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THE PERIOPTIC ATROPHIC RING AND ITS RELATIONSHIPS *

BY

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EXETER

THIS paper embodies the results of an investigation into the cause of atrophic rings which are occasionally found around the optic disc. No attempt has been made to find out the rarer cases of this, only the ordinary cases such as occur in every-day practice have been considered. In effect this has confined the paper to glaucoma, cavernous atrophy, and a certain kind of retinal atheroma. Of two cases of macular degeneration in this period, one pair of eyes were otherwise normal the other had narrowed vessels, neither had atrophic rings; they are not included in this paper.

The material studied was the eyes of 826 consecutive patients over 50 years of age. This group was a random group as far as the writer is concerned but not on the part of the patients. They were private patients, and were self selected on the grounds of finance, symptoms and social inclination, including in the last heading the fact that in private practice the women outnumbered the men far out of proportion to their proportions in the general population of the same age group. This is well shown in Table I, which is a comparison of the numbers of the two sexes in the 826 group at different ages with the percentages in the various age groups in Great Britain in the 1940 Census estimate. Taking 1 as the unit

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for men, it will be seen that in the 826 group the figure for women is 2.17 as compared with 1.34 in the Census. The figures must be taken with this being borne in mind. In Table II to give a comparison of the incidence of the three conditions dealt with, the figures for men are multiplied by 566/260; so that the figures for men are as if for 566 men, the number of the women in the whole group.

TABLE I
Group of 826 patients

All ages			Males	Females	Totals	Males 100 per cent.	Females 100 per cent.	Totals 100 per cent.
51-60 yrs. ...	...	...	89	205	294	8.9	9.8	9.5
61-70 ...	...	...	94	199	293	9.4	9.5	9.5
71-80 ...	...	...	63	123	186	6.3	5.8	5.8
81-90 ...	...	...	13	36	49	1.3	1.85	1.5
91 ...	...	...	1	3	4	0.1	0.15	0.2
Totals ...	...	...	260	566	826	26.0	27.1	26.5
<i>Census groups—1940.</i>								
50-59 yrs. ...	...	...	—	—	—	12.0	12.0	12.0
60-69 ...	...	...	—	—	—	9.0	9.0	9.0
70-79 ...	...	...	—	—	—	4.1	4.8	4.4
80-89 ...	...	...	—	—	—	0.9	1.3	1.1
Totals 50-89 yrs. ...	...	...				26.0	27.1	26.5
All ages ...	...	...				100 per cent.	100 per cent.	100 per cent.

Table I is also to try out whether the age sex groups in the cases dealt with are near those in the general population for the same ages. The total percentage of the case population is taken to be the same as that of the same age groups in the 1940 census estimation, and the percentage of the different ages calculated. It will be seen that at about 70 years the percentage is about the same as the general population, at an earlier age it is decidedly less, after 70 it is rather higher. The comparative freedom from disease in the earlier period, and its greater incidence in later years will explain the discrepancy.

The type of retinal atheroma dealt with is that in which the vessels are straight and narrow. In this form the fields are often contracted, sometimes irregularly so. There is usually no haemorrhage nor any white spots in this type, and this was so in the group presented here. The symptoms are minimal, the patients often

see well but tire easily when reading. During circulatory failure vision may be affected, varying with the condition of the heart.

The narrow white ring around the optic disc and contiguous to it is a well known condition. W. A. Frost gave illustrations of it as it appears in chronic glaucoma (*Fundus Oculi*, ed. 1896, Figs. 105-6-7.) His outlines are rather too smooth; of the apparent size of one to two millimetres, its outline is usually crenated. It may extend around the whole disc or, if not complete, be in one or more portions. In this paper it is measured by the clock hours it subtends. If it is in two or more portions these are added together. Thus a complete ring is recorded as 12, its absence as 0.

The fields in glaucoma and cavernous atrophy are given as the average radii of the 3/1000 white field, the normal being 41° . The blind spots are similarly shown, by the angle of the average of eight radii, the normal being 5° .

The eyes are classified according to the presence or absence of atrophic rings, and the normality or narrowing of the retinal vessels. The narrowing of the vessels is not always present in equal amounts over the retina; it may affect some vessels or parts of some vessels; if it is present in any part that eye is classified as having narrow vessels.

TABLE II (Persons)

Corrected for sexes—566 men and women

MEN—						
Diseases	Ages	51-60	61-70	71-80	81-90	Totals
Cavernous Atrophy ...	...	—	—	—	—	—
Glaucoma ...	...	—	2'14	4'28	—	6'5
Retinal Atheroma ...	...	—	11'0	6'5	—	17'5
WOMEN—						
Cavernous Atrophy ...	...	1	2	3	—	6
Glaucoma ...	...	1	2	—	—	3
Retinal Atheroma ...	...	1	2	3	1	7
		Men	Women	Chance		
Retinal Atheroma		17'5	7	1 in 80	Highly significant	
Cavernous Atrophy		0	6	1 in 64	Highly significant	
Glaucoma		6'5	3	1 in 4'2	Not significant	

From Table II it may be deduced that, while glaucoma is not specially more frequent in one sex than the other, retinal atheroma is decidedly more frequent in men than in women, while the reverse is the case with cavernous atrophy.

Table III shows the classification of the cases according to the diseases and symptoms. There were 26 persons in the 820 cases who had 50 affected eyes; one eye having cataract, another was normal, these two are not included.

TABLE III
NO RINGS

Cavernous Atrophy	Normal vessels			Narrow retinal vessels	
Case Nos. ...	1	2	3	4	5
3/1000 field radius ...	40	20	20	29	16
Blind spot radius ...	Ann.	5'8	B.O	5'8	Ann.
Glaucoma					
Case Nos. ...	6	7		8	9
3/1000 field radius ...	26	too small		34	4
Blind spot radius ...	5	B.O.		5'8	too small
Retinal Atheroma					
Case Nos. ...				10-22 incl.	

ATROPHIC RINGS.

Cavernous Atrophy				Normal vessels										Narrow retinal vessels							
Case nos.	...	...	23	24	25	26	27	28	29	30											
3/1000 field radius	...	...	29	36	34	30	25	25	4	0											
Rings blind spot rad.	...	...	5'0	5'0	8'2	6	6'6	6'6	BO	too small											
Rings	...	...	6	6	7	10	7	8	3	7											
Glaucoma																					
Case nos.	...	...	31	32	33	34	35	36													
3/1000 field radius	...	...	25	25	17	20	9	2													
Blind spot radius	...	...	too small	BO	BO	BO	too small	BO													
Rings	...	...	7	12	8	12	12	12													
Retinal Atheroma																					
Case nos.	...	...				37-50 inclve.															
Rings	...	...				3	3	4	5	5	5	5	5	5	5	5	6	6			
						7	10														

In the table a difficulty arises in the recording of the blind spots, because the worst cases have the blind spot broken out through the 3/1000 isopter, when it is recorded as BO, or there is an annulus from the blind spot around the fixation point, when it is marked "ann," or the isopter has receded within the latitude of the blind spot, when it is marked "too small." The following is the dominant feature of the table; of the eight cases of cavernous atrophy seven have narrow vessels, only one has normal. This gives a chance happening of one in 32, a decidedly smaller chance than the 5 per cent, which is the usual limit of chance employed; so that there must be some causal relationship in this coincidence.

By definition all the atheroma cases have narrow vessels, that is the sign by which they are identified; of these fourteen have partial atrophic rings, thirteen have none. Whereas the incidence of rings in the whole group of 1,640 eyes is 28, within the atheroma group it is 50 per cent. Obviously this is statistically significant in relation to the 1,640 eyes, there is a causal relationship between the atheroma and the rings.

The other groups are small and well divided between the narrow and the normal vessels.

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Serial Nos.	Increase in rings from	to	No. of years after operation	Vessels	Age at first visit
GLAUCOMA					
51	3	9	3	normal	57
52	0	12	6	normal	66
53	0	4	6	normal	65
54	0	8	6	normal	65
55	0	0	21	normal	61
56	0	11	21	normal at 0 yrs. narrow at 2 yrs.	61
33	12	12	9	{ normal at 0, narrow after 9 yrs.	68
34	12	12	9	{ normal at 0, narrow after 9 yrs.	68
<div style="text-align: center;">No. of years after first visit</div>					
CAVERNOUS ATROPHY					
38	3	12	14	normal	61
59	0	12	14	normal	61
60	0	6	1	normal	70
61	0	6	1	normal	70
57	7	12	6	normal	74
25	4	12	4	normal at 0, narrow after 4 yrs.	74
26	12	12	6	normal at 0, narrow at 6 yrs.	74
4	0	0	5	normal at 0, narrow at 5 yrs.	68
29	0	3	5	normal at 0, narrow at 5 yrs.	68
2	6	10	2	normal at 0, narrow at 2 yrs.	59
3	0	6	2	normal	59
RETINAL ATHEROMA					
20 (Rt.)	0	—	—	{ Rt. vessels not so	83
38 (Lt.)	3	—	—	{ straight as the left	83
50	10	—	—	{ R. All vessels narrowed	70
44	6	(from 3.0 to 9.0 o'clock)	—	{ L. Only inferior vessels 70 narrowed	70

Bracketed numbers are in the same person.

The glaucoma cases are interesting because the changes happened after operation, some of them after many years. It may be assumed that they are the consequences of glaucoma because of the improbability of the coincidence of the increases of the rings and the narrowing of the vessels as an accident in the glaucoma as compared with the likelihood of them being causally related to it. From this it follows that the relief of pressure does not always give complete exemption from the consequences of the pressure. In the group of fifty eyes there are 24 which show both rings and narrow vessels, these occurring in 826 persons and 1,650 eyes, one to 69 eyes. Taking from Table IV the cases which belong to this group, these give ten eyes, of which five have rings and narrow vessels. Obviously a fifty per cent. incidence is quite out of keeping with the general incidence of one in 69, and calls for an explanation, relating the glaucoma to the rings and vessels, and for not considering the coincidence as a mere chance.

In the eleven cases of cavernous atrophy showing changes in the rings five showed vessel narrowing; a similar reasoning applies to this group as to the cases of glaucoma.

Can narrowed vessels in the nerve head account for the atrophic ring? The nerve head is supplied by branches from the Circle of Zinn, derived from the posterior ciliary vessels, not from the retinal artery. Thus it would not be expected that the correspondence between the condition in the retinal vessels and the branches of the Circle of Zinn would be absolute. Whether in the form of atheroma now being dealt with, or in the more common form with unnarrowed vessels, it is frequently found that the retinal vessels in the same eye are unequally affected, and that this may remain so for years, while the other vessels of the body may show distinct signs of increase of atheroma. So that a moderate coincidence of rings and narrowed retinal vessels is all that can be expected, granted that the rings are the consequence of narrowed branches of the Circle of Zinn; and that obtains in the present cases.

In glaucoma, pressure from increased tension would tend to narrow the vessels, not so in the other two diseases; in those the action must begin in the vessels themselves, the atrophic ring resulting from the poor nourishment following upon partial or complete obliteration of the vessels. If this be granted, may not the whole picture of cavernous atrophy also be a sequel to a widespread affection of the Circle of Zinn? The association of narrowed retinal vessels with this disease has been shown in Table III to be very close, so close as to require some common cause. It is difficult to see anything that would do this, apart from the narrowing of the vessels in the nerve head. In Schnabel's description of cavernous atrophy he considered the loculi he found in the nerve head, which preceded the formation of the deep cup, as a glaucoma effect. It

is very difficult to see how a uniform pressure, exerted by a viscus vitreous of increased tension, could induce loculi in the substance of the nerve head. Remembering that his work was done before the use of the tonometer, and if his work was done on chronic cases without an acute ending, is it not likely that he was deceived by his fingers and that there was no rise of tension in the cases he observed? If this possibility be granted, as I have assumed in previous papers, his description would apply to the cases here called cavernous atrophy; a partial or complete deprivation of blood would account for the formation of the atrophic rings. The incomplete rings are accounted for by separate vessels, branches of the Circle of Zinn being affected, increase of the rings by other branches becoming involved, the separate portions by branches being affected which are not contiguous.

The effect upon the size of the blind spot is seen in Table III. This has not been taken for the atheroma cases. One of the nine other cases without rings has a normal blind spot, two of the ring group have normal sizes; there is nothing decided between the two groups, the majority in each class are enlarged. The effect upon the blind spot may be summarised thus:—

Increased size of measurable B.O. too small annulus blind spots

No rings	...	4	2	1	2
Rings	...	6	5	3	—

Fourteen out of 27 cases of atheroma have rings. As no special supervision was required in these cases, as in the other two groups, their fields were not taken, and the time elapsed has been too short to study changes. In one case one eye had no ring and its vessels were not so narrow as in the other eye, which had a three ring. In another case one eye had a ten ring with all the retinal vessels narrowed, and the opposite eye had a 6 ring from 3 o'clock to 9 o'clock, with only the inferior vessels narrowed.

In a third case an interesting coincidence was found. Both eyes had narrow vessels. The right eye had a 4-ring and a 50 per cent. cup, the left eye a 12 ring and a 100 per cent. cup; it was a case of cavernous atrophy. A coincidence such as this is, of course, a possibility; its occurrence as a mere matter of chance is very remote, as the following calculation will show:—

Total number of persons concerned	...	...	...	820
No. of cases of cavernous atrophy with rings and narrow vessels	...	...	...	6
No. of cases of atheroma with narrow vessels	...	...	...	15
Chances of this combination in cavernous atrophy—	$6/820 = 8 \text{ in } 136$			
Chances of this combination in atheroma—	$15/820 = 8 \text{ in } 54$			
Chances of this combination in the same person—	$1/136 \times 54 = 1 \text{ in } 7,344$			

That is, the probability of these two events as chances in the same person, in the population dealt with in this paper, is so small that it can be neglected. It is almost inevitable that the two conditions are causally related. The only lesions known common to these two conditions are the narrowed vessels and the rings. If the latter is in an effect of the former, the cavernous atrophy may also be presumed to have the same cause, the narrow branches of the Circle of Zinn. Here the irregularity of the incidence of the affection in the retina may be called in to explain the great differences in the amount of the ring and the extent and incidence of the field loss.

Is there any relation between the normal increase of the optic disc cup and the ring and cavernous atrophy? In 1921 (*Proc. Roy. Soc. of Med.*, Vol. XIV, 1921. *Sect. Ophthal.* pp. 57-66) I showed that a comparison of the size of the disc cups at different ages in a large group warranted the assumption that the cup increased in size with age. Experience has shown that this is a nearly universal rule, though the time rate and the amount vary greatly in different cases. In some the increase is so great that only the recording of the fields and tension can decide whether the cup should be considered pathological or normal. In its early stages this enlargement certainly cannot be considered as pathological, it is a normal occurrence; after middle life it must be considered in conjunction with the field and central vision. But the change to cavernous atrophy is uncommon, it must be presumed therefore that the intervention of some other factor causes the change. An irregular incidence of atheroma in the branches of the Circle of Zinn would easily account for the irregularity of the field of vision occurring in different cases; if the vessels supplying various nerve bundles in the nerve head are affected, an annular scotoma may form in one case, if the bundle which passes from the nerve head around the macula is involved; if a radial bundle, then a breaking out of the blind spot towards the periphery occurs. It is difficult to think of a cause antecedent to the atheroma and the rings, etc., acting locally, which will directly cause these various symptoms. For the vessels require a contraction and hardening of their walls, the cupping a preliminary weakening of the substance of the nerve head before its cup is enlarged, the one cause acting in two different ways, which is unreasonable. So the theory is put forward that the rings and cavernous atrophy are the consequence of a change in the Circle of Zinn, analogous to that which occurs in the retinal vessels. On the other hand the changes in glaucoma are due to pressure and consequent narrowing of the vessels or pressure on the nerves as they pass around the cup.

The distinction thus made is important from the point of view of treatment and prognosis. If the cavernous atrophy is due to

vessel trouble operation will do no good, and this has been my experience in the few cases in which I have tried it. In the only two cases in which glaucoma and this occurred together operation was done, with a good reduction of tension, in both the field continued to disappear, and nearly complete blindness was the end.

It is obvious that this thesis cannot be regarded as proved; it is shown to be a great probability. The final proof would be provided if a well established case of cavernous atrophy were found to have the branches of the Circle of Zinn narrowed at a post-mortem on the affected eye. And, as this disease is not one causing death, the chance of obtaining material for this proof is very small.

ARABIAN OPHTHALMOLOGY * †

BY

W. B. INGLIS POLLOCK

GLASGOW

Introduction

THE subject is the Arab School of Ophthalmology which, commencing in the 9th century continued until the 13th century.

It is not possible to enter into details of the life of each of the Arabic eye surgeons who produced a treatise nor even a full description of their textbooks, but for any student reference must be made to Hirschberg's (1843-1925)¹ brilliant History of Ophthalmology. He was a famous Greek and Latin scholar and translated a number of the Arabic writings with the aid of two orientalists, Lippert and Mitwoch after working at Arabic for twenty years.

After the death of Mohammed (571-632) his followers carried his domain and creed to India in the East and along the entire Northern countries of Africa, to Spain in the west. They actually reached Tours, but were defeated by Charles Martel in 732 and again in 737.

Baghdad was founded in 763 and became the capital of the Empire of the Saracens and during the reign of the Abbasid Caliphs of the 10th century many scholars and physicians translated most of the Greek scientific and medical works into Syrian and Arabic.

Gunde Shapur, a town in Persia, founded by Shapur I, in the 3rd century, became later the home of Nestorian Christians whose

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