PROXIMATE ANALYSIS OF PLANTS AND VEGETABLE SUBSTANCES

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FRIEDRICH ROCHLEDER

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OF

PLANTS AND VEGETABLE SUBSTANCES

BY

FREDERICK ROCHLEDER, M. D.

PROFESSOR OF ORGANIC CHEMISTRY IN THE UNIVERSITY OF PRAGUE.

[Intended as instructions to beginners, and students in chemistry in the prosecution of the qualitative proximate analysis of plants, etc.]

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NOTE.

The following work of Dr. Rochleder was originally published in Germany, at Wurzburg, by Stahel, in 1858.

In 1859, Mr. JOHN M. MAISCH, now Professor of Materia Medica and Pharmacy in the New York College of Pharmacy, made a translation, and offered it for publication in this city, but it was declined by the Publisher, owing to the limited number of persons by whom such a work is sought.

In May, 1860, the Editors of the *Pharmaceutical Journal*, of London, commenced the publication of a translation by Mr. William Bastick, Pharmaceutical Chemist of that city, in parts of a few pages, which continued with occasional interruption until March, 1861. Notwithstanding this translation had several defects, it was determined to adopt it as the basis of a reprint, in parts, in the American Journal of Pharmacy, Mr. Maisch having, very liberally, agreed to carefully revise the pages, before they were submitted to the printer, by a comparison with the original text. Its publication commenced in that Journal in January, 1860, and was continued until September, 1862, with but one interruption. The work as here presented will be found to vary somewhat from the translation of Mr. Bastick, and it is believed has been rendered clearer.

The subject is exceedingly difficult to convey in the abstract way in which the Author has seen fit to present it, and involves a constant repetition of terms that might perhaps have been partially avoided, and rendered more interesting to the student, if he had adopted the plan of giving actual examples of proximate analysis.

Believing that the printing of a small separate edition of the work would prove a useful aid to American pharmaceutical students, especially in the preparation of their theses, it has been accomplished and is here presented.

WILLIAM PROCTER, JR.

Philadelphia, August, 1862.

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INTRODUCTION.

The medicinal action which many plants, or parts of plants, possess, may have been principally the earliest occasion of the examination of plants. It is probable that the analysis of plants, and particularly of their sap, was the first original labor in relation to analytical chemistry, when the term analysis could be scarcely employed in the sense which we attach to this word at the present time. Indeed, some derive the word "Chemistry" from χυμος (the sap), because the sap of plants had been the object of the earliest chemical research. The applicability of many plants to technical purposes was the later and profitable occasion for the analysis of plants and their parts. It is, therefore, evident why the earliest labors were not directed to discover all the constituents of a plant or of its parts, but had for their object the isolation of one or the other of its constituents. Chemists endeavored to isolate the medicinally active substance, or the poison of medicinal or poisonous plants, and the substances, as coloring matters, tannin, &c., of plants, used for industrial purposes, and on these accounts employed. Nevertheless, we very seldom find analyses of all parts of a plant; mostly, analyses were preferred of those parts of plants which were employed in medicine or in the arts. All analyses were undertaken from views which must remain foreign to chemistry as a science, which proceeds without regard to medical or technical objects. Another period commenced first in more recent times in the investigation of plants, in which the former predominating views were more and more thrown into the background; chemists became sensible that one constituent of a plant possessed for the plant the same degree of importance as any other, quite independently of its applicability to different objects. They perceived that all the constituents of a plant must stand in the closest relations to one another; that one is formed from the other, that the existence of one constituent could not be regarded independently of the existence of the others, and that all constituents are links of one chain. The principal result of these new views was an alteration in the method of investigating plants; it could no longer be said to be a one-sided endeavor for the isolation of a substance with a disregard to all other simultaneously existing constituents. It became necessary to search for all the constituents of a vegetable substance by analysis, and to study them closely. The inquiries concerning the process by which one constituent is formed from others, and, according to the nature of the affinities, is converted into other substances, have rendered requisite more correct analyses with reference to all the constituents.

The first efforts of chemists in the analysis of plants and their parts were limited to the separation of their constituents from one another, as far as it was possible, by their different behaviour to solvents. The substances thus separated, often still a mixture of several bodies, had a peculiar name conferred on them, but their composition, their relation to other bodies, with the exception of some observations concerning their color, or the precipitates produced by the addition of reagents, were not further investigated. From a resemblance in the properties of individual constituents with bodies already known, their identity with the same was decided upon. While some chemists rather predicted than were able to detect an unlimited quantity of different bodies in various plants by a great number of analyses in the highest degree imperfect, others proceeded to examine more closely the detected constituents individually. It was quite in the nature of things to be expected that for the investigation of the composition and constitution of their individual constituents, those bodies in particular should be selected which from their properties appeared to give a guarantee of their purity by reason of the facility with which they could be isolated and purified. For example; volatile oils, by the facility with which they are volatilized undecomposed, and are separated at certain boiling points from other volatile substances with some precision; also crystallizable bodies of some permanence which may be easily separated from other amorphous substances by their disposition to assume the crystalline form. These were the objects of attention to those men of science who expected more benefit to chemistry from a fundamental study of some substances than by the discovery of many. Thus, then, it happens that besides some few well-conducted analyses of vegetable substances, we possess a great mass of imperfect analyses, and sometimes an exact chemical investigation of one or the other constituent of a vegetable substance, in which the remaining constituents have received no consideration. There exists, at the present day, no investigation of the various parts of a plant which has been completed so that, uniting the details of each investigation of all the constituents to a whole, it could give us a representation of the constitution of the plant.

The investigation of an individual constituent of a vegetable often requires a long time, and a great expenditure of patience and sagacity, not to speak of the pecuniary sacrifice combined with it. For these reasons few of the substances have been at present examined in comparison with the number whose existence is already known. But an exact and complete analysis is endlessly troublesome when the nature of the constituents are not known. To this is to be ascribed the few analyses we possess which correspond to the acquirements of science. For an analysis which informs us what constituents a plant contains in its various parts, and in what quantity they are present therein, we seek in vain in chemical works.

As we find only some analyses of plants which possess a value, when we examine the long series of such analyses, so also we search vainly for a definite method according to which they could be arranged. There is no difficulty in explaining why no method is given for the analysis of plants such as we possess in mineral chemistry. Inorganic analysis is, in general, the analysis of defined compounds, the properties of whose elements are, for the most part, correctly known, and likewise the properties of their most important combinations with one another. When the analysis of plants treats of the analysis of mixtures which cannot be separated mechanically, then terminates the precision and certainty of inorganic chemistry, which we only can boast of in its relation to elementary analysis. The investigations of the various minerals, as phonolithe, &c., show how little we know of the means of separating the individual constituents. Every part of a plant is a mixture of many constituents not mechanically separable, the number of contemporaneously existing constituents of such a mixture being infinitely greater than in the most complex fossils. If it be difficult in this case to find out a method of separation, how much more difficult will it be with plants, whose principal constituents are so readily decomposable and changeable that they may be altered not only by the reagents employed for their separation, but act reciprocally on one another, producing bodies which were not originally present.

When we have to deal, in the analysis of plants, with known compounds, as is mostly the case in mineral chemistry, still the investigation is not easy. In the analysis of a vegetable substance heretofore unexamined, we can reckon almost with certainty on meeting with one or more quite unknown bodies. The intimation which has been already often expressed, that a rational method for the analysis of plants is quite impossible until at least we are correctly acquainted with the majority of vegetable bodies, is, consequently, not without some foundation, for only when we know the properties of the constituents of plants and their combinations, can a method be established which will be available for all time. Consequently, both for the present and the next century we must renounce the hope of a permanent and rational method of vegetable analysis, as it is scarcely possible, in a shorter space of time for chemists to study correctly and copiously enough the majority of the constituents of plants. The number of plants is great, and increases yearly by fresh discoveries, and with the number of plants the number of peculiar vegetable substances also increases. Therefore, if we would wait for the establishment of a method of vegetable analysis until we are acquainted with the majority of all vegetable bodies, we should never arrive at one, because we can only learn the properties of these bodies by organic analysis, and to investigate plants without some such method of analysis tends to aimless researches. However, this is clear, that every method of vegetable analysis which is arranged for the present, must be only a provisional one, to be made more comprehensive as soon as the knowledge of the constituents of plants has been extended by its aid—in other words, the provisional method is the means to arrive at better methods.

With the majority of the older analyses of vegetables the foundation of the process was the application of different solvents in succession. Ether, alcohol and water were the solvents most commonly employed. In many cases, the residues were brought into contact with dilute acids and alkalies, generally with the assistance of heat, after having been more or less exhausted with the three fluids mentioned. In consequence of the facility with which many substances are transformed into others by the action of acids and alkalies in the heat, these latter methods of treatment often gave rise to incorrect views of the composition of the plants, or those parts under examination. The treatment of the substance to be examined in succession with ether, alcohol, and water, would have afforded much better results, as in fact was mostly the case when two conditions which did not prevent a complete separation in this way, were not sufficiently attended to and calculated upon. These conditions are the following: the exhaustion of the substance under examination with one fluid must always be imperfectly effected before the second is allowed to act thereon. We cannot so prepare the material that each individual cell and its contents are exposed to the action of the solvent, because the material reduced to an impalpably fine powder, and exhausted with a solvent, affords again to the same solvent substances after it has been freshly triturated. Thus it happens that there are always bodies retained in the substance under examination after its treatment with a solvent which are soluble therein. If we now bring the substance in contact with the second solvent, the bodies not only will dissolve that we intend therewith to extract, but often also the remainder of the bodies which the first solvent left behind. The same holds good with regard to the third solvent. A solution of certain bodies by a solvent will afford thereby no means in many cases for the separation of other bodies which are insoluble in this solvent, because frequently substances which are *per se* insoluble in a liquid, are not insoluble in a solution of other substances in the same liquid. In this way we obtain, in a watery or alcoholic extract of a vegetable substance, bodies which *per se* are insoluble in water or alcohol, but which, by the agency of other bodies, are dissolved therein. Independently of these detrimental circumstances, which are produced by an incomplete exhaustion with one liquid before the application of a second solvent, there is associated the condition that the exhaustion with a liquid, at the same time, produces a solution of bodies which should not dissolve, because they are held to be insoluble therein. But what is termed insoluble are, in the majority of cases, only very difficultly soluble substances, that is, such substances as require a large