which a fundamentally different method of obtaining a chemical analysis is used.

Throughout the development of the electron microscope it has been realized that the electrons, on passing through the specimen, often lose small amounts of energy due to inelastic collisions with the atomic electrons of the specimen. X-ray theory predicts that if in an inelastic collision one of the electrons from an inner shell of an atom of the specimen is removed, the colliding electron must lose an amount of energy equal to or greater than that found in the subsequently emitted x-ray photon. While this was realized sometime ago, it was only recently that the phenomenon was observed experimentally. Since for each type of atom it takes a discrete and different amount of energy to remove one of the inner electrons, it appears that this phenomena can be used to identify the atoms in a specimen.

The experimental method of doing this is quite straightforward. The specimen is bombarded by a beam of electrons of one velocity and the velocity distribution in the transmitted electrons measured by a suitable means. The position of the peaks on the resulting velocity distribution curve is sufficient to identify the elements present in the specimen. However, in itself, this is not satisfactory for direct application to the problem of identifying individual particles on electron microscope specimens because it gives no information regarding the location of the particles. It is the ability to identify both the elemental composition and the location of an area in a specimen that characterizes the electron microanalyzer.

In the electron microanalyzer electron lenses are used to confine the electron beam to only that area of the specimen which is to be analyzed. Moreover, the area being analyzed and the specimen as a whole can be observed by means of an electron microscope which is incorporated in the instrument. Since both modes of operation of the instrument use the same lens system, the instrument is extremely compact.

As a result of the use of the "probe" method and a high quality electron optical system, it has been possible to greatly enhance the resolving power of the conventional electron velocity analyzer. In fact, in this new instrument, practical limitations on the resolving power are almost completely removed. In the present experimental model the velocity of the transmitted electrons can already be measured to one part in 5,000. Moreover, this resolving power can be increased or decreased at will; the only limitation being in the degree of homogeneity of the incident beam.

At the present time the instrument is being carefully tested using thin films of known materials in order that its possibilities and limitations may be better understood. The velocity distributions which are characteristic of a number of elements have been obtained proving that all the elements up to atomic number 26 can be detected with the present experimental model of the instrument. There seems to be no theoretical reason why this list can not be extended throughout the periodic table.

It is apparent that the major limitation of the instrument at the present time is its inability to differentiate between organic compounds, though there are indications that quantitative measurements on the heights of the peaks in the velocity distribution curve will yield some information in this regard. As in all radically new types of instruments, it is extremely difficult to predict the future uses and applications. It is evident that the microanalyzer is worthy of further investigation. Already the high resolving power which is obtained in this method of velocity analysis points to the possibility of applying it to obtain direct information with regard to collision problems in quantum physics. Added to this is the attractive possibility of obtaining direct elemental analysis of supermicroscopic structures, particularly in biological problems where the location of elements other than carbon, nitrogen and oxygen in the specimen is important.

OBITUARY

WILLIAM EMERSON RITTER: NATURALIST AND PHILOSOPHER[1]

PROFESSOR RITTER had entered his eighty-eighth year at the time of his death a few months ago (January 10). His advanced age must have come as a surprise to many, for as recently as 1938 he had brought out an impressive volume of biological fact and interpretation, and he had contributed to some of our scientific journals even later than that. Ritter got a somewhat delayed start in his scientific career, but he more than compensated for this by exceptional productivity at an age when most of us lapse into silence.

William Emerson Ritter was born in Hampden, Wisconsin, on November 19, 1856. Much of his boyhood was spent on a farm, and to this period of his life he was fond of referring later. It was here, no doubt, that his life-long love of nature commenced. He graduated from the State Normal School at Oshkosh in 1884, and engaged in public school teaching in his native state before carrying his education to higher levels. In 1888 he received his B.S. from the University of California, and his doctorate was attained at

[1] Contributions of the Scripps Institution of Oceanography, New Series No. 223.

Harvard in 1893, when he was 36 years old. In June, 1891, he married Dr. Mary E. Bennett, whom he characterizes in a dedication as "my severest critic and best helper." There is no doubt of the important part which she played in various phases of his career. Ritter's quest of knowledge and adventure took him to Naples and Berlin in 1894–95; later to England, Japan and various points in the Pacific area. He was a member of the carefully selected party of naturalists which comprised the Harriman Alaska Expedition of 1899. His academic positions ranged from that of instructor in biology at the University of California to the headship of the department of zoology, in the same university, a position which he held until he assumed directorship of the Scripps Institution of Biological Research in 1909. He retained a professorship in the department, however, until he was retired as "professor emeritus" in 1923. Ten years later the degree of LL.D. was bestowed both upon Professor Ritter and upon Dr. Mary Bennett Ritter, his wife.

Ritter's first published paper of which I find record dealt with "The parietal eye of some lizards from the western United States,"[2] thus appearing in his thirty-fifth year. Two years later came his doctor's thesis, "On the Eyes, the Integumentary Sense Papillae, and the Integument of the San Diego Blind Fish (*Typhlogobius californiensis Steindachner*)."[3]

Up to nearly 1910, Ritter's biological contributions lay predominantly in the fields of taxonomy and morphology, his special groups being the tunicata and enteropneusta. The texts and figures of these papers (the figures mainly of his own execution, it would seem) bear witness to a high degree of care and thoroughness in his observation and delineation. But questions of interpretation frequently occupied his attention, as is evidenced, for example, by such a title as "*Hálocynthia johnsoni* n. sp., a Comprehensive Inquiry as to the Extent of Law and Order that Prevails in a Single Animal Species."[4]

These morphological and taxonomic studies gave place rather early to behavioristic and philosophical ones, and it is probably these last by which Ritter is more largely known. His stature as a biological philosopher can probably be fairly measured only by another philosopher. His writings reveal extensive acquaintance both with the literature of philosophy and of the history of science, such an acquaintance as I believe few living zoologists possess. And they reveal preoccupation with certain philosophical problems throughout much of his life. His association with Howison at the University of California appears to have been partly responsible for this trend, though the viewpoints of the two men differed very widely. Ritter was primarily a naturalist, Howison a subjective idealist.

Ritter's outstanding published work in the field of biological philosophy bears the title "The Unity of the Organism, or the Organismal Conception of Life."[5] This two-volume book has as its "central idea" that "The organism in its totality is as essential to an explanation of its elements as its elements are to an explanation of the organism." The contrary viewpoint he characterizes as the "elementalist" one, and this viewpoint he seems to attribute, in varying measure, to all other living biologists.

The metaphysical implications of Ritter's "central idea" are matters which the present writer is quite unqualified to discuss. That his position is a "vitalistic" one Ritter denies emphatically, and his denial carries conviction. Superficially, at least, there seems to be much in common between his views and ones set forth during several past decades under such names as "emergent evolution," "creative evolution," "creative synthesis" and "holism." He insists upon an all-out physico-chemical basis for vital phenomena, but he equally insists upon the appearance of entirely new attributes only potentially present in the chemical elements.

Ritter challenges the mechanistic physiologist to state just what he means by expressing a vital phenomenon (say a dog's scratching reflex) in "terms" of the physico-chemical elements involved. This "can be done in one and only one way, namely, by adding to the attributes, that is to the 'terms' which inorganic chemistry recognizes in the chemical agents concerned, just those attributes and terms which the dog's scratch reflex requires in order that the elements may explain the reflex." For brevity's sake, he coins the whimsical abbreviation "doscarex" for the reflex in question, and proceeds to discuss the "doscarecious powers of the oxygen, carbon and so forth," so unforeseeable by the mere chemist![6] This is rare humor. Is it not possibly sound philosophy?

In view of these forthright assertions regarding the relations of the organic to the inorganic, it is rather surprising to find Ritter aligning himself with those few biologists who seriously question the ultimate derivation of the former from the latter, and take refuge in such conceptions as the "panspermia" hypothesis of Arrhenius and others. He could scarcely have questioned the force of such contrary arguments as have recently been set forth by Oparin,[7] who removes one of the difficulties in the way of accepting the earlier

[2] *Bull. Mus. Comp. Zool.*, Harvard, January, 1891.
[3] *Ibid.*, April, 1893.
[4] University of California Publications in Zoology, November 15, 1909.
[5] Richard G. Badger, 1919.
[6] "Unity of the Organism," Vol. 2, p. 204.
[7] "The Origin of Life" (Trans. by S. Morgulis), Macmillan, 1938.

chemical origin of living matter by making it plain why this process could hardly be expected to occur under present-day conditions.

"The Unity of the Organism" was surely a valuable contribution to the literature of theoretical biology, and may still be read with profit twenty-five years after its publication. It is packed with important material, interestingly presented, and much of the discussion is still stimulating. Ritter, I think, was disposed to magnify the differences between his own points of view and those held by other biologists whom he characterized as "elementalists," a circumstance which gave to some of his utterances a needlessly disputatious tone. This was accentuated by his failure, at times, to discern the meaning behind the esoteric sounding terminology of the rather bumptious young science of genetics. Again, Ritter's own utterances did not always lack a cabalistic tinge, as when he asserts his belief that "every living individual organism has the value, chemically speaking, of an elementary chemical substance"; and he gives no biochemical grounds for the hypothesis that all manifestations of life, including the psychical ones, "result from the chemical reaction between the organism and the respiratory gases"—oxygen being almost certainly the effective one. Even the format was against the success of "The Unity of the Organism." One does not ordinarily look beneath such small covers for a work of so considerable importance.

Dr. Ritter's last work of book dimensions, and certainly one of his best, was "The California Woodpecker and I," to which we must add the subtitle so characteristic of the author, "A Study in Comparative Zoology, in which are set forth numerous facts and reflections by one of us about both of us."[8] The volume as a whole is as unique as the title, comprising sections designated "Chiefly Woodpeckers," "Chiefly Both of Us," "Mind, Brain, Conduct," and "Chiefly Myself." Here we are taken in review through Ritter's own more than twenty years' observations on the acorn-storing and other instincts of this remarkable bird, followed by excursions into anatomy, physiology, phylogeny, psychology, sociology, epistemology and ethics! The reader may fail to detect any great degree of coherence at all points in the narrative, but that is not necessary to the enjoyment of it.

No account of Professor Ritter's career would be at all complete without considerable mention of the Scripps Institution at La Jolla, which may, to a certain extent, be regarded as his monument. The Scripps Institution for Biological Research was the outcome of a series of endeavors by Dr. Ritter and some others to create a seaside laboratory in connection with the department of zoology at the University of California. These earlier ventures, commencing as far back as 1892, included the establishment of very temporary quarters successively at Pacific Grove, Santa Catalina Island, San Pedro, Coronado and within the village of La Jolla. Building upon the present grounds was commenced in 1909, and two years later the then "San Diego Marine Biological Association" deeded the property to the University of California, under the title "Scripps Institution for Biological Research." Omission of the word "marine" was deliberate.

It was during this period of unrestricted biological outlook that the present writer became a member of the institution's staff, and for many years thereafter my studies of the races of wild mice were regarded as altogether relevant to the liberal, if somewhat nebulous, "program" of the "Biological Station." Indeed, generous funds were allotted to them throughout. Mr. Scripps's own avowed interests were in human problems, and in biological problems only in so far as they might have human implications. At one time he became mildly interested in a project to establish a colony of anthropoid apes upon our campus, and somewhat later even a department of sociology. But neither enterprise got beyond the talking stage. However, Scripps's own support of the institution was primarily in behalf of Ritter. He more than once said that what he and his sister were really doing was "endowing Ritter," but this was probably a bit of Scrippsian hyperbole.

As already intimated, the first plan of Ritter and his associates had in view the building up of a marine biological station. Writing as late as 1911, he stated his program as being, in essentials, "a biological survey of the waters of the Pacific adjacent to the coast of Southern California." Rather a stupendous project those will say who have had anything to do with biological surveys! Later, as stated, the word marine was dropped, and mice and monkeys were regarded as germane to our "program." But the next tack in our institution's somewhat variable course took it well to seaward again. The word "oceanographic" was incorporated into the official name of our station, and the new director, succeeding Dr. Ritter upon his retirement, was selected with particular view to his qualifications in this field.

The motives behind this change on Ritter's part are somewhat inscrutable. Its wisdom, at the present date, is a purely academic question. The Scripps Institution of Oceanography is very much a going concern, even under wartime conditions. Most fortunately the word "oceanography" has been interpreted very broadly by both of Ritter's successors, and biological work, though changed somewhat in scope, has been liberally supported.

Dr. Ritter's cooperation with E. W. Scripps and others in the founding of the well-known scientific news agency, Science Service, can hardly be discussed

[8] University of California Press, 1938.

here, though it is important to note that it was to Ritter to whom Scripps intrusted the task of interesting and organizing the scientific supporters of the enterprise.

To all who really knew him William E. Ritter looms large, not only as a most lovable personality but as a scientist of much originality and forcefulness. His constant interest, both in the scientific achievements and the personal welfare of the members of his staff at the Scripps Institution, was an outstanding feature of our lives throughout his term as director. Every new bit of information gathered by one of us, whatever its subject-matter, seemed to fit in some way into his framework of thought, and often as not served to illustrate some one of his favorite ideas. He was fond of discoursing with us, singly or in groups. These discourses were often stimulating. But we did not always find them easy to follow. Former President Wheeler, of the University of California, once characterized Ritter, so I am told, as "a great soul struggling for utterance." But this epigrammatic description hardly does him justice, for these "struggles" were not infrequently productive of impressive results.

FRANCIS B. SUMNER

DEATHS AND MEMORIALS

GEORGE STEIGER, chief chemist, retired, of the U. S. Geological Survey, died on April 18 at the age of seventy-five years. He joined the survey in 1892 and was chief chemist from 1916 to 1930.

DR. ROGER CLARK WELLS, chief chemist of the U. S. Geological Survey, died on April 19 at the age of sixty-seven years. He had been connected with the survey since 1908, succeeding Mr. Steiger as chief chemist in 1930.

ALBERT HIGGINS SLUSS, professor of mechanical and industrial engineering at the University of Kansas, died on April 17 at the age of sixty-six years.

DR. HERBERT A. CLARK, physicist of the Taylor Instrument Company at Rochester, N. Y., a former professor of physics at Syracuse University, died on April 20. He was sixty-eight years old.

A LIBERTY ship will be named for the late Dr. William E. Ritter, co-founder and honorary president of Science Service. The *S. S. William E. Ritter* will be launched early in May.

SIR ROY FEDDEN will give next month the thirty-second Wilbur Wright Memorial Lecture of the Council of the Royal Aeronautical Society, London.

SCIENTIFIC EVENTS

A GOVERNMENT TESTING LABORATORY IN SOUTH AFRICA

IT is reported in *Industrial Standardization* that in order to safeguard the public and to aid in checking quality and performance of materials and manufactured products, the South African Standards Institution has recommended that a National Standards Testing and Investigational Bureau be set up by the Government. Such a bureau would act as a national standardization laboratory and would carry out or arrange for investigations and tests in connection with standardization. The institution recommended that this bureau be established by Act of Parliament as a corporate body.

The functions of the bureau would include the testing and calibration of precision instruments, gages and scientific apparatus; determining their degree of accuracy with regard to fundamental standards, and issuing certificates with regard thereto. Testing and investigations on behalf of the South African Standards Institution and others would be done either by delegating the work to approved institutions or by providing laboratory facilities. Such testing would include physical or chemical examination of materials and products and tests of their use and performance.

The bureau would also assist the South African Standards Institution in investigating any questions affecting the preparation of its standard specifications. It would provide facilities for testing goods, articles and materials purchased on specification to decide whether such materials comply with the specification, and would act on behalf of the Government in testing locally manufactured and imported goods with a view to determining whether the goods comply with the regulations laid down by the Merchandise Marks Act or any other act and to verify standards. It would also test manufactured products and carry out investigations and inspections to enable the South African Standards Institution and other standardizing bodies to control their marks. In addition to all this, it is suggested that the bureau could also assist the Government departments in any tests which might need to be undertaken.

THE AMERICAN MATHEMATICAL SOCIETY

MEETINGS of the American Mathematical Society are announced for April 28 and 29 at Columbia University, and on the same dates at the Museum of Science and Industry, Chicago. On Saturday, April 29, there will be a meeting at the University of California at Berkeley.

At Columbia University, by invitation of the Pro-