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Is there a science of microscopy?

Is there a Science of Microscopy?

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The words "science" and "scientific" are often used with very loose and indefinite notions of their meaning. In general, science is certain knowledge, the total written record of the observations and opinions of men trained in investigation, and logical in habits of thought. In particular, it means that part of such record as relates to one single class of closely related phenomena, as of light, the science of optics.

When the worker or investigator requires a knowledge of several different parts of science or sciences, which co-operate to enable him to produce a given result, such a collective body of knowledge of different kinds constitutes an art, as the art of medicine or of painting. Now in the telescope and microscope we have two instruments, each of which, in its own place, has equally aided in scientific research. The word telescope has the same form of derivatives, telescopic, telescopical, as microscope, but in place of telescopy we say astronomy.

Nobody questions the right of astronomy to be called a science, but it includes a knowledge of the instrument used, *i. e.*, telescope, and also of the things observed. The telescope is chiefly applied to celestial bodies in regard to which our powers are limited to a few characters, as size, distance, etc., while the microscope gives us a much greater variety of knowledge. If, however, we consider the applications of the latter instrument, we shall find it chiefly employed in examining the simplest forms and elements of organic life, and this is pre-eminently the field in which skill in the use of the instrument and knowledge of the thing observed go hand in hand. Here then is the basis of the science of microscopy as a definite branch or division of human knowledge, as accurately and well defined as astronomy.

Histology, the Protozoa and Cryptogamia, together with the technics of the instrument are the principal and particular subjects included under the more general term "Microscopy."

Certain other subjects are partially but less perfectly covered, as embryology, physiography, etc., because they involve in their treatment both macroscopic characters and ideas, chemical or otherwise, not microscopic. But the parallel with astronomy still holds good, for that science has, likewise, side or auxiliary branches, as spectral analysis, stellar photography, etc.

The use of the words "microscopy" and "microscopical" to indicate a particular science, is not only justified by the above parallel, but also by usage, which has much to do with fixing the meaning of terms, and, when fully established, dominates other considerations in the use of language. From the time when the compound microscope was made in its modern form we have had numerous societies, periodicals, and text-books, of the highest scientific value, in the titles of which the words in question are used. If we examine the character of this literature, we shall find it corresponds to the above statements. The Royal Microscopical Society of London publishes a journal which contains abstracts of all current microscopical literature as well as its own transactions. Less than half of the papers in the "Transactions," and a still smaller proportion of the "abstracts," relate to microscopical technics. The abstracts are classified in the index under the various subdivisions of Zoölogy and Botany to which they belong. The subject-matter of these abstracts may be considered to fairly represent microscopical literature and the science of microscopy.

In the previous remarks a parallel has been drawn between astronomy and microscopy, as having equal claims to the title of science.

But if the mixed nature of subject-matter lessens the claim of a pursuit to the title of Science, Geography, as the term is usually construed, has far less claims to be called a science than microscopy.

Until recently the applications of the microscope were almost entirely confined to living structures in their minute elements, or a special part of Biology, but "Geography as a science," as defined by Webster, includes more or less Astronomy, Politics, and Biology; in a word, as heterogeneous a mass of subjects as could well be assembled.

Neither can it be said that Botany, as commonly understood, includes all the results obtained by the use of the microscope, nor, similarly, that Zoölogy covers all the microscopical work belonging to the lower forms of animal life. The great majority of those students called botanists in this country know almost nothing of the use of the compound microscope in its more perfect forms, or of the lower classes of vegetable life. The same is true of numbers of zoölogists, and in these lower classes of living forms we tread so closely on indeterminate boundaries of form and structure that the distinctions between plants and animals cease to be of more value than species characters in higher groups, as illustrated by Hæckel's idea of the class Protista. Here again the parallel with Astronomy holds good. Spectral analysis and stellar photography are often classed as branches of Astronomy, but they belong by nature to Chemistry, and the bond of union to Astronomy is the principal instrument employed, as much as the subject-matter.

It may be further pointed out that no man is a competent observer in the field of microscopic zoölogy or botany who is not well acquainted with both classes of objects. Their habitats and forms are so similar as sometimes even to render it a matter of doubt as to which department of life they should be assigned.

This application of the microscope presents so much adapted to interest the observer that men are fascinated with its study apart from any pecuniary reason. Men who begin scientific work because they love it frequently acquire the highest skill in their specialty.

They find their highest pleasure in the pursuit of science in the sense defined at the beginning of this article, as a body of knowledge based on inductive reasoning. The essential conditions of this pleasure are enthusiasm for truth, and a judicial temperament that takes nothing for granted unsupported by a logical basis of reasoning. When to these we add the power of projecting on the mental plane of vision combinations of ideas hitherto unknown, (called by Tyndall "the scientific imagination") we have the conditions of greatest success in its pursuit.

These conditions are as likely to exist in the so-called amateur, as in the man who makes science his business.* Many attempts have been

*Amateur, "one who cultivates any study or art from taste or attachment, without pursuing it professionally."—*Webster*. This word does not in any way include the idea of careless, incorrect, or imperfect work.

See articles on the above subject in Zeitschrift für Mikroskopie, ueber die Entwickelung und gegenwartigen Stellung der Mikroskopie in Deutschland. Edouard Kaiser, October, 1877.

Also American Quarterly Microscopical Journal, vol. 1, p. 58, 1878, and Journal Royal Microscopical Society, Jan., 1879.

made to define the term "Amateur," as distinct from the professional man, but so far entirely without success. So far as microscopical work is concerned, the expense and time required will prevent any from engaging in it who have not a real love for it that will tend in any case to a higher plane of intellectual character, if not to substantial contributions to knowledge.

But on the latter point, many of the most important additions to our scientific literature have been made by men who were amateurs, if that term is applied to men who do not make a business, or gain a livelihood, by the exercise of science. Rutherford, Tulasne, Dallinger, Wolle, Strecker, etc., are amateurs, and the character of their contributions to microscopy and other sciences fully justify the admission of amateurs to consideration as scientific men and fellow-workers for the increase of our knowledge of absolute truth.

Aniline Stains for Microscopic Objects.*

By HERR HUEPPY.

The basic aniline colors are soluble in water, and for the most part in one or all of the decolorizing agents in use a weak watery solution colors at first the intercellular substance and the cell body, while the nuclei remain unstained. Through the subsequent treatment with alcohol, glycerine, or acetic acid an inversion of the staining takes place, by which the elements previously colored become colorless and the previously colorless nuclei are stained. In the use of the stronger solutions the staining follows (without any discernible inversion) directly and quickly, and, in general, its intensity is in proportion to the concentration of the solution. In a quite concentrated watery solution overstaining may occur, which can be reduced to the proper degree by subsequent decolorization.

If the dyes are dissolved in the decolorizing agents—such as absolute alcohol, acetic acid, or thick glycerine—they stain slightly or not at all. Instead of using some decolorizing agent subsequently to reduce the intensity of the staining to a proper degree in preparations which have been overstained in watery solutions, in many cases a solution of the dye-stuff in a mixture of water with alcohol (Hermann), glycerine (Schaefer), or acetic acid (Ehrlich) may be used.

The basic aniline dyes are used in the following solutions:

(1.) Concentrated watery solutions. These are either used directly, or after dilution to the desired degree with distilled water. The solutions are prepared with distilled water (which has been previously boiled), so that an excess of the coloring-matter remains undissolved. They must always be filtered before using. Only a small quantity of these watery solutions should be made at a time.

(2.) Concentrated alcoholic solutions. The solution of an excess of the coloring material is brought about in the best way by absolute alcohol, or, in want of this, by the officinal 90 per cent. spirit of the Pharmacopœia.

In general, one can calculate about 20 to 25 grammes of the dye-stuff to 100 grammes of the spirit or alcohol. These solutions are kept pre-

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* "Die Methoden der Bakterien-Forschung."

pared, and are not used directly for staining, but are mixed with a certain amount of distilled or aniline water. In place of concentrated watery solutions the alcoholic solutions can be used if five or six drops are added to a small watch-glass of distilled water. This mixture is often designated as the dilute alcoholic solution. From the watery or alcoholic solution of the basic aniline colors the various staining fluids are prepared. The preparations that are more commonly employed in staining bacteria are Koch-Ehrlich's solution of methyl-violet or fuchsin, and the alkaline methylene blue solution.

A New Diatom Mounting Medium.

By F. W. WEIR,
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$C_{10}H_7Br$. + Resin of Tolu.—Dissolve 3 oz. of commercial balsam tolu in 4 fl. drams of benzin (C_6H_6) at a temperature of about 45° C., and strain. Add 4 fl. oz. of carbon bi-sulphide, agitate thoroughly and allow to cool, when the tolu solution will separate and the carbon bi-sulphide with cinnamic acid in solution can be decanted. Add another portion of carbon bi-sulphide and treat as before. Finally pour the tolu solution into a glass tray and evaporate the benzin. Place in a ½ oz. glass stoppered phial 1 fl. dram of naphthalin monobromide and add gradually about three times its volume of the resin of tolu, or sufficient to make the mixture quite stiff when cold. The solution will be effected slowly at about 45° C. The above constitutes a mounting medium which is rather easier to use than Canada balsam.

Warm the medium at 40° to 45° C. until quite fluid, take up a minute quantity on a warm needle, place on centre of cover-glass and invert on slide. Use no pressure whatever, but warm the slide gently, when the medium will flow to the edge of cover.

After a few days ring with a non-alcoholic cement. This method of treating balsam tolu does not remove an atom of resin and does not allow an atom of cinnamic acid to remain. The subsequent solution in naphthalin-monobromide produces a medium of higher index (1.73) than the resin alone, permanent in structure and volume, and free from objections to which any medium in a volatile solvent is subject.

Cleaning Diatoms.

By J. J. MOLES,
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Having had a little experience in cleaning a large number of different earths, I have found that each deposit requires a special treatment; but as a general rule, the following will prove useful: First boil material in hydrochloric acid for two or three minutes in test-tube; allow to settle, pour off the clear portion, and substitute nitric acid, of course, both pure. Boil again for two or three minutes, then wash well in distilled water in a tall beaker, allowing the sediment to settle; repeat the washing till all acid is removed. Now examine on slide. Should the deposit not now be clean, boil with a small portion of soap; this removes a lot of "flock." Wash again to remove the soap; then decant, and add liquor ammonia (fort.) for 20 or 30 seconds. Lastly, wash well in distilled water; this leaves the pustules sharp and brilliant.—*English Mechanic, Dec. 6, 1889.*