thus produced a corresponding number of secondary species."

In 1859, language of which this is an unintentional paraphrase, occurring in the "Origin of Species," was scouted as wild speculation; at present, it is a sober statement of the conclusions to which an acute and critically-minded investigator is led by large and patient study of the facts of palæontology. I venture to repeat what I have said before, that, so far as the animal world is concerned, Evolution is no longer a speculation, but a statement of historical fact. It takes its place alongside of those accepted truths which must be taken into account by philosophers of all schools.

Thus when, on the first day of October next, the "Origin of Species" comes of age, the promise of its youth will be amply fulfilled; and we shall be prepared to congratulate the venerated author of the book, not only that the greatness of his achievement and its enduring influence upon the progress of knowledge have won him a place beside our Harvey; but, still more, that, like Harvey, he has lived long enough to outlast detraction and opposition, and to see the stone that the builders rejected become the head-stone of the corner.

T. H. HUXLEY.

WATER ANALYSIS.

The recent publication of Dr. Frankland's convenient little volume on this subject;* the important memoir by Dr. Tidy read and discussed last year before the Chemical Society, and published in its *Journal*;† and the volume published as long ago as 1868, and now appearing in a fifth edition, by Professor Wanklyn and Mr Chapman,‡ in which Dr. Frankland's title was anticipated, contains the literature of a subject which has of late years assumed extreme importance, but concerning which there is a haze of mystery and obscurity that assuredly ought not to exist. It is certainly very much to be regretted that there is no common and recognized method of procedure in this department of chemistry, but it is almost discreditable that not only are the results of analyses given in discordant chemical expressions, but even the figures are not in the same terms, so that a comparison of results is impossible without performing an arithmetical operaton. So long as one chemist expresses his results in 100-1000th parts, another in grains per gallon, and a third in milligrammes, or parts in a million; while one estimates ammonia as a total, another separates free from organic ammonia, and the third regards the quantity of what is called albumenoid ammonia as of vital importance; while one adopts the combustion or evaporation method to determine the actual quantity of organic contents of water, and another accepts the permanganate method to discover the quantity of oxygen required to oxidize the organic matter present; it is evident that the comparison of analyses affected by the pupils of the various schools cannot be satisfactory or conclusive, because they cannot be compared. Surely the time has come when methods of analysis giving the quantity of organic carbon and nitrogen and its condition or history in some intelligible form, the quantity of nitrogen as nitrates, the quantity of chlorine, and the hardness, in similar terms, should be so far agreed upon that results can be compared, and those who are not chemists will then be able to form some opinion as to facts. We believe all our most distinguished chemists would agree that this is possible. It only needs that each should give way in some matters that are not essential, but rather belong to the individual. Dr. Tidy well and properly observes in his paper (*Journal of the Chemical Society*, Jan., 1879): "I am afraid the public *have* taken note and *are* taking note of chemists' differences, and distrust our work accordingly. Nor indeed is their distrust to be wondered at, deeply as it is to be lamented."

In Dr. Frankland's book we find stated, in a compact and convenient form, the requirements of a water analysis, and in an appendix examples of typical analyses. He begins by pointing out the fact that complete and ultimate analyses are by no means called for in ordinary cases. He points out the unimportance, in a sanitary sense, of the dissolved gases, which vary but little in waters of very different kinds, and of which the presence of a smaller or larger quantity does not affect the goodness of the water; the difference, in fact, lying chiefly in the quantity of carbonic acid. The separate estimation of the quantity of each of the saline matters and of each organic constituent of the suspended matters, may in like manner, and for the same reason, be omitted. The processes adopted to determine the quantities of inorganic solids, the ammonia, the chlorine, the nature of the hardening ingredients, and the presence of poisonous metals, if any, are those which are really important, and a knowledge of them and of the amount of nitrates, and lastly, but of chief importance, the means of estimating approximately the proportion of the organic elements in a sample of water, are the objects of which attention is really required, and to the elucidation to which the volume is dedicated. Professor Frankland considers that there is no process, short of the actual combustion of the organic matter present in water, which affords thoroughly trustworthy evidence of the organic carbon and nitrogen, and of the fitness or otherwise of the sample for dietetic purposes. The "ignition" and "albumenoid ammonia" he merely mentions, and evidently disregards. The former is described by Dr. Tidy in his memoir, and he considers it is not satisfactory, as failing to show that, in carrying out the process—(1) no organic matter is lost, (2) that all the organic matter is burnt off, and (3) that no organic matter is added. Notwithstanding this, he adopts it in the analysis of sewerage, and thinks that in some respects it may be indicative, and suggestive in other cases. The ammonia process, described by Mr. Wanklyn as "a sort of combustion process, with ammonia for the ultimate product," has for its object the comparative determination of the nitrogenous organic matter by the quantity of ammonia yielded by the destruction of the organic matter, this quantity being called "albumenoid ammonia." (Wanklyn's "Water Analysis," 5th Ed., p. 31.) Dr. Tidy has considered in detail the advantages and disadvantages of this method and has given some remarkable illustrations of its failure in important cases. He points out the very important fact that the quantity of albumenoid ammonia in peaty water is very large, although it has never been proved that such water is in any sense injurious; and, on the other hand, that in waters regarded by Mr. Wanklyn as exceedingly bad, the albumenoid ammonia is almost *nil*. For these reasons apparently, as he quotes Dr. Tidy's paper and gives no other reference, Dr. Frankland rejects them.

In the commencement of this work, following Mr. Wanklyn in this, Dr. Frankland describes the preliminary considerations in water sampling, the quantity required, and the tests that should be applied to determine the presence of mineral poisons, the nature of refuse from manufactures, the action on soft lead, and the cause of turbidity. Having thus opened the subject, he proceeds to show in what way the total solids in solution can be best determined. To determine the organic contents, he prefers the combustion method. He describes the precautions required in evaporation, and believes that "the proportion of solid residue left on evaporation affords an approximate, though somewhat rough indication of the comparative purity of water." This, no doubt, is true in a certain sense, although it must not be concluded that waters showing a large residue are necessarily bad. It is with water as with many other things, we must be content with the best we can obtain under existing circumstances, and absolute purity is practically unobtainable. A tolerably good river water at hand is often better than deep well water or lake water from a distance, though theoretically superior.

* "Water Analysis for Sanitary Purposes, with Hints for the Interpretation of Results." By E. Frankland, Ph.D., F. R. S., &c. London: Van Voorst. 1880.

† "The Processes for Determining the Organic Purity of Potable Waters." By C. Meymott Tidy, M.B. *Journal of the Chemical Society*, Jan., 1879.

‡ "Water Analysis: a Practical Treatise on the Examination of Potable Water." By J. Alfred Wanklyn, M.R.C.S., and Ernest Theophron Chapman. London: Thrübner & Co. Fifth Edition. 1879.

In speaking of quality, Dr. Frankland adheres throughout to the strict technical use of the words "impurity" and "pollution," applying them to all foreign substances present in water. This is to be regretted, as they are eminently misleading when referring to the quality of water for ordinary purposes, and are certain to foster prejudices both unfair and mischievous. According to his use of these terms, all mineral waters, including those especially recommended for dietetic purposes, might be quoted as exceedingly impure, and loaded with polluting matter.

The determination of the ammonia is the next point considered. It is admitted that the actual quantity of ammonia present is, of itself no guide to the purity of water, as there are many cases of deep-well water in which the quantity is large, though there has been no access of animal matter. As, however, ammonia in water is very commonly caused by animal matter in a state of incipient decomposition, and is found in water polluted by sewerage, in shallow well water, and in some cases in river water, the quantity present in a given quantity of water is regarded as an essential inquiry, and its presence is suggestive of evil.

Chlorine is present in water chiefly as a constituent of common salt, and this is so uniformly found in the liquid excrement of animals, that its presence in water is also to be distrusted. At the same time, a certain quantity is certainly washed out of the air and soil by rain, although the proportion of this is not constant. The quantities allowed by Dr. Frankland as due to these causes are 0.22 per 100,000 for rain water, 1.13 for upland surface water, 2.49 for spring water, and 5.11 for deep-well water. The history of the water must, therefore, be known before its value can be ascertained. It is evident that there are special cases in which these quantities are enormously exceeded without danger.

The estimation of nitrogen as nitrates and nitrites is not difficult, and may be effected in one of three ways. Each is described at some length in Dr. Frankland's book, and each has its own advantages. He prefers that which involves the decomposition of the salts into nitric oxide, and the measurement of the gas evolved.

The methods for determining hardness that are suggested involve nothing new, and they have been too often described to require notice here.

The method of determining organic purity by the use of permanganate of potash, originally suggested by Professor Forchammer in 1850, approved by Dr. Miller and other eminent chemists, and brought into use by the late Dr. Letheby, has been perfected by Dr. Tidy, and appears to produce results so satisfactory, as compared with the combustion process, when carried on under the most favorable conditions, that Dr. Frankland admits its usefulness and general accuracy in waters of moderate purity. It is elaborately described by Dr. Tidy in his memoir, and its advantages discussed. The prominent objections to the combustion process, which is still regarded by Dr. Frankland as the only secure method of determining the organic elements, will also be found fully stated in that memoir.

It must not be supposed that the analytical determination of the foreign substances present in water is sufficient to justify a conclusion as to the quality of the water without a due consideration of all circumstances, not only those indicated by the association of the elements, but those under which the water has or may have acquired them. No chemist, however able and intelligent, is justified in giving an opinion as to water submitted for analysis without knowing the history of the water, except, of course, where there are definite poisons present which enforce an absolute condemnation.* Neither the ammonia nor the nitrogen, neither the salt nor the hardness, may be regarded alone, without reference to this history. Thus it is that while mere analysis is easy, the estimation of waters for sanitary purposes must always require very great judgment as well as long experience.

Dr. Frankland gives in an appendix a number of typical analyses of waters of various kinds and of various qualities. Adopting a classification suggested originally by Dr. Parkes, and modified by Dr. Tidy, he groups all waters into two sections—upland surface waters, and waters other than upland—and each section he divides into four classes—viz., waters of great purity, of medium purity, of doubtful purity, and of no purity at all; determining the value in each case by the permanganate process. This classification may be useful in some cases, but it is hardly of general application, inasmuch as "upland surface waters" is a very vague expression. The analyses given in this appendix are valuable, and are, we believe, chiefly quoted from the celebrated Sixth Report. We venture to suggest that they would be less liable to misconstruction if the estimate of what in this work Dr. Frankland still calls "previous sewerage contamination" were left out. This expression is, no doubt, explained (see pages 95–98.) as it has often been, and to those who understand the explanation it really means nothing that in any way affects the value of the water; but when we are told that rain water falling in London on November 8, 1873, contained 1,490 parts in 10,000 of this mysterious essence—that the deep-well water from the magnesian limestone contains, on an average, nearly ten times as much, and the upland surface water from the lower London tertiaries none at all, we confess to a feeling of wonder that so misleading a title should continue to be used in reference to waters whose real value for dietetic purposes is not, and cannot be, in the smallest degree, influenced by so ugly an expression. The term has been withdrawn from the official returns describing the state of the London water, and it would be well if it could be expunged from the literature of analytical chemistry.

We have already alluded to some of the reasons of Dr. Tidy for rejecting Mr. Wanklyn's "albumenoid ammonia" process, and have pointed out that they are fully recognized by Dr. Frankland. This method is, however, by much the easiest of all for determining the organic constituents and for that reason is very widely adopted. It is described in detail in Mr. Wanklyn's volume already referred to, and one of the means of determination involves the precise comparison of shades of color. A possibility of personal error is thus introduced, which detracts very seriously from the value of a method which appears in other respects to be doubtful in its conclusions. We are not aware that Mr. Wanklyn has replied to the objections to his method, but we observe that he still adopts it in his determination of the organic contents of doubtful waters. The best, easiest, and safest method of estimating organic matter is, no doubt, the great problem to be solved in water analysis; but as it is not agreed whether the combustion process, the permanganate or oxygen process, or the albumenoid process, is the right one, it would seem reasonable that in all cases of dispute the analytical chemist on each side should be expected to give his results, not only in the way he thinks best, but also in the terms adopted by his *confrère*, and in such form that they admit of immediate comparison. If no other agreement can be arrived at, we may at least expect so much, and we think that in time it might be found possible to obtain, by common consent, a middle way that should satisfy all parties. At any rate and first of all, there might be a consensus in the matter of arithmetic.

* It is well that this should be borne in mind by engineers and others who occasionally send waters for analysis with merely a number or other private reference. It is not fair to the chemist to require an opinion as to the goodness of water, without communicating its source and the circumstance under which it has been obtained. Generally the chemist should take the sample himself.

THE FLY-TRAP—ITS FIRST DISCOVERY.—The Fly-trap (*Dionœa muscipula*) has lately been much spoken of; so it will be interesting to learn when this plant was first made known. John Ellis (1711–1776), a London merchant, received in 1769, from Philadelphia, the plant, and described it with drawings in "Directions for bringing over Seeds and Plants from the East Indies and other Distant Countries in a State of Vegetation, to which is added the Figure and Botanical Description of *Dionœa muscipula*," London, 1770. The same gentleman published in 1771, "Copies of two letters to Dr. Linnæus and Mr. W. Aiton," containing descriptions and drawings of two other North American plants, *Illitium floridanum* and *Gordonia lasianthus*.

FRED. BRENDEL.