

by the facts that we have demonstrated with regard to the growth of the mastoidea. They are due to the partial or complete failure of the process by which the diploitic tissue is converted into the pneumatic. With reference to the sclerosed mastoids, they are in all probability the result of chronic inflammation.

It is evident that the condition of the mastoid portion of the temporal bone in children, from say 4 to 12 years of age, differs considerably both from that of the infant and of the adult, and are worthy of careful study by aural surgeons.

If the mastoids of these children be compared with those of infants, it will be seen that the size of the air cavity and the extent of mucous surface is about the same in each. Should, however, suppuration occur, the chances of the matter finding its way to the exterior of the bone would be much less in children than in the infant, and an operation for the removal of the pus would increase in difficulty with the age of the child.

In adults the amount of air space and of mucous surface is much greater than in children. This may in some cases allow the products of inflammation to approach more nearly the external surface, but, on the other hand, the dangers of extension of the inflammation to the lateral sinuses are much greater. In children there is a thick layer of fine cancellous tissue between the mastoid antrum and the lateral sinus, but this may be converted in the adult into air cells, some of which are only separated by very thin bony septa from the sinus.

I regret that the absence of suitable material has prevented me from investigating the progress of the conversion of the diploitic tissue into the pneumatic, and especially the histological changes which must accompany that process.

III.—SUBJECTIVE SYMPTOMS IN EYE DISEASES.

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VII. SUBJECTIVE LIGHT AND COLOUR SENSATIONS (PHOTOPSIA, CHROMATOPSIA).

A SENSATION of light may arise even when there is no objective cause to account for it—that is, even when no undulations of the ether, such as are capable of giving rise to luminous impressions, find their way to the retina. A purely subjective sensation of this kind may be the result of a mechanical, electrical, or chemical stimulation of the nerve fibres in the retina or optic nerve, or of the centres of vision. The light so seen may appear coloured or uncoloured, according to the site and nature of the stimulation. Further, under certain circumstances, coloured luminous impressions may be received when the objective source is of a nature which

should only give rise normally to uncoloured light sensations. This may be due either to causes which separate the compound white light into its constituent rays, or to such as give rise to a selection of some rays, and at the same time a greater or less absorption of others.

Many are familiar, probably, with the brilliant colours which can be elicited in the dark by light continued pressure on the eyeball. The pressure generally first produces a colourless, ill-defined cloud, which gradually extends in all directions towards the periphery of the field of vision, and is followed by colours, blue, red, and green, etc., which, beginning at the centre, spread outwards in the same manner as gradually widening rings towards the periphery. On continuance of the pressure, these colours become less vivid and less regularly disposed, until the field, after some time, becomes entirely dark. On relief of the pressure, there are again produced light sensations, which are, however, much more irregular and not so variedly coloured. Direct pressure over a portion of the eye behind its equator also produces in the dark a so-called phosphene or sensation of light, which is referred to the opposite side of the field of vision. If a similar pressure be made in the light instead of in the dark, it is a darkish spot which is seen, the retina being rendered apparently by such mechanical irritation less responsive to stimulation by light. The slight stretching which the retina is subjected to by the action of the ciliary muscle also gives rise to faint phosphenes, which may be experienced by suddenly relaxing the accommodation in the dark. Phosphenes also occur in forced movements of the eye. These appear to be most marked on turning the eye upwards, and are probably due more to intermittent pressure of the oculo-motor muscles in the eyeball than to stretching of the optic nerve by the movement. Electrical stimulation also produces light sensations, mostly coloured. According to Schliephake, closing of a current ascending the optic nerve and opening of one descending produces a momentary bluish-violet illumination of the whole field of vision. Others describe also a yellowish tinge when the galvanic current descends the nerve. Of chemical irritants, that which has been most studied is santonine. This substance produces, according to Woinow, first the sensation of a violet, and then of a greenish-yellow colour, which is sufficiently marked to cause objects looked at to appear yellow. Its further action seems to increase the visual acuity without giving rise at the same time to coloured vision. Woinow explains the action of santonine by assuming that it first produces a stimulation of the violet-perceiving elements of the retina, which is followed by an exhaustion of these elements, while in the case of an increased visual acuity alone all the colour elements are equally excited. This explanation is, however, based on the prevalent theory of colour vision, which is in many respects very unsatisfactory.

The presence or absence of colour in the phosphenes, due

to stretching of the retina from any cause, may be of importance as affording some indication of the portion stretched apart from the locality of the field to which they are projected. The most peripheral portions of the retina are either totally colour-blind, or require a very much greater stimulation to give rise to colour impressions than more central portions. Consequently, when they alone are mechanically stimulated, the phosphenes are colourless. As a general rule, indeed, colourless phosphenes are due to stretching of the anterior part of the retina. Such colourless and indefinite phosphenes are complained of, too, where there is slight cyclitis. They take the form of more or less incomplete circles, and, as they are not constant, are in all probability brought about by movements of the ciliary muscle, which cause dragging of or pressure on the hypersensitive anterior part of the retina.

Mayerhausen has lately studied a form of photopsia depending on pressure caused by over-dilated vessels in the retina. The sensation to which pressure of this nature gives rise is that of faint irregularly defined streaks of light disposed in a radial direction round the point of fixation. The length of these streaks is variable. When long they branch dichotomously, and gradually fade away at the ends, never terminating abruptly. They disappear when the eyes are closed. The vaso-motor disturbances giving rise to this kind of subjective light sensation occur in constitutionally nervous individuals suffering from more or less neurasthenia, and the vessels through whose over-distension the symptom is caused are probably the outer network of capillaries which are mostly situated in the inner nuclear layer of the retina. Mayerhausen was able to study more closely than had previously been done the nature of this form of photopsia as under certain conditions, viz., violent exertion following prolonged use of the eyes, and at a time when the nervous system was exhausted by fasting he was conscious of the sensation himself, which can therefore only be looked upon as pathological when arising independently of such abnormal conditions. Sudden loss of vision, due to embolism of the central artery of the retina, very often occurs at night and escapes observation, but it is said that in cases where its occurrence is noticed by the patient there is at the same time a consciousness of subjective light sensations. Inflammatory conditions of the retina or nerve do not appear, as a rule, to cause photopsia, thus it is seldom that in optic neuritis any complaint of this kind is made. In glaucoma, however, besides the coloured halos round lights to be afterwards more particularly referred to, there are frequently subjective colour and light sensations which seem to be due to pressure. In cases of diffuse retinitis or choroido-retinitis, where there are generally to be found areas in which the retinal functions are defective, there is often at the same time a sensation of coloured and generally flickering spots

of different shapes and sizes complained of. These are always referred to the portions of the field which may be found on examination to correspond to the areas of the retina in which the visual defects are most marked, and are the result of irritation or dragging on the retinal elements. The subjective light and colour sensations met with in this disease often continue for long after the inflammation has quite subsided. They are most evident, as a rule, after any prolonged exposure of the eye to strong light, or after anything causing fatigue, either of the retina or body generally. Conversely they tend to become less marked or to disappear when the eye is rested, and therefore at night, in which respect photopsiæ of retinal origin differ from those caused by irritation of the visual centres, which are often most distressing during the night and at times when the eyes are not subjected to stimulation from objective sources. Retinal photopsia often continues for long after there is complete blindness, and is sometimes, though rarely, even so severe and distressing as to call for enucleation of the eye. Plateau, who was blind for forty years, had constantly subjective light sensations proceeding at different times from irritations of different portions of the retina, but always projected in accordance with the direction of the movements of the eyes. Notwithstanding the degenerative change which takes place in the retina, and is characteristic of retinitis pigmentosa, it is only very rarely that patients suffering from this disease are troubled with light or colour sensations. The effect of dragging or stretching in producing photopsia and chromotopsia is, however, most marked in many cases of detachment of the retina where such subjective sensations usually accompany the occurrence of the detachment, and are often complained of from time to time as the separation becomes more and more extensive. The colours mostly seen are red and blue, and mostly at the beginning of the affection, the wavy distorted outline of objects being often then bordered by these colours. In cases of sclero-choroiditis anterior, especially when the affection proceeds to the formation of staphylomata, subjective sensations of light and colour are very frequent. These, too, are probably mostly due to abnormal stretching, though they may possibly, to some extent, arise from inflammatory irritation as well.

Closely allied to cases of photopsia due to pressure on or stretching of the retinal elements, are those which appear to originate from circulatory changes, often of the nature of vaso-motor disturbances,—recurrent paralyses of the vaso-motor nerves of the retina. In some cases, too, of hyperæsthesia of the retina, complaints of coloured vision are made. This kind of chromotopsia is evidently the result of the response to stimuli which would otherwise, on account of their feebleness, be disregarded, but which are observed owing to the irritable condition in the retina itself, or in the more central portions of the visual apparatus,

just as hyperæsthetic individuals may be affected with pains for which little or no objective cause can be detected.

A curious form of subjective colour sensation has recently received a good deal of attention. It has mostly been met with in aphakia after cataract extraction, and consists in a more or less constant sensation of everything looked at being coloured a vivid blood-red. There is no veiling of the objects, but merely a marked red coloration. The condition to which the name erythroptasia is generally given has not yet received a satisfactory explanation: it has been ascribed to the dazzling caused by light rays passing through the coloboma in the iris, or to that along with some fatigue of the retina. As it is met with under other conditions than aphakia and coloboma of the iris, and is by no means a common occurrence, it is impossible that these should in themselves be of paramount influence in the production of the erythroptasia. Hilbert, for instance, has described the sensation as it has several times occurred to him. Though with otherwise normal eyesight, he has had several attacks of erythroptasia, which have always come on after sleepless nights, and have disappeared after a good meal. When it occurs after cataract extraction, it seems usually not to come on until some months after the operation, and in cases, too, where everything has gone well, and good vision has been obtained. Thus Hirschler has described how, five months after having been operated on for cataract, he was troubled with this red vision, which lasted for two months and then disappeared. The only case which has come under my own observation after cataract extraction occurred one month after the operation, perfectly suddenly, and continued for several months. In this case, a healthy woman of 50, who obtained excellent vision ($\frac{20}{40}$), and from whose iris I had, as I am in the habit of doing, only removed a small portion, so that the resulting coloboma was small, and entirely covered by the lid, there was no evidence of any connexion between general fatigue and the symptom of red vision, which, though not constant, came on every day, and as often after a meal as before it. She herself ascribed it to glare, although there appeared to be no unusual circumstances of exposure to light connected with the case. The other eye was affected with immature cataract. Ophthalmoscopically there was nothing to account for it, and the symptom did not interfere with reading. Another case occurred in an extremely nervous lady, and came on after an exhausting mountain climb in Switzerland, the eyes having been subjected at the same time to a prolonged reflection of light from snow-peaks and glaciers. In this case there certainly was a coloboma in the only eye in which there was vision, the other having been lost by atrophy after a severe fall on the head, which had probably therefore caused fracture through the orbital foramen. The view entertained by Benson, Purtscher,

and others who have met with cases of erythropsia, viz., that it is due to hyperæsthesia of the retina, affords certainly the most probable explanation, though whether the condition of the retina is favoured by aphakia and the presence of a coloboma in the iris, or is brought about in some other way, is not clear. The following experiment, described by Chevreuil, shows the influence of strong light shining into the eye in producing a somewhat similar condition to erythropsia. Chevreuil allowed the sun to shine into his right eye while the left was closed. After two minutes' insolation, black objects on the table appeared to the right eye red and white-green, whilst with the left they were seen in their proper colours. This he gave as the explanation, too, of the historical "blood spots" which came before the eyes of Henri IV. and the Duc d'Alençon whilst playing chess in the open air a few days before the massacre of St Bartholomew.

The influence of fatigue or hyperæsthesia of the retina in giving rise to coloured vision is therefore undoubted. Some poisons which cause nervous fatigue occasionally also give rise to chromatopsia. Thus red and green vision has been met with by Bruce and others in cases of poisoning by bisulphide of carbon. Whether such poisons act by irritating the retina, or the centres which have to do with the perception of colour, is not certain. The latter seems the most probable, as not only are there conditions met with which point to the existence of such centres, such as hemianopia for colour alone, but the poisons produce at the same time other cerebral symptoms as well. Indeed, it is just possible that the cause of erythropsia may be a central irritation, unconnected altogether with operations for cataract, though associated, perhaps, with the conditions which have given rise to the loss of transparency in the lens.

Coloured vision may be produced again by the actual presence of coloured substances in the eye. Thus, when blood is effused into the vitreous, there is for a short time the sensation of a red veil covering the indistinctly seen objects. In cases, too, of hæmorrhage into the retina a red veiling is often seen which afterwards gives place to a yellowish or greenish discoloration of objects. In detached retina there is frequently, besides the colour and light sensations due to stretching of the retina, an appearance of a yellowish or greenish veil complained of, sometimes though the appearance is that of a more or less distinctly blue veiling. This Leber supposes may be due to contrast from the yellow subretinal fluid. Many authors have described a condition of yellow vision or Xanthopsia in jaundice. It is certainly not a common occurrence, however, and when it does occur is probably due to a yellow discoloration of the dioptric media, which for some reason or other is not often occasioned in jaundice. Here again, however, the pathology is not clear, although the explanation given seems the most probable one.

A common cause of coloured vision, owing to a change produced on the compound rays of white light as they enter the eye, is afforded by those states of the cornea which give rise to diffraction. This can only in so far be looked upon as a subjective sensation, in that the physical conditions, as far as the light is concerned, are such as would not under normal circumstances give rise to the sensation of colour. In looking at the street lamps, for instance, through the glass of a carriage window, which is covered with the closely packed minute particles of moisture which arise from the condensation on it of the vapour within, one frequently notices the lights surrounded by coloured halos. The same appearance may sometimes be observed without the intervention of the glass, and is then usually pathological and due to a similar arrangement of intransparent particles in the cornea. This symptom of seeing halos round lights is one of the commonest and most important indications of the early stage of glaucoma. The slight attacks of increased tension which only occur at intervals are accompanied by this symptom. When a flame of a candle or a gas jet is looked at, it is surrounded by a circle or halo of colours, which are separated from it by an uncoloured space. This uncoloured space is light where it immediately surrounds the flame, and dark towards the coloured rings, and the space as well as the coloured rings is broader the further the light is from the eye. The most external colour in the halo is always red, the most internal bluish, while at different parts of the circle there are brighter spots, so that the halo is not absolutely regular. The colours are seen with varying degrees of intensity in different cases, and are even sometimes, when very distinct, surrounded by a second halo, like a second rainbow, with this distinction, however, that the arrangement of colours in the second halo, which is much less distinct than the first, is similar to the first, and not reversed as in the case of the secondary rainbow. This is a proof that the phenomenon is due to interference or diffraction. A further proof of this, which was pointed out long ago by Donders, is that on covering the lower half of the pupil, the outer and upper and the lower and inner quadrants of the halo disappear. The halo, too, always remains stationary whether the light be fixed by the eye or not, or whatever be the state of accommodation of the eye. The cause of the distinctness of this appearance in glaucoma is probably owing to the haziness of the cornea and the simultaneous dilatation of the pupil. It occurs in non-inflammatory as well as in inflammatory glaucoma, so that it is in all probability due to the optical conditions which are introduced by disturbances in the lymph circulation within the cornea, although it has not yet, I think, been quite definitely proved that other of the dioptric media, more especially the lens, do not participate in the haziness. Although a frequent symptom in glaucoma, such coloured halos are by no means pathognomonic of that disease. They may be

seen in all cases where the cornea assumes from any cause a diffuse cloudiness. Even the secretion, which in some cases of conjunctivitis gathers across the cornea, may give rise to them. When spontaneously complained of, and especially when there is no appearance in the cornea at the time of examination to account for the halo, and when, too, it does not disappear on rubbing the eyes, its existence is strongly suggestive of glaucoma.

One form of subjective light sensation, viz., that which is in all probability of cerebral origin, still remains to be considered. One of the most common forms of this kind of photopsia is that associated with hemicrania. The symptoms of this peculiar affection are probably now well known to most medical men. It may begin in different ways, and last for a longer or shorter time, usually after prolonged bodily or mental fatigue, or at a time when there is more or less nervous exhaustion from want of food or sleep, it suddenly makes its appearance as a dark spot to one side of the field of vision in both eyes. The dark area slowly increases in size, and after some time becomes bordered by scintillating and often coloured zig-zag margins of greater or less intensity. The configuration of these margins of light often resembles the angular wavy outline of a fortification, and for this reason Airy gave to the affection, from which he himself suffered, the name of Teichopsia. The duration of the whole visual disturbance is generally rather less than half an hour. The appearances fade away from the centre towards the periphery, and are most frequently followed by severe headache, often accompanied by sickness, which lasts for several hours. The central nature of the subjective sensations just described is pretty definitely established by the fact that they occur, and, indeed, this is most frequently the case, in true hemianopic form. This could only be the case when the temporary disturbance, whether vaso-motor or of whatever other nature, was situated centrally with respect to the chiasma, unless possibly a vaso-motor disturbance took place simultaneously in symmetrical halves of both retinae. The latter possibility is unlikely, partly because it would not be in accordance with the anatomical arrangement, so far as is known, of the nerve fibres which supply the retinal vessels, but more especially because no such disturbance can be detected by ophthalmoscopic examination during the occurrence of the symptoms. On this latter point I am able to confirm the observations made by Foerster, Haskett Derby, and others. The occasional occurrence at the same time of other cerebral symptoms is another circumstance which is suggestive of a central origin. An interesting experiment, too, which points to the same conclusion was made by Kums. He found that phosphenes produced by pressure could not only be perceived during the attack, and whilst the subjective sensation of light was at its height, but that these were referred to a different plane from that to which the scintillating scotoma was projected. It seems probable, though,

that when the hemianopic or bilateral character is not marked the disturbance may in some cases really proceed from the retina. Thus I have occasionally met with excentric negative scotomata in one eye only which appear to have been the result of attacks of this nature. It would be interesting to try the result of Kums' experiment during the attack in such cases. Another kind of central subjective coloured vision, which is probably much rarer than that connected with hemicrania, takes the form of an aura preceding an epileptic fit. This I have not seen, but it is described by Hughling Jackson, and seems most commonly to be an erythropsia, everything appearing to the patient intensely red.

IV.—A CASE OF SUPPURATION OF THE PAROTID FOLLOWING OVARIOTOMY.

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ON the 19th of April last I removed an ordinary multilocular tumour of the right ovary, weighing 25 lb., from a lady aged 46. There is nothing of particular interest to be noted about the operation, except that there were somewhat extensive parietal adhesions. The operation was completed in 25 minutes, and when the patient was put back to bed it was not anticipated that there would be any trouble. The progress made up to the afternoon of the fourth day was satisfactory, the pulse never having reached 90, and the thermometer not having registered 100°. At the evening visit the patient complained of cramp in the left lower limb, and on inspection the leg and thigh were found to be somewhat swollen, and the pulse had risen to 116. On the seventh day, in addition to the phlegmasia dolens and quickening of the pulse, the patient began to vomit frequently, but this sickness was stopped by a couple of doses of the ordinary white mixture of the London Hospitals. In the afternoon the temperature was 100°·8; pulse peculiarly irregular at 136. On listening over the heart, strange, indefinite, and irregular sounds were to be heard, causing one to think that some small clots had been carried from the veins of the left thigh to the heart. For the next four days there was steady improvement; the heart gradually slowed down, and on the evening of the tenth day it was contracting 80 times in the minute. The temperature was 99°·2. There had been little change in the swollen leg, but what little there was was of a favourable nature. On the afternoon of the eleventh day the right parotid began to swell, and by evening the patient could scarcely separate her teeth. The temperature had risen two degrees, and the pulse 20 beats per