Philosophical Magazine Series 3

ISSN: 1941-5966 (Print) 1941-5974 (Online) Journal homepage: http://www.tandfonline.com/loi/tphm14

XLIV. On the so-called calorotypes, with animadversions on the papers of Mr. Hunt and Prof. Draper lately published in the philosophical magazine

Prof. Ludwig Moser

To cite this article: Prof. Ludwig Moser (1843) XLIV. On the so-called calorotypes, with animadversions on the papers of Mr. Hunt and Prof. Draper lately published in the philosophical magazine , Philosophical Magazine Series 3, 23:153, 356-360, DOI: 10.1080/14786444308644750

To link to this article: http://dx.doi.org/10.1080/14786444308644750

XLIV. *On the so-called Calorotypes, with Animadversions on the Papers of* Mr. Hunt *and* Prof. Draper *lately published in the Philosophical Magazine. By* Prof. Ludwig Moser*.

I WAS not a little surprised to find in vol. lviii. of these *Annalen*, an article by Mr. Robert Hunt† of Falmouth on Thermography, and one on Calorotypes by M. Knorr, in which are communicated as discoveries facts which I had previously described at length in the same work. Mr. Hunt sets out from my first Memoir on Vision‡, in which I demonstrated the existence of invisible light; he repeats the experiments which he read § in this Memoir, and gives them out as his own discovery. I cannot name a single experiment communicated by either of the authors which I had not previously described, except it be that the one employs a jasper instead of an agate, which I used, or a bronze medallion instead of a piece of copper coin.

In my Memoir on Vision, &c. of May 1842 (vol. lvi. of these *Annalen*), I communicated at page 206 [Scient. Mem. vol. iii. p. 43] the fact, that when any body is warmed it depicts itself on metallic or glass plates; that the same also occurs when the plate is warmed instead of the body. These experiments led me at first to believe that heat had some part in the production of these images, and Mr. Hunt, as also M. Knorr, who have repeated them, have stopt short at this erroneous view. Not so with me; for the following page described the same experiment made without the intervention of any artificial temperature, adding the following observations:—

"The action of light was therefore imitated and extended by my experiments; and indeed, as it appeared, by the employment of unequal temperatures. But this latter view could not possibly be long entertained; it is only necessary to observe one of the above-described images, if well executed, in order to be convinced that such representations, in which the finest lines of the original may often be traced, could not possibly be produced by differences of temperature, more particularly on a thin, well-conducting plate of metal. Moreover, the variety of the substances em-

* From Poggendorff's *Annalen*, vol. lix. part 1. Translated and communicated by William Francis, Ph.D.

† The paper referred to is a translation of Art. LXXXI. in the Phil. Mag. for Dec. 1842.—Edit.

‡ A translation of the whole of this Memoir, and also of those on Latent Light and on Invisible Light, by M. Moser, were published in Part XI. of Taylor's Scientific Memoirs, in Feb. 1843.

§ Mr. Hunt's paper, as just intimated, appeared in the Philosophical Magazine for December 1842. The first and very imperfect notice in this country of M. Moser's investigations was communicated at the Meeting of the British Association in June of the same year. It related solely to experiments and views detailed in the first of the three Memoirs.—Edit.

ployed forms a great objection to this view of the subject. It was therefore necessary to try whether the same phænomena could not be produced without the application of heat, and in this I succeeded." [Scientific Memoirs, vol. iii. p. 443.]

In the Addendum to this Memoir [Scient. Mem. vol. iii. p. 459], in which I advanced the hypothesis that the depicting of the bodies was due to a light proper to themselves, I have spoken of the auxiliary influence of heat in such a manner as will I hope settle this point. Bodies become luminous when heated; that is, they emit light of the refrangibility of ordinary light. After this it will hardly be admitted that this emission of light takes place suddenly; besides, the experiments prove the contrary; they show that light is radiated at all temperatures from bodies, that its intensity increases and its refrangibility decreases as the temperature becomes higher. According to my experiments the invisible rays of light pass very readily through aqueous solutions of various kinds, and through different oils, but they decidedly do not pass through the thinnest plates of glass, mica, amber or rock salt. [I have only recently made some experiments with the latter substance.] But if the temperature be raised, they pass very readily both through glass and mica, which is perfectly in accordance with the supposition that their intensity is increased and their refrangibility approximated to those of visible light. [Substances such as white glass, mica, &c., consequently lose the character of perfect transparency; they retain it only for a certain group of rays of light.]

Should it be concluded from the influence of heat on light, —corresponding so closely in its other properties to other physical forces,—that light and heat are identical, then let us see further on how the remaining phænomena are to be explained. I would merely impress on the reader not to be led astray by the mass of proofs which might perhaps be enumerated in favour of such an identity; they are all of them nothing more than variations upon the old fact of the incandescence of bodies at an elevation of temperature. With this I may at present take my leave of Mr. Hunt; the very title of his paper conveys the opinion of its being dependent on the influence of heat, and he has not even entered into the subject so far as he read it in my first Memoir. As I have stated above, he has not devised a single new experiment, for even those which appear to him sufficiently important to be adopted as the running head to his paper, "Art of copying engravings from paper on metallic plates by means of heat," will be found nearly word for word in these *Annalen*, vol. lvii. p. 570*.

* Published in 1842.

It is that experiment in which I caused a seal to depict itself on mercury with which a pure or silvered copper-plate had been coated, and afterwards produced the image in the iodine vapours.

I now turn to the calorotypes of M. Knorr. As soon as I had found from my experiments the fact that the actions of the bodies were manifested without any elevation of temperature, I operated at the ordinary temperature and never employed heat, for the phænomenon appeared already to belong to a somewhat complicated class, which needed not to be rendered more intricate by the introduction of any foreign force. In one case only did I depart from this rule, and that was in order to determine the colour of the latent light of oxygen. Since the affinity of several metals for this gas is increased by heat, I warmed plates of copper and brass, on which the invisible rays had acted, and on their becoming iridescent, I obtained the images by means of the various colouring. I communicated these results to several persons about the 18th Sept. 1842, and among others to the Editor of these *Annalen* (Prof. Poggendorff), who had the kindness to bring them before the notice of the Berlin Academy of Sciences, and to cause their publication in the Monthly Proceedings*. Now these are the calorotypes of M. Knorr, only, as I conceive, obtained in a more advantageous manner; for M. Knorr heats the plate with the body to be depicted on it until the former becomes iridescent. The image which is formed under these circumstances I have long been acquainted with, but even now in my opinion it affords no proof. If, for instance, a body is placed on the plate, at some points it will be in contact, at others not; the oxygen to which the iridescence must be ascribed will be present in some places in sufficient quantity, or have free access, at other points not; moreover, some parts of the plate will acquire a higher temperature on being heated than the others, so that if after all we see the image of a body on a plate, it may be owing to several circumstances. In my experiments I have avoided these, for I allow the body in contact or at a distance to act first on the metallic plates by its peculiar light, and then heat the plate uniformly, the body to be depicted being absent, and the oxygen having free access. I may therefore assert that the calorotypes of M. Knorr are no new discovery, and that they do not in the least alter the state of the case; for the conclusions which might be drawn from the images produced by iridescence I have already communicated, while M. Knorr contents himself with the fact.

* See Poggendorff's *Annalen*, vol. lviii.

As the question as to the identity of light and heat is now frequently discussed, I will communicate a fact on this subject which in my opinion will prove decisive: it had escaped me when writing the paper on the question of the identity contained in these *Annalen*, vol. lviii. p. 105. Heat, as is well known, is emitted from bodies to which it has been conveyed, presupposing that it was not employed to produce a chemical change in them: the light, on the contrary, which effected that peculiar change on the surface of bodies which subsequently is best rendered perceptible by the condensation of vapours, is not again radiated, and it must therefore be assumed that it has become extinct with this action. I have made numerous experiments to transfer the effect of the light from one plate to the other; sometimes I took iodized silver plates with a not yet perceptible image from the camera obscura, placed them in contact for a short or long period with other iodized plates, or with plates of other metals; sometimes I employed for the same purpose metallic plates on which the image produced by imperceptible light was in a far more advanced state. As soon as I became acquainted with the behaviour of the oils I tried them, and separated the two plates employed in the experiment by a layer of oil; in no case have I succeeded in detecting even a trace of transfer of an image on to another plate. The light which has produced its effect radiates accordingly no more.

Now what shall we say to the experiments of Dr. Draper, in which this re-radiation is assumed as something self-evident, and upon which indeed is principally founded a theory of tithonic rays? I may inform those philosophers who are not acquainted with the investigations of Dr. Draper, that these new kind of rays are nothing else than the chemical rays which have often been said to have been discovered in the solar spectrum. Dr. Draper has just as much discovered them, as the imperceptible and latent light; both of which species of light he likewise lays claim to, without there having been the least mention of them in his papers. But to keep to the subject, it is impossible not to be astonished at a physicist who conceives he has discovered a new force—the tithonic, and asserts that it radiates without even having made one single experiment to prove this. Dr. Draper knows no more than what every person who has been engaged in experiments on light is aware of, that the image of an iodized silver plate, as it comes from the camera obscura, disappears after a time, and can no more be made to appear in the vapours of mercury. Does it hence follow that the image radiates from the plate? This is so little the case, that, according to my experience,

the disappearance of the image must rather be ascribed to a peculiar action of the oxygen of the atmosphere, on which subject I recently made a preliminary communication to Sir David Brewster and Professor Magnus, and intend shortly to publish the details in these *Annalen*. Dr. Draper is so convinced of the radiation of these images, that he pretends to preserve them by covering them, and in this scientific manner has discovered specific light analogous to specific heat!

Königsberg, 30th April, 1843.

XLV. *On an Expression for the Numbers of* Bernoulli, *by means of a Definite Integral; and on some connected Processes of Summation and Integration. By* Sir WILLIAM ROWAN HAMILTON, *LL.D., P.R.I.A., Member of several Scientific Societies at Home and Abroad, Andrews' Professor of Astronomy in the University of Dublin, and Royal Astronomer of Ireland.*

THE following analysis, extracted from a paper which has been in part communicated to the Royal Irish Academy, but has not yet been printed, may interest some readers of the Philosophical Magazine.

1. Let us consider the function of two real variables, m and n, represented by the definite integral

$$y_{m,n} = \int_0^\infty dx \left(\frac{\sin x}{x}\right)^m \cos nx; \quad \ldots \quad (1.)$$

in which we shall suppose that m is greater than zero; and which gives evidently the general relation

$$y_{m,-n} = y_{m,n}.$$

By changing m to $m+1$; integrating first the factor $x^{-m-1}\,dx$, and observing that $x^{-m}\sin x^{m+1}\cos nx$ vanishes both when $x=0$, and when $x=\infty$; and then putting the differential coefficient $\frac{d}{dx}(\sin x^{m+1}\cos nx)$ under the form

$$\tfrac{1}{2}\sin x^m\{(m+1+n)\cos(nx+x)+(m+1-n)\cos(nx-x)\};$$

we are conducted to the following equation, in finite and partial differences,

$$2m\,y_{m+1,n} = (m+1+n)\,y_{m,n+1} + (m+1-n)\,y_{m,n-1}; \quad (2.)$$

and if we suppose that the difference between the two variables on which y depends is an even integer number, this equation takes the form