

Kinetic Theory of Gases

ON page 300 of the second edition of Maxwell's excellent little text-book on the "Theory of Heat," it is stated, as a result of the kinetic theory of gases therein set forth, that "gravity produces no effect in making the bottom of the column" (of gas) "hotter or colder than the top."

I cannot see how this result follows from the kinetic theory of gases. On the contrary, it seems obvious that thermal equilibrium can only subsist according to the kinetic theory, where the molecules encounter each other with equal average amounts of *work* or *vis viva*, and in order that this may be the case, the velocity of the molecules (and consequent temperature) of any upper layer must be less than that of the molecules in the layer next below; since, in order to encounter each other, the former must descend, and acquire velocity, while the latter must ascend and lose it. This would establish a diminution of temperature from the bottom to the top of a column of air at the rate (in the absence of any counteracting cause) of 1° F. for 113 ft. of height, as can easily be verified from the fact that on account of the specific heat of air 1 lb. requires 183 foot-pounds to raise its temperature 1° F. Radiation may diminish this and tend to produce equilibrium, but nevertheless it seems obvious from these two opposing tendencies a residual inequality of thermal condition would result, and that the top of a column would be cooler than the bottom. That this would be the case if the air were in general motion in the form of upward and downward currents, will not, I presume, be disputed; and surely molecular is on the same footing. If the particles of air are moving in every direction with great absolute velocity, in what respect does this differ from air currents? In fact, all the particles which at any epoch of time are moving in any given direction constitute an air-current in that direction, mingled, it is true, with currents in other directions, but moving with accelerated velocity if descending, and with retarded velocity if ascending, and thus always tending to produce a diminution of temperature with height as a condition of gaseous thermal equilibrium.

J. GUTHRIE

Graaf Reinets, Cape Colony, April 2

Kerguelen Cabbage

I WOULD like to know, through your paper, whether the naturalists of the *Challenger* have orders to attempt to collect the seeds of the Kerguelen Land cabbage (*Pringlea antiscorbutica*). It has often occurred to me that the attempt ought to be made to introduce this plant on the seashores of Northern Europe and America.

JOHN R. JONES

Milwaukee, Wisconsin, U.S. April 14

Yorkshire Terrier Story

THE anecdote of the instinct of dogs given in the number of NATURE, May 1, p. 6, is identical with one to be found in Bewick's "History of Quadrupeds," p. 367, 1800, which he calls the well-known story of the "Dog at St. Alban's."

The same story precisely, with some dramatic embellishments and names, occurs in "Bingley's Animal Biography," vol. 1, p. 223.

Dorking

BICHROMATE PHOTOGRAPHS

A SINGULAR discovery has recently been made touching the action of light upon substances rendered sensitive by the bichromates of potash and ammonia, which threatens to revolutionise photographic printing altogether, at any rate so far as the production of permanent prints is concerned. The printing by means of silver salts in the ordinary way, which is still in vogue with nearly all portrait photographers, will always find application, by reason of the simplicity of the manipulations and the delicate and pleasing nature of the results, albeit all silver photographs enjoy the unenviable notoriety of being perishable. First of all, they lose their pristine brilliancy and freshness, then a sickly yellowness gives place to the glossy whites of the picture, and finally the deep bronze shadows become of a flat brownish tint,

which grows weaker and weaker as time goes on. To secure permanent photographs, which shall possess all the beauty and detail exhibited by silver prints, has been for many years the aim of photographic experimenters, and it was not until Swan and Johnson had contributed their well-known improvements that the production of a delicate photograph in permanent pigments became at all possible. Mechanical photographic processes, where the pictures are printed off in a press, are still beset with many difficulties of a practical nature, the most perfect of them—Woodburytype—requiring further elaboration before perfect prints of large dimensions can be secured.

Pigment photographs, or carbon prints, as they are generally termed, require three elements for their production—a pigment (such as Indian-ink, lamp-black, or some such substance), gelatine, and bichromate of potash, or ammonia. A compound of these three substances is spread upon paper, and termed pigment or carbon tissue. This tissue is printed under a transparent negative in the sun, the light acting more or less energetically upon the sensitive pigment, and rendering it insoluble in parts, so that when it is immersed subsequently in warm water certain portions refuse to wash away, and these form the image; during the exposure of the tissue to light, these parts have in fact become fixed by its action. This, as we all know, is what takes place in the formation of a carbon print.

It has been found that the action of light upon a bichromate film is very different in its nature to the result produced by the sun upon iodide of silver. A film of pure iodide of silver, as Dr. Reissig and Mr. Carey Lea have abundantly shown, may be impressed with an image which will fade out altogether if the film is afterwards preserved for a sufficient time screened from light. Indeed it is possible to impress iodide of silver with an image, allow the same to fade away in darkness, and then impress the film with a second and different picture. The photographic image, therefore, on iodide of silver is of an evanescent nature, becoming weaker and weaker, and, if preserved for any time, ultimately fading away altogether. Now, with a photograph upon a bichromate film, the reverse is the case. If an impression of the slightest kind is produced upon a film of gelatine sensitised with bichromate, and put away in the dark, the action of the light still goes on, and progresses until the image has become a perfect and vigorous one. This continuation of the solar action has been turned to good account by carbon printers, who in winter time and busy moments have printed their photographs in darkness instead of light; that is to say, in lieu of exposing their sensitive tissue in the sun under a negative for hours and hours, they merely do so for a few minutes, the slight image thus impressed being allowed to gain in vigour subsequently by preservation for some time—half-a-day or so—in darkness, before development in warm water. In the ordinary way only half-a-dozen copies can be obtained from one negative during the day, if all of them are fully printed in the sun, whilst if only incipient prints are produced, a score of impressions may easily be secured.

Within the last few days we have progressed a step further in carbon printing. M. Marion of Paris has discovered that if you take a bichromate image printed in the sun, and put it into contact with another bichromate surface, you produce upon the latter a similar impression. You can in fact take a carbon picture fresh from the frame and employ it as a printing block, from which any number of impressions are procurable. It is a most singular fact that a solarised surface should be capable of setting up an action upon another sensitive surface placed in contact with it. But so it is. The impression made by light upon a bichromate film is capable of transmission to another surface of like nature merely pressed against it. We have, as it were, stored up in the original print a quantity of sunlight which has been

absorbed and may afterwards be communicated to other surfaces.

The importance of this discovery can scarcely be over-rated, and there is no doubt but that it will work an era in the matter of carbon printing. We need secure but one single photograph printed in the sun in order to obtain a large number of copies, all of which shall be as delicate and vigorous as if they had been printed by sunlight. A sheet of gelatine sensitised with bichromate of potash is put under a negative and printed; it is withdrawn from the printing frame and immersed in a weak solution of bichromate of potash which swells up those portions of the surface that have not been attacked by light, and thus produces a picture in relief. The sheet of gelatine is then put into a press and impressions from it taken on sensitive carbon tissue, the block being moistened from time to time with bichromate solution. The copies thus produced upon the tissue are not fully printed and cannot be developed at once; they are simply incipient, or nascent, pictures, it must be mentioned, and they require preservation in the dark for some hours to allow the action of the light to continue, exactly in the same way as if the carbon tissue had been exposed to sun-light for a few minutes. When the prints have been kept sufficiently they are developed in warm water, and fine vigorous copies are the result. Naturally enough if the tissue is kept too long after, the mordant action of the light continues rendering the film insoluble, and then the development of the image in warm water obviously becomes impossible.

Another application of the same principle has been made by M. Marion, in which carbon printing is assimilated to silver printing, to such a degree, that those accustomed to the ordinary method of printing photographs on albumenised paper, would find no difficulty in adopting it.

H. BADEN PRITCHARD

ON THE METHOD OF COLLECTING AND PRESERVING ENTOMOSTRACA AND OTHER MICROZOA

CONSIDERING the varied interest which attaches to the Entomostraca, it has long seemed to me that they attract a remarkably small share of attention from microscopists. In the case of so widely distributed and numerous a group, this cannot arise from any real difficulty in procuring materials for study; but I believe it does arise in great measure from a want of information as to the best means of capturing and preserving specimens. I propose, therefore, briefly to point out some of the methods which in my own hands have best answered these ends.

Classification.—The Entomostraca constitute, as all microscopists know, a division of the class Crustacea, and for the purposes of the present paper we may with sufficient approach to accuracy consider them as forming four groups—*Cladocera*, of which the common *Daphnia*, or water-flea, is the type; *Ostracoda*, typified by the little hard-shelled, bivalve, mollusc-like *Cypris*; *Copepoda*, represented by the well-known *Cyclops*; and the parasitic species, *Pacilopoda*, commonly known under the name "fish-lice."

Respecting the last-named group, I shall have nothing to say here; the mere knowledge of their mode of life indicates the method of capture.

Habitat.—All collections of still-water, large and small, from the mere road-side pool to the mountain lake and the ocean, support, with scarcely an exception, their quota of entomostracan inhabitants; nor is purity an essential condition of their existence, for sometimes they are found in great numbers when one would think the foulness of the medium too much for animal existence of so high a grade. Doubtless, however, a moderate purity of water is necessary to the presence of any great variety

of species; a luxuriant aquatic vegetation is also very favourable to the growth of most Entomostraca, affording them probably not only food, but shelter. For this reason the weedy margins of lakes are as a rule much more prolific than the clear central portions, where, indeed, but little microscopic life usually exists. Rapidly flowing water is of course unfavourable to the existence of these organisms, but the sea, both between tide-marks and in the open, abounds with them. Ostracoda, except the fresh-water Cyprides, live for the most part on the bottom, and are therefore to be obtained chiefly by dredging. The brackish water of salt-marshes and estuaries supports its own peculiar species, some of which often occur in prodigious numbers; and even the highly saline waters of brine springs and salt lakes have been found to contain Entomostraca.

Methods of Collecting

1. *Freshwater.*—An ordinary "ring-net," made of "hard muslin," or "crinoline," from six to twelve inches in diameter, and fitted to the end of a walking-stick, will be found the most convenient apparatus for the capture of such swimming species as haunt the weedy margins of ponds and lakes. For such shallows as are matted with a growth of *Littorella*, *Lobelia*, or other dwarf ground-plants a "horse-shoe" net, with a frame made after the fashion of a Dutch hoe, is very serviceable; while in working from a boat in the centre of a lake the ordinary ring-net on a stick will be quite sufficient. In this way the net will, after working for a few minutes, usually be partially filled with fragments of weed and other *débris*, amongst which there will also be found a fair sample of the Microzoa inhabiting the locality. The coarsest fragments, such as stems of rushes and portions of water weeds, may conveniently be picked out with the fingers, and thrown away, while the rest of the contents of the net must be transferred to a bottle of clear water, an eight-ounce being a convenient size for the purpose. The Microzoa may then be readily separated by filtering into another bottle through a net of sufficiently wide mesh to allow of their passage through it: "mosquito-netting" I have found to answer well for this purpose. Having thus obtained our Entomostraca in a condition tolerably free from admixture with extraneous matter, they may easily be collected in a patch on the centre of a piece of fine muslin by passing the whole through a piece of that material, arranged over a funnel. They should then be transferred at once (if it be not wished to keep them alive) to a small phial of some preservative fluid. This may be effected easily by a penknife, but a very convenient instrument for the purpose is an ordinary quill toothpick. This process, which appears somewhat cumbrous in writing, is in reality very easily performed, but it may be still further simplified, according to the fancy of the collector, by fitting an outside funnel with a muslin net, and having a small inner one of perforated zinc, so as to do all the filtering at one operation. The collecting net may also be protected from the entrance of very coarse rubbish by a light, moveable wire grating. The species obtained by these means will often include numerous representatives of all three orders, Cladocera, Ostracoda, and Copepoda. For the capture of such Ostracoda as haunt the bottom in parts too deep to be reached by a walking-stick, a small hand-dredge is required: this will be more particularly noticed in the marine section.

2. *The Sea.*—The free-swimming species, the great majority of which belong to the order Copepoda, may be most conveniently captured by the walking-stick net held over the side of a row-boat in gentle motion. Care should be taken that the lower end of the net is as wide or wider than its mouth, and that the material, while close enough to retain the Entomostraca, is yet open enough to allow a free current of water through it: if those points be not attended to the result will be a back-wash, carrying back out of the net much which should have been retained.