

# Popular Science Monthly/Volume 7/June 1875/The Microscope and its Misinterpretations

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## THE MICROSCOPE AND ITS MISINTERPRETATIONS.

By JOHN MICHELS,

**T**HE old adage that "seeing is believing" has long been exploded, and folks nowadays receive with caution the impressions conveyed by their eyesight.

There is still, however, a fixed idea with many people that, when the human sight is aided by powerful and correctly-constructed optical instruments, full reliance can be placed upon such united powers, and that the investigator may record that which he believes he sees, as veritable and established facts.

In contradiction of such belief, I shall place before the reader some curious results, which will show that the utmost caution is required by those using optical instruments for the elucidation of scientific problems or ordinary research.

Quite an interesting paper could be written upon the optical delusions with which astronomers have to contend in the use of the telescope, but I propose to confine my remarks to the difficulties



FIG. 1.—DRAWING BY DR. PIGGOTT, SHOWING THE BEADED MARKINGS ON PODURA-SCALE.

which beset the path of the microscopist, in obtaining truthful and accurate results, while using the microscope, leading to the most contradictory statements from men whose powers of observation and skill in the use of the instrument are admitted.

Those who make use of a microscope for the first time are usually fascinated by the wonderful and beautiful appearances presented, and, having illuminated the object under examination with a flood of light, and focused it to their satisfaction, congratulate themselves upon the ease with which they have handled the instrument, and fondly believe they have attained to a knowledge of its use. More extended study, however, and the use of high

powers with the more complicated pieces of apparatus, soon convince the student that the instrument requires the most delicate manipulation, and that much practice is necessary before its true powers are developed. Until full command over a microscope has been acquired, the most contradictory and perplexing results are obtained by those who use high powers in the examination of difficult objects, especially if the subject is very transparent. Things examined yesterday appear quite different to-day, both in form and color; and, even while the eye is still fixed upon the object, a slight change in the position of the mirror will alter its appearance, or present entirely new features.

Again, an object mounted in different mediums, or without any, will present the most varied appearances, and the honest investigator is thus embarrassed to decide which is the true form.



FIG. 2.—SAME SCALE FOCUSED TO SHOW NOTE OF EXCLAMATION MARKS.

These complications follow the use of the instrument through all its stages; but, when the causes are well understood, the difficulties are reduced to a minimum, and even turned to account in the examination of difficult objects.

Great success in the use of the microscope can only be obtained by the skillful manipulation of the light, and he that is not acquainted with the numerous schemes, devices, and contrivances in its management, might as well be in the dark; no directions here avail, and nothing but diligent and constant practice will render the student efficient in this respect.

I once stood an hour watching a leading London optician struggling to show me the true markings of a diatom with a new object-glass he had recently constructed, with which he had had no previous difficulty. He at last gave up the attempt in despair. Of course, an objective that has once performed a specific test will do so again. In this case, the only thing in fault was the management of the light. This had disgraced the object-glass, and enraged its maker.

In contrast with the above case, I may mention the real pleasure I experienced in witnessing the skill of a professional microscopist of this country. In his hands, all difficulties appeared to vanish, and he showed me one of the most difficult objects known, with marvelous promptitude.

But, to return to my subject: To enable the student to familiarize himself with the true power of the microscope, and to train his eyes to detect errors of vision, certain well-known test-objects are in general use; which are also convenient to test the quality and power of objectives. A favorite object of this class is the scale of the Podura, a minute insect, which dwells in remote nooks of dark and damp cellars, and similar localities.

This scale is usually mounted dry, and, when viewed under the compound microscope with suitable objectives, presents a surface studded with marks similar to the well-known note of exclamation (!)

This test-object has been for years the delight of microscopists possessing high powers, and a sharp definition of its peculiar markings as above mentioned was accepted as its true appearance and form.

For twenty-five years this scale was under constant examination by every grade of microscopists, from the grandees of the Royal Microscopical Society to the humble tyro, without any new or special feature being noticed, when on November 10, 1869, Dr. G. W. Royston Piggott, F.R.M.S., read a paper "On High-Power Definition" before the Royal Microscopical Society, and surprised the members by stating

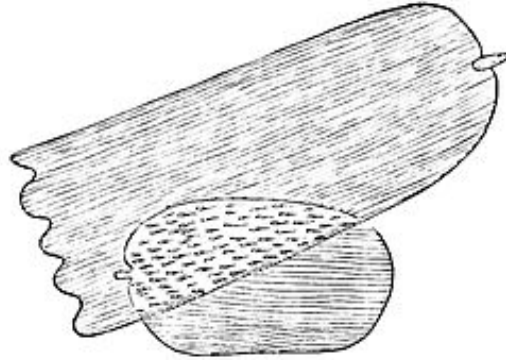


FIG. 3.—SCALE OF AZURE BLUE, PLACED IN POSITION, TO SHOW FALSE MARKINGS SIMILAR TO TEST PODURA-SCALES.—(Piggott.)

that all these years they had been gazing at the podura-scale, but had never yet seen its true markings. Dr. Piggott's paper described very fully what he had discovered as the true markings, and illustrated it with drawings which represented them to be distinctly of a beaded character; in fact, as dissimilar from the old accepted idea of their form as contrast could depict them.

Every microscopist was now hunting poduræ, and cellars damp and dismal were ransacked for the little scale-bearers, doubtless to the astonishment of numerous colonies of spiders, who must have been much provoked by this invasion, and thus commenced a controversy which is not yet concluded. Men equally eminent have taken opposite sides and expressed the most contrary opinions; and I now propose to give a brief *résumé* of what has been said and done in regard to this subject, because the matter is full of instruction to those interested in microscopical research. Not that the markings of the podura are of the slightest importance, or have any scientific significance, but the gravity of the conclusions which are sought hinges upon the fact that, if the views of Dr. Piggott are correct, our most eminent microscopists have been promulgating false and erroneous statements respecting the form of a well-known and common object; and, in whatever light the controversy is viewed, the humiliating confession must be made that they are still unable to determine the correct focus or the proper method of illuminating it.

Dr. Piggott commences by calling resolving the podura-scale "a difficult enterprise," and then describes the beaded appearance in the following manner: "Under a low power, as 80 or 100, the podura-scale is remarkable for its wavy markings, compared to watered silk; raising the power to 200 or 250, and using a side-light, the waviness disappears, and in its place longitudinal *ribbing* appears; with 1,200, they divide themselves into a string of longitudinal beads; but with 2,300 they appear to lie in the same plane and terminate abruptly on the basic membrane; in focusing for the beads attached to the lower side, the beadings appear in the intercostal spaces."

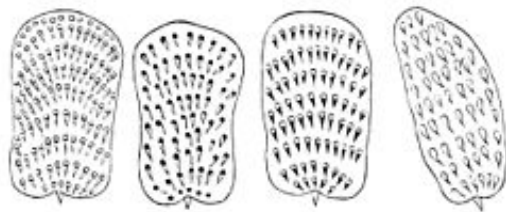


FIG. 4.—THE SAME PODURA-SCALE AS VIEWED UNDER DIFFERENT PHASES OF OBLIQUE LIGHT.—(Westropp.)

Respecting the old received views of the podura-scale, Dr. Piggott says: "With 300 to 500, the celebrated 'spines' appear, according to the size of the scale, as very dark tapering marks (like 'notes of admiration' without the dots ' ' '). To see these clearly with 2,500 has been considered the *ne plus ultra* of microscopical triumphs, and it is consequently with no small diffidence that the writer ventures to traverse the belief of twenty-five years."

Dr. Piggott further states that he reckons these beads to be 1/50000 to 1/150000 in diameter, and that the "spines," which he calls spurious, really embrace in general three or four beads, while the intervening space abounds with beads seen through the basic membrane, and very difficult of observation without special management; and concludes with the remark that he expects in a few months the podura headings, such as he described them, will be fully established.

Thus was the gauntlet thrown down, and the challenge was at once accepted by various members of the Society, who, on the conclusion of the reading of the paper, at once disputed the new doctrine. Mr. J. Beck was the first to express an opinion, and rather increased the confusion of the subject by stating that both the spines and the beads were illusory, and that the true structure of the podura-scale was a series of corrugations on one side, and that the reverse side was slightly undulating or nearly smooth, and that the notes of exclamation were due to refraction of light.

Mr. Hogg, the Hon. Secretary of the Society, thought Dr. Piggott in error; he had never seen such appearances as beads; thought probably Dr. Piggott had seen them by using too deep an eye-piece, bad illumination, and drawing out the tube of the microscope to too great an extent; or, perhaps, to a disturbed vision caused by advanced age and presbyopia.

The President, the Rev. J. B. Read, followed by stating that he agreed with the observations made by Mr. Hogg, and such was his faith in the skill of the opticians of the day, that he could not but feel that what he saw with their instruments really existed.

On the same date and occasion on which Dr. Piggott expounded his views, Mr. S. J. McIntire, a member of the same Society, read a paper "On the Scales of Certain Insects of the Order Thysanura." Now, Mr. McIntire, although a recent member, and young in microscopical research, is always listened to on this subject with respect by the Society,



FIG. 5.

having devoted his attention specially to these insects, and shown a patient and intelligent power of observing, not only their structure but their habits; he, in his communication, opposed Dr. Piggott's views, and calls the beads "optical illusions," and concurred with Mr. Beck's statement that the surface of the scale is corrugated, but flatly contradicts him by stating that both sides are alike.

December 8, 1869.—The President, the Rev. J. B. Read, stated that he, with Dr. Miller and others, had interviewed Dr. Piggott, and was bound to say he had seen the beaded appearances, and it was clear to him, now that in the best object-glasses small residuary aberration existed.

This slur upon the best object-glasses brought out Mr. Wenham with a paper in the *Microscopical Journal* of June, 1870, in which he repudiated such error, and described the beaded appearance as an illusion, obtained by

a trick of illumination, and by examining the scale with the microscope out of focus.

At the June meeting of the Royal Microscopical Society, a letter was read from Colonel Woodward, of Washington, inclosing photographs of the podura-scale, showing what he considered to be the true appearance. These photographs showed the spines. Colonel Woodward, however, reserved his opinion, and asked for a specimen of the true test podura-scale.

Dr. Maddox, in August, exhibited various photographs of podura-scales, which Mr. Wenham commented on in a paper to the *Microscopical Journal* of September following, which merely reiterated his views that the "spines" were the true appearance of podura-scales.

The Rev. J. B. Read, in the *Popular Science Review* of April, 1870, appears to accept Dr. Piggott's views entirely, and writes: "I can now see with my own powers what has been before invisible, viz., the beautiful beaded structure of the whole test-scale, as discovered by Dr. Piggott."

It would be tedious to continue the subject and give even an out-line of the papers and discussions that have been provoked by this knotty question: I shall, therefore, conclude by stating that Colonel Woodward has since produced two photographs, showing the two aspects of the question; they are made from authentic scales, and are pronounced very perfect.



FIG. 6.

In further illustration of the difficulty of obtaining a true and reliable image of an object when viewed under the microscope with high powers, I offer drawings which have been made by Mr. Ralph H. Westropp, B.A., T.C.D., of Allyflin Park, England, and represented at Figs. 4, 5, 6. These figures all represent the same object, a scale of podura viewed under different phases of oblique light; they are interesting as showing the effect produced by the play of light upon a refractive object. The reader will note that not only the details of the markings are greatly changed, but the very outline of the figures.

The fact that the most skillful microscopists of the age all differ upon the true appearances of a common and not very minute object, and the microscope itself presenting to the vision the most opposite appearances of one and the same object, should act as a caution to those who accept too readily theories based upon microscopical research; and suggests that, in the cause of justice, when life is at stake, single-handed evidence relating to the microscopical examination of apparent blood-stains should be verified at least by a second person before being accepted.

Thus we see that the so-called revelations of the microscope are but hieroglyphics, needing the interpretation of a mind of the highest culture, and that while the microscope is a good servant it is a bad master—mighty in the hands of a Huxley, but as useless to a man without the powers of discrimination as the chisel of Michael Angelo would be in the hands of a Modoc.



## THE MIGRATION OF INLAND BIRDS.

By CHARLES C. ABBOTT, M. D.

As understood by us, the migration of a bird is simply the desertion of a given locality by that species for a certain, and always the same, portion of each year. As an example, the common house-wren (*Troglodytes ædon*) is migratory, in that it remains in New Jersey<sup>[1]</sup> only from late in April until late in September, having left its Southern home for six months.

Before endeavoring to determine the causes of this movement on the part of some birds, we must first note the various features characterizing the movement itself; for it may safely be asserted that no two birds migrate alike, although the similarity is marked among the various species of the same family. The most marked feature in migration is the apparent uniformity in the time of its occurrence, i. e., of the dates of the arrivals in spring, and of the departures in autumn. Is this arrival in spring as regular as claimed by some, and supposed by most people? To the casual observer, and, indeed, to many who have for years noted the first appearances of our various birds, the arrival seems to be quite regular; and, curiously enough, we find many such observers insisting that, however late a bird may be any one season, he is never earlier than a given date. Thus we

- ↑ The observations upon which this essay is based were made by the author during the past sixteen years, while residing at Trenton, New Jersey, and the dates of arrival and departure of the various birds that we give refer solely to them, as seen in that locality.

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