analysis of immense value to the industrial arts and sciences, and secondly, of even greater significance, a furtherance of our present concept of the structure of the atom.

Now why have I brought to you, my fellow teachers, this rather specialized discussion of research work? In the first place, because it is typical of all modern research work in the physical sciences, it is concerned with the problem of atomic structure in which we are all interested. Secondly, and most important of all, you hold a very strategical position in the program of research in this country in the fields of physics and chemistry. It is given to you, the unique honor of introducing very many of our future research chemists and physicists to their first formal knowledge of the fundamental sciences of chemistry and physics. To you is given the opportunity to inspire these embryo scientists with a love and enthusiasm for the fields of knowledge in which we are so interested. Every hour in the class-room or laboratory is one of golden opportunity to instill in their minds a desire for more knowledge in these fields. We may erect on the highway of knowledge along which these young people travel signboards bearing the words "On to College." That wisdom may be shown in whom we recommend for college and that the proper college be urged to these students needs to be emphasized. Our zeal in recruiting should not run riot. The slogan "On to College" is for those servants which have more than one talent. Beyond the college lies the graduate school. To only a gifted few is the invitation, "Enter thou into the joy of creative scholarship." In the matter of pushing a favorite college it should not be from the standpoint of its being our Alma Mater, unless we are sure that these young people will be furthered on in the divine life of scientific knowledge. They must be recommended to a college which is known for its equipment and scholarly and enthusiastic teachers and not because it happens to have a winning football or other athletic team.

Isn't this hope of being able to contribute to the development of future great physicists and chemists a stimulus to do our own work just a little better than ever before as thus we help young men and women to find their life work? I believe it is.

S. R. Williams

Oberlin College

EXPERIMENTAL BIOLOGY AND THE WORK OF THE MOSCOW INSTITUTE*

Zoology of to-day differs greatly from the zoology of the nineteenth century. Two points are characteristic in modern zoological research. First, the chief method of zoology is now experimental and we call our science a branch of experimental biology. Second, during the period of the last ten years all branches of the natural sciences have come to need organization, and experimental biology requires organization more than any other science. The organization of science must be national in the sense that every country will coordinate its own researchers, who must work under the particular conditions which their country may afford, but the work of these national organizations can of course be regulated by international meetings.

I wish to offer many thanks to the American Zoological Society and the Genetics Section for their kind invitations to take part in the meeting at Cincinnati. I am very sorry that circumstances have not allowed me to take part in it personally, as had been my wish, and that I have been compelled to send the report, which I intended to read.

Some of the American biological laboratories have been devoted to determined special purposes. So, for instance, the celebrated laboratory of Jacques Loeb pursues the fundamental problems of the application of physical chemistry to biology, and T. H. Morgan's laboratory is especially devoted to the genetics of Drosophila. But it would be very interesting to unite these two scientific tendencies in the same institution. In every science the best results are to be obtained when the same theme is treated with two quite different methods belonging to two different scientific branches. Therefore, I have tried to put together in my Moscow Institute of Experimental Biology many different sections, such as cytological, biochemical, physiological, behavioristic, genetic and eugenic sections. Sometimes two or more of these sections work on the same subject, but every section investigates the problem from its own point of view and with its own methods.

I

The chief problem of our cytological section is that of the cell-skeleton. In 1905, when studying the structure of the sperm of different crayfishes[1] I came to the conclusion that every cell whose external form differs from the spherical one ought to consist of a drop of liquid protoplasm (hydrosol) and of a hard protoplasmic skeleton (hydrogel), whose form determines the external form of the cell. The rôle of this skeleton is played by the hard cell membranes or by the organic fibers which lie in the outer layer of the protoplasm and define the form of the liquid proto-

* Address sent to the convention of the American Society of Zoologists, upon invitation of the society.—Ed.

[1] N. K. Koltzoff, "Studien ueber die Gestalt der Zelle." Th. I, *Archiv für Micr. Anat.*, Bd. 67; Th. II and III, *Archiv für Zellforschung*, Bd. II and VII.

plasmic drop, as metallic frames (circles, spirals, etc.) define the form of oil drops in the well-known experiments of Plateau. I have found such formative fibers in the spermatozoa of very different animals, in the red blood corpuscles of Amphibia, in connective tissue, etc. In nerve tissue the form of the cell and the nerve fibers is determined by the hard neurofibrils, and their chief function is to be considered as the defining of the external form of the nerve cell. In the contractile cell or cell organ (such as muscle, the stalk of Vorticella, or vibrating cilia), the form of the contraction or vibration is also determined by the hard formative fibrils, while the moving force (such as surface tension) is gotten from the liquid kinoplasm. Experiments on the influence of osmotic pressure, of acids or alkalies, etc., on the living cell, are necessary for distinguishing the liquid from the hard parts of the cell.

In recent years the experimental investigations on the form of the cell have been continued in my Institute by G. I. Roskin[2] on muscle fibers, and by L. S. Peshkovskaia on the various Protozoa. The former has described the muscle-fibers in different Protozoa and Metazoa (Hydra, Ctenophora, Mollusca) and found out that everywhere the contractile fiber consists of a thick hard tube full of the liquid kinoplasm, which under the influence of acids, alkalies, etc., breaks up into minute drops; when this reaction takes place, the contractility disappears. This structure is characteristic for smooth muscle fibers, but as Marcus, continuing our researches, has established, striated muscles can have a similar structure. L. S. Peshkovskaia is studying the "kinostatical" apparatus in different Infusoria. She has published a work on Trichodina and has described a very complex system of intracellular fibers, some of which are undoubtedly hard and determine the external form of the animal, as also the form of its different layers, and some of which are contractile and contain in themselves a complex internal structure. The same kinostatical apparatus is visible in Stylonychia, Bursaria and other Infusoria; in many respects it is identical with the neuro-motor apparatus of Kofoid and his school, but since it is difficult to distinguish whether the fibers in each given case are contractile, "nervous," or formative, I prefer to give it the name "kinostatical apparatus."

The chromosomes appear to us—after the fundamental researches of Wilson upon sex chromosomes and of Morgan's school upon the genetics of Drosophila—as permanent cell-organs. Without doubt they possess a hard skeleton. The investigations of P. I. Shivago suggest the existence of (1) a hard internal stalk ("linin" stalk) in every chromosome, which can grow longer or become shorter, but persists through all stages of the mitotic process and in the resting cell-nucleus; of (2) a more or less thin layer of liquid substance (pyrenin ?), clothing the hard internal stalk and merging (during the telophase) into the pyrenin-nucleoli; and of (3) chromatin corpuscles, which lie regularly on definite points of the hard stalk through all stages of the mitotic process and in the resting nucleus. These chromatin corpuscles appear to be the carriers of heredity, perhaps of groups of genes; the internal hard linin stalk may be a skeleton of the chromosome; and the liquid pyrenin covering acts as a medium of exchange between the chromatin corpuscles and other substances of nucleus or protoplasm.

The genetic investigations, to which we shall refer later on, are accompanied by researches on mitotic division in the same animals. Thus, it has been established by P. I. Shivago that in the somatic cells of fowl there are 15 pairs of autosomes and two sex chromosomes (two X-chromosomes in the male and one X and one Y in the female). The succeeding investigations of P. I. Shivago suggest that the variability in number of chromosomes in different somatic cells of young feathers having a distinctive coloration depends upon the circumstance that they may be deprived of one X-chromosome. Further, S. L. Frolova has described the reduction of chromosomes in Chermes[3] and is studying the number of chromosomes in Russian species of Drosophila. A. O. Tausson has published a (Russian) work on reduction in Asplanchna.

II

The study of the kinostatical structure in the cell brought me to the problem of the action of inorganic ions upon the living cell. Since my published investigations on the influence of K, Na, Ca, Mg, Sr, etc., upon the stalk of Zoothamnium[4] and H (— OH) ions upon phagocytosis in Carchesium,[5] many of my collaborators have been working on this problem, which is so intimately connected with the name of Jacques Loeb. In the meantime we have explored the dependence of the life of different species of Infusoria and of many fresh-water Invertebrates upon the concentration of H-ions and other kations and anions. As a result of these investigations it was established that the concentration of these ions in fresh water determines the fauna and flora of fresh-water tanks to a greater degree than the temperature, the concentration of O_2 and CO_2, etc. At the Hydrobiological Station of the Institute of Experimental Biology under the guidance of S. N. Skadovsky the

2 Roskin, *Archiv für Zellforschung,* 1923; *Anatomischer Anzeiger,* 1923.

3 This work has been sent to *Archiv für Zellforschung.*

4 *Archiv für gesammte Physiologie,* Bd. 149, 1912.

5 *Internat. Z. für physik-Chem. Biologie,* Bd. I, 1914.

concentration of H-ions has been determined in many different tanks in every season, and the data thus established have been compared with the data on the fauna and flora of each of these tanks in all seasons. The summary of this work of the Hydrobiological Station was reported to the International Limnological Congress at Kiel in 1922 and published in the Proceedings of this Congress. The method and the results of the researches of our Institute appeared new and interesting to the limnologists of Central Europe, and the last Congress of Limnologists at Innsbruck (1923) decided to convoke the next International Congress, in 1925, in Moscow. Professor S. N. Skadovsky was asked to make the general report to the Congress on the significance of the concentration of H-ions to the life in fresh-water tanks.[6]

III

When in 1916 I began the organization of the new laboratory of the Institute of Experimental Biology, great difficulty was encountered in getting in time of war all the necessary instruments for providing a modern physico-chemical laboratory, and we still lack some important apparatus, as, for example, the American potentiometer. In such circumstances we have been forced to concentrate our attention on such problems of experimental biology as may be studied without complex instruments and rare chemical preparations.

In connection with these circumstances I was compelled to lead the most immediate investigatory work of the Institute in two new directions: firstly, surgical experiments, especially in relation to endocrine glands, and, secondly, genetic investigations.

As to the endocrine organs, their study was begun in 1913 by the transplantation of gonads in various amphibians, birds and mammals. I. G. Kogan attempted to transplant the gonads from one frog to another, by way of verifying the Steinach results. M. M. Zavadovsky began his researches upon the transplantation of gonads, which he continued by himself in *Ascania nova* and published in 1922. In 1917, with the assistance of Miss Burdakova, I succeeded in bringing about the experimental metamorphosis of *Siredon* under the influence of thyroidin and we are now studying the comparative morphology of the endocrine system in *Siredon* and *Amblystoma*.

During the last two years I. G. Kogan has been working on the rejuvenation of old guinea pigs and fowl which had ceased to reproduce. We have paid our chief attention to the rejuvenation of females by the transplantation of young ovaries. Many old females of guinea pigs, which for a whole year had had no young, after having gotten a transplanted ovary became gravid in a few weeks and brought forth normal young.

The most interesting experiment with old birds we succeeded in getting from a Faveròl hen, which is now seven years old. In the summer of 1921 this hen (5 years old) laid only one egg; in the autumn it received a transplanted ovary from a young hen born in the same year. In the summer of 1922 it laid 16 eggs. In the winter of 1922 another young ovary was transplanted into this rejuvenated hen and in the summer of 1923 it laid 36 eggs; the last egg has been laid on the 30th of October, after all other hens in our menagerie had ceased laying eggs. Very good results have also been obtained in the case of a transplantation of young testicle into an old dog of 18 years. About 150 grafts of sexual glands are now being studied in microscopic sections.

Since the experiments of Przibram's Institute in Vienna on the transplantation of eyes in different adult vertebrates were published in 1922, we have endeavored to verify them. E. E. Trapesonzeva in 80 cases transplanted one frog's eyes to another or cut the optic nerve, replacing the eyeball, which had previously been taken out, in its original position. In many cases the grafts or the eyeballs with the optic nerve cut perished in a few weeks, but in other cases the eyeballs kept their normal aspect and transparency. In seven operated frogs the reaction of the pupil to light, which had disappeared for about a month after the operation, was restored.

In order to ascertain whether the sight of the operated frogs may also be reestablished, two frogs, one of which had kept the pupillary reaction and the other not, were transmitted to the zoopsychological section of the institute to observe their behavior. It was established by M. P. Sadovnikova, by means of a special apparatus, that the frog whose pupils did not react had become insensible to a sudden light, whereas the other one reacted to the light like the normal autumn frogs, by running away to the dark room of the apparatus. As to the form of the object, neither of the frogs showed any receptivity: they did not notice the flies creeping on the walls of their terrarium, but they had developed their touch, as blind animals often do, and learned to grasp the flies sitting on their forefeet, which normal frogs never do.

In the investigation of this problem the cooperation

[6] In connection with the work of this section the following papers also are now ready for publication: (1) W. N. Schroeder: "The significance of the acid reaction of the medium for the life of some Protozoa under anaerobic conditions" (Colpidium, Paramaecium, Volvox, Euglena.) (2) A. T. Iazenko: "The gas exchange of Sphaerium and the function of the mantle-liquid"; (3) A. O. Tausson: "The influence of H-ions and Ca-, Mg-, Na- etc. -ions upon the development and the life-cycle in *Asplanchna intermedia*"; (4) S. N. Skadovsky: "The influence of external conditions on the gas-exchange of the larva of *Chironomus*"; (5) V. I. Uspenskaia: "The influence of quinine on *Spirostomum ambiguum* in the presence of different electrolytes."

of physiological and zoopsychological sections has proved very useful. Other investigations of the latter section, employing the methods of Yerkes, Watson and other American behaviorists, are known in America, because the works of Mrs. Sadovnikova upon her experiments on the behavior of birds in the maze and in the multiple choice apparatus have been published in the *Jorunal of Comparative Psychology* this year.

IV

Our genetic work began five years ago at the Anikovo Station (60 kilometers from Moscow, in the country) annexed to the Moscow Institute. As the first subject of our investigations, quite new in Russia, we have chosen the domestic fowl, especially of two Russian races: Orloff's with nutcombs and Pavloff's with compressed crests and feathered legs; these two races are of very ancient origin and now after the war and the revolution nearly extinct in Russia. We are now about to publish a summary of our investigations (with 15 colored plates and an English résumé) on the genetics of these fowl. Professor Serebrovsky is investigating 40 genes of the fowl and as yet he has not been able to divide these genes into 16 groups, in relation to the number of chromosomes established by Dr. Shivago. That is particularly astonishing, because six chromosomes of the fowl are very small and probably contain but very few genes. Only three genes (*suke, trage* and *tuge*) appear to be correlated and included in the sex chromosome (see *American Naturalist,* 1923). As to the genetics of fowls the following results are to be noticed: intensive search for linkage has not given a single sure case, althouhg a great number of combinations, containing about 20 well Mendelizing genes, has been studied. In some cases perhaps there might be observed a slight linkage (*tifa* and *truklake,* black plumage and white shell; *sune* and *sule,* crest and frizzling; *wele* and *tode,* Y-comb and blue coloration), but the data we possess are too insufficient for insisting on this linkage. In one case, indeed, we have nearly absolute linkage (*sunu* and *gidu*—expanding crest and narrow nostrils), but the single case of breaking between the genes could not be studied in a satisfactory manner. It is true that in fowl the number of chromosomes is very great (32); nevertheless, the absence of linkage is to be explained only by the ease of crossing over, occurring in both sexes. It can be explained in the same way that the three genes, whose mutual positions in the sex-chromosome we succeeded in determining (*suke-tuge-trage*), are giving a very high percentage of crossing over between *suke* and *trage* (about 50 "morganids").

Very interesting observations have been made on the hybrid cocks, heterozygous for two sex-linked genes, *tuge* and *trage* (silver and barred condition). Among the feathers of these cocks, colored as in Plymouth Rocks, feathers sometimes occur whose coloration admits the suggestion that these feathers are deprived of the chromosome (or a part of the chromosome) carrying the genes *tuge* and *trage,* while on the whole the same cocks contain the genes *tuge* and *trage.* We may suppose that in the development of these exceptional feathers some irregularity of mitotic division and the disappearance of the corresponding chromosome has taken place.

The second subject of our genetic investigations was guinea pigs. I have already published the beginning of these experiments: we have found for the first time in Europe the pink-eyed race with diluted color, and a white black-eyed race; the latter transmits its coloration, but not quite regularly. At present Professor Lebedeff is engaged in working out further the problem of the coloration of the guinea pigs, taking into consideration the American researches of Wright, which we did not know of till this year. We have not yet found Wright's long series of allelomorphs, but many of our genes for color in guinea pigs appear to be different from those of Wright. Furthermore, we have obtained some interesting types of coloration after crossing the white rat with the wild Russian gray rat.

The genetic work on Drosophila had already begun in our institute before Professor Muller brought us from America a very valuable present: 32 living races of *Drosophila melanogaster.* We have now published a Russian translation of Morgan's "Physical Basis of Heredity" (translated by Professor W. Lebedeff). Thus we are able to study the genetics of this famous fly on a large scale. The study of the mutations of the Russian species *D. funebris* is being carried on by Professor S. S. Czetverikoff, D. D. Romashov and others. Six mutations have been established more or less precisely in this species: (1) *Abdomen abnormalis*—identical with "Abnormal abdomen" of *D. melanogaster,* selected until they now yield 100 per cent. of abnormal progeny; (2) *Alae naucellae;* (3) *Alae curvatae;* (4) *Alae divergentes;* (5) *N. transversus 2 abnormalis,* and (6) *N. longitudinalis 2 abnormalis.* Mutations (1) and (4) are dominant, the others recessive. Most of the mutations can not be identified with those found in *D. melanogaster.* In *Drosophila transversa* also a new recessive mutant, *Alae divergentes,* has been found by N. W. Timofeew.

All 32 mutations brought by Professor Muller are still living and breeding true, under the chief observation of Professor Serebrovsky. Some new mutations have arisen during this year: (1) White eyed (3 times), (2) eyeless and (3) notch; but not all these mutations are identical with those found in Morgan's laboratory and the corresponding genes probably lie in another place in the same chromosome or in another chromosome.

Recently Professor S. S. Czetverikoff, with the assistance of a group of our younger collaborators, has begun a biometrical study of the variability of characters in the free population of *Drosophila funebris.* The variability of 75 characters in 150 males, taken in the same place, has been studied. This investigation has been made with the purpose of establishing the existence of many distinct types of *Drosophila funebris,* living at the same time in normal communities, and all together to detect the correlation between different groups of characters. As a result of these investigations both questions have received a positive solution, and a further analysis is being carried on to ascertain to what degree the observed variations are of phenotypical or genotypical origin.

F. G. Dobrgansky, who works in Kiev but in intimate connection with our institute, is studying the structure of the genital apparatus in different mutants of *Drosophila melanogaster.* This study has established the very remarkable fact that in most mutations of D. (vestigial, black, etc.) the structure of different parts of the genital apparatus (in male and female) is also modified. This work has been sent for publication in *Zeitschrift für induktive Abst. und Vererbungslehre.*

The connection between two sections of our institution—the genetic and the physico-chemical sections—has evoked the appearance of a series of investigations "on the chemical hereditary properties of blood"; under this title I began to publish the results of these researches. When I and Miss S. S. Elisarova began, according to the method of A. N. Bach, the quantitative determination of the different enzymes in the blood of guinea pigs (catalase, lipase, peroxidase and protease), we found that the contents of catalase in different animals varies greatly: from 3 to 20. The influence of external conditions proved incapable of causing a profound change in the individual index of catalase in a given guinea pig. When we fed an animal (having an index, for instance, of 4) with thyroidin, castrated it or contaminated it with the bacteria of phthisis, the index fluctuated between 3 and 6—no more nor less; in other animals the fluctuations under the same conditions varied between 7 and 14, or between 16 and 20. Therefore, we came to the conclusion that there exist three chief genetic groups of guinea pigs, for each of which the definite index of catalase is characteristic: for group I—the index 3–6, for group II—7–15, for group III—14–21. Having divided all our guinea pigs (more than a thousand) into these three groups, we studied the heredity of corresponding families and established the facts that group I is always homozygous and recessive for "a," with the genetic formula aabb (perhaps also aaBb or aaBB); group II is heterozygous, Aa (with bb or Bb); group III is AA or Aa BB. Most recently, in collaboration with Miss Höptner, we detected another fourth group with index 0–1; this index is also transmitted by heredity and the genotype of this group is now going to be studied.

By some further investigations of Miss N. Savitsh three similar hereditary groups, characterized by their index of catalase, have been established in fowl; but the genotypic formula is here probably quite different. At the Russian Agricultural Exhibition of 1923 in Moscow we determined the contents of catalase in cattle which had been gathered from different parts of Russia from Vladivostok to Archangel and from Samarkand to Odessa. Most of the animals showed an index between 4 and 8.5, but a few (especially Zebu-hybrids from crosses of Turkestan domestic buffalos and cows) gave a much higher index (even 12); thus it may be that in cattle also we have two genetic groups. In sheep the catalase index fluctuates from 0.5 to 4.1, but the greater number of the Romanovsky sheep of Central Russia are characterized by a low index. Investigatory work on the contents of catalase in the blood of human beings of different races is now being carried on.

We are also determining the agglutination of human blood (Miss M. Avdeeva and M. Gryzevicz) and have gotten the four well-known hereditary groups; their distribution is somewhat different in Russians and Jews. Further, we have determined that in subjects suffering from phthisis the distribution of groups differs distinctly from the normal: group IV (whose serum agglutinates all other groups) appears here less often. Thus the probable deduction is that the subjects of group IV possess in a greater or less degree an immunity of phthisis.

A variety of haemagglutination has also been found in fowl and cattle (and perhaps rabbits). Our observations in horses and in some races of cattle (yak, some Caucasus races) have proved that here autoagglutination cases are often to be noticed, and the autoagglutination (occurring in the cooled blood serum of the same animal) appears to be of genetic origin in the race.

We have studied agglutination in members of 100 families, but as group I (having non-agglutinating serum) is very rare, the genotypic analysis can not yet be made definitively; the most probable hypothesis is, that group I is Abc; group II, ABC; group III, ABc, and group IV, a (with either BC or Bc or bc).

V

The Institute of Experimental Biology has also a eugenical section. In connection with the work of this section the Russian Eugenical Society has been founded; I was elected its president, following its inauguration in 1920. In 1922 I was elected by the Russian Eugenical Society as member of the International Commission of Eugenics, officially representing Russia.

The chief aim of the Russian Eugenical Society has been propaganda for eugenical ideas, which are as yet quite new in Russia. The society has had about 50 conferences and is publishing *The Russian Eugenics Journal.* The scientific investigatory work of the eugenical section of the institute has followed two chief directions: firstly, experimental work in anthropogenetics—the above-mentioned researches on haemagglutination and catalase in man, the classification of the colors of hair by the method of spectrophotometry (Professor V. V. Bunak and G. W. Sobolewa), the genetics of the human hand (M. M. Wolotzkoi), etc.; secondly, the study of the genealogy of some eminent Russian families (thus, Tchulkoff has established the consanguinity of two of the greatest Russian writers, Leo Tolstoi and A. Pushkin, of which Leo Tolstoi himself had not the slightest notion). The institute, together with the Russian Eugenical Society, has organized two eugenical expeditions under the guidance of W. W. Bunak: (1) Into some of the Volga districts for the investigation of miscegenation betwen the Slavish and some Finnish races, (2) into the Minsk district for the investigation of the settled Jews; for the study of anthropogenetical characters of Jews the Russian Eugenical Society has organized a special commission.

Here I have given the picture of the work of my institute. It embraces most of the chief problems of modern experimental biology. The plans of these investigations might perhaps be considered as too large for one laboratory, especially under the unfavorable conditions which Russian science is now going through. It would of course appear more natural to concentrate our whole attention on a single problem. But from the point of view of the organization of science in Russia, it was desirable to unite in the institute many biologists who were interested in various branches of experimental biology; on the other hand, this arrangement has been very convenient for carrying on work in the intermediate regions of our science, in fields in which it is easier to plan new problems despite scanty literature and lack of expensive apparatus. Only thanks to such a variety of sections could we attempt to bring together cytology, limnology and physical chemistry; genetics and biochemistry; transplantation of eyes and zoopsychology, etc. The results of our investigations in each section of experimental biology may be of no great significance; but this collaboration is forming a new generation of Russian biologists, who will carry further the work in the intermediate regions of our science.

NIC. KOLTZOFF

INSTITUTE OF EXPERIMENTAL BIOLOGY,
MOSCOW, SIVZEV VRAGEK 41

TWO UNPUBLISHED MONUMENTS TO AMERICAN SCHOLARSHIP

THE assertion that American scholars do not engage in those tasks of scholarship requiring long-continued devotion has been so often made and implied that even Americans are wont to accept the assertion as founded in fact. However, there are now so many published works which refute the above assertion that one may hope that the illusion will vanish.

On a recent trip in search of American arithmetics published before 1800, I chanced upon two monumental undertakings of a fine type of American scholarship which though completed remain unpublished, because of the monumental character of the enterprises.

At the Library of Congress, Phillip Lee Philips, chief of the division of maps, had at his hand in typewritten form 25 volumes comprising a complete bibliography of cartography. The material includes all the literature of cartography which had come to the attention of the author and compiled during some 50 years of service at the Library of Congress. Bibliographical work of this character can rarely, if ever, properly be described as complete. However, as the material in published form would extend over five octavo volumes of about 1,000 pages each it is sufficiently complete so that the work would be of inestimable value to all scholars interested in cartography, historical and practical. Particularly would the work be useful to libraries like the John Carter Brown Library at Providence, the William L. Clements Library at Michigan, the Newberry and the Crerar Libraries in Chicago, the Bancroft and the Huntington Libraries in California, the New York Public Library, and, in short, useful to all libraries that make any serious attempt to collect early maps and atlases of America.

Mr. Philips has to his credit an enduring monument in the List of Geographical Atlases in the Library of Congress as well as numerous monographs on related topics. The Library of Congress catalogue is in four volumes, with a fifth about to be issued. Critical scholars are able to point out in this work certain possible changes which would extend the usefulness of the work. Undoubtedly the same is true of the "Bibliography of Cartography," as it is, indeed, commonly true of similar work in any line of scholarly endeavor. However, neither the "Catalogue of Atlases" nor the "Bibliography of Cartography" could, in my opinion, be produced by the work of any scholar without constant and unremitting attention to the task over a period of many years.

The publication of this material would cost probably ten to fifteen thousand dollars. Congressional action would be necessary to have it issued as a gov-