The progress of ophthalmic surgery : from the invention of the ophthalmoscope (in 1851) up to the present time : being an oration delivered before the North London Medical Society on February 11, 1863 / by John Zachariah Laurence.

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OF

OPHTHALMIC SURGERY

FROM THE INVENTION OF THE

OPHTHALMOSCOPE (IN 1851) UP TO THE PRESENT TIME.

BEING AN ORATION

DELIVERED BEFORE

THE NORTH LONDON MEDICAL SOCIETY

On February 11, 1863.

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ANNUAL ORATION DELIVERED BEFORE THE NORTH LONDON MEDICAL SOCIETY, BY J. Z. LAURENCE (FEBRUARY 11, 1863).

Mr. President and Gentlemen,

According to the strict letter of the law of this Society, the Annual Oration is to consist in an exposition of 'The Advance of Practical Medicine or Surgery during the past Year.' But a review of some of the previous Orations held before this Society justifies me, by precedent, in selecting as my theme a subject which may be said, in point of time to be wider, in point of material narrower, in its scope than that indicated by the law I have just quoted. This subject is—The Progress of Ophthalmic Surgery since the Invention of the Ophthalmoscope in 1851. In approaching so vast a field of human intelligence and research, I may well say it is not the want, but the excess of subject-matter that renders its adequate elucidation embarrassing. 'Hujus autem orationis difficilius est exitum, quam principium invenire.'

Arrangement of Material.

To overcome this difficulty, some systematic arrangement became imperative. Two methods suggested themselves: an arrangement according to time, or one according to locality—a chronological system, which displayed each successive step of progress in the order of its date of publication; or one which, disregarding the individual eleven years comprised in our epoch, discussed each improvement in practice according to the special part of the eye to which it referred. The former system I found, on reflection, was, if perhaps preferable in some respects, so much outweighed by considerations of clearness of apprehension, that I altogether rejected it for the

latter, which alone appeared to me capable of affording a clear retrospective contrast of the Past and Present of Ophthalmic Science.

Ocular appendages.

Not much advance has been made in the surgery of the ocular appendages. The most striking is undoubtedly a slight, but important, modification Mr. Bowman has introduced into the treatment of the various obstructions the

Lacrymal strictures.

lacrymal passages are liable to. These obstructions or strictures involve principally either the canaliculus or the nasal duct. In the former case, the method of slitting up the minute canal, and subsequently dilating it by fine probes, was very closely foreshadowed by Jünken.* In the latter case, the idea of dilating a stricture of the nasal duct from the punctum lacrymale through the canaliculus was too obvious, to long escape the attention of surgeons. Accordingly, we find Anel, Travers, and Jacob advocating this practice; but it never found favour. Mackenzie characterises it as 'painful, dangerous, and ineffectual; apt to end in incurable atony of the puncta, by causing them to split or ulcerate.' It was reserved for Mr. Bowman to point out that all these disadvantages depended on the anatomical fact that the punctum lacrymale, analogous to the meatus urinarius, was one of the, if not the, narrowest parts of the entire track of the canal, and that, if we opened this up by a cutting instrument, we were at once placed in a position of readily introducing probes of sufficiently useful size, and of thus dilating the nasal duct from the punctum without the disadvantages incidental to the older practice. This method of treatment has found much favour both at home and abroad, and possesses great advantages over the old style, which I now only regard as a last resource, after every other plan of treatment has failed. The treatment of lacrymal strictures by the modern method is as superior to that, by the style, as the periodical

* He removed a portion of the eyelid and strictured canaliculus together, and kept the new punctum lacrymale (nearer the inner canthus) dilated till cicatrisation took place. — *Vide* his 'Lehre von den Augen Krankheiten,' p. 628. Berlin, 1832.

dilatation of an urethral stricture would be to that of the life-long retention of an instrument in the urethra. On its first introduction, it shared the common fate of all novelties: it was either rejected *in toto* by those who either could, or, what is worse, would not recognise its advantages; or, on the other hand, its value was, I believe, overrated by those who adopted it. I have myself pursued it from its very first appearance, but must admit that, whilst I have found it easy and efficient in many instances, in others it has proved difficult and unsatisfactory in its application. In these latter cases, I find the best treatment is to make a small opening with a bistory directly into the lacrymal sac, and hence dilate the nasal duct by periodic probing, leaving the superior lacrymal passages altogether intact. I know, however, of no class of affections that tax the surgeon's patience and ingenuity greater, than these lacrymal strictures. Some will not yield permanently to any plan of treatment hitherto suggested. As an extreme measure, the lacrymal sac has been destroyed by caustics or the actual cautery—a procedure which, however apparently illogical in theory, has proved successful in practice.

Eversion and closure of the puncta.

There are two very common conditions of the puncta lacrymalia, which may, if overlooked, originate long-protracted and ineffectual treatment. We may find them everted, turned away from the surface of the eyeball, or skinned over by chronic inflammation (especially in old people). In either case the puncta no longer fulfil their physiological function—that of receiving the tears as they distil down over the surface of the eyeball. Hence arise watering of the eye, chronic conjunctivitis, and even ectropion—all three effects acting and reacting on each other, so as to form an accumulated fund of discomfort to the patient. Such cases, after having been treated *ad infinitum* by all varieties of lotions and ointments, I have over and over again seen at once cured by slitting up the canaliculus. Effects had previously been mistaken for causes.

A great variety of operations has in modern times been devised for the cure of in- and e-version of the eyelids, but none appear to me to present any striking novelty or

The eyelid-tourniquet.

advantages over the older operations. All, however, have been wonderfully facilitated by the 'eyelid tourniquet' of my friend Dr. Snellen—a vast improvement on the old ring-forceps (pince-anneau) of Desmarres. I have myself slightly modified Snellen's forceps, and very recently adapted the same principle to the lower eyelid.* With these instruments, all operations on the eyelids may be performed with the same facility and precision as on the dead subject, the flow of blood being entirely checked, and sensibility greatly benumbed. No one who has not actually used these 'tourniquets' can form a conception of their extreme practical value.

Pathology of the ocular muscles.

No part of ophthalmic surgery has made greater advance, than the pathology of the muscles of the eye; and it is but right to say, that it is chiefly due to the labours of Professor v. Gräfe, whose elaborate papers will be found in the 'Archiven f. Ophthalmologie.' No more striking evidence can, I think, be adduced of the genius of this great ophthalmologist than the spirit of research and the logical acumen which pervade these papers, more especially when we consider how apparently exhausted the subject was before he took it up. The basis of these researches was the determination of the true normal actions of the various ocular muscles. This had been previously most ably investigated by Meissner, Donders, and v. Gräfe himself. To give an at all adequate account of this important branch of our subject would lead me far beyond the limits of this discourse. These researches start with certain—in part experimentally, in part inferentially—ascertained actions of the ocular muscles. These actions are either those of association, or of concurrence of the eyeballs. On looking, say, to the right, the external rectus of the right eye is associated with the internal rectus of the left, and *vice versâ* on looking to the left. Here we have an example of the associated action of the two muscles. But in regarding an object in the middle line, the two internal recti act together in harmony with the ciliary muscle. Here we have

* These instruments may be had of Messrs. Weiss or Coxeter.

an example of concurrent (or accommodative) action of the ocular muscles. In either case, if the natural equilibrium of force of the muscles is disturbed, the optic axes are no longer directed to the same points, and double vision ensues. If a convergent squint is thus induced, the resultant right-hand image belongs to the right eye, the left-hand one to the left. But if a divergent squint arises (either from excessive action of the external rectus, or deficient of the internal rectus), then the images are no longer corresponding, but crossed ones—i.e. the right-hand image will be perceived by the left eye, and *vice versâ*. We can artificially produce these double images, either by mechanical pressure on the eyeballs, by their voluntary distantial misconvergence, or by prismatic glasses. In the above instances the double images exhibited simply a lateral separation; but you will readily understand that if the superior or inferior recti or obliqui be involved, the double images will also present corresponding differences of elevation and inclination. You will further easily conceive that the ocular muscles may be so slightly affected (paralysed or contracted) as to render any deviations of direction of the eyeballs quite inappreciable to your eye. In such a case, we may, by an inverted order of ratiocination, utilise the relative positions of the double images for the determination of which of the muscles, and how, are affected?—in a word, substitute for an objective, a subjective method of diagnosis. It is in the elaboration of such often highly complex problems, their solution by different degrees of tenotomy, by prismatic glasses, &c., that Prof. v. Gräfe has so largely contributed to our exact knowledge of the subject.

Double vision.

I may here remark, that for the cure of squint I have practised both the subconjunctival section of the ocular muscles and the old operation of Dieffenbach; and I must confess that, prepossessed as I was at first with the former operation, I have again reverted to the older one, which I believe, performed cautiously, with the addition of an *ad libitum* limiting suture, surpasses the subconjunctival one—not in certainty, but in the power it affords us of very nearly regulating our

Operations for strabismus.

operation in proportion to the amount of effect we wish to produce.*

Inflammations of the eye.

The various inflammations of the eye have always commanded a large share of attention, on account of their frequent occurrence, their obvious characters, and their occasionally serious consequences to the visual functions of the organ. In comparing their present and past pathology and treatment, no very marked difference is apparent, if we except that tendency against active depletion which characterises generally the practice of the day. There are certain affections of the eye which, from their extreme speciality, fall, by nearly universal consent, to the almost exclusive lot of the ophthalmic surgeon; but there are others which the practitioner in general surgery is quite as competent, and is as frequently called upon, to treat as the specialist. Of these, perhaps none exceed in their importance the various forms of ophthalmia. I shall, therefore, not consider it superfluous to direct your attention in some detail to two methods of treatment which are not very generally known, but which I have found most effectual in practice. The various inflammations of the eye may be divided into two great groups—(1) those of the superficial tunics, the conjunctiva and cornea; (2) those of the deeper structures, the sclerotic, iris, choroid, and retina. The symptoms of both groups will be often found combined, but still those of the one or the other generally to predominate to a degree that justifies us, both diagnostically and therapeutically, in referring any given case to one or other of these two categories exclusively. It would be misplaced to enter here into the diagnosis of these two groups: it is rather to a peculiar treatment of them to which my remarks will apply.

Treatment of conjunctivitis.

If you examine a large number of cases of any member of the first group—e.g. of mucous conjunctivitis ('catarrhal ophthalmia')—and adopt the practice in every instance of evert-

* The author may here perhaps allude to a very simple little instrument he has constructed for the linear measurement of the exact amounts of deviation of the eyeballs in cases of strabismus. It may be had of Messrs. Weiss.

ing both eyelids, you will be surprised to find in how large a majority of the cases the palpebral conjunctiva is the starting-point of the disease—the origo et fons mali. Acting upon this fact, the rational treatment of these forms of ophthalmia is to direct your remedies to the part primarily and principally affected. All such cases I am in the habit of treating by everting both eylids, and bringing the mucous membrane at the palpebral sinuses so together, that whilst the palpebral conjunctiva is completely exposed, the ocular conjunctiva (and sclerotic and cornea) are as equally protected from the useless and positively injurious action of the eye-water we may think proper to apply. I for this purpose generally use solutions of nitrate of silver (of strength from iv.—x. gr. ad ℥j.); these I with a camel's-hair brush freely apply to the everted conjunctiva of the eyelids, allow them to exert their action (as indicated by the whitish bloom they produce on the scarlet surface of the conjunctiva) for a few seconds, and then carefully and completely wash off any residuary eye-water with a second brushful of warm water. The old and still common method of dropping strongly astringent and caustic eye-waters 'into' the eye, I regard as highly pernicious, but calculated, by continuous irritation, to protract and extend the inflammation they are intended to cure, and also thus unnecessarily prolong the immediate pain to the patient to whose eye they are applied. In some exceptional cases (especially of conjunctivitis purulenta) we find the ocular conjunctiva inflamed equally to that of the palpebral: to such cases alone is the old method rationally applicable. The treatment I have advocated I first learned in Utrecht, to which city I believe it was transplanted from Berlin.

Treatment of Sclerotitis, etc.

The second group of ophthalmiæ embraces the inflammations of the deeper structures of the eye. They are, as a rule, of a much more grave and dangerous character than those of the preceding group, with any member of which, however, they may be, and often are, combined. These deep-seated inflammations are commonly treated by depletion, counter-irritation, and mercurialisation. I treat them simply by the

Treatment by opium.

internal administration of opium, in combination with sedative local applications. This method was, as far as I know, first systematically investigated and practised by myself in 1859.* Since this I have published in the *Edinburgh Journal* for December 1862, a complete memoir on the subject, exhibiting the histories of twenty-nine cases thus treated, twenty-three of which were cured.

Glaucoma and iridectomy.

Following out the natural order of ocular disease, we now come to the much-vexed question of glaucoma and iridectomy. Under the term 'glaucoma,' Hippocrates comprehended all opacities behind the pupil.† But the term soon became limited to those which were of a greenish colour, and were irremediable by operative measures. Brisseau,‡ in 1779, originated the view that 'green cataract' was an affection of the vitreous humour. A century later, Wenzel§ sought the seat of the disease in the retina and optic nerve—a view which was also taken up by Wardrop. Later still, we find the arthritic and choroiditic nature of the disease assumed by Beer and Sichel. Weller then gave a very faithful picture of the symptoms, and speaks of the 'great hardness' of the globe, and of a 'feeling of tension in the eyeball as if it would burst.' In 1830, Mackenzie gives as precise a history of the symptoms and intimate nature of the disease as would be possible at the present day without employing the ophthalmoscope. After the invention of this instrument, Ed. Jäger‖ gave a faithful delineation of the appearances of the optic nerve entrance and retinal vessels, in a case of 'amaurosis arthritica (glaucomatosa).' V. Gräfe¶ then described still more definitely the peculiar appearance of the optic disc (erroneously considering it, however, as an undue *prominence* of that structure), and added a new sign in the 'arterial pulse' of the retinal vessels. Later still, he placed the true interpretation on the apparent

* *Vide* Medical Times and Gazette for 1859.

† Aphorism. Sect. iii. 31.

‡ Brisseau's Traité de la Cataracte et du Glaucome. Paris, 1709.

§ M. de Wenzel, Manuel d'Oculiste. Paris, 1808.

‖ Über Staar u. Staar Operationen. Wien, 1854.

¶ Archiv f. Ophthalmologie, i. 1, p. 371.

bulging of the nerve, by insisting upon its being really of the nature of an excavation, or 'cupping,' as it is technically termed, and was thus able to refer the whole series of phenomena of glaucoma to one cause—a morbidly increased tension of the ocular tunics, produced by intra-ocular hydrostatic pressure of their contained fluids. In 1857, v. Gräfe, in an elaborate memoir on the entire subject, introduced his operation of iridectomy. He states as a matter of experience that this operation yields different results, according to the period of its performance. In all acute cases it completely restored vision, if performed within a fortnight of the attack. At later periods of the disease, the results varied: in some cases, restoration of vision ensued after several weeks, or even months; in others, especially those attended with extreme limitation of the field of vision and marked excavation of the optic disc, the amelioration of sight was at the best but temporary; whilst in a third class of cases, in which all perception of light had been lost, iridectomy might relieve pain, but had no influence on vision. My esteemed friend Dr. Haffmanns, to whose excellent *résumé* of the entire subject* I owe the greater part of the preceding epitome, remarks that in no other country did iridectomy meet with greater opposition than in England. This opposition, however, lost, I believe, much of its force from its frequent origination in surgeons, who rejected the operation so unconditionally as not to hesitate to condemn it upon purely speculative considerations, without their having had any personal experience of its effects. Indeed, so high did this tide at one time rise, as to seduce gentlemen, otherwise of the highest professional standing, to descend to expressions and methods of discussion that reminded one rather of the virulence and acrimony of byegone days than of that temperate moderation that should prevail in questions so momentous, I will not say to science, but to humanity at large.

We may discuss the effects of this operation, firstly, as

* Arch. f. Ophthalm. viii. 2, p. 124, *et seq.*

pure matters of fact. From this aspect, my own opinion and experience is, that its influence on the restoration of vision is inversely proportional to the duration of the disease. In chronic glaucoma I have never seen it remarkably successful. Contrary to this observation, however, it is only right to add that Dr. Haffmanns states (Op. cit. p. 173), in Donders's practice, an arrest, or even a diminution, of impending blindness has been noticed not only in many cases of chronic glaucoma, but even in those of 'amaurosis with excavation' ('glaucoma simplex'), in which tension of the tunics was a prominent sign. V. Gräfe himself says (Arch. f. Ophthalm. viii. 2, p. 303) he can adduce numerous cases, which had been progressing from six months to three years, in which he has obtained the same results with a permanence, which he had the opportunity of testing for periods varying from one to three years. We may next discuss the *rationale* of the operation. In this point of view iridectomy is singularly weak, unless we consider the division of the attached border of the iris as the essential of the operation, in accordance with the opinion of Mr. Hancock, to whose operation I shall presently advert. Whilst (nearly) every other operation, not only in ophthalmic, but in general surgery, has some tangible reason to exhibit for its performance, iridectomy stands (almost) alone in the utter insufficiency of the various far-fetched explanations that have from time to time been assigned for its assumed efficiency. I cannot help thinking the greater part of the benefit of the operation results from the largeness of the corneal incision, necessarily preliminary to the actual excision of the iris, and the consequent completeness of the relief to the intra-ocular tension thus implied; that a limited paracentesis corneæ is as inferior to 'iridectomy' precisely in the same ratio as the temporary relief afforded by the mere puncture of an abscess is to the permanent relief given by a free incision. V. Gräfe assumes there can no longer be any question as to the comparative merits of iridectomy and paracentesis corneæ. A perusal of Professor Sperino's recent work on the effect of repeated paracenteses corneæ, exhibits

a widely different view of the question.* I must now say a few words on Mr. Hancock's operation of Division of the Ciliary Muscle. From a careful perusal of his latest paper on the subject,† I glean that he regards a constricting action exercised by the ciliary muscle on the constituents of the eyeball, as if not the primary, the efficient cause of several morbid conditions. Thus, he considers glaucoma to have 'its origin in some peculiar condition of the blood . . . the ciliary muscle, losing its elasticity and contractility, is converted into a rigid, unyielding cord;' and hence, as a secondary result, the subsequent intra-ocular pressure. Assuming this theory to be correct, division of the ciliary muscle as a curative measure is rationally indicated; and I must say, the cases of glaucoma Mr. Hancock reports, although not given quite so detailed as desirable,‡ still appear to prove the efficiency of his operation. But Mr. Hancock does not confine division of the ciliary muscle to cases of glaucoma. He narrates several instances of staphyloma, leucoma, ceratitis, myopia, &c., in which very striking results have followed the operation.

Artificial pupil.

In the operation for artificial pupil, the most marked improvement has been effected in this country by Mr. Critchett, in his operation of iridesis.§ This consists in opening the cornea with a broad needle, drawing out a portion of the iris between its ciliary and pupillary margins, and confining the slight prolapse by a fine ligature. The advantages of this operation are that the pupillary margin of the iris is preserved intact, the pupil being, as it were, only dislocated into a more favourable position than it before occupied, in the iris not being wounded in the operation, and in its general innocuous nature. Its author has made a very practical application of it in certain cases of stationary partial opacities of the lens: by dislocating the pupil from an opaque to a transparent

* Études cliniques sur l'évacuation répétée de l'humeur aqueuse dans les maladies de l'œil. Par C. Sperino. Turin, 1862.

† *Lancet* for 1862, Nos. V. and IX.—XI.

‡ Case (26) reads more like one of retinitis pigmentosa and hemeralopia than of glaucoma.

§ Ophthalmic Hospital Reports, No. V.

portion of the lens, the patient's vision is restored without any destruction of the lens-substance, and without, therefore, any necessity of his wearing glasses after the operation.*

Cataract.

The capital operation of ophthalmic surgery is undoubtedly the extraction of a hard cataract through the cornea. The ordinary flap operation, originated by Daviel in the middle of the last century, has held its ground up to the present day, notwithstanding the many dangers, both immediate and secondary, incidental to its performance. The question as to whether the flap should be made from the upper or lower half of the cornea, has given rise to much discussion. Daviel practised the lower section, which remained the ordinary one till Wenzel, Richter, and Benjamin Bell recommended the upper section, which was first introduced by Santarelli. This is the one generally practised in this country, but many eminent continental operators still adhere to the older section. In the fifth volume of the Archiven (Part. 1, p. 158), v. Gräfe describes a method of extraction applicable to cataracts with a moderately hard nucleus, but a soft pulpy envelope. Such cataracts he describes as bulky, pressing forward the iris, —beset with bluish, glistening, broad striæ, and possessing a yellowish centre. They occur at and after the age of thirty. The operation consists in making an incision with a broad lance of about one quarter of the cornea at its temporal margin, then excising a corresponding portion of the iris, dividing the capsule of the lens horizontally through the whole breadth of the natural and artificial pupil, and finally scooping out the cataract with a modified Daviel's spoon. Subsequently, Dr. Schuft introduced a graduated series of spoons (not unlike miniature fire-shovels), better adapted for their purpose. Since that time the operation has somehow acquired the name of 'Schuft's operation,'† although it is quite clear v. Gräfe was its originator, and that he again primarily derived his first ideas from Gibson of Manchester. I have

Schuft's operation.

* The operations on the iris and parts within the pupil are often much facilitated by the use of Charrière's valuable canula forceps.

† Die Auslöffelung des Staars. Ein neues Verfahren v. Dr. A. Schuft.

performed this operation several times myself, and have seen it done many more times by others; but I must say that I perfectly coincide with Dr. Mooren (of Oedt, near Crefeld) — who in thirty-two cases had ten failures — in considering it an operation, however neat, satisfactory, and comparatively free from danger in its immediate performance, as one attended with the most imminent after-consequences—iritis, closed pupil, suppuration of the cornea, &c. This I ascribe to the large and repeated amount of manipulation involved in its performance. It is one thing to see a series of brilliant operations done by others—another to do them oneself, and be compelled to follow them out into their ultimate consequences. The more a surgeon assumes the position of a responsible operator, the more must he become impressed with the unfortunate consequences that almost invariably follow any protracted instrumental interference with the parts behind the cornea.

I have, to my repeated regret, remarked the unfortunate results that follow the slightest injuries—especially those of a contused character—inflicted on the iris; injuries which, as far as their immediate evidence is concerned, may completely elude the first observation of the operator. No living structure hardly inflames so readily as the iris; in none is there a greater tendency to propagation to the adjacent tissues.

Mooren' operation.

Dr. Mooren has recently introduced a modification of Gräfe's operation*—applicable, however, to cataracts of all degrees of consistence. He first excises a portion of the iris; then allows an interval (generally from a week to a fortnight) to elapse, till the effects of this first operation have subsided; and, finally, extracts the lens by the ordinary flap operation (by the lower section) of the cornea. He gives the details of fifty-nine operations. Two only of these failed. A very important additional element is, that most of the cases were highly unfavourable ones. Under any circumstances, the

* Die verminderten Gefahren einer Hornhautvereiterung bei der Staar, Extraction von Albert Mooren. Berlin, 1862.

results of this operation are the most remarkable ever submitted to the profession.*

Ophthalmoscope.

In 1851, Helmholtz published the first account of his immortal discovery—the ophthalmoscope. Up to that time nothing exact was, or, indeed, *could* be, known of the diseases of the deeper structures of the eye, except such scanty information as could be gathered from the comparison of the anatomical conditions of extirpated eyes, either during or after life, with the symptoms previously observed. Such inferences were, however, unsatisfactory for several reasons. The opportunities afforded to individual practitioners of dissecting eyeballs could be but few, compared with the number of diseases of the deeper structures they would probably meet with in practice. Such anatomical examinations indicated, at the best, only the ultimate physical condition of the parts of the eye, after all the mischief was done, leaving the commencement and progress of the disease altogether a matter of conjecture. To speak then of the 'progress' of our knowledge of the diseases of the deeper structures of the eye, since the year 1851, would be a misnomer: we should rather speak of the first foundation of any precise knowledge we have acquired of what, up to that time, was at best but a pure matter of individual hypothesis.

It may, therefore, not perhaps be considered out of place to enter here into a slight digression on the influence physical science in general has exerted on the progress of medicine and surgery; preceding these remarks by a brief sketch of the successive phases, so to say, the tendencies of the human mind have undergone in their appreciation of the essence and functions of medical science.

Schools of medicine.

In the middle of the seventeenth century, Sylvius propounded the chemiatric school, which had been previously advocated by Paracelsus, who went the length of publicly burning the writings of Galen, asserting the body was governed by purely chemical laws. A perpetual fermentation was thought to be

* My friend Dr. Carter of Stroud and myself have performed the operation successfully.

going on in the organism—an excess of acid, or alkali, engendering what was recognised as disease. Thus says Sprengel, 'He degraded the physician to the level of the brewer.' In England this school was especially taken up by Willis; whilst in France the Hippocratic and Galenic were the prevalent doctrines.

The iatro-mathematical school originated in Italy with Borelli's treatise, 'De Motu Animalium' (Portal's History of Anatomy, iii. 246), in which the principles of mechanics were applied to the actions of the muscles. John Bernoulli even went so far as to introduce the differential calculus into such investigations.* Then we have Van Helmont's school of Vitalism—a principle supposed to preside over the body, and directly opposed to the influence of mechanical and chemical agents.

At last, however, the empirical or inductive school, first steadfastly insisted on by Haller, under the auspices of the illustrious Sydenham, gradually asserted its legitimate supremacy.

Were I asked to designate with one word the prevailing characteristic of the Medicine of to-day, I should say it was Materialism. Indeed, the more our senses have been assisted by physical science, the stronger has the material nature of disease stood out in relief. The first grand application of such aids to diagnosis we find in the sciences of percussion and auscultation, which, alluded to upwards of 2,000 years ago by Hippocrates, and still more definitely by Hooke, was in 1761 made the subject of a formal discourse by Leopold Avenbrugger; to be again forgotten for nearly half a century, till rescued from oblivion, and established on an undying basis, by the genius and energy of Corvisart and Lænnec. Nothing has, however, more strongly impressed medicine with its present material character, than the revelations of pathological anatomy, which is daily tending more closely to connect the symptoms of disease with material changes in the organism

* However far-fetched this may appear, it is being strictly imitated by several of the modern speculative German writers on ophthalmic 'surgery.'

after life. Here again has physical science stepped in with the microscope, and laid bare such a multitude of before unsuspected facts as to almost warrant us in invariably ascribing the seeming absence of post-mortem appearances rather to imperfections in our powers of observation, than to their actual non-existence.

Vision is undoubtedly the most perfect of our senses, whether we regard it for its range of comprehension or the precision of its information. If, then, a, so to say, but second-rate sense, as that of hearing, has shed such a flood of light on the diseases of the chest, we need not feel surprised at the results of the ophthalmoscope—the eye's eye, if I may be permitted such a laconicism.

Luminosity of the eye.

The luminosity of the eye, especially in the tapetum of dogs and cats, had been observed from the earliest times. It was regarded as evidence of a voluntary nervous irritation on the part of the animal, and thus came to be viewed with a degree of popular superstition. In 1704, Méry observed the retinal vessels of a cat under water (on the principle of Czermak's orthoscope). In 1810, Gruithuisen and Prevost showed the luminosity was not intrinsic to the eye, as it did not take place in the dark, but referred it rightly to an extrinsic cause—to reflected light from without. In 1846, Cumming published his paper 'On a Luminous Appearance in the Human Eye' (Medico-Chirur. Transactions, vol. xxix.). Rarely has an observer approached closer to an important discovery without actually reaching it. 'The establishment,' he says, 'of a similar reflection from the healthy human eye to that from the eyes of animals, appears to me chiefly important in its adoption as a mode of examining the posterior part of the eye. The retina and choroid hitherto concealed in the living eye, and little opportunity being afforded of examining their condition after life, in consequence of their diseases not terminating fatally, considerable uncertainty has attended the diseases ascribed to these structures; but the existence of this luminosity having been recognised, its non-existence or abnormal appearance may enable us to detect changes in these structures heretofore unknown, or

satisfactorily to see those which we only suspected.' Cumming then distinctly pointed out the luminosity of the human eye, the method of observing it, and its true *rationale*. About this time, Brücke arrived at the same result.* His method was to allow the light from a lamp to enter the observed eye, whilst he protected his own eye from the glare by a screen, much in the same way as in Helmholtz's 'simplest form of ophthalmoscope.' He at the same time refers to an observation of Dr. Carl v. Erlach, who simply observed the luminosity of a second person's eye by light reflected from his own concave spectacle lens (which acted as a concave mirror). Both Cumming's and Brücke's principle was for the observer to regard the eye in a direction nearly parallel to the entering (external) rays of light. But it was reserved for Helmholtz, in 1851, to first clearly perceive the true optical relations between the incident and reflected rays, and thus to be led to the invention of the ophthalmoscope.† He used as his reflector a series of thin plates of glass, *correcting the direction of the emergent rays by suitable concave lenses*. Thus did it for the first time become possible to observe the details of the fundus oculi—its nerve and vessels. All previous observations on the human eye had been limited to observing simply its luminosity. Notwithstanding, however, the magnitude of Helmholtz's discovery, the difficulty of manipulation, the feeble illuminating power, and the limited field of view of his ophthalmoscope, would in all probability have restricted its application to that of a philosophical instrument, had not Ruete of Leipsic ‡ given to it its present world-wide diffusion, by introducing two important improvements—1st, the use of concave mirrors as reflectors;

Helmholtz's discovery.

Ruete's instrument.

* E. Brücke: 'Über das Leuchten der Menschlichen Augen.'—Müller's Archiv for 1847, p. 225.

† Beschreibung eines Augenspiegels, v. H. Helmholtz. Berlin, 1851.

‡ Der Augenspiegel und das Optometer, v. C. G. Theod. Ruete. Gottingen, 1852. He says, 'Much more comprehensive and instructive is the view, if we, in the examination of the eye, instead of a concave glass use one or two convex glasses, and thus convert the eye into an astronomical telescope' (p. 9). Helmholtz (op. cit. pp. 24—28) discusses theoretically the application of convex glasses, but does not appear ever to have put them into actual practice.

2nd, the application of a convex object-glass, with which we may view the fundus oculi by its reversed image.

Binocular instruments.

It forms no part of my design to enter into the theory of the ophthalmoscope. Zander, in his work on the Ophthalmoscope*—by far the most complete yet produced—enumerates no less than twenty-seven distinct forms of the instrument, and since several others have been proposed. Indeed, it appears to have been the aim of every ophthalmic surgeon to invent his own instrument, just as every physician does his own stethoscope, every obstetrician his own forceps. A really great step has, however, been made by Dr. Giraud-Teulon, of Paris, who has invented a binocular ophthalmoscope. It would be inappropriate to discuss here the advantages of binocular over monocular vision. Solidity of form, precise localisation of the various objects seen in the fundus oculi, a natural play and entire absence of fatigue to the eyes (as everyone must have felt after any prolonged use of a monocular instrument), are amongst the chief advantages of the binocular ophthalmoscope. Of this I am convinced, that anyone who has once learned to use the binocular instrument will prefer it to the monocular one (except for the direct image).

Giraud-Teulon's instrument.

Giraud-Teulon's instrument is on the combined principles of Helmholtz's telestereoscope (reversed) and Brewster's stereoscope. I have myself improved the instrument, by substituting Wheatstone's principle in its construction. In the 'British Medical Journal' for November 1st, 1862, in a paper on 'Binocular Ophthalmoscopy,' I have briefly described the principle of my binocular ophthalmoscope and the advantages I conceive it possesses over that of Giraud-Teulon's, to whom, however, I wish it to be distinctly understood, the entire merit of the fundamental idea is due.†

Author's instrument.

To expatiate on the inestimable advantages the ophthalmoscope has con-

* 'Der Augenspiegel,' von Adolf Zander. Leipzig, 1862. I may here refer to the excellent work, 'A Practical Treatise on the Use of the Ophthalmoscope,' by my esteemed friend Mr. J. W. Hulke.

† The author's instrument is to be had of Messrs. Murray & Heath, 43 Piccadilly.

ferred on the pathology of the eye—how it has opened out an inexhaustible mine of enquiry; how it has shed its light on an heretofore chaotic darkness; how it has, in brief, completely revolutionised all our preconceived notions of the diseases of the deeper structures of the eye—I hold to be superfluous. But a very striking fact it is, indeed, that the almost unparalleled strides ophthalmic surgery has made within late years, date, by a remarkable coincidence, with Helmholtz's immortal discovery. Nor has the greater part of this progress the most remote connection with or dependence on the ophthalmoscope; on the contrary, it relates to researches in ophthalmology which might have been pursued with equal prospects of success a century ago. Thus has one great discovery given an impulse to an entire science.

Optics applied to the eye.

The analogy of the eye to an optical instrument has from the earliest times attracted the attention of philosophers; hence their efforts to apply the ordinary laws of optics to the resolution of the various problems of vision. By none have these been adapted with greater felicitude than by our great countrymen, Young and Porterfield. But nearly all these researches referred to physiological optics. The study of the pathological deviations of the dioptric system of the eye is of comparatively modern growth. All I know is, that when I was a student, the knowledge I had imparted to me was limited to the fact that concave glasses improve myopia, convex ones, presbyopia, and that the selection of the precise power required for any given case was an entire matter of rude empirical trial.

Donders's researches.

The basis of the exact knowledge we now possess of pathological optics were the discoveries of Cramer and Helmholtz, who have for ever solved the much-vexed question of the adjustment or accommodation of the eye to different distances, when they proved it to depend on a change of convexity of the crystalline lens, and that this was effected by the ciliary muscle. We then come to the researches of Professor Donders, of Utrecht. He, for the first time, insisted on the absolute necessity of separating the two factors,

refraction and accommodation; to adopt the language of mathematics, the 'constant from the variable.' None but those who have intimately studied the subject can form any conception of the importance of this one simple step: of the precision it has conferred on our ideas—how it has smoothed the path for all future researches. Donders recognises three conditions of refraction—1st, normal; 2nd, excessive (myopia); 3rd, deficient (hypermetropia). The first step in the investigation of any given case is to refer it to one of these three classes, then to estimate the precise amount of refraction—the 'power'—of the eye. Having thus determined the constant, we may examine the variable—accommodation—and thus finally form a complete analysis of the case. To adopt a familiar simile—if we wished to investigate the qualities of a telescope, we should first test its powers of defining distant objects, as the heavenly bodies, and then those of adjustment for near objects at variable distances. The first elements of science appear in the form of isolated facts. As these multiply, a kind of mutual connection appears possible. Possibility becomes successively probability; probability, certainty. And thus the individual truths of science, like the wheels and pinions of the engine, become all subservient to one great common end. In no branch of science has this been better exemplified than in what has almost become a speciality of a speciality—viz., our knowledge of the deviations of refraction and accommodation of the eye. Within the last year, Donders has again added to our knowledge of this subject by an elaborate treatise on Astigmatism.

Astigmatism.

Astigmatism (coined by Professor Whewell, from α privativum and στίγμα, point=focus) is an inequality of refractive power in the different meridians of the eyeball—understanding by the term meridian, as in astronomy, a great circle passing through the poles. Practically we may limit our investigations to the horizontal and vertical meridians of the eyeball. Thomas Young, in 1793,* was the first to discover this

* Philosophical Transactions, vol. lxxxiii. p. 169.

peculiarity in his own eye: this 'in a state of relaxation collects to a focus on the retina those rays which diverge vertically from an object at the distance of ten inches from the cornea, and the rays which diverge horizontally from an object at seven inches distance.'* Consequently, the refraction of his globe was greater in the horizontal, than in the vertical meridian. In 1827, Professor Airy published a remarkable instance of the same anomaly in his own (left) eye.† In this, the furthest point of distinct vision for vertical rays was three and a half inches; for horizontal ones, six inches; the eyeball thus being nearly double as myopic in the vertical, as in the horizontal meridian. To Airy likewise belongs the merit of first having applied cylindrical glasses to the cure of astigmatism. This has been shown by exact measurements to depend generally on an inequality of curvature of the vertical and horizontal meridians of the cornea. It may, however, as in Young's case, originate in an irregularity of curvature or position of the crystalline lens. Astigmatism is remediable by cylindrical lenses. These represent sections of cylinders parallel to their axes. Such lenses have the peculiarity of exerting a lenticular (refracting) influence on rays striking them transversely to the axis, allowing those striking them parallel to the axis to pass through no more refracted, than they would be by a piece of plane glass. Thus we may add to or subtract from, by cylindrical, convex or concave lenses, the refractive power of one meridian of the globe, leaving the other unchanged, and thus restore the equality of refraction in the two meridians—correct the astigmatism.

Up to the period of Donders's recent researches, only eleven cases of this optical defect had been recorded. He has shown that astigmatism is really a very common disturbing cause of vision, and that many cases hitherto but imperfectly correctible by ordinary (spherical) lenses, are almost completely so by

* Philosophical Transactions for 1801.

† Transactions of the Cambridge Philosophical Society for 1827, vol. ii. p. 267.

cylindrical ones, either alone or conjoined with spherical ones.*

Conclusion.

After all I have said, no one can fail being struck at the almost incredible rapidity with which discovery has succeeded discovery, in ophthalmic science, within the last ten years. Assured of the fact, he will naturally be led to enquire into the reason. This may, I think, be attributed partly to the attractive nature of the science itself, partly to the genius it has enlisted in its cause, partly to the exclusive nature of its speciality, which thus demands a more than ordinary preparatory knowledge and concentration of ideas for its successful pursuit. What more brilliant example have medicine and surgery to offer of the advantages of specialism? The diseases of the chest, of the nervous system, and lately of the throat, have all been first reduced to states of science by specialists. Without ignoring the advantages—nay, the necessity—of a comprehensive knowledge of general medicine and surgery for everyone, whatever be his special predilection, is it not quite an open question whether the indiscriminate anathemas that have been launched against specialism may not be taken as so much evidence of the narrowness rather than of the assumed comprehensiveness of mind of those from whom they have emanated? Differently constituted minds will instinctively seek different spheres of action. Well-directed intelligence, energy, and earnestness of purpose, will gradually enlarge these spheres by a sort of simultaneous centrifugal expansion of the two elements, mind and matter; whilst, on the other hand, a species of mutual attraction appears to be constantly tending to unite these separate spheres into one harmonious whole, whose ultimate form or dimensions are as impossible to foresee, as the bounding horizon of the ocean for the mariner to measure—that perpetually expanding circle, whose limits the waves never reach, the eye never spans.

* Astigmatismus und Cylindrische Glaeser, von F. C. Donders. Berlin, 1862.