November 20, 1856.

Dr. MILLER, V.P., in the Chair.

In accordance with the Statutes, notice was given of the ensuing Anniversary Meeting for the election of Council and Officers.

Edward William Binney, Esq., and Cæsar Henry Hawkins, Esq., were admitted into the Society.

Wilhelm Karl Haidinger and Antonio Secchi were balloted for and elected Foreign Members of the Society.

The following communications were read:—

I. "Experimental Researches on the Organ of Vision.—Part I. Microscopic Examination of the Circulation of the Blood in the Vessels of the Iris and of the Choroid Membrane, &c." By AUGUSTUS WALLER, M.D., F.R.S. Received July 10, 1856.

(Abstract.)

In a former paper on the section of the optic nerve, the author described a process of producing temporary extrusion of the eyeball from the socket in the living animal. Although adopted in the first instance merely for the purpose of dividing the optic nerve *de visu* with as little injury as possible, the same means of exposing the eyeball may be advantageously employed for studying various other points relating to the physiology of the eye. In the first place, as the eyeball is so much protruded from the orbit, Kepler's experiment on the eye removed from the body, showing that external objects form inverted images on the retina, may be performed on the living animal. For this purpose it is merely requisite to place a bright object obliquely before the pupil, a candle for instance, in order to ascertain that a reversed image of it is formed on the opposite side of the eye. On a young rabbit

placed in a dark room, particularly if an albino animal is used, the inverted image of the candle, although having to traverse the choroid, the sclerotic and the muscular parts, is perceived bright, and tolerably well defined. When this bright spot is examined with a lens or a compound microscope, it is found to be sufficiently illuminated to allow of the examination of the motion of the globules of the blood. On the young guinea-pig the same may be still more easily examined, but it is particularly the albino rat or surmulot (*Mus decumanus*) that the author has found most suitable for these observations, exophthalmosis being most easily produced on this animal, while the eye is so transparent and the iris so close to the cornea, that the circulation of the blood-globules in the vessels of the iris may be observed. At the same time, beneath the iris and sclerotic may be seen the ciliary processes from their origin at the ora serrata to their anterior extremity, where they are seen to form a circular crown with a serrated edge surrounding the crystalline lens. The vessels of the ciliary ligament of the choroid are likewise rendered accessible to actual inspection during life.

For the purpose of examination, the animal is secured by a few turns of a band, about $1\frac{1}{2}$ inch in width, passed round its body so as to confine the limbs. It is then placed on a narrow slip of cork, to which it is fixed by some turns of string. When steadily fixed, exophthalmosis is produced and maintained by passing a strong thread around the slip of cork and the head of the animal close to the eye, alternately in front and behind it. When the compound microscope is used, it will be found requisite to place the animal sidewise, so as to direct the object-glass over the bright image above mentioned, which is always formed when the eye is placed before any bright light.

The author first describes the vessels of the conjunctiva over the sclerotic and cornea. These vessels form a network behind and before the ciliary ligament, and join into numerous small trunks which unite with a circular ciliary vein running all round the ciliary ligament. In the corneal conjunctiva the vessels may be traced towards the summit of the cornea over the outer half of its surface, and even beyond. They are seen to commence internally, as if with free extremities, from whence the blood is seen circulating rapidly towards the circumference of the cornea. Then large meshes soon

form, which become smaller as they approach the ciliary ligament, where they terminate in a circular vein surrounding the cornea. The rapid circulation of the blood at the apparent extremities of the vessels over the inner parts of the cornea, indicates their further continuation inwards or below, although the author has not traced them further over the cornea.

The vessels of the anterior surface of the iris, which Dr. W. next examines, consist of arteries and veins. The former are derived almost entirely from the two long ciliary arteries which arrive near the outer and inner angles of the eye, their course being traced over the anterior half of the sclerotic until they reach the great circumference of the iris, where they each subdivide into two equal branches, one inferior, the other superior, which diverge at an obtuse angle, each of them running in an oblique direction towards the edge of the pupil until they attain the inner third of the iris, where most of the final subdivisions are bent outwards. These four oblique branches form a symmetrical figure of a lozenge-shape over the iris, each branch giving off internal and external twigs, the former ending in the small circumference, the latter in the large circumference of the iris. The course of the blood may be watched in these vessels from over the sclerotic to their termination in the iris, but in general the current is too rapid to allow of the detection of the direction of the separate particles of the blood. It is only when the circulation becomes languid that the separate globules can be seen distinctly running in a centrifugal (*i. e.* arterial) direction.

By compressing the eye slightly, the passage of the blood may be retarded, and by that means be easily followed; but in so doing an error may possibly be committed respecting the arterial nature of these vessels, as the course of the blood is then generally reversed in the arteries, and will be seen to take a centripetal direction, sometimes for upwards of a minute, according to the amount of pressure. But in a short time, after oscillating within the vessels, the blood again resumes its natural course, which may be sufficiently regulated to enable us to watch the passage of the globules in the oblique branches and in their internal and external subdivisions.

The veins of the iris form two layers. The superficial layer comprises all the larger veins—generally twenty-three or twenty-four in number,—which radiate in a regular manner from the pupil out-

wards towards the ciliary ligament. They arise at the pupillary edge, each by two or three fine twigs, which quickly meet in a common trunk, or sometimes run separately as far as the outer half of the iris, where they unite in a common trunk.

The deep layer consists almost entirely of a fine network belonging to the radiating muscular fibres, and presenting a close analogy with the fine vessels supplying striated muscular fibre; the vessels being very minute, and the meshes elongated in the direction of the fibres. Sometimes the vessels from this layer unite into a small ramuscule, which empties into a radiating vein; at others they unite in a common trunk, passing beneath the ciliary ligament into the choroid.

The movement of the blood in the veins is generally not too rapid to distinguish the direction of the current and the separate globules, which appear to be constantly springing from around the edge of the pupil and pouring outwards along the veins of the iris into the choroidal and ciliary vessels.

When the pupil is contracted, the radiating vessels are rectilinear; but when it dilates they become curved and bent into zigzag and spiral forms, which are more or less curved or obtuse in proportion to the degree of dilatation of the pupil. This change in the form of the vessels does not appear to produce any difference in the speed of the current of blood.

Around the ciliary ligament are two and often three circular vessels, receiving the blood from the conjunctiva of the cornea and sclerotic, partly from the iris, and probably from the ciliary processes. Two of them are venous, and empty themselves into four large veins, corresponding to the anterior ciliaries, which arise in a perpendicular direction, and after following a rectilinear course over the sclerotic, finally end in the ophthalmic vein. The third circular ciliary vessel is of an arterial nature, as shown by the greater thickness of its parietes and the rapidity of its current.

The current of blood in these vascular circles is a most interesting object from the variety of its course, as into each anterior ciliary vein the blood is seen pouring out from the circular vein in two opposite currents, to be united into one in the larger vessel. The author also describes the appearance presented by the blood poured into the circular veins by their afferent vessels.