not be found. Since the only method in which its origin can be absolutely shown cannot be used without expensive excavation, it only remains to give the probabilities so far as ascertainable from the mass itself. Such microscopic characters and mineral association have been, so far as we know, only found in eruptive rocks when the origin of such rocks has been studied with sufficient care to determine it. Hence we must conclude it is most probable that this mass is eruptive also, until found to be otherwise.

It closely resembles in structure and composition some of the meteorites, except that its iron is oxidized and not in a native state—a resemblance which for others of the peridotites has long been pointed out. It is rocks of this character, as has been suggested by others, that give us the most probable clew to the interior composition and structure of the earth.

The rock in the field shows, to our mind, no signs of structural planes that should be referred to sedimentation. On one side the rock is massive and jointed, and on the other it is jointed in fine parallel planes. This portion of the rock is more highly metamorphosed than the other, and, as is usual in highly altered eruptive rocks, joints parallel to certain lines of pressure occur. The writer has seen this structure in many rocks that were indisputably eruptive, forming well marked dikes in other rocks.

A rod away from the main mass of the iron ore, near one end, some serpentine appears that cannot be directly connected with the other peridotite. Microscopically its characters and structure are the same as the main rock, and there is no reason to regard it as distinct. The rock nearest to the peridotite is a mica schist some hundred feet away. It shows no characters that would indicate the transition of the ore into it.

The locality was visited by the writer in October last, in company with Professor A. S. Packard, Jr., of Brown University, and Mr. T. S. Battey, of the Friends' School, Providence, R. I. To the latter gentleman I am especially indebted for a copy of the paper of the Rhode Island Society before mentioned, and for other favors.

This examination may serve as an illustration of the aid that microscopical lithology may be to the practical side of life, since now, for the first time since this rock has been worked, can the ironmaster who wishes to use it approach understandingly the metallurgical problems it presents; whether he desires to employ the rock as a whole, or to concentrate the magnetite first.

In direct-vision spectroscopes the number of prisms involves a considerable loss of light. M. Zenger now uses a liquid prism of ordinary form, having attached on its anterior plane a quartz prism of the same refringent angle, but arranged in opposite direction. The posterior face of the liquid prism carries a plane parallel plate. The rays fall normally on the quartz. The loss of light is by this arrangement reduced to a minimum. The spectra obtained are very intense, and the lines are well defined. A single parallelepiped of the kind decomposes the D line to the naked eye, and with a small Galilean telescope, magnifying five times, one can distinguish the difference of breadth of the two lines, and easily see the extreme red and ultra-violet rays, though there are only two prisms of 60 degrees.

M. Poliakoff, the distinguished Russian naturalist, has examined a horse presented by Colonel Prejvalsky to the St. Petersburg Academy, and decides it to be a new species, which he has named *Equus Przewalskii*. A translation of his memoir appears in the "Annals of Natural History," and from this it appears that the new representative of the family of undivided-hoofed mammals is in some respects intermediate between our domestic horse and the wild ass, but it differs from the asinine genus in having four callosities, one on each leg. In the form of skull, absence of dorsal stripe, and other particulars it resembles the domestic horse. This newly-recorded animal is indigenous to the plains and deserts of Central Asia, and has not hitherto fallen under the dominion of man.

COMET (*b*), 1881.

We continue the interesting series of sketches of this comet, made by Professor Edward S. Holden with the 15-inch equatorial at the Washburn Observatory, Madison, Wisconsin.

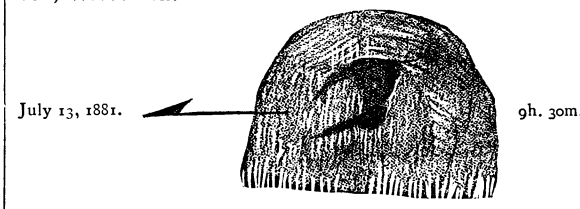


Figure 1.

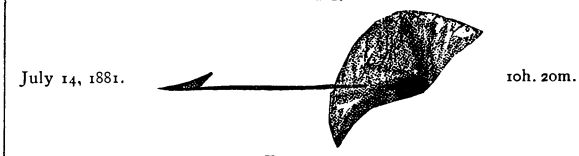


Figure 2.
Moonlight.

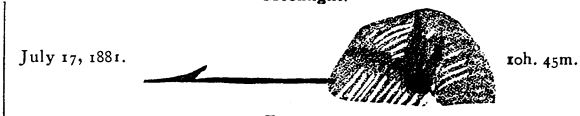


Figure 3.

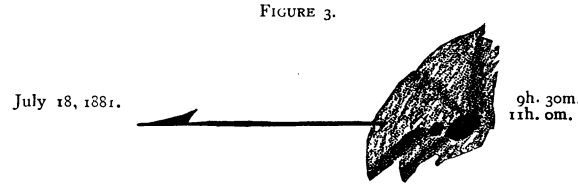


Figure 4.

The nucleus is DOUBLE (it has not been previously) $p = 275^{\circ} \pm$, $s = 1''.5$, with a dark space between the parts.

DO WE SEE NON-LUMINOUS BODIES BY REFLECTED LIGHT?

By A. G. Gaines, Pres. St. Lawrence University, Canton, N. Y.

All who have treated this subject have answered the above question with an unequivocal *yes*.

It may appear presumptuous to call the answer in question. Nevertheless, while reflecting recently on some of the peculiar facts of light and vision the thought came to me to doubt this universally accepted proposition; and now I wish to express my more confirmed doubts, and give some reasons for thinking we must revise our views on this point to some extent.

What I now hold is that neither *transmitted* nor *reflected* light reveal to us in vision either the body transmitting or the body reflecting, but that *radiant* light does reveal in vision the radiant body, and that the light by which any non-luminous body is visible is essentially of the nature of radiant light, and is properly to be so called. Paradoxical as these views may seem on bare statement, I think that a little consideration of the facts involved will soon convince us that they must be accepted as true, and show us that the present paradox is due to the illusions of an erroneous point of view.

It is a known and universally accepted truth that *transmitted* light does not reveal the transmitting medium. It may be refracted, little or much, but when it reaches the eye it reveals, not the refracting medium, but the body from which it was emitted. The refracting or transmitting body may be *visible*, but is not visible by transmitted light. Were it perfectly transparent, that is, were it to transmit *all* the light coming to it, it would be invisible. This is no new truth, but one universally held and taught; and thus far we are all agreed.

Now let us attend to *reflected* light. As we attend to it we shall learn that reflected light does not reveal the reflector but the body emitting it. If bodies are seen by reflected light, they should be more clearly seen in proportion as they reflect more perfectly the light falling on them. The facts are exactly contradictory to this. In proportion as any given surface is a good reflector it is to that degree invisible, and when a surface becomes a perfect reflector it becomes invisible. Can it then be true that bodies are seen by *reflected* light when it is palpably true that the better they reflect light the less visible they are? The reflected light makes visible the body emitting it, not the reflecting body, and it results that, in studying the stars, the astronomer uses nearly indifferently a reflecting or a refracting telescope. Plainly then, we would say, it is not by reflected light that bodies are visible. This conclusion cannot be escaped by any conjectures as to the extent and form of the reflecting surface. The minutest surface reflecting the sunlight gives a brilliant, dazzling star, not a revelation of itself. Curved, convex or concave, or variously warped surfaces give only images variously enlarged or diminished, or variously distorted, of the body emitting the light, and not at all of the surfaces reflecting it. If the microscope be applied to the surface, the facts are still found to be as above stated. No theory of minute reflecting surfaces changes any of these facts, unless it were imagined that a surface might be so small as to *decompose* the light falling on it, but this result would be destructive of the theory now objected against. Thus it appears from all the facts stated and referred to that the proof is conclusive that, in no case is a body seen as such by the light it *reflects*.

If, now, we go on to inquire as to the light by which bodies are seen, we may find some good reasons for believing it to be essentially *radiant light*, even when proceeding from non-luminous bodies. Note, then, that it is the peculiarity of radiant light that it is emitted in straight lines in every possible direction from every luminous point. The light, hence, by which such a point or body is seen is *divergent* light, and the office of the optical apparatus is to bring it to a focus on the retina. It is not possible for a single point (the minimum of visible surface,) in any reflecting surface to reflect light in every direction; and for light thus to proceed in every direction from a luminous point is the distinguishing characteristic of radiant light. What thus characterizes the light of what are called luminous bodies will be found to characterize the light by which all non-luminous bodies are visible. From every point of any such visible body the light proceeds in every possible direction; whence we note that every such point is a point of dispersion or radiation, and not a point of reflection. Here, as we learned in the case of luminous bodies, the light by which any ordinary non-luminous body (so-called) is seen is *divergent*, and the office of the optical apparatus is to bring it to a focus on the retina. This brings before us the perfect similarity of the conditions under which luminous and non-luminous bodies are seen; and which seem to compel us, hence, to regard the light by which non-luminous bodies are seen as having essentially the same qualities and relations as radiant light.

If, now, we seek to know how this can be explained, seeing that non-luminous bodies are not original sources of light, I think we may find a nearly perfect analogy in the facts of heat that may afford us much help. We are tolerably familiar with radiant and reflected heat. The heat which a body reflects follows all the laws of reflected light, and has this peculiarity, that it does not change the temperature of the reflecting surface. For the rest, the heat which falls on a body, and, as it is said, is *absorbed* by it, raises the temperature of the absorbing body, and immediately said body begins to *radiate* heat, and the heat thus radiated shows all the essential characteristics of radiant heat. What we wish to have particularly noted here is, that this *heat* has been all along said to be *radiated, not reflected*. By the principle of the correlation of forces the heat which is said to be absorbed is transformed first into increased molecular activity in the absorbing body, and then again transformed into what is emitted as radiant heat; and this emission is in straight lines in every direction from every point in the surface of the body radiating. All this is plain, and in perfect agreement with the accepted theory of heat. We have now only to apply these facts and principles, by analogy, to light, and we may obtain an equally plain and consistent theory of light as to visible bodies.

We have already called attention to the fact that the light which a surface *reflects* does not reveal that surface. The light by which any non-luminous body is seen is emitted, let us say, *radiated*, from every point of its surface. This may now be explained by supposing the light (luminous energy) received by such a body as in some degree or manner absorbed by the superficial particles of the body, and then radiated from every such particle as a centre, analogous to what we believe of heat. The light thus taken in appears to be always *decomposed*, with numberless variations of results; so that the light emitted or radiated is always of a different *color* from that received. This difference of color affords us another contrast between the light by which bodies are seen and reflected light; this last being always of the same color as the incident light. In making this statement we have in mind the fact that the same surface may both reflect and radiate light; and that, hence, in each case we must take care not to confound the one with the other in making our observations. When this caution is observed, the statement above concerning the color of reflected light will not, we think, be called in question.

The explanation, then, that I would offer is, that the light which falls on non-luminous bodies (so far as it is not reflected) is somehow absorbed by them, decomposed, and then radiated, at least in part, that the body is visible by this *radiated* light, and not at all by that light which it reflects. In these actions and reactions between the luminous energy falling on a non-luminous body and the body itself, we think it not improbable that there are some correlations of force; and that these may be essential parts of the change that enables the light radiated to make visible the non-luminous body.

If the views presented in this paper be allowed, they enable us to place the facts of phosphorescence, and may be of fluorescence, in harmony with the action on light of ordinary non-luminous bodies; and differing from these chiefly, if not wholly, in *degree* only. And is it not true that this so-called phosphorescence is possessed in some degree by every visible body? We do not now speak of cases of slow combustion, like exposed phosphorus, but those continuing to emit light for a time after being cut off from extraneous light, like snow and the diamond. We would look for the explanation of these greater degrees in phosphorescence in the power of the bodies exhibiting it to absorb and decompose light more deeply, and then more tardily radiate the luminous energy, than is true of non-luminous bodies generally.

It may be proper here to notice the facts of *iridescence*, with which our theme may have some interesting connections. Inasmuch as the facts of iridescence are explained by the interference of the luminous waves, caused by the reflection of light from very thin laminæ, it might be thought the same explanation would apply to *decomposition* of light by ordinary non-luminous bodies. We think the facts in the two cases so different that the same explanation is not applicable to both. In the first place, the facts of iridescence agree with the usual characteristics of *reflected* light; while, on the contrary, we have noted in this paper that the facts in the case of ordinary visible bodies do not so agree. And, in the second place, the results of the decomposition of light in iridescence

agree with the results obtained by prismatic decomposition; while the results in the other case do not. We think it would be correct to say that iridescence does not reveal non-luminous bodies in the same way, nor with the same certitude, as that light reveals them by which they are ordinarily visible. In making this last statement we have in mind the fact that the iridescent surface, in addition to its iridescence, also emits or radiates light in the same manner as ordinary visible bodies; and that these two facts are not to be confounded in our observations and reasonings. Without pursuing the subject further into details, these are some of the reasons why we think the facts of iridescence are not inconsistent with the main doctrine of this paper.

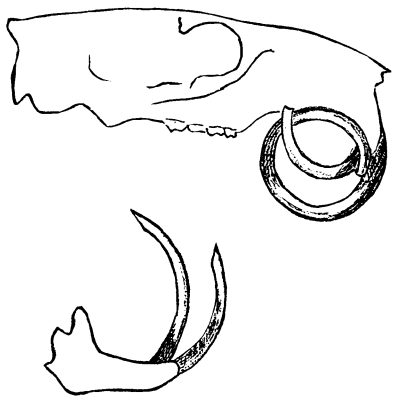
We conclude then, by reason of the facts and relations to which we have now called attention, we cannot believe that it is correct to say that non-luminous bodies are seen by *reflected light*; and we offer the suggestion that the light by which such bodies are seen should fairly and properly be called *radiant light*, as manifesting all the essential qualities of such light.

CORRESPONDENCE.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

To the Editor of "SCIENCE."

In an article on overgrown teeth of Fiber Zibethicus (which by a singular typographical error is printed Fiber Wibethicus) in "SCIENCE" for July 16th, the writer describes a not very uncommon phenomenon among rodents to which I can add an interesting example.



The inclosed drawing represents a similar case, being a woodchuck (Arctomys monax); it will be noticed that one of the upper teeth has grown far enough to form a semicircle while the other upper incisor has described a somewhat larger curve and finally thrust itself through the first and then continued to form a *complete circle*, as will be evident from the figure. This specimen was mounted here (with one other similar but not so extreme a case) and is now in the Museum of Comparative Zoology at Cambridge. F. W. STAEBNER.

July 20, 1881.

WARD'S NATURAL SCIENCE ESTABLISHMENT, Rochester, N. Y.

COMET (c) 1881.

To the Editor of "SCIENCE."

The comet discovered by Mr. Schaeberle at Ann Arbor, July 13, promises to become a very interesting object, not only because it will soon be visible to the naked eye, but also because its orbit shows great similarity to the great comet of 1337, as may be seen by the following comparison:

	1881 (Stone)	1337 (Hind)	1337 (Lanzier)
Distance of perihelion from node	122° 30′	108° 44′	90° 41′
Longitude of node	98 43	99 6	93 1
Inclination	141 35	137 6	139 32
Logarithm perihelion distance	9.7959	9.97	9.92

The difference between the orbits of the two comets is perhaps not greater than the uncertainty of that of 1337. The latter was first seen in China on the 26th of June, and afterwards in Europe on the 24th of October.

Schaeberle's comet has been observed here on a number of mornings, and its increase in brightness has been quite perceptible. This morning the tail was very apparent, the sky was very cloudy, or I presume it would have been visible to the naked eye. It ought to be quite plainly visible at any rate before the end of this week. It will be at perihelion and nearest the earth about the 20th of August, and will remain at approximately the same distance from us for a week or more. A few days before that time its right ascension will have become equal to the sun, so that when at its greatest brilliancy it will be visible in the evening. While it will undoubtedly become a magnificent object, it will not probably equal the great comet now receding from us.

ORMOND STONE.

MT. LOOKOUT, O., *July* 25, 1881.

ASTRONOMICAL NOTE.

WASHBURN OBSERVATORY, UNIVERSITY OF WISCONSIN, MADISON, WIS., July 17, 1881.

To the Editor of "SCIENCE."

Among the new red stars found here, the following is by far the finest and may be of interest:

Anon. 9 mag. R. A. $1^h\ 48^m\ 45^s$: Dec. $= +58°\ 40'.2$ 1880.0. EDWARD S. HOLDEN.

ADULTERATION OF SUGAR.

To the Editor of "SCIENCE."

DEAR SIR—In the leading editorial of "SCIENCE" of June 18, you speak of the different results obtained by Prof. Leeds and myself of examination of commercial sugars and syrups for glucose and grape sugar. I can only take exception to one statement contained therein, *i. e.*, the one which intimates that these different results form the theme of a scientific controversy. Since the reception of your letter I have renewed my inquiries for statistics, and can now say that I do not believe my estimates of the quantities made in the United States are very wide of the truth. Dealers and manufacturers are extremely reticent on the whole subject, and it is only by hard work and often indirection, that one can get at the truth. In your own city, New York, there is a large establishment for making "New Process Sugar," the Manhattan Refining Company, unless it has lately changed its name. Yet a prominent New York chemist stated publicly, and published over his own signature, that he had made diligent search for this establishment, and it could not be found. At the same time, to my personal knowledge, a western firm had just received a large consignment of "New Process Sugar" from this firm.

At the Boston meeting of the A. A. A. S., I stated on the strength of this personal knowledge that I believed the Manhattan Company was no myth. This statement was published in the Boston and New York papers, and was seen by the proprietors of the Manhattan Company. They wrote to assure me that I was right in my statement, sending me at the same time samples of their different sugar for analysis.

Within the past year the mixing of sugars has largely increased, and is now carried on in New York, in Buffalo, in Chicago, and at other points. A prominent