the society's best allies because they are evidence of the disinterested character of the work. The magnitude of these hitherto untapped sources of material for the map of Hispanic America is indicated by the fact that the unpublished surveys received by the society during 1925 and 1926 included 110,000 square miles of high-grade topographic surveys, 60,000 square miles of less accurate topographic surveys and 15,000 miles of traverses.

The standards of the International Map were adopted because they achieve the purposes which the map is designed to serve. Briefly, those purposes are: to use the source material available to all cartographers with greater accuracy and discrimination than has been employed on previously compiled maps; to add to these sources the great mass of material in the archives of government bureaus and the collections of development and construction companies which is not available to the commercial cartographer; to give, by means of contours and layer tints, topographic expression to our best knowledge of the physiography of both the land areas and the

sea floor; to present the cartographic details obtained from the sources used so as to distinguish between surveyed and unsurveyed areas; to express the most accurate information available as to location and status of political boundaries, position and population of towns, location and gauge of railways, location and character of roads, location of telegraph lines and stations; in a word, to furnish a map which will represent, as far as the conventions of the topographic-political map will permit, the results of a critical and exhaustive research into the cartography and human geography of the whole Hispanic-American realm.

To the scheme of the International Map have been added certain modifications considered essential to the thoroughly scientific presentation of the cartographic status of those parts of the world which are not covered by one type of survey. These modifications are a further development of that feature of the International Map which distinguishes between surveyed and unsurveyed rivers and contours by solid and broken lines. They consist of a relative reliability diagram, incorporated in the legend, which classifies by appropriate symbols the types of surveys used in the compilation, and a pamphlet accompanying each sheet which lists the sources used in the compilation of the sheet and discusses the manner in which they are organized with respect to each other. Thus each sheet sets forth both our cartographic knowledge and our cartographic ignorance. In addition, by means of the relative reliability diagram and pamphlet, it indicates to the consultant the character of the survey work which has been done in the area in which he is interested.

These maps will cover sections of Hispanic America that are of the greatest interest to the physiographer and the geologist, by virtue of their physiographical and geological make-up, of scarcely less interest to the meteorologist, the biologist and the student of political and economic geography.

Parallel with the work upon the cartography of Hispanic America we have compiled a catalogue of the maps of Hispanic America in scientific periodicals, sheet map collections, atlases and books contained in the libraries of the American Geographical Society, the New York Public Library, the Library of Congress, the Pan-American Union Library and the libraries of Columbia, Yale and Harvard Universities. Grouped and classified and accompanied by reliability maps and introductory articles on the general subject of Hispanic-American cartography, this catalogue will be published in six volumes.

ISAIAH BOWMAN
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AMERICAN GEOGRAPHICAL SOCIETY

CALVIN OLIN ESTERLY

THE subject of this article was born on August 1, 1879, at Fort Stockton, Texas, and died at La Jolla, California, on August 10, 1928. He received the degree of bachelor of arts from the University of California, in 1902, and that of doctor of philosophy from Harvard University, in 1907.

Soon after completing his formal education he became professor of zoology in Occidental College, Los Angeles, California. This position he held until his death, though the disease that proved fatal incapacitated him for college work during most of the last years of his life.

In 1910 Dr. Esterly joined the staff of the Scripps Institution of Oceanography at La Jolla, as a non-resident investigator in marine zoology. This position he likewise held to the end of his life, spending most of his vacations and leaves of absence from college duties at the institution. His college work was usually so adjusted as to enable him to devote some time to investigation during the college terms.

Thus "the short and simple annals of" a truly noble life of one type; for greater devotion to a worthy career worthily conceived is rare indeed.

The single sharply defined field of research to which Esterly set himself, and pursued for more than two decades without a moment of doubt about its worth, of swerving in purpose relative to it, or relaxation in pursuing it, brought results the significance of which reaches far beyond the narrow bounds of the specialized field of knowledge involved.

The group of crustaceans, the copepods, which furnished the subject for his doctor's thesis, furnished the main subject for his whole life of research.

These animals constitute the greatly dominant group of minute animal life of the open seas. Numerically they are to the ocean what flies and gnats are to the air. Economically they are even more than that, for they figure much more as food for their pelagic neighbors than do their aerial congeners for their neighbors. The almost illimitable numbers of the smaller pelagic fishes, as the anchovies, sardines and herring, to say nothing about various other groups, depend mainly on the copepods for food.

Any scientist who in the future gives attention to the copepod fauna of the northeastern Pacific will find that no one before Esterly had learned anything worth mentioning about these creatures in this region. But he will find that Esterly described so many dozens of species and did it so well that not much remains for anybody else to do on this aspect of the subject.

But extensive and excellent as were his labors on the taxonomy of the group, these labors were only