
The first part of the paper, which deals with the history of the subject and with the experimental work by which its action on the pathogenic bacteria has been demonstrated, has been abstracted. The latter part is quoted in full.

Lysozyme was described by Fleming in 1922. It is an enzyme which has great antibacterial power and is able to destroy not only the non-pathogenic bacteria, but also many of the bacteria pathogenic for man in such concentration as exists in human tears.

Lysozyme is present in great concentration in leucocytes and cartilage and in the tears, nasal mucus, and sputum of man. It is also present in great amount in the white of eggs, especially the common hen’s egg. Pus, alone, among pathological fluids contains a considerable amount of the enzyme.

It is not found in the cerebro-spinal fluid, faeces or urine.

It is not destroyed by a temperature of 60°C and will withstand even 75°C for a short time. It is not a protein, as has been shown by Wolff. It is a colloid and is absorbed readily by particles in suspension.

The characteristic property by which it is most readily identified, and which led to its discovery, is its ability to dissolve an opaque suspension of certain bacteria, especially M. lysodeicticus. The latter organism was isolated by Fleming and is the most sensitive yet described. A solution of the pure enzyme, as isolated by Wolff, containing only one gramme in 100 million gallons of normal saline would produce complete clearing of an opaque suspension of M. lysodeicticus in 24 hours in the incubator.

Lysozyme (tears), was compared with a large number of antisepsics in dilutions which can be used therapeutically, and it was shown that no antiseptic tested compared with the enzyme in its power to inhibit the growth of the test organism, M. lysodeicticus.

The Action of Lysozyme on Bacteria

Lysozyme has been shown to be present in such concentration as will destroy most of the pathogenic bacteria in the tears and leucocytes of man. Fleming and Allison showed that 75 per cent. of all air-borne bacteria are destroyed by 1/100 tears.

The lysozyme of tears has a marked bactericidal action on the following pathogenic organisms, even in recently isolated
cultures:—Staphylococci, streptococci (haemolytic and faecal), pneumococci, B.anthracis, and tuberculosis, gonococci, meningococci and the cholera vibrio. Most strains of B. coli and typhosus are not affected by this concentration of lysozyme. Boiling the tears destroys the enzyme and also this bactericidal power (see plate).

PLATE SHOWING THE BACTERICIDAL POWER OF TEARS AND ITS DESTRUCTION BY BOILING.

(A) Control count of staphylococci implanted in B, C, and D.
(B) Number of cocci surviving after six hours’ incubation in tears and 10 per cent. serum—implanted on to agar.
(C) Cf. B, but using tears which had been boiled, the lysozyme being thereby destroyed.
(D) Cf. B and C, but using normal saline instead of tears.

The Importance of Concentration

These pathogenic bacteria, for the most part, are not destroyed to anything like the same extent by dilutions of tears of less than \( \frac{1}{2} \) strength. The concentration of lysozyme in normal tears in the protection of the eye from bacterial invasion is, therefore, of importance, and it has been shown that in disease the content is much reduced.

The Unit of Lysozyme

Normal human tears, which are constant in their lysozyme content and easily obtained, afford a suitable standard of concentration. Tears have the advantage, as compared with egg-white,
that they contain only a trace of protein. The lysozyme content of all the material tested has, therefore, been expressed as a percentage of that of normal tears.

Method of Investigation

In each case a flow of tears was provoked by applying a drop of lemon juice with a sterile platinum loop to the conjunctiva of the lower lid at the inner canthus. The tears were collected in a Wright's blood capsule from the outer canthus. A trace of lemon does not influence the reading obtained. The capsules were now labelled and sealed and kept in the ice-chest pending estimation. In this way the lysozyme, even in tears from an infected eye, may be preserved unchanged for weeks.

The following observations are based on the estimation of the lysozyme content of the tears in each eye in 130 cases, normal human tears being estimated as a control in each case. The technique of estimation is described in the original paper.

Causes of Reduced Lysozyme—Epiphora

A fall in the lysozyme concentration of the tears always accompanies epiphora lasting more than a few hours. All conditions which lead to such a period of epiphora thus expose the eye to immediate danger of infection. In five cases of foreign body retained in the eye for more than three days the concentration in the affected eye was less than 45 per cent., the other eye being normal. Two cases are interesting as showing the significance of such a reduction. In each the foreign body was a particle of stone which had been retained for three days and had produced acute epiphora. In one case the eye was injected only and cleared up at once when the foreign body was removed; in the other acute conjunctivitis and hypopyon ulcer had developed and this was associated with obstruction of the duct on that side and an old standing chronic dacyrocystitis. The organism infecting the sac had not previously invaded the conjunctiva, but did so at once when the lysozyme titre fell. The patient recovered under treatment, and the lysozyme of the affected eye returned to normal, although the sac infection persisted.

This case indicates, firstly, that a chronic infection may invade a previously immune tissue area if the lysozyme titre in that area falls below 50 per cent., secondly, that the lacrimal gland is able to maintain the titre of its secretion to only a limited extent in epiphora, and thirdly, that recovery from an infection is accompanied by a return to the normal titre of lysozyme.

In sixteen cases of conjunctivitis, both acute and chronic, including several cases of angular conjunctivitis, the infected eye was
found to have a reduction of lysozyme to between 30 and 60 per cent.

The unaffected eye was found in most cases to have a normal titre. This reduction of the lysozyme content in the tears of infected eyes was observed in all the cases investigated, including cases of trachoma, corneal ulcer, hypopyon ulcer, phlyctenular conjunctivitis and keratitis, and interstitial keratitis.

Nine cases of unilocular infection having a normal concentration in the unaffected eye were followed up by repeated estimation, and in each case recovery was associated with a return to normal titre in the affected eye.

In three cases of obstructed lacrimal duct without conjunctivitis the concentration was normal in the affected eye.

**General Causes of Lysozyme Reduction**

Findlay observed that in growing rats deprived of Vitamen A a condition of keratomalacia developed, and that this was associated with a fall of lysozyme in the tears. He also observed that if a drop of human tears was introduced into the conjunctival sac from time to time, the onset of this condition could be delayed.

In six cases of early phlyctenular disease, and in four cases of recent interstitial keratitis, it was noticed that the lysozyme titre of both eyes was below 55 per cent. of normal, although in two of the former and two of the latter only one eye was affected. This low lysozyme titre in the unaffected eye appears to be confined to these two conditions, and may be due to the general ill-health which is associated clinically with them. This would account for the regularity with which these diseases attack both eyes as had happened in six cases of phlyctenular disease and nine cases of interstitial keratitis examined.

The low lysozyme titre observed in these cases may account for the clinical fact that these eye diseases do not recover until the underlying systemic disease or deficiency has been effectively treated.

This is of importance in forming a conception of the action of lysozyme in the natural cure of these eye diseases, since it is obvious that local treatment could only raise the titre of the affected eye to that of the unaffected eye, and in cases having a low titre in the unaffected eye this would be inadequate to bring about recovery from the infection.

Further, in five cases of interstitial keratitis which had received thorough general treatment and were well at the time of examination, the titre in both eyes was over 80 per cent., and in one case, examined three months after complete recovery and when the full course of injections had been given, was 100 per cent. in each eye.
The following two cases of typical interstitial keratitis have been observed recently. The first patient (L.S.), was a woman of 33, who had a positive Wassermann reaction and typical signs of congenital syphilis. The right eye was affected and it was noticed, as in other cases, that the lysozyme content of the apparently normal eye was almost equally reduced, 55 per cent. and 60 per cent. respectively. Within a month the second eye became involved, and both eyes are running the usual clinical course. The epiphora common to all acute eye infections has been well controlled by atropine, but the lysozyme content after two months has never risen above 70 per cent. in either eye.

The other case (C.K.) involved the right eye in a boy of 15. He showed no signs of congenital syphilis, and his Wassermann reaction has been repeatedly negative. He was exceptional in that the lysozyme titre of his left eye was from the first normal (see chart). The right eye watered very freely, and its titre remained

![Chart showing the variations of lysozyme titre in a case (C.K.) of interstitial keratitis.](chart)

Left eye, normal, thirteen estimations are shown, in each of which the titre is 100 per cent. (normal tears being estimated as a control in each case).

Right eye, affected (see text).

A. Rise following direct injection of the lacrimal gland with atropine.

B. Point at which treatment was changed to scopolamine—an immediate and permanent rise in titre followed. Epiphora was very marked up to the point B, except for a few hours at A, and ceased after the point B.
The Action of Atropine in the Eye

It has been observed consistently that epiphora is associated with a fall in the lysozyme titre. When epiphora ceases the lysozyme titre rises, and this has been associated in every case with clinical improvement in the eye condition. It is well recognized that epiphora is much reduced by the instillation of atropine in eye affections, especially of the cornea, and this is commonly attributed to its action as a mydriatic and to its "putting the eye at rest." It is more than this, however, for even painful stimulation of the conjunctiva in an eye thoroughly under the influence of atropine evokes only a small flow of tears as compared with the normal eye. The lacrimal gland itself must be partially paralysed by atropine instilled into the conjunctival sac. In one case (C.K.), showing acute epiphora and a titre of only 45 per cent., the gland was injected directly with atropine sulphate—epiphora ceased at once, and the titre rose to 70 per cent. in a few hours (see chart). It may be that the action of atropine in producing clinical improvement in infections of the eye, is due to its action in reducing epiphora, and in consequence producing a rise in the lysozyme titre: this reduction of epiphora being due partly to its direct paralysing action on the lacrimal gland, and partly to its action as a mydriatic, whereby reflex stimulation of tear secretion is diminished.

Possible Use of Lysozyme in Treatment

Since lysozyme is tolerated by the tissues in concentrations as great as forty times tears (as has been shown by Wolff), the possibilities of its application in the treatment of bacterial infections cannot be overlooked. The preparation of the enzyme in a pure state presents many difficulties and demands a laboratory especially equipped for the purpose.
As is quoted by Fleming in his first paper on lysozyme, Metchnikoff in his treatise on "Immunity and Infectious Disease," says "Nature, to protect the skin and mucous membranes, does not use antiseptics. The fluids which bathe the surface of the mouth and other mucous membranes are not bactericidal, or very imperfectly so."

It is clear from the work which has been done upon lysozyme that this view, which is still generally held, must be changed.

Nature does provide, especially in the tears, a very efficient antibacterial substance, lysozyme, to which must be attributed all important rôle in the prevention of, and recovery from, bacterial infection.

II.—ANATOMY AND PHYSIOLOGY

(1) Dejean, Ch. (Montpellier).— The zonule of Zinn: its development, structure, topography and physiology. (Recherches sur la zonule de Zinn: développement, structure, topographie, physiologie.) Arch. d'Ophtal., February-March, 1928.

(1) Dejean has already published the results of his earlier researches on this subject, in 1925 and 1926 (see bibliographical appendix). His present communication contains the record of prolonged research concerning the zonule and deals comprehensively with the subject. He begins with an historical section, referring to all important works on the zonule since that of Maitre-Jan in 1740 and Saint-Yves in 1761. Zinn's original work "Descrip'tio anatomica oculi humani iconibus illustrata" was published in Göttingen in 1775.

The earlier anatomical observers, studying the zonule macroscopically, usually described it as a membranous formation: the use of the microscope led to a modification of their conceptions. In 1886 Czermak, who, by the aid of celloidin, obtained better preparations than his predecessors, showed that the earlier views were untenable and demonstrated that the zonule is "a complex system of fibres." Since that date much has been written on the subject and references to all the important papers are furnished by Dejean.

The next section is on the embryology of the zonule and it is this part of the subject which has been discussed by Dejean in his previous papers. Section 3 is on the structure of the zonule; it is followed by one on the "topography" of the zonule. The final section is on "Physiology." Including the bibliography of four pages, the article extends to 59 pages of the Archives. It contains
much that is interesting and informative, but its length renders impossible any attempt to summarize it adequately within ordinary limits. The author's "résumé et conclusions" are as follows:—

"For more than a century investigators have been divided in their views as to whether the zonule of Zinn is a differentiated portion of the vitreous, a simple expansion of the hyaloid, or the product of retinal cells. This problem, we think, should be capable of solution by embryological and anatomical examination, showing the origin and the varied nature of the different parts of the zonule.

In the zonule it is necessary to consider (1) a median portion; (2) membranous walls.

The median part is a differentiated portion of the vitreous body, derived from the primitive or vascular vitreous, particularly from the cilio-lenticular portion: in the adult eye it consists (like the vitreous) not of fibres contained in a fluid, but of very thin membranes which are transparent, elastic and fragile. Fibrils are included in these membranes and re-inforce them in places. The usual histological technique destroys these areas or stains them slightly or not at all; the fibrils only show in the sections. To demonstrate them clearly, it is necessary to examine fresh unprepared tissues with a binocular microscope. These membranes, streaked with fibrils, form various systems of zonular lamellae directed from the lens to the ora serrata. Near the anterior and posterior surface their direction is tangential to this surface. Near the centre their direction is sagittal along the sides of the ciliary processes.

The membranous walls or boundaries are transparent, elastic and fragile: there are two chief walls, an anterior and a posterior. The anterior is actually a ciliary part of the hyaloid, and in the embryo cannot be distinguished therefrom: in the adult it extends directly from the hyaloid. Between the ora serrata and the posterior chamber it forms the ciliary limiting membrane on which are implanted the zonular fibrils. Between the tip of the ciliary processes and the lens capsule it is free and bounds the posterior chamber at the back. The extreme tip of the ciliary process situated anteriorly to this is not covered by any limiting membrane and is bathed directly by the aqueous fluid. It is uneven in its free portion which contains numerous fibrils.

The posterior wall 'la limitante intervitréenne' bounds the primitive vitreous body, and is derived from it by condensation of its lamellae. It is called the anterior hyaloid although it has nothing in common with that structure. It passes like a bridge from the crest of one ciliary process to the other, sinking a little over the intervening space. In certain animals it is easily separated from the posterior layer of the zonule in the hollows between the ciliary processes: the space so formed can be insuff-
lated and is the canal of Petit. In reality there is no definite canal but merely spaces of Petit or Hannover, permeable to fluids.

Our observations support the conclusion that these membranes containing fibrils which follow the lines of force of physiological action (suspension of the crystalline lens) are not a simple artefact. Like those of the vitreous, which they resemble in origin and nature, they are a condensation of the hyaline substance which constitutes the zonule and the vitreous. Coloured with difficulty they are immersed in this equally transparent substance like fragments of glass in water: this it is which renders examination so difficult in both the living and the dead specimen.

The vitreous origin of the zonule, the development of the vitreous and of the zonule from the basic embryonic membranes throw some light on certain physiological problems. These basic extensions (basesles élargies) afford support to the retinal and lens epithelium. Their peripheral reinforced portion (hyaloïd, lentali and ciliary) adheres to the retina and to the lens. Their median portion drawn into fibro-lamellae of the vitreous and zonule are engaged in the suspension of the lens. Between the separated membranes are spaces in which the aqueous circulates freely from the ciliary body towards the lens. The impulsive force exerted on the ciliary processes by the contraction of the ciliary muscle during accommodation is thus canalized towards the equator of the lens, with the aid of the iris and of the fluid enclosed in the posterior chamber. Such is the mechanism of the central bulging and the peripheral flattening of the lens in accommodation. The fragile and very extensible zonule probably does not play the part in accommodation attributed to it by the Helmholtz theory: the bulging of the crystalline lens is surely an active not a passive change.”

A plate containing 10 photo-micrographs illustrates the paper. A very full bibliography is appended.

J. B. Lawford.


(2) It has already been shown that to a large extent the eye is a self-determining organ whose development proceeds almost normally when the optic cup is isolated from its surrounding embryonic tissues and completely deprived of nerve connections and of a blood supply. This capacity of the isolated embryonic eye for self-differentiation has been studied by means of grafts by
Lewis (1907), who found that the primary optic vesicle of amphibians grew and differentiated when grafted subcutaneously in abnormal situations, and by Hoadley (1924), who showed that the eye primordium of the embryonic fowl grew and developed readily as a graft upon the chorio-allantoic membranes. The study has been carried a stage further by Strangeways and Fell, who, cultivating explanted embryonic eyes of the fowl, have verified its great powers of self-differentiation and development in vitro (the organotypic growth of Maximow, 1925).

Fowl embryos of 64-72 hours' incubation were removed from the shell, and one eye was dissected out and placed in a tube containing a mixture of ten drops of embryonic extract and ten drops of plasma, the medium being periodically changed. The explants were examined at various periods of growth and compared with the other eye, which was fixed at the beginning of the experiment and served as a control. When first transplanted the eyes were minute, colourless bodies; on the second day of culture they were double the original size and had begun to be pigmented; on the third day they appeared as darkly pigmented spherical bodies; thereafter they became irregular as the inner layers by their more rapid growth ruptured the outer pigment layers; the maximum size was reached about the eighth day; after the seventeenth day of cultivation the eyes underwent no further development and began to degenerate, showing increasingly large necrotic areas and a tendency to fat infiltration, until they died on the average about fifteen days later.

During this time the histogenesis of the retina and lens proceeded almost normally. The pigment layer, the rods and cones, the inner and outer nuclear layers, the inner and outer plexiform layers, the ganglion cells and nerve fibre layer and the pars ciliaris retinae, as well as the fibres of the lens were almost perfectly formed. Although this histological differentiation was almost perfect, the shape of the eyeball was distorted almost beyond recognition, an occurrence explained by the authors as being due partly to the lack of the supporting sclerotic, and partly to the various abnormal mechanical influences brought into play by the conditions of the experiment.

A comparison of the rate of growth of the normal and the explanted eye shows that the differentiation of the organ in vitro advances much more rapidly than the growth. Thus, while differentiation in its later stages proceeded at almost the normal rate, the growth becomes greatly subnormal after the first four days of cultivation. The disparity is seen in that while the retina after seventeen days' growth may exhibit a histological structure almost equal to that of a day-old chick, the cultures attained a maximum size of only 1-2 mm. It thus appears that inhibition of
normal cellular multiplication in an embryonic organ is not necessarily correlated with inhibition of normal tissue differentiation.

REFERENCES


W. S. DUKE-ELDER.


(3) Goalwin’s report is based on an examination of 806 optic canals in living, and 194 in dried skulls. It contains a considerable amount of important detail. The average normal optic canal measures 4.1 by 4.65 mm. An optic canal that measures less than 2.9 mm. in one of its diameters cannot contain a normal optic nerve. An enlarged circular optic canal is indicative of optic nerve tumour.

A. F. MacCALLAN.


(4) Wilbrand has studied the course of the fibres of the optic nerve through the chiasma by examining histologically specimens in which one optic nerve had atrophied during life. He finds that there is no disorderly mixture of crossed and uncrossed fibres, but that a partial decussation of bundles takes place always in a definite arrangement which in its essentials is the same for all normal individuals. The method does not lend itself to the tracing of the uncrossed fibres with accuracy, but the course of the crossed fibres is followed much more readily. In the upper layers of the optic nerve in front of the chiasma the trabecular system of the nerve gives place to a pad of neuroglial tissue running postero-medially from the outer edge of the nerve which guides the uppermost fibres inwards towards the chiasma where they run medially and downwards, and looping round the anterior commissure of the chiasma, radiate into the other optic tract. The fibres of the lower layers turn at right angles in a medial direction, and then, splitting up into a bundle spread out like the fingers of the hand, they run
upwards across the commissure, and bend forwards in the form of an anterior loop to join the fibres which have come from the upper layers of the nerve. The fibres from the inner half of the nerve cross the chiasma anteriorly, forming a well-marked loop in the optic nerve of the opposite side: the loop of fibres arching forwards in the opposite optic nerve forms the anterior genu of the chiasma. The fibres from the outer side of the optic nerve traverse the posterior commissure of the chiasma, but before doing so they describe a similar curve sweeping posteriorly in the optic tract of the same side, a conformation which constitutes the posterior genu. The medial fibres thus form a sharp loop anteriorly in the opposite optic nerve after crossing the chiasma, while the lateral fibres form the posterior loop in the optic tract of the same side before crossing. Having reached the opposite side the crossed fibres form a half-moon shaped mass in the lateral part of the chiasma, where they alternate in well-defined layers with the uncrossed fibres running directly from the nerve to the tract of the same side.

W. S. Duke-Elder.


(5) Wilbrand and Saenger (Neurologie des Auges, III, i, 1) showed that the internal architecture of the intra-orbital and intra-cranial portions of the optic nerve differed from each other, in that the former is built up of a system of cylindrical bundles of nerve fibres enclosed in connective tissue, which unite in the intra-cranial portion into a single large trunk undifferentiated by septa. These authors described these structures as "processes of the pia," and therefore of mesodermal origin. The histological examination of eight optic nerves cut in serial section has led Schindler to dispute this, and to conclude that these structures are in reality "processes of neuroglia," and, therefore, of ectodermal origin.

In the region of the chiasma at the change over in the septal system which distinguishes the intra-orbital from the intra-cranial portion of the nerve the neuroglial tissue appears massed in a cone-shaped body or process, with the point of the cone directed medially. Distal to this and running in continuity from it, there are septa; in the proximal portion these are practically absent, and they disappear entirely (of necessity) where the crossed and uncrossed fibres separate. The neuroglial system appears to have a close connection with the lymphatic system of the nerve. Bohr has shown (Arch. f. Ophthal., XXXIX, 1915) by experimental
injection that fluid tends to follow the glial system; it remains isolated in the separate nerve bundles of the intra-orbital nerve trunk, while it tends to spread laterally to the surface in the intracranial portion and penetrates into the third ventricle at the posterior angle of the chiasma. Schindler has followed out the connections of the lymph channels of the glial system with those associated with the process of neuroglia. This last appears to contain the main stream into which the smaller channels pour their contents in a definite order. Posteriorly this mass is continuous with the neuroglia covering the recessus opticus of the third ventricle, and the anatomical structure suggests that the position and the direction of the process of neuroglia enables the lymph from the nerve to drain easily into the ventricular system of the brain at this point.

W. S. Duke-Elder.

(6) Salvati (Alexandria).—The ocular tension during accommodation and convergence in the normal and in pathological states. (La tension oculaire pendant l’accommodation et le convergence chez les sujets normaux et pathologiques.) Ann. d’Ocul., Vol. CLXIII, p. 366, 1926.

(6) Salvati took measurements of the ocular tension by means of Bailliart’s tonometer on the cornea and on the sclerotic; (1) in the resting state, and (2) with the eye accommodating for a distance of 20 cms. He found the tension in every case higher in accommodation than in the resting state, and the sclerotic tension higher than the corneal. Measurements are recorded for four normal persons, for one chronic glaucoma, and for one detachment of the retina. The difference between the tension at rest and during accommodation varied from about 10 per cent. to 25 per cent.

Humphrey Neame.

(7) Tournay, Auguste. —Normal anisocoria in extreme lateral fixation. (Sur l’Anisocorie normale dans le regard lateral extrême.) Arch. d’Ophtal., September, 1927.

(7) Prof. Tournay writes to disclaim the position accorded to him by ophthalmologists and others of priority in the observation of the dilatation of the pupil of the strongly abducted eye. In 1917 and again in 1918 Tournay made communications to l’Académie de Médecine drawing attention to this pupillary phenomenon. He had first observed it in a wounded man during the war, and subsequently examined a large number of healthy persons in whom he found it almost constantly present. At that time he had not the opportunity to make a complete bibliographical
search. Since his papers appeared several observers have written on the subject, and in France and elsewhere this pupillary reaction has become known as Tournay’s phenomenon. In a recent enquiry on pupillary inequality Prof. Tournay has discovered that in 1907 Augusto Gianelli, of Rome, published a paper entitled “Sulle modificazioni del diametro pupillare nei movimenti de lateralità dei bulbi oculari.” Tournay gives excerpts from Gianelli’s paper reporting that in examining a number of young females he found that in 25 out of 40 dilatation of the pupil occurred in extreme abduction. Tournay thus makes it clear that, unknown to him and others who have investigated this pupillary reaction, Bianelli had anticipated his observation by ten years.

J. B. LAWFORD.


(8) Ferree and Rand find that within a certain range increase in size of the object causes an increase in the size of the field in which its colour is perceived. The increase of field, however, is not in direct proportion to that of the size of the object, and is greater in pathological than in normal fields. In other words, “any factor which decreases the response of the retina to light or colour narrows the field more for pathologic than for non-pathologic cases.” The authors consider that it should be possible to find two sizes of object which gave no difference in size of field in a normal case, but do give a difference in pathological cases. The following are some of their conclusions:—With stimuli subtending a visual angle of 5°, illuminated by 7 foot candles of light, the fields for red were only 6 per cent., and for blue only 11 per cent. smaller than for a 1° stimulus of white on black. Further increase of the size of the stimulus for this intensity of illumination did not materially increase the size of the field. With a higher intensity of illumination, however, the size of field for these colours is of course increased. Alteration of size of stimulus produced the least effect with a pre-exposure and surrounding field of the same brightness as the colour.

F. A. WILLIAMSON-NOBLE.
III.—GLAUCOMA


Knapp's patient was a boy of 11 years of age with a generalized vascular naevus of the skin of the face and body, and a drooping of the left upper eyelid. He had worn glasses for defective vision for four years. With his myopic correction (about 6 D. sph.) his vision in each eye was only 20/100. The iris was dull grayish-blue in colour with superficial atrophy; a network of superficial branching white lines and some dilated vessels were visible. The most striking features (illustrated by a coloured plate) were many grayish nodules, which were scattered over the iris without any zone of predilection. The right disc showed a deep cup with atrophy. There was a concentric contraction of the visual field to 30 degrees in the right, and 40 degrees in the left eye. Tension: R.E. 50 mm., L.E. 62 mm. (Schiotz). A trephine operation was performed in both eyes with success, the tension being reduced to 16 mm. R., and 18 mm. L. The portion of iris removed was fixed in Zenker's fluid and showed a thickening of the iris from a proliferation of endothelial cells with many new-formed vessels, suggesting an angiomatos condition. The iridic changes offer an explanation of the glaucomatous condition since they would tend to obstruct the periphery of the anterior chamber.

In reviewing the literature of the subject Knapp points out that this is the first case associated with naevus in which changes have been observed in the iris. In the February number of this year the reviewer and Mr. James published a case of glaucoma in which a peculiar naevoid condition of the eye was present, but unfortunately no examination of the removed piece of iris was made.

E. E. H.

(2) Hofe, K. von (Jena).—Clinical and experimental contributions concerning the medical treatment in glaucoma. (Klinische und experimentelle Beiträge zur Wirkungsweise der medikamentösen Glaukomtherapie.) Arch. f. Augenheilk., Bd. XCVIII, September, 1927.

At the outset von Hofe enters into a critical survey of the existing opinions regarding the connection between the vegetative nervous system and glaucoma, and then describes his own experiments and clinical observations as to the mode of action of various vaso-constrictor and vaso-dilator drugs.
He finds that pilocarpine brings about reduction of tension in the glaucomatous eye by dilating the draining blood-channels of the eye. It can produce disturbance of vision in three ways; (1) by causing spasm of accommodation, (2) through miosis in the presence of an abnormally sclerosed lens nucleus or of central lens opacities, and (3) exceptionally by directly disturbing foveal vision. Given a clear lens, occasionally the miosis produces a temporary improvement of vision both for far and near.

In the guinea-pig 2 per cent. barium chloride injected subconjunctivally increases the tension of the eye in spite of its miotic and vaso-constricting action. But, in conjunction with adrenaline, Ba. Cl₂ acts as an extreme hypo-tensor of the eye, considerably more so than does adrenaline by itself. Similarly calcium also strengthens the action of adrenaline. Adrenaline acts as a hypotensor of the eye even after division of the cervical sympathetic.

Quantitatively and qualitatively tyramin (p. oxyphenylae-thylamin, a derivative of tyrosin and contained in ergot) acts like adrenaline on the pupil and tension of the guinea-pig’s eye. Tenosin (Bayer)—a combination of tyramin and histamin, the latter also contained in ergot—but acting as a vaso-dilator—acts more powerfully as a mydriatic and hypo-tensor of the eye. This action is of long duration. Particularly striking is the very appreciable effect on the untreated eye. Though tenosin is effective on the glaucomatous eye, owing to the small number of cases hitherto treated, its use in practice is not yet warranted. In the low concentration in which they are present in tenosin, neither tyramin nor histamin have any effect on the normal tension of the eye. Here is an instance of increased potency of two substances in combination whose action on the blood vessels is antagonistic.

Besides histamin, azethylcholin as a vaso-dilator was tried. No direct effect on the eye was noted.

After parenteral injection of protein, fall of tension of the eye was observed. Attacks of cramp produced by various drugs also resulted in reduced tension of the eye.

His own investigations, and those of others, lead the author to the conclusion that the mode of action of drugs in glaucoma is due only partially to their being vaso-dilators and constrictors and that in addition, a direct action on the cells of the vessel wall must be accepted. He holds that the newer views on the physiology and pharmacology of the vegetative system as a whole justify his conclusion and doubts the theories which attribute glaucoma to sympathicotony or to sympathetic neurosis.

D. V. GIRI.

(3) Heim has treated, during the course of five months, seventeen cases of glaucoma with ergotamine. The drug is given in doses of 0.001 gm., by the mouth in tablet form, two or three times a day. It has a miotic effect which is stated to act over a longer time than most other miotics, and to exert an influence when they have failed. In his opinion in selected cases of glaucoma, better results can be obtained by its use than by an operation.

Some cases may be cited. One patient, a high myope of about 22D. with a bilateral staphyloma posticum, developed typical symptoms of glaucoma, the tension being 38 and 39 mm. Hg. in each eye respectively. Eserine and pilocarpine were both given, bringing the tension down to 22 and 20 mm. Hg. The tension rose again in 48 hours, when ergotamine was given, whereupon it fell to 18 and 16 mm. Hg. A second case, a woman of 56, had been suffering from glaucoma for 12 years. The right eye was amaurotic, and with the left she could count fingers. The tension was 52 and 47 mm. Hg. Eserine and pilocarpine lowered the tension of the left to 38 mm. Hg. It rose again, but, with ergotamine in addition, was brought down to 28 mm. Hg.

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(4) Hamburger has for some time been advocating the use of glaucosan in the treatment of glaucoma. He has now introduced another compound, “amino-glaucosan,” a preparation of ergot and histamine in seven to ten per cent. solution, which is administered as drops. With this he reports good results. The course of three cases is as follows:

In one case the tension was 45 mm. Hg. The exhibition of eserine brought this down to 31, but it rapidly rose again. Glaucosan, followed by amino-glaucosan, was then given, which brought the tension down to 18 mm. Hg. A second case had a tension of 33 mm. Hg. which glaucosan brought down to 18; it rose again to 31, and was similarly brought down again to 21. Some days later the tension rose to 31, and glaucosan brought it down once more to 15. One year later the patient came back with a tension of 32 mm. Hg., which was again reduced by glaucosan in combination with amino-glaucosan to 15 mm. Hg. A third case was brought down by glaucosan from 32 to 16 mm. Hg. Three
days later the tension was 26, and one day later 32. Glau-
cosan again brought it down to 21, where it remained. Some
months later the tension was 33. Glaukosan in combination with
amino-glaukosan reduced it to 17. Three days later it had risen
to 31, and the combination again brought it down to 13.
(Previous notes on this subject were published on p. 614 et seq. of

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(5) Kubik, J. (Prag).—Experimental and clinical researches on
the hydrogen-ion concentration of the aqueous. (Experi-
mentelle und klinische Untersuchungen über die Wasser-
stoffionenkonzentration des Kammerwassers.) Arch. f.
Augenheilk., Bd. XCVIII, January, 1928.

(5) The contributions of Hertel and Meesmann on the subject,
are based on the determination of reaction of the aqueous by the
indicator method. As in this method certain sources of error are
unavoidable, thus rendering results unreliable, Kubik has
employed electrometric measurement—the so-called gas-chain
method (Gaskettenmethode)—in his investigations. He explains
the nature of the process.

The outcome of his work is that, for certain, alkalosis has
nothing to do with glaucoma. His results should not be construed
into supporting the acidosis theory of glaucoma either; they rather
lend themselves more to establish that neither alkalosis nor acidosis
is the cause of glaucoma, the acidity of the aqueous seen in
non-compensated glaucoma being wholly due to the concomitant
congestion.

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(6) Holth.—Iridencleisis with meridional iridotomy in acute
glaucoma. A proposal to make use of iridencleisis with
transverse iridectomy in infantile glaucoma (buphthalmos).
(Iridencleisis cum Iridotomia meridional bei Glaucoma
acutum. Ein Vorschlag bei Glaucoma infantile (Buphthal-
mus) die Iridenkleisis mit transversaler Iridotomie
anzuwenden.) Klin. Monatsbl. f Augenheilk., Bd. LXXI X
S 620, 1928.

(6) Holth reviews the results of his well-known operation of
iridencleisis for glaucoma which he has practised for some time.
He still considers it the method of choice in many cases. For
acute glaucoma he advises iridencleisis with a meridional irido-
tomy, and in infantile glaucoma, iridencleisis with a transverse
iridotomy. He now makes his conjunctival section 1.5 mm. from
the limbus and enters the anterior chamber 1 mm. from the limbus.
He considers the results in acute glaucoma more lasting than those of an iridectomy, and in infantile glaucoma he contends that no sclerotomy, not even Elliot’s, gives a permanent result.

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(7) Koyanagi has verified the previous observation that when external pressure is applied to the eye the intra-ocular pressure rises. He used rabbits anaesthetised with urethane. A known force was applied to the eye with a Bailliart’s ophthalmo-dynamometer and the intra-ocular pressure was measured by a modification of Henderson and Starling’s manometer. He found that immediately on the application of pressure the intra-ocular pressure rises to a maximum height in about 30 seconds. With a weight of 30 to 40 gm. the rise is about 15 to 20 mm. of water. Thereafter the intra-ocular pressure falls slightly, remaining, however, at a higher level than it was originally. On removing the pressure the intra-ocular pressure at once falls considerably below its former level, and a condition of hypotony prevails. The clinical importance of these investigations with reference to repeated tonometry and to massage of the eye, is obvious.

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(8) Stoutenborough, Wm. A. (Columbus, Ohio).—Cyclodialysis upon the eyes of rabbits. Amer. Jl. of Ophthal., April, 1927.

(8) Stoutenborough has collected various theories as to the modus operandi of cyclodialysis. Heine’s original one was that the contraction of the ciliary muscle pulled the ciliary body away from the sclera, forming a permanent filtration path. Experimental work disproved this, and he now suggests that a capillary fistula develops between the ciliary body and sclera which allows the aqueous to drain away. Krauss believes that atrophy of the ciliary body from trauma results in a diminished production of aqueous, Wernicke that a delicate cicatrix forms between the ciliary body and sclera which allows aqueous to filter back into the suprachoroidal space, while Gradle holds that the reduction in tension is due to freeing of the angle of the anterior chamber, allowing aqueous to escape through the canal of Schlemm. With these theories in mind, the author performed cyclodialysis on a series of 14 rabbits in order to determine the true explanation. His conclusions are: (1) Cyclodialysis is an operation which produces a moderate and temporary reduction in intra-ocular tension. (2) The reduction in tension, other than that caused by evacuation of
the anterior chamber, is due to the formation of a temporary drainage canal between the ciliary body and sclera, connecting the anterior chamber and supra-choroidal space. This path is soon closed, however, by firm union of the tissues, and after a few weeks all evidence of its patency disappears. (3) The principal immediate complication of the operation is detachment of Descemet’s membrane followed by the development of corneal opacities which may or may not be permanent and by anterior synechiae, which are permanent. (4) There is apparently no atrophy of the ciliary body.

F. A. WILLIAMSON NOBLE.

BOOK NOTICES


With this monograph is incorporated a reprint of a recent article on Barraquer’s operation by J. Russell Smith, M.R.C.S., from The British Journal of Ophthalmology, that takes up 40 pages of the volume. Reprints of old papers by Colonel Smith, and by Capt. A. E. J. Lister, I.M.S., and Arnold Knapp (New York), are included in an appendix. The very numerous illustrations are by Derrick T. Vail (Cincinnati) and Russell Smith.

This book, based on an experience of over 50,000 cases of cataract extraction, is said to be a second edition of one published in 1910. In the preface the opinion is expressed that this “latest development of the Indian method . . . constitutes a revolution of the greatest importance. It reduces the procedure to a simplicity hitheto undreamt of, enabling it to be performed in relatively unskilled hands”; and it is said to be destined to supersede all other methods in the rest of the world, as it is claimed already to have done in the Punjab.

There can be no question, after more than twenty years’ experience, that Smith’s work has abundantly justified itself in Northern India. His method of intra-capsular extraction, developed in the Punjab with the simplest of instruments and accessories, and with no after-treatment, has proved most suited to the work where great numbers of patients have to be treated in a very limited time, most of them never to be seen again. The freedom from after-cataract is sufficient to outweigh many drawbacks. But these drawbacks, when the operation has been