On the Varieties and Etiology of Cataract in Children and Adolescents, with Notes on Cases. By William Eadie M.B., Ch.B.,

The following is a General Classification of the different forms about to be described:

I. Congenital Cataract: That is cataract due to maldevelopment or to intra-uterine inflammation of the eyes. It must be present at birth, however, although it is often not recognised until sometime afterwards; it is generally bilateral; and the following kinds will be dealt with:
   (a). Total Bilateral, discovered at birth.
   (b). Fusiform, spindle-shaped or Axial.
   (c). Central Lenticular.

II. Anterior Polar Cataract: by which is meant an opacity occurring,
either in connection with the anterior central part of the capsule or involving the anterior polar part of the cortex; this variety may be either acquired or congenital.

III. Lamellar or Zonular Cataract: this is a condition consisting of opaque zones, or of a single zone, in the substance of the lens situated between the nucleus and the more peripheral layers of the lens and may be either acquired or congenital.

IV. Posterior Polar Cataract: this is due to an opacity occurring at the posterior part of the lens, either on the capsule there or in the posterior cortical layers of the lens; this again, may be either acquired or congenital.
V. Punctate or Stellar Cataract: These which usually occur together are formed in the substance of the lens; they are apparently very common and may be either congenital or acquired.

VI. Complete Spontaneous Cataract in the young: this is an exceedingly rare condition and is, from its name, obviously acquired. When it occurs in adolescents it is very often associated with Diabetes Mellitus.

III. Traumatic Cataract: does occur in young people, and in connection with it, it must be noted that the lens capsule in the child is thinner than in the adult and therefore more easily ruptured.
Total Congenital Cataract:

Although congenital cataract is, as a rule, partial, total cataract may be observed at birth or very soon afterwards. It is nearly always bilateral and generally blueish-white in appearance (Higgins, Ophthalmic Practice, p. 174), and of course distinctly soft. The centre or nucleus may become hard, and the perinuclear material soft or even fluid, producing a mobile nucleus, known as a "Morgagnian Cataract," as described by Becker and quoted in Norris and Oliver's System of Diseases of the Eye, vol. 4, page 339. The nucleus may become absorbed or even undergo calcareous changes; this latter condition tending more to occur in the young (W.D. 17, 313). The suspensory ligament may be very thin or may be so incompletely developed that the cataractous lens has been found to be dislocated.
There is often in the child other congenital defects, such as microphthalmos, congenital amblyopia, or choroiditis disseminata which suggests at once congenital syphilis (Syphilis by Hutchinson).

These children generally have nystagmus (Becker) as a prominent symptom, as one would expect.

**Fusiform, Spindle-shaped or Axial Cataract.**

This is a very rare condition and always congenital. It consists of opaque lens fibres in the shape of a spindle in the axis of the lens extending from the anterior to the posterior pole. It is usually associated with other lens changes such as, zonular cataract, anterior or posterior polar conditions, or even a central lens cataract. The affected fibres are less elastic than the normal lens fibres and may therefore interfere with the
alteration in the shape of the lens during accommodation (Krömer H. C. iv. 833)

Mention may here be made of two theories which have been put forth in explanation of the origin of this variety of cataract: (a) According to Norris in H. C. iv. 333, the opaque fibres in the axis of the lens, which are derived from the centre of the posterior wall of the primary lens vesicle, and which, according to Shäfer and others, grow towards the anterior pole of the lens, were badly nourished when they were being put down and so they became opaque. (b) Hess in the same work, H. C. iv. 333, is quoted as suggesting that the condition is due to delay in the closure of the hollow vesicle (lens) which has grown in from the layer of epiblast.
Central Lenticular Cataract.

This variety, described in H. O. H. p. 339, consists of an opacity in the very centre of the globular lens of the child, here are situated the oldest fibres which, as before mentioned, came from the posterior wall of the lens-vesicle. The condition is bilateral, remains partial and has no tendency to progress.

It would appear that the new fibres which are laid down do not degenerate after the period of malnutrition which affected the early-formed lens fibres, has passed. Again, it might be due to the persistence of those cells of the papillary elevation on the anterior aspect of the posterior wall of the lens-vesicle which, according to Schäfer (Darwin's Anatomy) become separated from the posterior wall and disappear entirely.
Anterior Polar Cataract

In this variety the opacity is either on the anterior lens capsule at or near its middle, this being the capsular variety; or there takes place a subcapsular cell proliferation (Fuchs p.487) which invades the lens substance, this is the cortical variety and the true anterior polar cataract.

Anterior polar cataract is dead white in appearance and is usually well defined though it may be somewhat irregular; as a rule it is stationary and does not tend to progress (Fuchs p.369).

There are two varieties namely the congenital and the acquired.

(a). The congenital variety begins during intrauterine life and may arise from the remnants of the vascular pupillary membrane which originally surrounded the capsule and nourished the developing lens fibres; should the anterior
portion of this membrane not become completely absorbed, a very common condition according to some authorities, it will remain in the pupillary area though on a slightly posterior plane to it and lying anteriorly to the lens capsule becomes adherent to it, and will thus produce a somewhat ill-defined anterior polar cataract.

Intra-uterine iritis may occur which causes a well defined sub-capsular cell proliferation which invades the cortical part of the lens substance. Becker points out (I. t. 11. 305) that these round cells, which are derived from those cells lining the lens capsule may develop into spindle-shaped cells. This organised tissue pushes forward the anterior lens capsule, producing thus a pyramidal protrusion, hence the term pyramidal cataract.

In this connection it must be remembered that in the
entry, the lens is globular in shape and in close contact with the posterior surface of the iris, and also in opposition with the posterior surface of the cornea, there being therefore practically no aqueous chamber present; this will account for the fact that intra-uterine cataract which is usually bilateral, causes the lens changes described above.

There is yet another cause of sub-capsular cataract of the anterior polar variety, the pathology of which is similar to that of posterior polar cataract associated with choroidal disease (Fuchs p. 406): the anterior part of the capsule-pupillary membrane is partly nourished through the vessels of the ciliary region, intra-uterine cyclitis is therefore liable to interfere with the nourishment of the cells of the anterior part of the lens capsule, the lens
fibres which are put down by
these cells may therefore become
opaque.

(6). The acquired variety of
anterior polar cataract usually follows keratitis asso-
ciated with ophthalmia-
neonatorum or it may be
due to the perforation of a
corneal ulcer: as to the latter
Kries states that the contact
of the lens capsule with the
edges of the perforation of the
ulcer for a few days is suffi-
cient to cause it. (W. O. 17. 6303)
The corneal inflammation spread-
ing to the lens capsule causes
the subcapsular proliferation
of cells in the lens substance
and as before stated the lens
in quite young children being
globular and in contact with
or adjacent to the posterior
surface of the cornea, if the
ulcer in the cornea perforates,
permitting escape of the aqueous fluid, the anterior surface of the lens capsule will come into direct contact with the edges of the ulcer, and the resulting proliferation may amount to a pyramidal cataract. This form is larger and whiter and more defined than the congenital variety.

Sclerotic, Zonular or Perinuclear.

This is the form which is most frequently found in children, it is as a rule bilateral, as one would expect from its etiology. Berry states that it is most frequently congenital (p. 168) and judging from the relative size of the cataract and that of the lens at birth, this is so. Until Becker (U. S. N. N. p. 337) published his case — where Zonular
cataract was observed by the parents immediately after birth and he himself then minutely examined the eyes—there was no general belief in foetal cataract in this form. Focal cataract may be acquired however, for Grafton has reported a case due to iritis and synechiae, and other observers cases due to corneal ulceration (N.Y.O. vol.1).

The opacity or opacities exist between the clear cortex and the transparent nucleus. The opaque portion consists of lens fibres which have undergone granular degeneration accompanied by interstitial vacuolation (N.Y.O). In the congenital variety the lens is occasionally found partially dislocated generally in an upwards direction.

Three distinct conditions may exist as follows:—(1) One or more opaque zones in the lens, one
is the commonest form, yet two or three may be present, and these may be either complete or incomplete zones. (b) A circular opaque disc may be seen with radiating striae from its periphery, running towards the margin of the lens, which are called "rider," and according to Berry (p. 107) they are due to commencing opacities in the equatorial zone of a more peripheral layer of the lens, they are therefore of clinical importance indicating progression of the condition in all probability. (c) A zonular condition accompanied by an axial spindle-shaped opacity of the lens (see Liebreich's fig. 44, Vol. IV, p. 334)

It has been shown by various observers that the vacuoles mentioned before are filled with fluid or granular hyaline substance.
According to Lawson, the eyes are often small and ill-developed, with the iris immobile and inactive to adopting a condition he considers, due to maldevelopment of the iris or to faulty nerve supply. The cataracts are generally discovered when the child is beginning to learn to read and therefore about 5 years old.

The child is often myopic and there is, as a rule, a history of "fits," which may be associated with "teething," errors of diet, constipation, infantile diarrhoea, and such conditions that one might expect to produce a condition of toxæmia from the alimentary tract, and it is here interesting to note that if the condition of the lens is due to the absorption of the products of malnutrition
that the process of absorption is much more active in the young lens than in that of adults, according to the researches of H. Prince-Jones. In his experiments with lithium chloride on pigs, mentioned in N. T. T. 1976.

The various authors all seem to attach much importance to the occurrence of Ricketts in these children, a condition which really amounts to malnutrition.

In connection with the "fits" as a causative agent of the cataract it has been suggested that spasms of the ciliary and external ocular muscles may cause injury to the lens or its capsule and malnutrition of the lens fibres which are those of the superficial Zone at the base (Arlet & Knies in N. T. T. 1976, p. 337).

An interesting point is the
evidence of the maldevelopment affecting chiefly those structures which are derived from the same embryonic layer as the lens itself, that is from the epiblast, for instance, the teeth are marked by deficient in enamel, which is pitted, eroded and transversely ridged, with their cutting edge often serrated and irregular. The enamel instead of gradually tapering away at the neck of the tooth is seen to end abruptly there. This condition is manifest both in the temporary and permanent teeth and the upper incisors seem to be the ones most markedly and oftenest affected, although Berry (p. 170) states that he has observed the canines to be most frequently affected, and in one of his unilateral cataract cases the canine tooth on the same side exhibited this faulty condition.

The hearing is often impaired in these children and as the
essential part of the organ, that is the epithelium of the external ear, is developed much in the same way as the crystalline lens, the probable cause is obvious.

The cerebral tissue is no doubt also imperfectly developed, as is manifested by the relative small size of the head, but the outstanding feature is often the great mental deficiency. Some of these children are very backward at school and one finds a boy of 17 years with the mental capacity of one of 12 years. At the same time one must keep in mind that on the other hand the head is often larger than normal no doubt due to the accompanying rheumatic condition.

The skin is often rough and pitted, especially on the forehead and cheeks.

In considering the morbid anatomy of this type of cat-
aract one would be inclined to look upon the convulsions as the result of the interference with the nutrition of the cerebral cells during the period of faulty metabolism and which causes the changes in the recent zone of lens fibres at the same time, rather than setting the "fits" down as being the cause of the cataract, though one must admit that the theory of Arlt and Kniez as to the spasm of the internal and external ocular muscles as causing the injury to the lens is perhaps more than entertaining.

Posterior Polar Cataract.

In this form of cataract the opacity may exist on the posterior pole of the lens, that is a posterior polar cataract.
of the cortex, but more commonly it occurs on the posterior aspect of the capsule; occasionally there exists a cone-shaped process extending from the posterior pole into the vitreous. There are two varieties of this form namely the congenital and the acquired.

The former exists as a well defined dot at the posterior pole that has this appearance: \( \odot \) (Fuchs p. 406), it is usually associated with a persistent hyaloid artery (Berthold as quoted by N. T. C. II. p. 333). In this connection it is interesting to note the changes which normally take place in this artery during development; the following diagram helps one to understand the condition:

(Diagram Modified from Quain's Anatomy)
In the embryo the central artery of the retina runs forward thro the vitreous as the hyaloid artery transmitting blood to the capsule-papillary membrane which surrounds and nourishes the globular fetal lens (Schräper in Traut's Anatomy); the membrane also obtains blood from the cuneal vessels which are distributed to the ciliary body and the iris; the importance of this has been mentioned in discussing the etiology of anterior polar cataract. The tunica vasculosa lentis usually disappears after the seventh month of fetal life in the human embryo (Ryder), Schütz states that it only disappears in full term children, a few days prior to birth; its persistence is often accompanied by other conditions of arrested development and most probably occurs in all premature children and in full term
twins or triplets.
When persistent it may be
as a functioning vessel carrying
blood to the posterior aspect of
the lens, as a lymph tract or as
a mere fibrous cord.

The cataract accompanying
this anomalous vessel is as a
rule non-stellate & well defined:
it may however, show slight
ramifications in it which
suggest the remains of atroph-
icd blood vessels.

The acquired variety of posterior
polar cataract is generally
stellate in shape with fine
radiating striations (Fuchs 406);
this condition is, according to
Juler (Ophthalm. Practice p.369),
generally associated with inflam-
atory or degenerative processes
in the fundus.

It is interesting to consider
why inflammatory & degenerative
processes are associated with
This condition: In this connection, it must be remembered that the vitreous and the crystalline lens depend upon the vessels of the retina and the choroidal tract for their nourishment after the disappearance of the capsule-papillary membrane. Most of the fluid which nourishes these two structures, according to Teachher Hollins, comes from the ciliary bodies; should there be any diseased condition of them, there will be some alteration in the character of the secretion which, according to the laws of pathology, will lead to the malnutrition of the vitreous humour and the crystalline lens.

Hartridge (Refractors of the Eye p.148), states that in cases of progressive myopia the nutrition of the lens may suffer, opacities forming in it, especially at the posterior pole.
Punctate, or Stellar Cataract.

Pulvermacher, as quoted by W. T. T. T., p. 186, states that in 60 children under 10 years, with normal eyes, the magnifying glass behind the mirror showed lens opacities in 43%: this somewhat surprising statement is backed up by the authors. This form of cataract is not unusual; therefore, it is congenital although not discovered until young adult life, if at all. The distribution of the opacities must be of clinical importance, as regards their effect on vision, if at the periphery of the lens they may not produce any symptoms.

Very rarely are stellar opacities in the lens, as described by Liebreich and by Has-ner (W. T. T. T. p. 338), associated with minute dots which are arranged in a star-shaped
manner & showing the original lens sectors on the anterior and posterior surface—it may be accompanied by Zonular cataract. It is as a rule congenital & associated with other abnormalities: there is such a case accompanied by aniridia referred to in Morris & Olivier's book, v. 10, p. 338.

Complete Spontaneous Cataract of Young People.

Dr. Swainzy and other authors mention this form. It occurs just after puberty or during early adolescence; it forms rapidly & is therefore of soft consistency. The cause is not known but it has been found in young people suffering with Diabetes Mellitus which suggests alteration in the character of the nourishing fluid of
the lens. It is very rare and of course symmetrical.

Traumatic Cataract.

It is usually unilateral and due to either a penetrating wound which exposes the lens fibres to the action of the aqueous fluid, or it may be the result of concussion. Should it be due to the former there is generally evidence of the cause in the shape of a corneal wound which may be accompanied by an iridocyclitis and increased intra-ocular tension.

A blow or concussion in the region of the orbit may bring about the formation of a cataract by rupturing the lens capsule, the rupture occurring either on the anterior or the posterior aspect of the lens.
Cataract has followed a blow where no rupture could be made out, yet it is always possible that a posterior partial rupture may be present (Fuchs and H.T.O. 121 p. 3146). This will be more likely to occur in a child than in an adult, being due to the delicacy of the capsule, and oftener on the posterior aspect on account of the capsule being thinner there than anteriorly.

In these posterior ruptures, the fluid makes its way in from the vitreous chamber, this fluid being originally derived from the ciliary processes (Brecher Collins).

**Nystagmus:**

This is a common affection in children suffering with cataract, especially when
The opacities are in the central axis of the lens, where they will necessarily interfere with macular vision and the child is unable to acquire fixation properly. Nystagmus does not develop should the child be born blind or become so very early, nor does it develop should blindness come on very late in life, owing to the fact that in the latter case, that the individual has acquired the power of fixation prior to the blindness (Tichenor 1859).

It is important to remember that nystagmus is seen in other conditions in the young, for instance, in disorders of the central nervous system such as: Friedreich's Ataxia, Disseminated Sclerosis, which is most commonly found in young people (Oster). It also occurs in children suffering with morbid conditions of the
fundus of the eye, such as Disseminated or Central Chori
citis, and Pigmentary Degenera
tion of the Retina. It may be
seen where there is interference
with vision due to Central
Corneal nuclei & such-like.
Berry states that it is seen
in Albinos.

Nystagmoid movements oc-
curring in children, have been
seen, due to their copying
the true affection, which may
have existed in an adult
with whom they are in close
contact with, from day to day.
The following are the chief works consulted, and referred to in the foregoing:


II. Ophthalmic Science & Practice: Juler.

III. Diseases of the Eye: Berry.


V. Handbook of Diseases of the Eye: Swanny.

VI. Ophthalmic Practice: Higgins

...and others.
Notes on
Cases of Cataract in
Children.
Edith Roberts.  
9 William Road.  
Wimbledon.  

Age 8 years.  

Complaint: The child's mother states that she noticed that her 'eyesight was failing' two years ago and that she has been getting rapidly worse since she had Scarlet fever in 1903.

Family History: She is the eldest child; her father is living aged 33 yrs, he is a strong, healthy looking man, with no history or signs of any venereal disease. He has a periodic periodic shabismus of the left eye; there is no amblyopia. His family history is good.

Her mother is living, aged 31 years, who is an anemic & delicate looking woman, she has had four children but no mis-
carriage. There is nothing remarkable about her. Her family history is good.

The other children are healthy with no evidence of eye trouble or any history of convulsions.

Previous Illnesses & Accidents:

She had convulsions at the age of 6 months, at the rate of 5 or 6 per diem, for 7 days, which were supposed to arise from "overfeeding," she being fed artificially; she had also one fit at 9 months.

She was persistently constipated as an infant; and had whooping cough at the age of 12 months. Measles in 1900, Rickets in 1903, and Scarletina in Aug. 7 Sept. 1903.

History of Present Trouble:

Two years ago it was noticed
That she failed to see obstacles in her path and this has become more marked since the attack of scarletina.

The child declares that she sees better under the influence of atropine.

Her head perspires at night.

**General Appearance:**

She is small for her age, yet a fairly healthy looking child; she is intelligent and spells and counts well.

She does not exhibit any signs of previous pockets.

Her skin is rough and pilled on the cheeks and forehead.

**Head:** the forehead is high and tends to squ aweness, the circumference is 19½ inches.

**Mouth:** the palate is high and the arch tends to the Gothic. There is no signs of adenoids.

**Teeth:** the upper permanent
incisors are present with her other temporary teeth - both are markedly deficient in their enamel, the surfaces being eroded, pitted and ridged and their biting edges serrated.

Ears: at times she appears not to hear well.

Eyes: They are well formed and present no evidence of external disease. The pupils have readied to atropin fully and equally. She fixated with her right eye constantly, possesses only slight power of convergence and exhibits nystagmus on extreme movement.

The tension is normal in both eyes. With the distant type she reads 6/40 in both. Her pupils previously to the instillation of atropin were active and equal. Under atropin she sees 6/40 in both and is unimproved with plus or minus, or the pin-hole test.

With the oblique illumination
there is a tangential opacity to be made out with radiating striae (ridges) towards the periphery, which are well marked at 8 oc in both eyes. The opacity is much denser in the left eye.

There are no anterior posterior or nuclear changes to be made out.

Transillumination: There is no opacity in the media other than that of the lens, the fundus is clear; the cataract is more evident in the left than in the right eye.

The striae (Richterchen) are to be seen in the left eye at 12. 14. and 8.0%, and in the right eye at 8.19%. 

Woodgate Row.
Epsom, Surrey.

Age 16 yrs.

Complaint: he has had difficulty in seeing from early childhood, and has always been backward at school, reaching only the second standard.

Family History: his father is alive and aged 44 years; he is a strong, healthy man, with no eye trouble and no evidence of "specific" trouble.

The mother is also alive, aged 40 yrs; she enjoys good health. Has had 7 children but no miscarriages.

The remaining children are healthy with no peculiar defects or history of "fits."

Previous Illnesses and Accidents: he had convulsions when eighteen months old; they were severe and extended over a period of a month. He had Rotheloia when 3 yrs old; there
is also a history of infantile diarrhoea.
He had head-sweating, but no other evidence of rickets is forthcoming.
When two years old he had a severe fall, which was followed by symptoms of concussion.
His mother, when eight months pregnant with him, had also a fall.

**General Appearance.**

He is a delicate looking boy who is manifestly mentally deficient, small and ill-developed.

**Head:** It measures in the circumference 21 inches.

The forehead is high & square. His face is relatively small. The skin on the forehead & cheeks is rough & pitted.

**Month:** The palate is distinctly high & narrow; while the teeth exhibit deficiency in the enamel, being characteristically pitted, eroded & grooved on the surface with their edges serrated; this is especially marked in the upper incisors &
Eyes: They are small but well-formed and show no external evidence of disease. The movements are good. The pupils are fully and equally dilated under atropine.

In both eyes the tension is normal and on trying the distant type he reads 6/60 in both and is unimproved with plus or minus lens or the pin-hole test.

They both exhibit lamellar cataracts with irregular stellate changes at the anterior poles and typical "riders" at the periphery accompanied by posterior capsular stippling. The anterior polar condition suggests persistence of the capsule-pupillary membrane.

The axes of the lens appear to be normal. The media are clear at the fundus, and discs are normal. He is apparently emmetropic. The upper and lower parts of the cone present crescentic areas of opacity.
in both eyes.

The whole condition is more distinct
and advanced in the right eye.
William E. Burbaw.  
Feb. 1904.  
3 East Ave Sheet  
Wandsworth  
Age. 3 years.  
Complaint: Difficulty in seeing objects & falling over slight obstacles in his path.

Family History: There is nothing of note in his family history. His father and mother being strong & healthy. He is the only child.

Previous Illnesses & Accidents: He was late in attempting to walk. He had bronchitis at "teething" also whooping cough and croup. There is no history of fits or any injuries to be elicited.

Personal Appearance &: He is quite a healthy looking child, who is extremely well nourished and shows no evidence of rickets. His intelligence seems to be below the normal.  
Head: it is well formed, with a
circumference of 19 inches.

The skin is rough & coarse.

Month: The palate is well formed. The teeth are very much decayed, especially the upper incisors and first molars with evident prenatal deficiency.

Ears: No deafness can be made out.

Eyes: They are well formed, with pupils dilated fully & equally under atropine.

On examining the right eye with the oblique illumination a milky white lamellar cataract is seen accompanied by a distinct circular dead-white anterior polar opacity. There is no riders to be made out. The media is clear and the fundus reflex present.

The left eye presents similar changes with the exception that the anterior polar cataract is distinctly seen in outline.