ernment scientific bureaus undertake such cooperative projects. I only refrain from referring specifically to others because I do not wish to take too much of your time, and because other examples must be already familiar to most of you.

Let us not be afraid of organization. It means no real surrender of individual freedom or achievement. It only means that we direct our efforts more intelligently, to more important undertakings, with more material aid and more mutual encouragement. Organization lies in the very spirit of America. See what great things it has accomplished in American industry. Can American science not profit also from it? No one wants to organize the geniuses; no one proposes to; no one can. But I am no genius and most of you are no geniuses. Yet you and I counselling together, planning together, working together, can do something steadily to advance scientific knowledge. And that some geniuses at least do not scorn association with other workers nor hesitate to recognize the advantage that coordinated work may bring to science, is proved by the fact that in some of the most pronounced attempts in this country to set up coordinating enterprises a number of the men to whom American science owes most and of whom we are all most proud, and whom we recognize as geniuses if we recognize any at all, are taking an enthusiastic part.

Dr. Henry Pritchett has said:

> The world still conceives of scientific investigators in much the same light as the old-time prospectors for the precious metals—each individual sinking his shaft here or there as chance or inclination may carry him. Of the great number so engaged a very few will strike veins of true gold, a larger number will obtain ore that will at least repay the labor and cost involved in their adventure, but the great majority will sink holes in barren and fruitless soil.
>
> The prosecution of research to-day [he continues] is upon an entirely different basis. Not only do those in the same science coordinate their work, if they are to attain the highest results, but all branches of science are regarded not as separate and unrelated agencies, but as parts of a common effort. A research started in a purely physical field may find its solution in a chemical reaction or a physiological process. The research men of a nation are not isolated individuals but an organized and cooperating army.

And Elihu Root, not a scientist but a very wise man, looking in at us from outside has said:

> Science, like charity, should begin at home, but has done so very imperfectly. Science has been arranging, classifying, methodizing, simplifying everything except itself. It has made possible the tremendous modern development of the power of organization which has so multiplied the effective power of human effort as to make the differences from the past seem to be of kind rather than of degree. But it has organized itself very imperfectly.

The scientific body to whose upbuilding I am at present giving all my attention and effort wants to promote in every way possible to it the sound development and increase of scientific research in this country. It wants to avoid interfering in any way with what is already going forward in this direction; least of all things it wants to dictate to any scientific man or men the things he should do. There is fortunately no possibility of the National Research Council, or any other body, ever being able to dictate to scientific men; scientific men will suffer no dictation. But it wants to help, in making things easier for scientific workers from geniuses down; it wants to influence colleges and universities to recognize ever more clearly their research responsibilities; it wants to make clear to the great industries how inescapably their success depends on scientific advance and hence that they should in every way encourage such advance; it wants to bring the support of the great philanthropic foundations, with their large financial resources, to scientific men and undertakings. And it believes in cooperation and coordination of effort. It is not afraid of that bugaboo phrase "organization in science," which is still anathema to a few scientific men.

It believes that science should not be broken up into water-tight compartments, nor men of science separated from each other by artificial barriers. It believes that entomologists should mix with and learn from general zoologists and botanists and physicists and chemists—and that these should learn from entomologists. It likes to support projects of investigation which involve the working together, in concerted ways, of biologists and geologists and chemists, of mathematicians, physicists and astronomers. It believes in bringing scientific men together for counsel. It believes there is strength and speed in union, and weakness and lag in isolation. The genius individualist it applauds and would like to help if help is possible and desired. To the rest of us who are not geniuses it wants to bring its slogan of cooperation and coordination as indicating modern methods of effective work.

VERNON KELLOGG
NATIONAL RESEARCH COUNCIL

THE SCOPE OF BIBLIOGRAPHIES

APART from the activity of a genius, three things are chiefly necessary for realizing profitable scientific work: First, clear, precise formulation of the problems; second, sharp observations in field, laboratory

or museum, and third, the knowledge of what others have already done on a subject. This last is the special domain of bibliography.

For this end published papers are registered and the references arranged by groups (in zoology, for instance, by phyla, and taxonomic categories in general, as well as from morphological, physiological and geographical standpoints). At an early period book catalogues were fairly adequate for this purpose. But when the number of publications steadily increased, this method alone could not suffice. Another form has been introduced which has proved itself more and more advantageous for the study of private workers as well as for the catalogue of large libraries—that is the card-catalogue, the mention of titles on cards which are provided with classification numbers and can be filed consecutively as issued.

This method makes it possible, even after many years, to find all cards on a special subject together in a relatively small place.

This matter has now entered a new phase, in so far as the number of published papers has grown so large that the cost of such a card catalogue is beyond the *present* means of many institutes. The budgets of the institutes for expenses on bibliography are still adapted to the old requirements. In fact, while bibliography has quantitatively reached an absolutely new level, the budgets of the institutes as well as most naturalists continue to estimate the necessary expenditure on bibliography on the former scale.

It is therefore necessary to examine more closely the essentials of bibliography, and this can be best done in a country where, as, for instance, in the United States of America, the elaboration of bibliographical services has recently been particularly advanced, thanks to the special interest of the Rockefeller Foundation.

Such an analysis of what bibliography is demands a study of both practical and intellectual factors, and consequently it is perhaps no mere chance that a special interest for this study is shown in countries with a practical mentality: in the United States of America and Switzerland, where the first scientific bibliographer had worked, the naturalist Conrad Gessner, as was emphasized, for instance, by Mr. J. Christian Bay, of the John Crerar Library (in the Papers of the Bibliographical Society of America, Vol. 10, 1916), on the occasion of the four hundredth anniversary of Gessner's birthday.

What importance the knowledge of the bibliographic methods has reached is best shown by the fact that, as everybody knows, a scientific man who to-day is fully conversant with the literature of his branch of science is, from another point of view, just as powerful as a skilled technical worker in the experimental field. And this is not a transitory or unmotivated situation. It is brought about by the fact that, as has been stated above, one of the roots of scientific work is the formulation of questions, and it is just by the knowledge and critical use of bibliographies that an essential advancement is achieved in the manner of raising questions. For this reason not only must technical training be provided in the universities but also the use of bibliographic methods must be taught, as has been already realized in an initial form through the efforts of Mr. Andrew Keogh, librarian of Yale University.

The claims which are made on bibliography are as different as the special domains in which work is done. For instance, in zoology, *taxonomists* want a survey, which shall be quick and as complete as possible, of all new species that have been described in their domain, whether the reference appeared in one of the principal American publications or in a local paper in Switzerland, Mexico or Borneo. Practically, in this case, there is, however, even more to be expected of the personal contact of these specialists than through bibliography.

It is evident that existing bibliographies can also be of use for such a purpose. In fact, book-bibliographies will render services in proportion to the extent of the material which their funds permit them to collect, but without offering the advantages of a card catalogue. As regards card bibliographies, of which—also in this case of taxonomists' requirements —Mr. Gordon Gates (SCIENCE, Vol. 62, No. 1592, July 3, 1925) seems to expect the same services, they are in an essentially different situation, as will be shown in the following sections of the present article.

Of course the *experimental worker* or the *embryologist* likewise wants to know as soon as possible what has been done in his domain. But his dependence on the promptness of information is of a less degree than that of the taxonomist, because he will much more often be allowed to uphold the results he has found independently of the most recent discoveries.

Quite different is the claim to bibliography of the *general zoologist,* who has to survey a large part of this science. He will often be face to face with new problems to which he has not devoted his attention before, in view of the great surprises which the advancement of science involves. This will also be the case for the *general biologist* who, while experimenting on heredity, sees himself compelled to be oriented, *e.g.,* on the varieties of the butterflies of Japan. Here it will be a great advantage for him to be able to find immediately and easily in a card catalogue a number of titles on this new subject. From this starting point he can step by step attain further information.

And here, besides the claim to promptness and completeness, another function of bibliography comes to the fore, which is a very essential quality of bibliography, though not as popular as the other two. I mean the character of bibliography as an anticipatory and reserve instrument, which allows one to confront problems arising from such unexpected situations. This last purpose is accomplished in a remarkable and unique way by a card catalogue which extends over some decades, such as the complete zoological card catalogue of the Concilium Bibliographicum.

In the same way as many melodies can be called forth from a musical instrument, an infinity of kinds of information will be found in a card catalogue, provided its use is understood. Of course this demands a certain degree of training. Without such a training only the most superficial advantages will be obtained from any catalogue. Just as the other two roots of scientific work, precise formulation of questions and technical work in the laboratory, can not be perfected without training, this is also the case for the third component of scientific work, the consideration by means of bibliography of what others have achieved.

It is absolutely necessary to work with the same carefulness in the library as in the laboratory. Only thus is good work produced, that is to say, useful and lasting work. If no care is given to the literary elaboration of one's own papers and no consideration is shown for the work of others, a *circulus vitiosus* is originated. Professor Sedgwick Minot, in his excellent vice-presidential address delivered before the section of physiology and experimental medicine of the American Association for the Advancement of Science, 1911, has already said:

> If an author fails to show respect for his own scientific work, how can he expect others to respect it.

And in partly reproducing Professor Minot's address in the "Annotationes Concilii Bibliographici" Vol. 7, p. 1, Dr. Field, the founder of the Concilium Bibliographicum, added the following instructive observations:

> It is amazing with what callous neglect authors cast these children of their intellect into the great world in the fatuous belief that they have provided for the future of their offspring, that they have made a "contribution" to science. It would be interesting to study statistically the sum the world spends to-day in printing and publishing the results of research compared with the expenditure on making these same publications accessible and of value for the progress of science. The disproportion would certainly be startling.

Since then of course bibliographic work has obtained the support of the Rockefeller Foundation and of the United States National Research Council. This support concerns the *production* of bibliographies, that is, the outward frame, which had suffered through the war; but beyond this it is necessary to meet the undervaluation which most naturalists cherish for bibliography. This can be changed only by degrees, when the scientific worker will become aware that bibliography stands in about the same relation to the original papers as interest to a capital debt. Both must be kept in mind, else there would arise situations which through the disregard of the interest, respectively bibliography, might become confused and dangerous, one for economics, the other for the future of science.

In such a time as the present, when so many more people do scientific work than before, it is necessary to consider in a larger measure the work of others, to look out for and to understand it. But very often the contrary is observed (in some respects an anachronism), that very little trouble is taken to consider and do justice to the activities of others and to the thoughts they propagated. Partly in consequence of this, bibliography is considered as something unessential which must be disposed of quickly and easily. Apparently time is gained by this, but in reality much cooperative energy is lost through non-consideration of what others were aiming at and have found, and our responsibility towards humanity is in danger of being compromised.

Before such a line of thought is recognized, the importance of bibliography will not be acknowledged at its full value in the mentality of the individual worker, and in consequence it will not get the share due it in the budgets of the public scientific institutions. For the present in most European scientific laboratories no special item for bibliography is included in the budget. The necessary bibliographic purchases must be made out of the budget for the library. And yet bibliographical instruments, just as the collections in a museum, are most important means of teaching and documentation which certainly justify a separate appropriation of funds. That this situation is being recognized and will in time be altered, was shown, *e.g.*, by the importance accorded to the discussion of bibliographic questions during the third International Congress of Entomologists in Zurich in 1925. This importance was also made evident during the different discussions of the Committee on Intellectual Cooperation of the League of Nations, where, moreover, the question of bibliography revealed itself to be almost the only one in the field of intellectual cooperation which can be taken up in a practical manner.

Only when every scientific laboratory has special funds for bibliographic equipment, as cabinets,

card and book bibliographies, will it be possible to complete more and more the card bibliography, the value of which has been explained above, without having to meet difficulties concernnig the solvency of the subscribers. Such a time will come, and it will then be a great advantage for zoologists and general biologists to find a card catalogue ready for them, going back over thirty and forty years, as is that of an institution which the British scholar Stephen Gaselee in his "Petronius Bibliography" (Transactions of the Bibliographical Society of London, 1909) called "the zoologist's wonderful Concilium Bibliographicum," regretting that they had no such institution in letters.

In the meantime the value of an institution like the Concilium Bibliographicum consists in the consideration of the above-mentioned anticipatory and preventive functions of bibliography and in the maintenance of a continuity which in this domain is of more value than in any other.

J. STROHL,
Director of the Concilium Bibliographicum
ZURICH, DECEMBER, 1925

CARLOS WERCKLE

COSTA RICA has been favored by nature beyond all other parts of Central America, and she has been fortunate also in the development of her resources. Secluded in her upland valleys, which are fertile and temperate, and possess a climate almost ideal for human existence, she is barred on the north from the rest of Central America by high mountains and uninhabited lowlands, and from Panama on the south by a still higher chain of mountains, and by almost impassable forests. Secure in her economic position, Costa Rica has been little affected by the occasional turbulence of outside politics, and has been able to develop in peace and independence.

As one result of this happy state of affairs, more attention has been devoted to education in Costa Rica than elsewhere in Central America. Here there have lived and still live men of eminent scientific achievement, who have made signal progress in the study of the natural features of Central America. It would be erroneous to infer that there has been no progress in other Central American republics; but Costa Rica, as her neighbors are the first to acknowledge, has made greater contributions to science than any of her sister states.

In large part this advance is the result of the residence in Costa Rica, for long or short periods, of foreigners with scientific interests. Among these may be mentioned such men as Frantzius and Polakowsky, of the middle of the nineteenth century and later, and the famous Danish botanist, Oersted. At the end of the same century definite plans were adopted for improving the public school system of Costa Rica, and several Europeans, chiefly Swiss and French, were employed by the government, and resided in the country, some of them for many years. Chief of these, from a botanical standpoint, were Henry Pittier, who published numerous papers dealing with Costa Rican botany, Pablo Biolley and Adolfo Tonduz. The last collected more specimens of plants than any collector who has worked in Costa Rica and to his labors are due in very large part our actual knowledge of Costa Rican botany.

The Costa Rican government believed that with the encouragement gained by employing European teachers and scientists it would be possible to stimulate in its citizens an interest in pedagogical and scientific matters, an assumption that has been fully realized. The country has developed a superior system of public schools, and there have been educated a considerable number of men who have made their mark in the scientific world. Among those of the present generation who are interested in botanical as well as in other branches of natural history may be named Anastasio Alfaro, Alberto Brenes, Rubén Torres Rojas, Otón Jiménez and Juvenal Valerio, all of whom have performed excellent work in the botanical field and have tried to instil in others an interest in natural history. It may now be expected confidently that in Costa Rica natural science will become self-perpetuating, a condition highly to be desired for all the Central American countries.

One of the men of European birth whose name will ever be associated with Costa Rican plants was Carlos Werclé. Born at Wiebersweiler (Vivverville), Arrondissement de Chateau-Salins (Department Meurthe), Lorraine, in 1860, he emigrated to Costa Rica about 1890. Regarding his personal affairs he was always extremely reticent, and no information is available concerning his early life. He was very proud of the fact that he was a German subject, and during the late war is said to have stated always that he was a German. This attitude will be appreciated by those familiar with conditions in Central America during and after the war, when there were no Germans to be found, but only Swiss, Alsatians or Dutch.

There is no doubt that Werclé received a good education, and he was evidently a man of exceptional native talent. He spoke English with great perfection and fluency, likewise Spanish, French and German, and he is said to have read Latin, Greek and Hebrew with ease. His skill as a cartographer was utilized by the Costa Rican government upon more than one occasion.