If it should turn out that magnetic fields so high as those given above are present in atoms of elements such as those in the alkali group, the results obtained by Wood and Ellett would be easily explained.

Whether the existence of a magnetic coupling between the valency electron and the atomic core justifies Heisenberg in adopting the artifice of partitioning the quanta of rotation between the electron and the atomic core is a debatable point.

It does not appear to be permissible to adopt the value ½ for the azimuthal quantum number in defining the stationary orbits of a heavy atom such as that of uranium. In a recent paper by Rosseland,[8] in which a suggestion is put forward that the phenomenon of radioactivity exhibited by the heavier atoms may be due to some interaction between the nuclear and the external electrons in these atoms, he finds that the nearest approach of an electron to the nucleus in the atom of uranium according to Bohr's scheme of orbits is 16×10^{-12} cm. If the electronic orbit closest to the nucleus in the atom of uranium had ½ for the value of its azimuthal quantum number, it would mean that the shortest distance of approach to the nucleus would be equal to 4×10^{-12} cm. As the radius of the nucleus of the atom of uranium has been shown to be 6.5×10^{-12} cm. it is evident that such an orbit could not exist. For reasons of this character we are practically precluded from assigning to k, the azimuthal quantum number, a value less than 1 in defining the electronic orbits in atoms.

In this paper an attempt has been made to outline some of the leading features of the quantum theory as it is being used to solve the problems of atomic structure as well as of those connected with the origin of radiations emitted by atoms. Other illustrations of special interest might have been drawn from the treatment of problems that have arisen in a study of band spectra[9] and of fluorescence phenomena.[10] The recent work of Cabrera,[11] Epstein[12] and Dauvillier,[13] on paramagnetism, too, has a most interesting connection with the development of inner systems of electronic orbits in atoms in Bohr's scheme of the genesis of atoms.

I venture to think, however, that the few illustrations presented may serve, in a measure, to indicate the power and also the beauty of the methods being put forward to elucidate the problem of the origin of radiation.

J. C. McLennan

University of Toronto

[8] Rosseland, *Nature,* March 17, p. 357, 1923.

[9] Kratzer, *Die Naturwissenschaften,* vol. 11, Heft 27, p. 577, 1923.

[10] Franck and Pringsheim, *Die Naturwissenschaften,* Heft 27, vol. 11, July 6, p. 559, 1923.

[11] Cabrera, *Jl. de Phys.,* t. 6, p. 443, 1922.

[12] Epstein, Science, vol. lvii, No. 1479, p. 532, 1923.

[13] Dauvillier, *C.R.,* June 18, p. 1802, 1923.

BY-PRODUCT VALUES IN THE STUDY OF QUANTITATIVE ANALYSIS[1]

Many of the friends of chemistry as well as some of chemistry's devotees, chemists in the making, do not completely appreciate the value of the study of quantitative analysis because they do not realize the tremendously important rôle which quantitative analysis plays in an industrious world and because some of the worth of its study is in the form of intangible values difficult to analyze and evaluate. Quantitative analysis may be regarded by the student as a meat and potatoes course. After his appetite has been whetted for it by preliminary general and qualitative courses, it forms the "pièce de résistance" of a college chemical education, but leaves room for such hearty side dishes as organic chemistry, physical chemistry, etc., and a light chemical research dessert. But it is meat and potatoes to a young graduate in a very literal sense, for the first position of a large majority of young chemists is in analytical work. Many an ambitious man has used his routine analytical position as a stepping stone to a larger salary in his industry.

The rôle of quantitative analysis in the world's work is truly tremendous. It is absolutely essential to the appraisal of basic raw materials—the different ores and minerals, coal, water, limestone and a host of others. It furnishes the means whereby factory processes are controlled in iron and steel, sulfuric acid, corn products, fertilizer, dye and explosives industries, for example. By it the finished products are analyzed. It is necessary to the enforcement of the federal pure food laws and the state fertilizer and feed laws and it is the backbone of pure and applied chemical research.

Once the student has had the importance of quantitative chemistry pointed out to him and the undoubted help that it will be to him in earning his living some day, he quickly understands part of the benefits of its study. There are, however, other values which the instructor and student both should keep in mind, if full benefit for the latter is to be derived from the analytical courses.

Chief among these are:

(1) Stimulation of the logical mental processes required in thinking through the reasons for the steps necessary in each new method, for figuring out results

[1] These undoubtedly also apply to many other laboratory courses as well.

and working problems—similar mental training to that afforded by mathematics.

(2) Training of the memory in the technic of the art. Much of the memory work involved is in learning to make the physical motions necessary adroitly and with fair speed. To achieve this result requires constant effort and much repetition.

(3) Practice in learning how to work. The student should learn not to waste time, to plan his work in advance, and make every minute count to the best advantage. If the courses are well planned he will have to learn this lesson or put in hours of extra work. To turn out work in quantitative analysis is largely a question of planning work in advance. Let the student remember that it is the man who looks ahead who will later have the chance to look behind.

(4) An increase in self-reliance and resourcefulness. When a precipitate appears where it is not expected, the student will not resign in despair but will logically review his steps and figure out in all probability what it must be and govern himself accordingly.

(5) Development of neatness and care in the manipulation of apparatus and in the recording of data and the calculation of results. In the very nature of things neatness and care are prime requisites in quantitative work. The exercise of the constant care and the neat cleanliness which are necessary to accurate analysis strengthens these attributes for use under similar conditions in other fields.

(6) Education in dependability and integrity. Nothing is so dangerous to the success of an analytical chemist as dishonesty in obtaining his results. There are few dishonest analysts in industrial work, for they can not hold their positions. Honesty not only is the best policy, but it is also the best sense, for ethical values are recognized by all educated men. Let the analyst remember that he is a scientist and that in common with all scientists his motto should be "veritatem quaerero," to seek the truth. It is what it is and not necessarily what he thinks it should be.

(7) Encouragement of the use of scientific methods in finding out realities, in discovering the truth. The methods of quantitative analysis are based on facts and it recognizes the value of conclusions founded on observation. It gives the thinking student a distrust of, even disgust for, conclusions reached by a line of reasoning which is based on assumptions.

(8) Admiration and respect for nature and natural laws. When the instructor rejects a student's erroneous results, thereby necessitating the repetition of an analysis, he explains that the results are wrong because of some error that the student himself introduced and not due to some supernatural agency, that the laws which govern the process are immutable. Admiration and respect for nature and natural laws are indeed among the chief by-products in the study of any pure science.

Quantitative analysis is one of the delectable handmaids of civilization. The student often realizes her worth from a dollars and cents point of view, but he often does not realize that, in wooing the lass for her money alone, he overlooks some of her charms. There are certain lessons she can teach that so enrich the student that in later years he will not have to depend on her money for his living. These are some of the by-product values of quantitative analysis.

WALTER S. FROST
UNIVERSITY OF NEW HAMPSHIRE

THE UNION OF AMERICAN BIOLOGICAL SOCIETIES

THE Union of American Biological Societies was formally organized by a meeting of the Council, composed of representatives of the various societies composing the Union, in Washington on April 26 last. The constituent societies were represented as follows:

American Association for the Advancement of Science:
At large, B. E. Livingston, Henry B. Ward.
Section F, Herbert Osborn.
Section G, C. O. Appleman.
Section N, C. A. Kofoid.
Section O, R. W. Thatcher.

American Association of Anatomists: Henry H. Donaldson, G. L. Streeter.

American Association of Economic Entomologists: A. L. Quaintance, William Moore.

American Dairy Science Association: C. W. Larson.

American Genetic Association: G. N. Collins, Sewall Wright.

American Physiological Society: C. W. Greene (A. J. Carlson also appointed, but not present).

American Phytopathological Society: Donald Reddick, C. L. Shear.

American Society of Agronomy: Firman E. Bear, R. W. Thatcher.

American Society for Horticultural Science: C. P. Close, J. H. Gourley.

American Society of Naturalists: H. S. Jennings, A. Franklin Shull.

American Society of Zoologists: W. C. Allee, F. R. Lillie.

Botanical Society of America: B. M. Duggar, J. R. Schramm.

Ecological Society of America: C. C. Adams, R. F. Griggs.

Entomological Society of America: A. N. Caudell, A. G. Böving.

Society of American Foresters: I. W. Bailey, W. N. Sparhawk.

The following were also present:

Representing the Temporary Executive Committee of the Union: I. F. Lewis, C. E. McClung.

By invitation: L. A. Rogers, R. J. Haskell.