Thus, and only by way of illustration, means have been provided permitting us to gratify our desire for travel, far and near, over land and water and through the air, and with ever-increasing speed and comfort; or again, means have been given us responsive to our urge to communicate with our fellow, whether a neighbor or a dweller in the antipodes, and with the spoken voice or the written word and with the practical annihilation of time. Again, means wherewith to send our own produce to markets far and near over the earth's surface and to draw on the whole world's produce for our own convenience and comfort. And there have been provided as well all the complicated agencies and means suited to secure the needed degree of regulation in human conduct in a society so interdependent in its elements as has ours become; functions again needed to cater to our sense of the esthetic —to that urge to pass beyond the merely utilitarian to that which appeals to the sense of the beautiful; functions needed to meet our urge toward amusement, sport, relaxation; functions multiple in number and often interlinked in character and in exercise.

And how has the civilization of our caveman forebears or of Homeric days or of medieval times become so marvelously transformed into that of our own day? There has been one central effective means and that is the transmission by racial inheritance of the elements of the civilization of one generation to the next following. Biological inheritance provides for the transmission of biological characters, but there is a larger sense in which we may view inheritance—a sense in which the generation, the nation or the race is the individual unit and in which we view the transmission of knowledge, of achievement, of culture, from one generation to the next, as a process broadly parallel to that of the transmission of bodily or personal characteristics from parent to children. In a racial sense each generation is the child of that which precedes and we may have a racial heredity and a racial transmission of culture, of learning and of the integrated elements of civilization.

It is true that with racial inheritance through the ages, the gradient of progress has not been always continuous or uniform. At times there has seemed to be regression rather than progression. Advance has been made in periodic movements, perhaps at the moment not always forward and upward, but in the large and viewed in distant perspective, always with an ultimate gain, always with a net upward and onward trend and always again as the expression of racial inheritance.

But this implies something to inherit, and what is more, a widening field of choice over which the material to be passed on may be chosen. Progress does not depend so much upon the continuous transmission, without discard, of a gradually accumulating store of learning, culture and achievement, as upon the conscious and intelligent selection, over an ever-widening field of choice, of those elements best suited to the environment of the moment or to the racial demands of the time. In this way, progress implies examination, comparison, test, discard and selection, and exercised over this ever-widening field of choice. But who shall provide the ever-widening field of choice? Here indeed is the function of the worker in fundamental science. His the duty and the privilege to provide the basic material which shall give to civilization this ever-widening horizon of selection and which shall make possible the transmission to the coming generation—already interpenetrating with our own—some increment in quantity and some improvement in quality, of those elements which shall furnish the material basis for the civilization of which they are to be the exponents.

The obligation of the worker in these fields seems clear—it is an obligation which may be viewed collectively or individually. In no case can we escape it. The remainder of humanity are standing aside, as it were, and are waiting upon our performance of this particular function. This is our contribution to that great pool of the products of human effort. Without this particular contribution, the progress of civilization must falter and cease.

Whether individually or collectively, we may view our passage through life as that of a comet coming from afar, remaining for a time a member of our system and then passing on, whither we may not know. So we journey between two unknowns and are given but a short day in which to perform our allotted task. Like the comet from the depths of space, we pass this way but once.

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BACTERIA AND THE ORIGIN OF SPECIES

THERE is, perhaps, no field of research that has borne such an abundant harvest in recent years as the study of bacteria. While micro-organisms have been investigated from many points of view and in relation to many and diverse activities, the intimate relationship of pathogenic or disease-producing microbes to human happiness and welfare appears to have blinded not only the popular, but also the scientific mind to the broader significance of bacteria in the world.

Not many years ago we were orthodoxically taught that the atom is the indivisible unit of matter. Today we are amazed to learn of the tremendous com-

plexity of electrons that are bound together in the larger atoms! While we recognize the significance of the cell as the unit of structure and organization in the architecture of complex plants and animals, we have never felt entirely secure in the thought that the cell represents the ultimate unit of living matter. Bacteria and ultra-microscopic bodies have stood in the way of snug contentment with such a theory. Just as inorganic bodies of varying complexities are dissectible into molecules, the molecules divisible into atoms, and atoms into electrons, so also it appears that living bodies are dissectible into tissues, tissues into cells and cells into smaller units.

In the early nineties, it was shown by means of special cytological technique that bacteria-like bodies could be demonstrated universally in cells. Altmann,[1] who investigated these structures extensively, developed a theory that they represent the ultimate units of living matter, and named them "bioblasts." Altmann's theory was rejected by most biologists, although Bütschli, O. Hertwig and a few others leaned toward this hypothesis. The microscopic bodies in question have come to be known by the name "mitochondria" ("chondriosome" is also used extensively), and have been considered a product of the cytoplasm of the cell.

In 1918, Portier[2] embraced the fundamental conception embodied in Altmann's theory, namely, that the mitochondria are independent micro-organisms, and he named them "symbiotes." Portier's conclusions were based on his results in cultivating animal tissues in culture media and obtaining bacterial growths. Portier's ideas were rejected on the basis of errors in technique. In 1923, the author (Wallin[3]) published a critical analysis of Portier's researches.

Seven years ago the author began investigations on the nature of mitochondria. As these investigations progressed it became more and more evident that mitochondria are bacteria-like. In the last series of publications (Wallin[4, 5, 6]) it was shown that mitochondria can be induced to grow independently in artificial culture media.

The bald statement—that the cells of all complex plants and animals normally contain bacteria—is almost incredible in the absence of a rational hypothesis by which to explain the significance of such associations. Obviously, such a "symbiotic" association must involve a relationship of fundamental significance.

In searching biological literature for a clew to this significance, a number of phenomena were discovered which directed the path toward a solution of the problem. It was found that bacteria elaborate metabolic products that are identical with the metabolic products of the cells of complex plants and animals. Bacteria enter into diverse types of relationship with plants and animals, such as "parasitism," "symbiosis." "infection," etc.* The relationships that are usually classified as "symbiosis" exhibit varying degrees of intimacy in life-relationship and tell the story of the significance of mitochondria in the cell.

In many cases, the invasion of the micro-organism results in new cell formation in the host to harbor the symbiont ("bacteriocytes," "mycetocytes," special cells in corals and other coelenterates). In the firefly and squid, luminiferous bacterial symbionts are apparently responsible for the development of "light organs" in which a number of tissues become modified in response to the bacterial invasion. A large number of examples could be cited in which there are evident morphological and physiological modifications in the host in response to the presence of micro-organisms.

The term "symbiosis," which implies "mutual advantage," is not applicable to this fundamental association. "Mutual advantage" further involves an "element of choice" on the part of the microsymbiont and the host symbiont which, obviously, can not be recognized. The author (Wallin[7]) has introduced the term "Symbionticism" to signify the underlying fundamental principle involved in these life-relationships.

Cytological literature contains a large number of references to investigations in which it is claimed that mitochondria are concerned with the *specific* activity of the cell. The validity of these findings has been questioned chiefly on the basis of an *assumed* passive nature of mitochondria. The demonstration of the *living bacterial* nature of mitochondria removes the objections that have been raised against the diverse activities attributed to them.

Briefly stated, micro-organisms unite with higher forms of life. In many such associations new tissues and new organs develop in response to the microbic invasion. Some of the "symbiotic" micro-organisms persist as mitochondria in the cell. The mitochondria are responsible for the specific activity of the cell. These demonstrable facts can lead to no conclusion other than that symbionticism, or the development of bacterial "symbiosis," is a fundamental factor in the origin of species.

This revolutionary conception of the cell, obviously, affects every department of biological science, and if true must correlate with all *established* facts in the various biological fields. The author has collected the evidence and is preparing a manuscript in which this

[1] Altmann, R., '90, "Die Elementarorganismen und ihre Beziehungen zu den Zellen," Leipzig.

[2] Portier, P., '18, "Les Symbiotes," Paris.

[3] Wallin, Ivan E., '23, *Anat. Rec.*, Vol. 25.

[4, 5, 6] *Am. Jour. Anat.*, Vol. 33; Vol. 35; Vol. 36.

[7] *Anat. Rec.*, Vol. 26.

will be presented together with a discussion of a few of the problems in biology that are affected by this new point of view.

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SCIENTIFIC EVENTS

THE FIRST SIX MONTHS OF THE INTERNATIONAL INSTITUTE OF INTELLECTUAL COOPERATION

IT is six months since the International Institute of Intellectual Cooperation was formally installed, under the auspices of the League of Nations. According to the first bulletin of its Information Section it has completed its organization and begun work on a number of problems.

Up to the present, in accordance with decisions of the council and the assembly of the League, the complete framework of intellectual cooperation has taken the following form: First, the *International Committee on Intellectual Cooperation.* This committee, appointed by the council of the League from among the distinguished scholars of various countries, meets once or twice a year to consider the more important problems of intellectual cooperation and approve their study where study seems practicable. The detail of special questions is referred to one of a series of *sub-committees,* made up partly of qualified members of the main committee, and partly of co-opted experts.

Next, the *National Committees on Intellectual Cooperation.* These committees are constituted by various countries themselves, in such fashion as to present a cross-section of the intellectual life of the country. Their function is to study national questions of intellectual cooperation and to collaborate in international questions with the central committee.

Thirty-one national committees have already been established in Australia, Belgium, Bolivia, Brazil, Bulgaria, Cuba, Denmark, Esthonia, Finland, France, Great Britain, Greece, Holland, Hungary, Italy, Latvia, Lithuania, Luxembourg, Norway, Poland, Portugal, Rumania, Salvador, South Africa, Spain, Sweden, Tchecoslovakia, the United States of America and Yugo-Slavia.

Third, *Government Delegates accredited to the Institute.* The function of these delegates is to secure to the institute the direct contact with governments necessary for the carrying out of its projects. More than twenty states have already nominated official delegates, who meet periodically as a group in Paris.

Finally, the *International Institute* itself, with seven sections.

The *General Section* has succeeded in establishing close contacts with the outstanding general international associations. The section conducts a service of documentation on intellectual questions. This service has begun to publish a selected bibliography on the international organization of intellectual life, and is preparing the ground for an international statistical survey of intellectual activities, and a repertory of international institutions and associations.

The *University Section* has been studying the international relations of universities, particularly with reference to the exchange of professors and students. It has begun to publish a *Bulletin of University Relations,* which gives an account of the international activity of universities in all parts of the world.

The *Science Section* has a wide field of action, since all the sciences are in need of agreements and research programs conceived on an international scale that will economize effort by avoiding duplication of work.

The section has prepared an agreement among libraries in all parts of the world for an international information service available to the public: 400 have actually responded to the questionnaires sent out by the section. It is also studying projects for an international lending library, the reorganization of analytic bibliography in the physical sciences, and the creation of a permanent international bureau of meteorology. The section has been in close touch with the proceedings of scientific congresses. It has begun the publication of a *Bulletin of International Scientific Relations.*

There are in addition sections of law, literature, art and information.

ENGLISH VITAL STATISTICS

THE Registrar-General's *Statistical Review* of England and Wales for 1924 has been issued. According to an abstract in the *British Medical Journal,* the number of deaths (473,235) is the smallest registered since 1867, when the population was only 56 per cent. of that estimated for 1924. They correspond to a rate of 12.2 per 1,000 of the estimated population, but when standardized this rate is reduced to 10.7. The standardization was effected by comparison with 1901, when the population included relatively few infants and old people; it formed, therefore, a standard exceptionally favorable to low mortality and accordingly yielded comparatively low standard rates all round. To correct any wrong impression thus produced and to provide standard rates comparable with those of other countries the standards recommended by the International Statistical Institute were used, when the rate was increased from 10.7 to 12.0 per 1,000. The standard rate of 10.7 was less than any returned prior to 1924, when the low record of 10.3