the second eye cannot see the other picture. If, before the sensation of one eye exhausted, the slide shuts the first lens and opens the other, a new impression is produced, and we have an uninterrupted sensation of vision as if the object had moved before us: and if a sufficient number of pictures represent that object in the various consecutive positions it has assumed during the several stages of its motion, we experience the sensations we have when we see the object while moving; and although the pictures in their limited number do not show all the intermediate positions, still the mind has the power of filling up the deficiency, as it does if, when looking at a real object in motion, we accidentally wink the eyelids, or an obstacle happens to pass between us and the object. To exemplify this, Mr. Claudet has employed two photographic pictures, one representing the beginning of an action, the other the end. By moving the slide one way, the right eye can see the picture representing the figure in one position, while the picture showing the other is invisible to the left eye; then by moving the slide the other way, the left eye sees the figure in the second position, and the first picture is invisible to the right eye. Although we have really only seen the figure in two extreme positions, still we have the illusion of having observed the intermediate positions—as, for example, in a slide exhibited having one picture of a boxer with his arm close to his side as preparing to hit, and another with the arm extended delivering the blow. Here, although all the intermediate positions are omitted which must have been assumed during the act, the mind completes the action. Another curious phenomenon of this alternate vision is, that one cannot distinguish which eye the object is seen by; for although the vision is transferred alternately from one eye to the other, we are not conscious of the act; and during the change of pictures which has taken place in the meantime, we have had a uniform and uninterrupted sensation, and consequently it has appeared as if the object were moving.

On Spectacles for Divers, and on the Vision of Amphibious Animals. By F. Galton, *F.R.S., F.G.S.*

Bathers who have surmounted the very natural repugnance, felt by beginners, to open their eyes when they dive, find when they look about them under water that nothing is to be seen with distinctness. They perceive little more than a haze of diffused light; for their eyes are thoroughly out of focus in a water medium. When a man under water holds his hands at a little distance from his face, so great is the confusion of outline, that he cannot discover the spaces between his fingers even when he has separated them as widely as possible. The appearance is a formless blurr of white. Now what is the precise cause of this indistinctness of vision? By what optical arrangement can it be overcome? And how do amphibious animals accommodate their sight to the requirements both of air and of water? Suppose a tube, with a flat bottom of glass, filled with water; when the surface is perfectly still, and we look down the tube, we see objects lying in the water and others in the air below the glass bottom, with perfect distinctness. But if we bend the head down to the tube, the instant the eye touches the water all distinctness of vision ceases. The convex surface of the eyeball has indented the plain surface of the water and thereby turned the tube into a concavo-plane water-lens. The convexity of the eyeball is very great; according to physiologists, the radius of its curvature is only 0·31 of an inch; the effect of the concave lens which it stamps on the surface of the water must be proportionately large; and if it be desired to counteract its influence, a convex lens must be used of such high power that, when immersed in water, its effect shall be equal and opposite to that of the concave water-lens. A simple calculation shows the description of lens required. A double-convex lens of flint glass, each of whose surfaces has a radius of 0·48, is the equivalent. It would exactly neutralize the effect of the concave water-lens, if it were held close to the eyeball. This curvature of the lens would require to be somewhat modified according to the convexity of each individual eye, and to the refractive power of different kinds of flint glass. When held at the usual distance of an eye-glass from the eye, a lens of more moderate power, such as a radius of 0·60, or even 0·70, is found sufficient. Furnished with eye-glasses containing suitable lenses, we might expect that the vision of a diver would be rendered as clear under water as in air, that its range would be limited only by the turbidity of the water, and that it would not be affected by indistinctness due to the disordered focus. But the author had found that the eye, when looking through a lens of this description under water, has not much power of accommodating itself to different distances; and with the best of those the author had as yet constructed, the limit of distinct vision appeared practically restricted to a range of about eight feet. The attempt, however, was only provisional: his experiments had but very recently been commenced. It must be distinctly understood that men in diving-machines or helmets do not require such lenses; for their eyeballs are separated from the water by the apparatus in which they are cooped up. All that is needed by such persons is to have ordinary windows of stout plate glass through which they can look out into the medium which surrounds them. The author's contrivance refers to the wants of divers in pearl- and sponge-fisheries, to sailors who have occasion to examine the bottoms of their ships, to persons who have dropped something in the water which they wish to recover, and to bathers generally. To those who can swim, the author promises a material addition to their enjoyment, in the possession of these eye-glasses or spectacles. It is no slight pleasure to live in some degree the life of a mermaid, keeping below water for a minute at a time, and seeing everything in one's immediate neighbourhood as clearly as it could be seen by leaning over the gunwale of a boat on a still day, when the glare from the water was perfectly shaded. There are many amphibious animals that see as well under water as in air. Amongst these are seals, otters, hippopotami, water-rats, and diving birds of many descriptions. The cornea of the seal is flattened, but that of the other animals appears to be as convex as in man. By what means these other animals are able to adjust their eyes to the requirements of water and of air indifferently, is wholly unexplained. Physiologists do not seem to have been aware of the vast powers of optical adjustment which the habits of these animals necessitate.

The Refraction Equivalent of Carbon. *By* Dr. J. H. Gladstone, *F.R.S.*

The refractive index of a substance, minus unity, divided by the specific gravity, is termed its specific refractive energy; and this multiplied by the chemical equivalent has been termed, by Landolt, its refraction equivalent. The present communication was intended to show that carbon, whether as the pure element, or as a part of solid, liquid, or gaseous compounds, has the same refraction equivalent, viz. 5, or a little more. Diamond gives 5; carbonic acid, 5·03; bisulphide of carbon, 5·3; chloride of carbon, 5·15; cyanogen, about 5·2; many hydrocarbons, 5; sugar, about 4·8; while Landolt, from the refraction equivalents of compounds differing by one equivalent of carbon, determined the number 5. In some highly dispersive substances a higher number was arrived at by calculation.

On a New Form of Spectrum-Microscope. *By* H. C. Sorby, *F.R.S.*

The superiority of this instrument, as compared with that first proposed by the author, consists in the employment of a compound direct-vision prism over the eye-piece. The slit is fixed in the focus of the upper lens of the eye-piece, which is made achromatic, so that all parts of the spectrum may be distinctly seen at the same time. By using a binocular microscope, the inclined tube can be employed as a finder; and on arranging so that a minute object is in the centre of the field, it will be directly in front of the slit fixed in the eye-piece of the other tube. On looking through this eye-piece it is easy to see that the object is properly placed in front of the slit; and then, on placing the prism on the eye-piece, as if it were a Nicol's prism, the spectrum of the object can be seen to great advantage. This compound analyzing prism consists of two right-angled prisms of flint glass, between which is a rectangular prism of crown glass, and at each end a crown-glass prism of about 75°, all cemented together with Canada balsam. Arrangements are also made in the instrument, by means of a reflecting prism covering half the slit, so that the spectrum of a minute object placed on the stage may be compared with that of a larger object placed on a stage attached to the side of the eye-piece, and thus their difference or identity may be seen at a glance. It is thus easy to compare the spectra of minute crystals and of their solutions, to study the spectra of small coloured blowpipe beads, and, in fact, accurately examine the nature of the light