It will be observed that ordinary masses are just in the center of our list of physical units. Shall we go back to the old notion that we are the natural center of the universe, or shall we regard this as a mere appearance, due to the fact that it is more and more difficult for us to have experience with those units which are more and more remote from us in the physical scale? We are at the center, because the center is everywhere. Two atoms of gold seem just alike because we are not very familiar with atoms of gold, and two electrons seem to be identical merely because of our profound ignorance. Super-galaxies exist though we have had no experience with them at all; likewise, hyper-super-galaxies,[37] and so on indefinitely. Things do not cease to exist merely because we are ignorant. We should beware of the tacit postulate, which often crops out, "Only those things exist with which we have had experience." Nature is much broader than experience, and we must have plenty of room for expansion.

(9) *The phenomena of nature occur always in such a way that certain relations remain invariant.*

This postulate asserts merely that science is possible, and the main purpose of science is to ascertain these invariants.

(10) *Every physical situation is definite and determined, both as to its extensions in space and its sequential states in time;* or, in simple language, nature is never in doubt.

This is not the case in mathematics. The value of a function at a point may be quite indeterminate, and the limit of the function as we approach a point may depend upon the mode of approach. Imagine all space filled with matter uniformly distributed. (I am speaking mathematically now), and that Newton's law of gravitation holds. What is the resultant acceleration on any given particle. Let p be the particle and let O be a point at a distance R from p. Let S be the sphere with center at O which passes through p, so that R is its radius. Then the attraction of this sphere upon the particle p is directed towards O and its magnitude is proportional to R. Take a second sphere S_1 with its center at O and its radius $R_1 > R$. Then the resultant attraction of the spherical shell between S and S_1 upon the particle p is zero however great R_1 may be. We conclude that the resultant attraction of the matter in all space upon the particle p is the same as the attraction of the sphere S_1, which is proportional to R and directed towards O. But as the point O is arbitrary, both as to distance and direction, the resulting attraction is completely undetermined. This is the Neumann-Seeliger proposition. Similarly, the attraction of a thin disk upon one of its own points is completely undetermined. But these are mathematical situations. According to the postulate, such situations do not arise in nature.

[37] This word is due to Moulton.

(11) *In every region of space, however small, there exists at least one physical unit.* The postulate denies the existence of empty space, and asserts on the contrary that every portion of space is infinitely complex.

(12) *The energy within a region of space does not increase or decrease, unless there is a corresponding decrease or increase in some other region of space.*

This is the doctrine of the conservation of energy to which physicists were led about the middle of the last century. It possesses some quality that appeals to the esthetic sense, for it has been adopted, almost universally.

(13) *The universe does not change always in any one direction.* Using figurative language—the universe is not like a stream which flows steadily from one unknown region to another. It is like the surface of the ocean, never twice alike and yet always the same. At the same time that the physicists were formulating the doctrine of the conservation of energy, which is sometimes called the first law of thermodynamics, they also formulated the second law of thermodynamics, which has been stated in various ways, but the essential idea is that energy is constantly being degraded into the form of heat and radiated away; the energy available for useful work is always diminishing, or in modern terms, the entropy is always increasing. Physicists and chemists have been very successful in predicting phenomena by means of this law, and it has a thoroughly reputable standing. Nevertheless, it has always met with violent opposition and dislike. It is out of harmony with the idea contained in postulate 13, and therefore it is unpopular. As I see it, the second law of thermodynamics is similar to the statement that under natural conditions water always flows down hill. This is true enough, but if it were the whole truth one could not avoid wondering why the water had not all gotten to the bottom of the hill long ago. The statement is true of water in the liquid state, but in the state of vapor it is equally natural for water to rise. We shall see later that the second law of thermodynamics states only one half of the complete process.

WILLIAM D. MACMILLAN

THE UNIVERSITY OF CHICAGO

(*To be continued*)

THE JOHN SCOTT MEDAL FUND

THE following is an extract from Power of Attorney to carry out certain provisions in the will of John Scott dated April 2, 1816.

. . . that the interest and dividends to become receivable . . . be laid out in premiums to be distributed among ingenious men and women who make useful inventions; but no one of such premiums to exceed twenty dollars, and along with which shall be given a copper medal with this inscription "To the most deserving" comformably to the tenor of the will of the said testator, John Scott, deceased.

By decree of the Court of Common Pleas of Philadelphia the administration of the trust was modified as follows:

And now, this nineteenth day of February, A.D., 1919, the Report of the Master having been duly filed and no exceptions having been taken thereto, it is adjudged and decreed that the same be confirmed, and that the Board of Directors of City Trusts having in charge the trust created under the will of John Scott, deceased, be authorized and directed in the administration of said fund to distribute the income arising from the fund as it stands with its accumulations as of the date of this decree, in premiums to be distributed among ingenious men and women who make useful inventions, but no one of such premiums to exceed Eight Hundred Dollars ($800) in value (increased under Decree of Court, dated November 29, 1921, to $2,000); and along with such premium shall be given a copper medal with this inscription "To the most deserving" comformably to the tenor of the will of the said testator.

It is further ordered and decreed that in the selection of the recipients, the said trustees shall be at liberty to make such rules and regulations for enabling them to make a wise selection of beneficiaries either by the selection of an advisory board or otherwise, as they may deem best. The premiums shall be awarded for useful inventions which shall include any inventions that will be useful to mankind in the advancement of chemical, medical or any other science or in the development of industry in any form; the test being that the invention is, in the judgment of the trustees, definitely accomplished, and that it may add to the comfort, welfare and happiness of mankind.

The following resolution has been adopted by the Board of Directors of City Trusts:

Resolved—that the award of medals under the John Scott Medal Fund be made hereafter upon the recommendation of an Advisory Board, to consist of five persons, to be appointed by the Board of Directors of City Trusts; three to be nominated by the National Academy of Sciences, one by the University of Pennsylvania, and one by the American Philosophical Society; all of said nominees to be acceptable to the Board of Directors of City Trusts; the recommendations of the Advisory Board to be made on a majority vote:

Personnel of the Advisory Committee:

National Academy of Sciences:
H. H. Donaldson,
Theobald Smith,
W. B. Scott.
University of Pennsylvania:
Arthur W. Goodspeed.
American Philosophical Society:
Samuel M. Vauclain.

Awards of the John Scott medal with prizes of $1,000 have been made as follows:

William G. Houskeeper, E.E., Research Physicist, Bell Telephone Laboratories, Inc.

For the invention of a method for sealing through glass metals having widely different expansion coefficients. It is popularly known as "the copper-glass" seal and is gas-tight.

This work has made possible in a fundamental way the practical use of vacuum seals in general between glass and metals.

The process is very valuable in the construction of high power electron tubes and other similar devices used in engineering in recent years.

Charles H. Norton, Inventor and Engineer, Worcester, Mass.

For the development of grinding and the invention of apparatus for precision grinding.

To Mr. Norton is due the development of grinding as a distinct manufacturing process with or without the preliminary use of other cutting tools.

The design of special machine tools effectively to apply these principles to manufacture on a large scale. The Norton processes have revolutionized production in many industries, notably in one of our largest—the automotive.

Ross G. Harrison, Ph.D., M.D., professor of comparative anatomy, Yale University.

For devising and developing the method and apparatus by which he was the first able to graft together whole bodies of vertebrates of the parts and organs of different individuals and even of different species and for inaugurating the method of "Tissue Culture," by which parts removed from the living animal may be kept alive and studied under the microscope, for months or years.

In Roux's *Archiv für Entwicklungs Mechanik*, Vol. 7, 1898, he published results of his work on grafting the tail of one species of tadpole onto the body of another species and the resulting regeneration of various tissues and organs. Such grafted forms were reared to adult life, the anterior part of the body preserving the characteristics of one species, the posterior part that of the other species. From 1902 to 1919 he continued such grafting experiments on limbs which were taken from one individual or species and transplanted to another, devoting particular attention to the regeneration of nerves in the transplant. In later years (1915–21) he continued such work with reference to the symmetry of transplanted limbs. All of this work opened a field for surgical transplantation of organs and limbs of higher animals which bids fair in time to be of great value to mankind.

A second line of work of even greater present importance, which was first inaugurated by Dr. Harrison, is that known as "Tissue Culture." In 1907 (Anatomical Record, Vol. 7), he first studied the growth and development of a living developing nerve fiber. This paper was followed in 1908–14 by other important contributions in which he described in detail this new method of research and demonstrated its unique value in the study of different kinds of living cells. Dr. Harrison's pioneer work in this field has been recognized by election to honorary membership in various foreign scientific societies and by the award of the gold medal of the Australian Zoological and Botanical Society in 1914.

Marshall Albert Barber, Ph.D., expert in malaria research, U. S. Public Health Service, jointly with Robert Chambers, Ph.D., professor of microscopic anatomy, Cornell Medical College.

Dr. Barber—for his invention of the pipette method and the apparatus for its control; used for the isolation of single micro-organisms and the injection of substances into single living cells.

Dr. Chambers—for his improvements in the micro-dissection apparatus, the extension of its use to the anatomy of single cells and the determination of the physical structure of protoplasm.

The micro-dissection apparatus consists of a device for the delicate movement and control of a pipette or needle in three planes.

The apparatus is attached to the stage of a microscope and the object, which is in a hanging drop of fluid under a glass slip, is manipulated by the observer as he views the field.

The needles have diameters of 1/25400 of an inch or less. The pipettes are about 4 times as large. By their use single cells can be removed, cut, dissected—or injected with various fluids. This apparatus, and the technique which has grown up with it, permit an extension of anatomical studies to the details of living cells. Through these studies important contributions to our knowledge of the living substance—protoplasm—have been made. This apparatus has thus opened a new field for investigation.

Orville Wright.

He was a pioneer in the art of aviation; was the first to experiment with wing warping; invented the system of control used in all flying machines to-day and built a motor-driven aeroplane in which the first flight in history was made.

From 1910 to date he has been at work in designing and testing aeroplanes, automatic stabilizers, wind tunnel research and research in every line pertaining to aviation.

His inventions in the field of aviation are universally used and his contributions are primarily responsible for the great advance in this art.

GILBERT VAN INGEN (1869–1925)

PROFESSOR GILBERT VAN INGEN, since 1903 a member of the faculty of geology of Princeton University, died at his home in Princeton on July 7. He was born on July 30, 1869, at Poughkeepsie, N. Y., where his father was professor of art in Vassar College. He was of Dutch descent, both his parents having been born in Holland in families many of whose members had been gifted artists, sculptors and musicians. He received his early education in a private school in Poughkeepsie and, while still a boy, acquired from his father a dexterity in the use of the pencil and brush which was to prove of great use to him in after life.

He inherited a keen interest in art, but early developed an even deeper interest in botany and zoology, and spent much of his spare time in the fields and woods of the beautiful countryside around his native town, studying the plants and animals which he found there. When ready to enter college in 1886, he had fully decided to become a botanist and went to Cornell University to study toward that end. He was interested in all branches of natural history, however, and in his first year at Ithaca attended Professor H. S. Williams's lectures on geology and paleontology. He was so deeply impressed by Professor Williams's personality and lectures and by the interest of these subjects that he abandoned his plan of becoming a botanist and determined to devote his life to the study of stratigraphy and paleontology. He studied geology and paleontology under Professor Williams and Professor C. S. Prosser during the college years 1886–87 and 1887–88, and acted as assistant to Professor Williams in field work in the spring and summer of 1889. He was then appointed assistant geologist on the staff of the U. S. Geological Survey and spent most of the year 1890 and the early part of 1891 in a study of the subcarboniferous rocks of Missouri, under the direction of Professor Williams and Dr. G. K. Gilbert. In the fall of 1891 he returned to Cornell as assistant to Professor Williams, and when the latter went to Yale in the following year, he went with him and spent the academic year 1892–93 at that institution, studying paleontology under Professor Williams and zoology under Professor A. E. Verrill. He did not receive a degree at either Cornell or Yale, but got an excellent training in field and laboratory methods of research and valuable experience in teaching. In 1893 he went to Columbia as assistant in paleontology and remained there for eight years, being appointed curator of the geological collections in 1895. While at Columbia he did much to help Professor J. F. Kemp build up the geological and paleontological collections which are so valuable a part of the present department of geology of that university.

While in New York he served as editor of the *Transactions* of the New York Academy of Sciences and of the paleontological department of the New International Dictionary. In his summer vacations he carried on field work on the Paleozoic rocks of