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[I-21] The Disease Which Begins Incipiently from Macular Area in Ghana

—Preliminary Report—

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We have made a co-operative research study of various ocular diseases at the Univ. of Ghana Medical School, Korle Bu Teaching Hospital for a period of one year (May 1973 to May 1974). In the course of this study, a type of macular disease was found which appeared to be different from others already reported.

Some of these cases progressed like a type of diffuse chorioretinitis with macular degeneration; others remained localized at the macular area to macular degenerations.

We would like to present this macular disease and retinal changes by means of fluorescein angiography of the retinal fundus, electroretinography and colour fundus photography. They will be compared with other macular diseases, diffuse chorioretinitis and onchocercal retinopathy.

Introduction

We have made co-operative research to study on various ocular disease at the University of Ghana Medical School, Korlu-Bu Teaching Hospital for one year, from May 1973 to May 1974.

In advancing our study, a type of macular disease which seems to differ from others already known was detected. We give two representative cases of this disease in this paper.

Materials and Case-report

123 cases were selected as chorioretinal disease with involved macular lesion. They were divided into two groups A and B. Group A was given difinite diagnosis. (see Table 1) Cases in Group B were not given any definite diagnosis and therefore referred for study. (see Table 2) Table 2 shows further classification of each type; Cases of pigmentary degeneration of retina, Pigmentary degenearation sine pigmento and central serous choroidopathy. Figure 1, 2 and 3 show Fundus-Fluorescene-Angiographs (FFA) of central serous retinitis of 37 years old male patient in Group B.

Case Report

Case 1 (Table 3): This 14 year-old female patient was referred as a refractive error. Her complaint was irritation and blurred vision in the right eye. Fundus examination showed abnormal reflex around the right macular region. Figure 4 and 5 show Fundus-Photographs (F-P) of the right and left eyes. Visual acuity was RV: 6/36 (n.c), LV: 6/6 (6/5–0.5D). Slitlamp examination showed no findings. Electroretinography (ERG) revealed normal pattern in both eyes. (see Figure 6) FFA showed no leakage in both eyes. (see Figure 7 and 8) Figure 7 and 8 shows FFA of right and left eyes respectively.

Case 2 (Table 4): This 16 year-old female case had macular scar in her right eye fundus on the first visit on 17/4/73. Macular lesion and haemorrhage at macula were detected on 28/8/73 during a fundus examination. This haemorrhage disappeared on 16/1/74. In her

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left fundus, optic nerve atrophy was found at the same time of 28/8. Figure 9 and 10 show two F-P of right and left fundus each.

Table 1. Group A

heridetary		inflammatory		others		
1 pig. deg.	17	injury	5	mac. hole	2	
2 pig. deg.+onch.	1	chr.-scar	8	retinoschsis	2	
3 Starrgardt?	1	chr-ret. deg	4	senile change	1	
4 gyrate atrophy	1	uveitis	3	abnormal position	1	
5 circinate retinopathy	3	toxoplasmosis	6	?	2	
6 cong. nyctalopia	1					
7 Oguchi's disease	1					
total	25		26		8	59cases

Table 2. Group B

Maculopathy		
1 macular lesion 39;	macula (abnormal-edema)	19
	macular degeneration	10
	macular scar 6 macular hole	4
	macular hemorrhage	2
	crystal like substance	4
2 macular+paramacular lesion		2
3 chorioretinal lesion involved macula		6
4 macula+optic disc pallor		6
5 chorioretinal lesion iinvolved macula+optic atrophy		5
	total	64

Table 3. Case 1.

	13/9	27/9	11/10	25/10	1/11
visual acuity	6/36	1mcF	1mcF	2mcF	2mcF
F-P	(+)	(+)	(+)	(+)	(+)
ERG	normal	normal		normal	
FFA	leakage (−) R	same as 13/9		leakage (−) L	leakage (−) R

SACKEY J. F 14
- first visit: 13/9/73 for suspect of refractive error
- clinical note: R; Macular abnormal reflex

Fig. 1

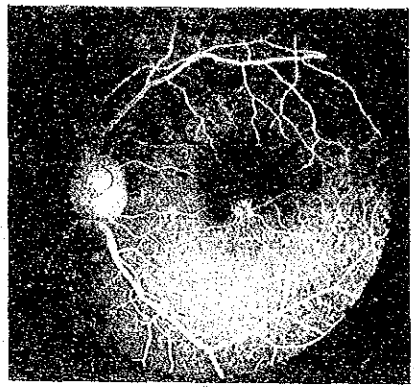


Fig. 2

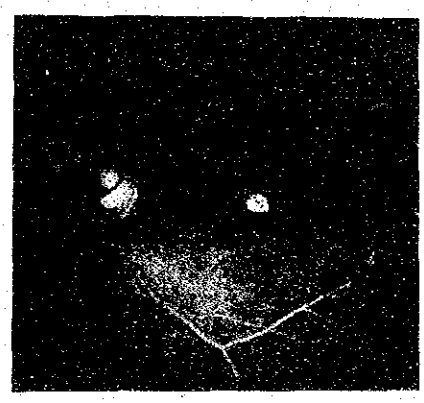


Fig. 3

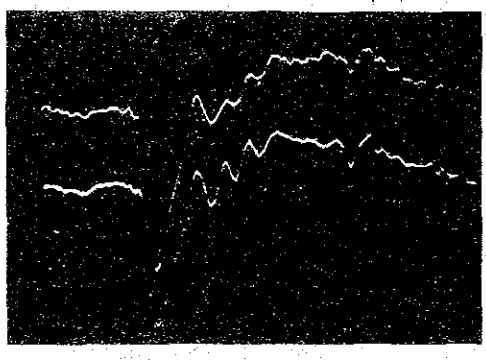


Fig. 6. Scotopic ERR of case 1

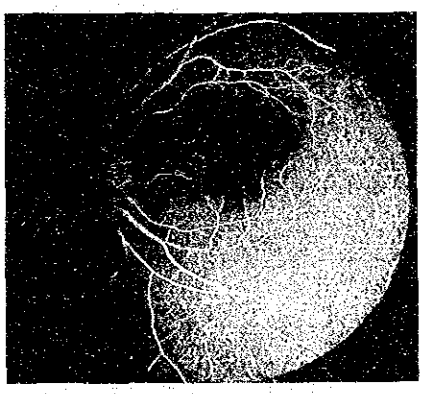


Fig. 7. FFA (15 sec later) of case 1

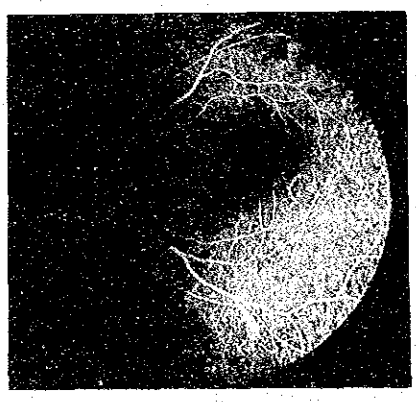


Fig. 8. FFA (45 sec. later) of above

Fig.4 right fundus

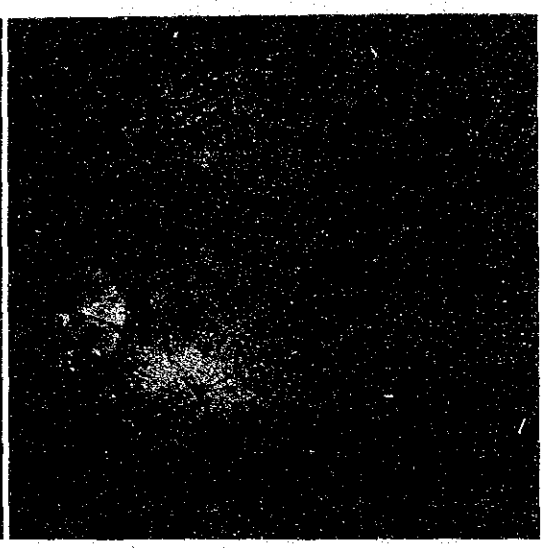


Fig.5 left fundus

Fig.9 F-P of case 2 right fundus

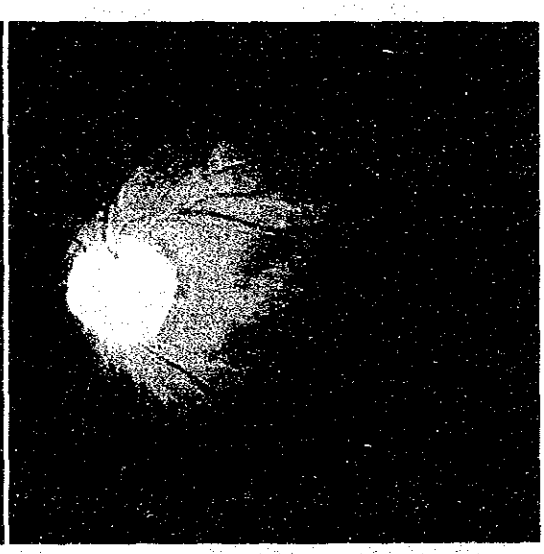


Fig.10 F-P of case 2 left fundus

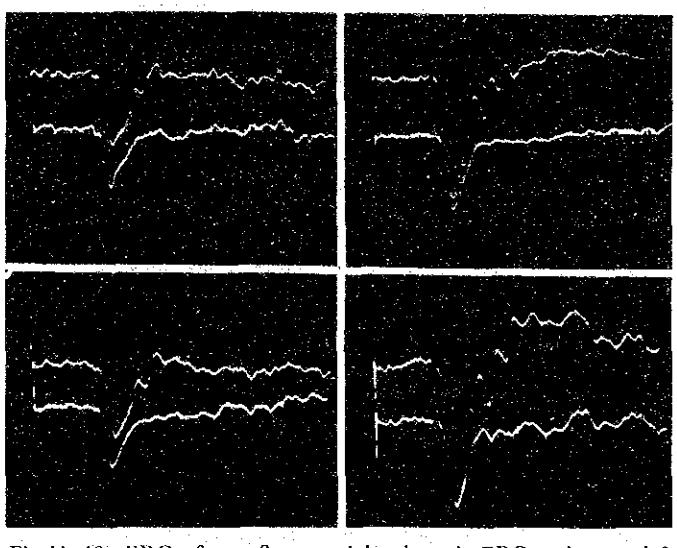


Fig. 11, 12　ERG of case 2 upper right photopic ERG and upper left scotopic ERG on 28/8 lower same on 13/11

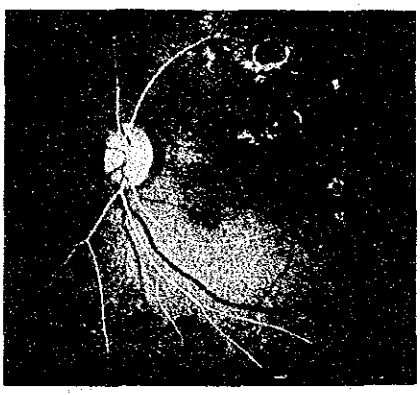


Fig. 13 right FFA of case 2

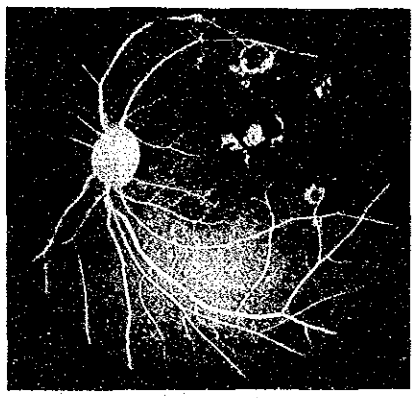


Fig. 14

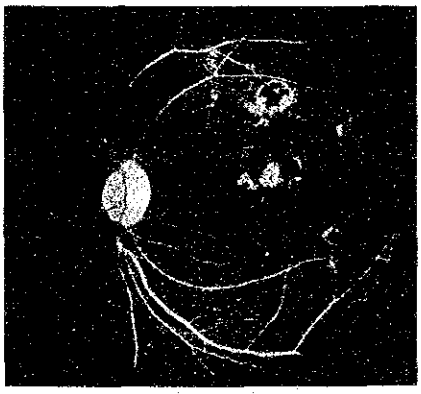


Fig. 15

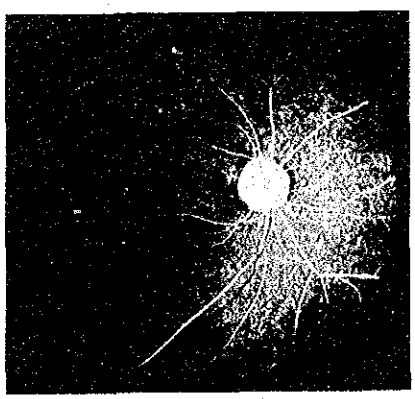


Fig. 16　left FFA of case 2

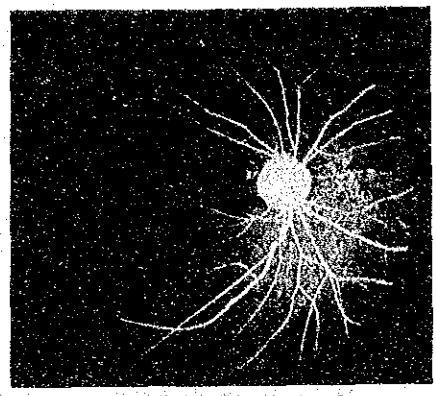


Fig. 17 left FFA of case 2

Table 4. Case 2.

	28/8	3/10	30/10	13/11	27/11	16/1
visual acuity	6/12 (optician) / 6/60	6/36(6/24 = −1.0180 / 6/60(mn.)	〃 / 6/120	〃 / 6/120(6/60 = −2.0180)	〃 / 6/60	6/18 −1.0180 / 6/60(n.)
F-P	(−)	(+)	(+)	(+)	(+)	(+)
ERG	(−)	nor sub	—	nor sub	(−)	(−)
FFA	leakage (++) R	choroidal fluo. L	same L	same as 28/8 R		

G. CATHRINE F 16 (M+haemorrhage)
- first visit 11/4/73 defective distant vision in B/E
- clinical note: R: Macular scar L: optic nerve head: pale
- 2nd visit 28/8 R: haemorrhagic macular deg.+opt. atr.
  L: Maculor-deg+optic atr.

Table 5.

	−10	−20	−30	−40	−50	−51	?	total
M	3 (7.9)	7 (18.4)	8 (21.1)	12 (31.6)	7 (18.4)	1 (2.6)		38 (70.4)
F	0 (−)	3 (18.8)	4 (25.0)	4 (25.0)	1 (6.3)	4 (25.0)		16 (29.6)
?							5 (−)	5
total	3 (5.6)	10 (18.5)	11 (20.4)	16 (29.6)	8 (14.8)	5 (9.3)	5	59 (54)
M	1 (2.2)	15 (33.3)	16 (35.6)	10 (22.2)	2 (4.4)	1 (2.2)		45 (72.6)
F	0 (−)	6 (35.3)	4 (23.5)	3 (17.6)	2 (11.8)	2 (11.8)		17 (27.4)
?							2 (−)	
total	1 (1.6)	21 (33.9)	20 (32.3)	13 (21.0)	4 (6.5)	3 (4.8)	2 (−)	64 (62)

( ): %

ERG revealed normal pattern in right and subnormal pattern in left. (Figure 11) Figure 12 shows the ERG of the same case on 13/11. FFA shows leakage from macular lesion and from other lesions. (Figure 13, 14 and 15) Figure 16 and 17 show in the left eye. It is considered a cases of chorioretinal degeneration with optic nerve atrophy from the results of left FFA and ERG. Visual acuity was RV: 6/36 (6/24 cyl.–1.0 ax. 180°), LV: 6/60 (n.c) on 8/28. and right visual acuity showed improvement, 6/18 on 16/1/74.

Result

Table 5 and 6 show compcsitions of the ages of groups A and B. On the view of graph, there is a single peak at ages 31–40: 29.6% (male, 31.6%, female, 25%) in group A; and there are two peaks at ages 11–20 and 21–30 in group B. Each peak shows 33.9% (male 33.3%, female 35.3%), and 32.3% (male 35.6%, female 23.5%). Table 7 shows each portion of lesion

Table 6

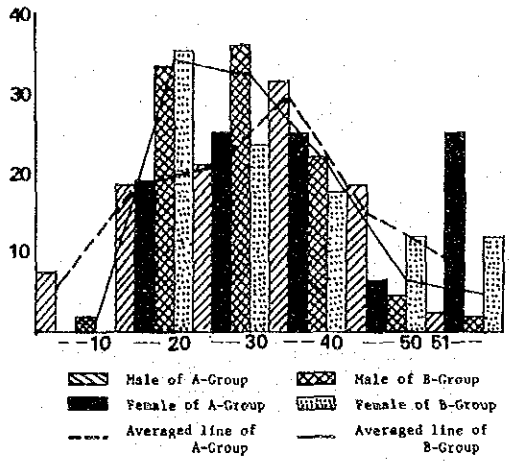


Table 7.

	M(ab)		M(deg)		M(scar)		M(hole)		M(hge)		substance		M+para. M		M-c-r		M-0		M-c-r-o		total	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
—10															* 1						1	
—20	*** *** 6	** 2	* 1		** 2	* 1	* 1			* 1	* 1				** 2		* 1		* 1	** 2	15	6
—30	*** * 4	** 2	*** 3		* 1		** 2						** 2		* 1		*** 3	* 1		* 1	16	4
—40	*** 3	* 1	** 2		* 1		* 1		* 1			** 2					* 1		* 1		10	3
—50		* 1	* 1	* 1							* 1										2	2
51—						* 1									* 1	* 1					1	2
total	13	6	7	1	4	2	4	0	1	1	2	2	2	0	5	1	5	1	2	3	45	17

2 M (deg): M, ge?.

and each ages. There are 19 cases (30.6%) of macula abnormal reflex-oedema type. It seems to be clear from these data that the disease begins at an earlier age in group B than it is in group A. And primary lesion is considered to be at macula. In these cases the youngest case was 10 year-old boy with already chorioretinal lesion involving macular area. (type M-c-r?) Thus, it is thought that every age group suffers from this disease which appears to be progressive. Table 6 shows the relation between each type and each age. It shows 42.1% of cases aged 11–20, 30.8% of cases 31–40 in the type of macular abnormal reflex oedema. In the type of macular degeneration, it shows 37.5% of cases aged 21–30 and 25% of cases aged 31–40. ERG of 51 out of 64 cases were taken and 39.2% of these cases had abnormal ERG. (Table 8) FFA of 56 out of 64 cases were taken and 33.9% of the cases showed leakage (+). (Table 9)

Table 8. Findings of ERG

pattern	case	
normal	29	(56.9%)
normal?	2	(3.9%)
subnormal	15	(29.4%)
subnormal?	1	(2.0%)
extinct	4	(7.8%)
not taken	13	
total	64	51 cases

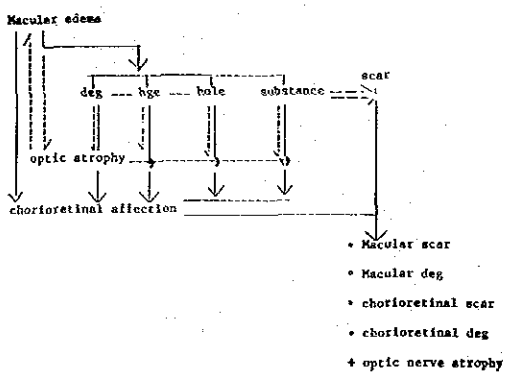
Table 9. Findings of FFA

leakage (+)	19	(33.9%)
leakage (−)	29	(51.8%)
persistance of choroidal fluo	8	(14.3%)
not taken or failure	8	
total	64	56 cases

Discussion and Summary

Since all the data have not been collected and summerized as yet we are obliged to present just 2 case-report and some of the findings in 64 cases. This disease is considered to differ from hereditary macular degeneration of Best, Stargardt, Behr at the points of its composition of age, accompained general symptoms and family history. It is clear that this macular disease is completely different from the retinopathy of Onchocerciasis and Sickle Cell disease which can be detected by skin ship and sickling test reapectively. The effects of Malaria itself or chloroquine and quinine against Malaria should also be discussed. It seemed that most of the patients suffered from Malaria fever but we were unable to find a typical chloroquine retinopathy in Ghana. And also the dose of chloroquine does not reach the dangerous range. In view of the findings of ERG and FFA they show abnormality in more than 30% of the cases. These values will be decreased by accurate selection of B-group. Choyce reported optic nerve atrophy and familial retinal degeneration in the patients affected by Onchocerciasis in Ghana. Table 10 shows

Table 10 Hypothesis.



hypothesis of progressive process of this disease. It begins incipiently from macular lesion. And it is divided into 2 groups. One type is non progressive localized macular degeneration and the other type runs a progressive course. The latter type seems to reach a diffusive chorioretinal disorder at its final stage. This preliminary report presents two representative cases of undefected maculoperthy in Ghana hence the short discussion. The further studies on this disease will be presented in the near future.

Acknowledgement

We wish to express our gratitude to Professor Mutsuo Kajiura for his advice and helpful discussion, to the staff of eye clinic, Univ. of Ghana Medical School and Mr. Satoru Takano for their much assistance and to Overseas Technical Co-operation Agency for special support.

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討　　論

田　沢　　豊（岩手医大）

病変が比較的黄斑部に限局していると思われるが，ERG b 波の減弱の結果をいかにお考えでしょうか。

水　野　勝　義（東　北　大）

螢光眼底写真をみると死数が小さく，血管の蛇行がない。rhesus monkey のそれとにているが，ガーナ人の特徴か。

山　田　宏　図（福島医大）

田沢先生へ：

この症例で患眼は normal pattern であるが他眼が subnormal pattern (reduced b have) を示したのは，螢光上からも choroidal degeneration を思わせる所見を得ているので ERG も subnormal を示すことと一致しているように思う。

水野先生へ：

FFA 用には NIKON の Retinapan を使用したので広角のため一見視神経乳頭が小さいようにみえていると思う。さらに血数の変化については炎症状による変化を思わせる narrowing, sheathing を持つ症例が64例中にも認められ，さらに検討するつもりである。

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[I-22] Ocular findings of Onchocerciasis in Ghana

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Introduction

Onchocerciasis(Oncho) is one of the most important causes of blindness in West Africa[11),17),19)]. It has been clarified that the disease is transmitted to the human host by the infestation of Onchocerca volvulus through the mediation of certain black flies. However, it is not entirely clear how the microfilariae enter the ocular tissues and what is the true pathogenesis of the ocular involvement. Having had an opportunity to observe onchocercal patients in Ghana, the authors would like to report the ophthalmological features of the disease.

Subjects

The present subjects are composed of forty-seven patients who visited the out-patient clinic of the Unit of Ophthalmology, Ghana Medical School for the period of one year, from May 1973 to May 1974. Out of forty-seven patients, thirty-seven are male and ten are female. Ages of the patients range from twelve to seventy-five.

All the subjects had some eye troubles, and the diagnosis was established by the presence of characteristic nodules and skin changes as well as skin snip positivity.

Results—ocular findings

Ocular findings in each subject are shown in Table 1. Since the general descriptions on the ocular signs and symptoms are seen elsewhere and reviewed also by the authors[13),20)], here, the findings in the present subjects are briefly described.

Visual acuity was expressed by corrected vision. The conjunctival signs are not employed because they did not seem to be characteristic in the present subjects. In the cornea, epithelial or subepithelial opacities are summarized as fluffy opacity and separated from sclerosing keratitis. Moreover, the presence of corneal scars (including degeneration and pigmentation) are shown. In the anterior uvea, "active" stands for the definite inflammatory processes e.g. the presence of floaters and flare, and "old" means the sequelae of previous inflammation e.g. synechiae, iris atrophy and pupil deformation etc. Glaucoma found in the present series is secondary to the anterior lesions and none of primary ones were encountered. In the fundus, presence of active lesions is called "active" and of definite post inflammatory lesions (most of which are associated with irregular pigmentation) is called "scar". Although chorioretinal degeneration is controversial in itself (as discussed later), chorioretinal atrophies or degenerative changes are tentatively called "degeneration", which also includes the lesion of possibly old scarring. The retinal vessel changes such as narrowing, sheathing, sclerosis and closure (aside from hypertensive changes) are shown, since they seem to be important findings. Complicated cataract, vitreous opacity (including hemorrhage) and optic atrophy are also recorded.

In Table 1, ○ sigifies positive finding, ◎ main finding and △ findings due to other causes. The results of electroretinography, which will be discussed in another report, are briefly shown in the table. N means normal, S subnormal and N-R nonrecordable. Electroretinography could not be taken in three eyes.

Microfilariae were detected in the anterior chamber in eight cases, fifteen eyes. In No. 45,

Table 1. Ocular findings in the present subjects

fl: fluffy opacity, usually acute and superficial
sk: sclerosing keratitis
sc: corneal or chorioretinal scar
m.f.: microfilariae in the anterior chamber
ant. uvea: anterior uvea
act: active lesion in the anterior or posterior segment
old: sequelae in the anterior uvea
gl: secondery glaucoma
lc: lens
vt: vitreous
vs: changes in the retinal vessels
dg: degeneration
o.a.: optic atrophy
ERG: findings in electroretinogram
N: normal
S: subnormal
N-R: non-recordable
In each case, upper belongs to right eye and lower to left

No.	name	age sex	vision	Cornea			m・f	ant. uvea		gl	lc	vt	Fundus						Note
				fl	sk	sc		act	old				act	sc	vs	dg	oa	ERG	
1	D.G.	41	L.P.		○		○	○	○		○				○	◎	○	N-R	
		M	L.P.		○		○	○	○		○				○	◎	○	N-R	
2	I.A.	25	H.M.												○		◎	S	
		M	H.M.												○		◎	S	
3	A.F.	35	L.P.						○		△			◎	○	○	○	S	nuclear cataract
		M	H.M.						○		△			◎	○	○	○	N-R	
4	F.A.	22	6/6															N	
		M	6/9					○										N	
5	R.D.	16	6/5						○	◎								N	
		M	0					○	○			○	○			◎	○	N-R	vit. hemor.
6	P.D.	38	H.M.		○										○	◎	○	S	
		M	H.M.		○							○			○	◎	○	S	
7	A.S.	40	6/12	○				◎	○				○	○				N	
		M	6/12	○				◎	○				○	○				N	
8	C.B.	16	L.P.			△			○		○							S	bacterial infection
		F	6/9					◎	○									S	
9	C.S.	50	6/5	◎		○					△				△			N	senile cat. hypertension
		F	6/12	◎		○					△				△			N	
10	A.B.	39	0			○	○		○		○				○	◎	○	N-R	
		M	L.P.			○	○		○		○				○	◎	○	S	

No.	name	age sex	vision	Cornea			m・f	ant. uvea		gl	le	vt	Fundus						Note
				fl	sk	sc		act	old				act	sc	vs	dg	oa	ERG	
11	E. A.	20	6/ 5															N	
		M	6/ 5															N	
12	E. A.	26	6/ 6	◎				○										N	
		M	6/ 5															N	
13	G. F.	55	6/12	○					○			○					◎	S	
		M	6/12	○					○								◎	S	
14	B. B.	18	6/ 5															N	
		M	6/ 5															N	
15	O. B.	23	6/ 6	◎		○			○									N	
		M	6/ 6	◎		○			○							○		N	macula, early
16	M. A.	18	6/ 6	◎									○	○				N	
		F	6/ 6	◎									○	○				N	
17	J. S.	25	6/ 9												○	○	◎	N	scar and deg. in periphery
		M	6/12	○					○					○	○	○	◎	N	
18	A. Y.	12	6/ 6						◎							△		N	hereditary degeneration
		M	6/ 9	○					◎							△		N	
19	D. T.	65	6/18	◎					○									S	
		F	H.M.	○					○							◎	○	S	
20	B. C.	29	6/12	○				◎										N	
		M	6/12	○				◎						○				N	
21	F. N.	19	H.M.	○			○	○	○					◎		○		S	
		M	6/24	○			○	○	○					◎		○		N	
22	S. N.	35	6/ 6	◎														N	
		M	6/ 5	◎														N	
23	K. E.	43	6/24			○						○			○	◎	○	S	
		M	0	○				○	○		○				○	◎	○	S	
24	K. B.	50	L. P.			○			○		○					◎	○	S	
		M	0			○			○		○					◎	○	S	
25	K. S.	37	C. F.			○			○								◎	N	
		M	0			○			○								◎	N	
26	K. B.	66	6/30								△						◎	N	senile cataract
		M	6/18								△						◎	N	

No.	name	age sex	vision	Cornea			m. f	ant. uvea		gl	le	vt	Fundus						Note
				fl	sk	sc		act	old				act	sc	vs	dg	oa	ERG	
27	K. A.	23	6/ 5															N	
		M	6/ 5															N	
28	Y. A.	50	L. P.			○			○		△				○	◎	○	S	senile cataract
		M	L. P.			○			○		△				○	◎	○	S	
29	K. F.	50	H. M.									○			○	◎	○	N-R	
		M	H. M.			○						○			○	◎	○	N-R	
30	I. L.	23	L. P.						○	○						◎	○	S	
		M	H. M.						○	○						◎	○	S	
31	A. A.	16	0			○	○		○	◎							○	S	
		F	6/ 5															S	
32	A. A.	75	C. F.			○					○					◎	○	S	
		M	C. F.			○					○					◎	○	S	
33	E. A.	75	C. F.		○	○												S	
		F	C. F.		○	○												S	
34	K. O.	23	6/ 9	◎														N	
		M	6/ 9	◎														N	
35	K. A.	28	6/24				○		○	◎							○	N	
		M	0				○		○	◎							○	N	
36	A. A.	36	6/ 5										◎					N	extreme symblephron
		F	L. P.			○													
37	K. A.	50	L. P.						○			○	◎					N-R	
		M	0			○			○		○							N-R	
38	V. T.	19	C. F.	○			○	○	○	◎								N	
		M	C. F.	○			○	○	○	◎								N	
39	K. Y.	32	6/18						○						○	◎		S	
		M	L. P.						○		○				○	◎		N-R	
40	A. B.	54	H. M.								△				○	◎		S	senile cataract
		F	H. M.								△				○	◎		S	
41	G. A.	56	L. P.						○			○	◎					N-R	ret. detach.
		M	6/ 6									○		○				N	
42	S. O.	39	6/ 5															N	
		M	C. F.						○			○		◎			○	N	

No.	name	age sex	vision	Cornea			m・f	ant. uvea		gl	le	vt	Fundus					ERG	Note
				fl	sk	sc		act	old				act	sc	vs	dg	oa		
43	A.W.	60	6/36	◎		○			○							○		N	
		F	6/18	◎		○			○							○		N	
44	K.O.	31	6/ 4						○									N	
		M	0		○	○		○	○	◎				○			○	N-R	
45	D.A.	55	C.F.				○				△								traum. cat.
		F	6/ 9			○	○	◎											
46	F.C.	18	H.M.	○	○		○			◎								N	
		M	L.P.	○	○		○			◎								N	
47	S.O.	27	H.M.						○				○	○	○	◎	○	S	
		M	6/ 6															N	

Table 2. Corrected vision at the first visit

	(R)	(L)	(total)	
6/ 4—6/ 9	16	15	31	
6/12—6/18	5	7	12	
6/24—6/60	4	1	5	
C.F.	5	4	9	
H.M.	7	7	14	46(49%)
L.P. or 0	10	13	23	
	47	47	94	

Table 3. Relation between age and vision in the worse eye

	6/4—6/9	6/12—6/18	6/24—6/60	C.F.	H.M.	P.I.	(total)
11—20	4			1	1	4	10
21—30	5	2			2	2	11
31—40	1	1		1	1	6	10
41—50		1			1	5	7
51—60		1	1	1	1	1	5
61 or more			1	2	1		4
	10	5	2	5	7	18	47

Table 4. Incidence of affected regions

anterior segment	22	23.4%
posterior segment	10	10.6%
ant. & post. segment	45(49)	47.9%(52.1%)
no findings	11	11.7%
uncertain (?)	6 (2)	6.4% (2.2%)

left eye had iritis and the posterior segment of right eye was invisible because of traumatic cataract. Secondary glaucoma was present in seven eyes, all of which were blind except one eye (No. 35, right). In the other six eyes, both anterior and posterior segments were involved.

The vision at the first visit is seen in Table 2, showing that half of the eyes were blind. Bilateral blindness was found in sixteen cases (34%) and unilateral in fourteen (30%).

Table 3 shows the relation between age and vision in the worse eye. Twenty eyes out of twenty six were blind in the patients aged more than thirty, though there were occasional blind cases in the teens and twenties.

The incidence of affected regions in each eye is shown in Table 4. Any abnormalities were not detected in eleven eyes (11.7%). The anterior segment was affected in twenty-two eyes (23.4%), posterior segment in ten eyes (10.6%) and both anterior and posterior segments in forty five eyes (47.9%). Six eyes are nominated as uncertain because of opacity in the media, but in four eyes (No. 8, right, No. 33, both eyes, and No. 37, left) also posterior segment were probably affected. Then, majority of the eyes proves to be affected both in anterior and posterior segments.

1) Cases affected only in the anterior segment (22 eyes)

Out of twenty-two, eighteen eyes showed corneal fluffy opacity and or acute anterior uveitis. The vision was 6/6 or more in ten eyes and 6/18 at least. No. 38 had prolonged glaucoma resulted from recurrent anterior uveitis associated with marked fluffy opacity was not relieved. No. 46, however, regained 6/18 vision in both eyes in a week (by appropriate treatment), though it had been severely affected by secondary glaucoma associated with fluffy opacity and sclerosing keratitis at three o'clock and nine o'clock position.

2) Cases affected only in the posterior segment (10 eyes)

No. 36 (right eye) showed slight edema at macular area. No. 41 (left) revealed a small round scar inferior to the disc and moderate vitreous opacity. These seem to be slight inflammatory changes and vision was good.

The other eight showed H.M. vision except for No. 17. Generalized chorioretinal degeneration associated with pigmentation was found in No. 29 (right) and No. 40 (both eyes). Main lesion was attributed to optic atrophy in No. 2 (both eyes), No. 17 (right) and No. 21 (both eyes).

3) Cases affected both in the anterior and the posterior segments (45 eyes)

The group can be divided into two subgroups, that is, cases of which main lesion locates at the anterior segment and that at the posterior segment.

a) Cases affected mainly in the anterior segment (11 eyes)

In No. 7 (both eyes), No. 16 (both), No. 20 (left) and No. 43 (both) various changes in the cornea and or the anterior uvea were found but vision was well preserved.

The other four eyes (No. 31, right, No. 35, both and No. 44, left) with recurrent anterior uveitis followed by glaucoma got completely blind except for one (No. 35, right).

b) Cases affected mainly in the posterior segment (34 eyes)

Exudative changes were found in three eyes (No. 37, right, No. 42, left and No. 41, right) and especially in the latter retinal detachment was also detected.

Both eyes in No. 3 and No. 21 showed large irregular scarred lesions.

Most frequent feature was generalized chorioretinal atrophy or degeneration found in twenty-two eyes: No. 1, 6, 10, 23, 24, 28, 30, 32, 39 (both eyes, respectively), No. 5 (left), 19 (left), 29 (left) and 47 (right). These are probably in accord with "degenerative type", Rodger[17], but it should be pointed out that in No. 5 moderate vitreous hemorrhage was found. Optic atrophy was the main affection in five eyes (No. 13, both eyes, No. 17, left and No. 25, both).

Excluding seventeen eyes (no findings in eleven, and uncertain in six), relation between vision and the main lesions in seventy-seven eyes is shown in Table 5. It appears that the vision can be well maintained in the anterior lesions unless severe sclerosing keratitis or secondary glaucoma developed, while 75% of the eyes with posterior lesions were blind.

Table 5. Relation between vision and main lesions in 43 cases, 77 eyes

	cornea	anterior uvea	glaucoma	retina, choroid	optic atropyhy	(total)
6/ 5—6/12	11	10	1	2	4	28
6/18—6/60	3		1	3	2	9
C.F.			2	3	1	6
H.M. or less			5	26	3	34
	14	10	9	34	10	77

The above description refers to individual eyes, but from the point of the subject another aspect can be drawn. Only four cases had no abnormalities in either eye. Seven cases had anterior lesions in both eyes. Three cases had anterior lesions in one eye and no abnormalities in the other. On the other hand, bilateral or unilateral affection of both anterior and posterior segments were found in twnety-six cases. The figure will rise to twenty-nine (about 60%) if No. 8, 33 and 37 are included.

Ophthalmoscopical examination revealed changes in retinal vessels in twelve cases (twenty-five eyes), which means more than a quarter of the present subjects. These vessel changes, obviously different from those of hypertension, include narrowing, sheathing and occasional sclerosis and closure. Besides, the main features in these cases were: optic atrophy in two (No. 2 and 17), chorioretinal scar in one (No. 3) and degenerative lesions in the other nine (No. 1, 6, 10, 23, 28, 29, 39, 40 and 47).

Discussion

The present subjects who visited the Eye out-patient clinic of the Medical School are, so to spreak, selected cases and not the material of mass examination. Therefore, the general results cannot well be compared with those of epidemiological study. It should be stressed that the ocular findings were fully observed by several ophthalmologists. Unfortunately, detailed examinations of patients' nutritive condition etc. were not performed. However, some discussions in the aspect of ocular findings can be given.

Previous reports suggest that the anterior lesions are predominant in Middle and South America[1),5),18)] and the posterior lesions are predominant in Africa[5),8)]. Budden[2)] (study in Nigeria) reported that chorioretinal lesions predominated in lightly infected areas and anterior segment lesions were frequent in heavily infected communities. There have been few studies performed by ophthalmologists, and when the patients were blind due to anterior affection, posterior involvement, if any, seem to have often been neglected.

In the present series, more than half the cases revealed the involvement in both anterior and posterior segments. This strongly suggests that any part of the ocular tissue can be involved in the course of time after the infection has beene stablished despite what the true pathogenesis giving damage to the ocular tissue is. Necessity of precise and detailed ophthalmological examination must be stressed.

It is generally accepted that conjunctivitis and superficial opacity of the cornea are the early signs and that anterior uveitis is caused by infestation of microfilariae into the anterior chamber[6),7),8),13),15),18)]. Neumann et al[9)] in chimpanzees and Rodger[17)] in rabbits succeeded in experimental anterior lesions by injection of microfilariae into the anterior chamber, but could not produce posterior lesions. It is Rodger[15)] who first disclosed two types in onchocercal posterior lesions—exudative and degenerative. He described[16)] that the exudative type was usually associated with involvement of the anterior uvea, while degenerative type was confined to the posterior part and thus suggested a different pathogenesis. Afterwards[17)], he assumed that the former is due to the death of microfilariae in or adjacent to the choroid and the latter is caused

by combination of vitamin-A deficiency with a toxin liberated by free adult worms. Having had pointed out that the two types are not clearly differenciated, Budden[3] advocated that heavy infection may cause focal choroiditis and light infection with mild inflammation may cause choroidal sclerosis and there are various features between the two extremes. Quèrè[14], Cesar[4] and Paul[12] described that the posterior lesion, though its pathogenesis may be different from that of the anterior lesion, is caused by Oncho regardless of nutritive condition.

Recently, Neumann et al[10] demonstrated histologically that the posterior lesions were inflmmatory changes due to the death of microfilariae in the sclera or the choroid. They suggested the possibility that many microfilariae migrate through the orbit and penetrate the posterior pole of the eye alongside the posterior ciliary arteries and nerves. If microfilariae can reach the ocular tissues both by anterior and posterior routes, various features must be found: anteriorly localized, posteriorly localized, mixed and generalized involvement. The present observation does not seem to conflict with the speculation.

The authors are not in a position to state definitely if the posterior lesions can be divided into two different types. In the present subjects, active inflammation was found in eight eyes of which two were severe. Out of fourteen eyes which showed inflammatory scarring, five were associated with degeneration. Generalized chorioretinal distiurbances followed by optic atrophy (so-called edgenerative type) were found in twenty-seven eyes. Careful examination revealed that the generalized lesions are not entirely uniform—irregular shape, pigmentation of various sizes and possible fusion of inflammatory foci. This suggests that even the "degenerative type" is quite different from essential degeneration as seen in hereditary one. Inflammation and degeneration, observed ophthalmoscopically, may be the extreme features and various changes can be produced according to the degree of infection, immunity and the stage of the disease.

Changes of the retinal vessels in more than 25% of the present subjects coupled with the histological pictures which have previously been reported[17] are suggestive of unitary formation of the posterior lesions.

Another question is whether optic atrophy without or with few other signs can be caused by Oncho. Some authors[19] deny the exitence of onchocercal optic atrphy and others[13],[14] believe this kind of optic atrophy has some connection to Oncho., since the incidence is distinctly higher in the endemic territories, though no evidences have been demonstrated. Budden[3] presumed that perivascular inflammation, which prevents the blood supply to the optic nerve, might develop. Among the present subjects, optic atrophy was considered as the main lesion in ten eyes. Optic atrophy without other signs was found in only two eyes, another four were associated with retinal vessel changes and the other four were with anterior lesions. As there are many kinds of optic atrophy of unknown aetiology in Africa, further studies will be needed, but Budden's opinion seemes to be worth listening to.

Summary and Conclusion

Ocular findings of Onchocerciasis in forty-seven patients observed at the eye clinic of Ghana Medical School are reported.

1 In more than half cases, both anterior and posterior segments of the eye were involved. It is strongly suggestive that any part of the ocular tissue can be affected in time after the infection has been established.
2 The anterior lesions develop in connection with the infestation of microfilariae into the anterior chamber. The prognosis is not bad unless severe sclerosing keratitis or secondary glaucoma follows.
3 The pathogenesis of the posterior lesion is yet unknown and most of the cases get blind ultimately except for the localized type.
4 The "exudative" and "degenerative" choroiretinal lesions may not be essentially different each other. Various features can arise depending upon the degree of infection, immunity

and the stage of the disease.

5 Vascular factors may play a role in the formation of chorioretinal degeneration and optic atrophy.

Acknowledgement

We wish to express our thanks to the staff of the Eye Clinic of Korle Bu Teaching Hospital, Accra, for much assistance and to J.I.C.A., Japan, Fukushima Medical College and University of Ghana Medical School for special support of our programme.

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討　　論

山　田　宏　図（福島医大）

Onchocerciasis に関する ERG は非常に少ない。共同研究者として70眼の scotopic ERG において a 波，b 波，律動様小波の変化（減弱）が著明である。

また視神経萎縮，緑内障による失明は ERG 上では normal で，subnormal type と extinguished type は眼症病変と平行し Toufic 等の報告とは異なる，以上スライドを供覧した。

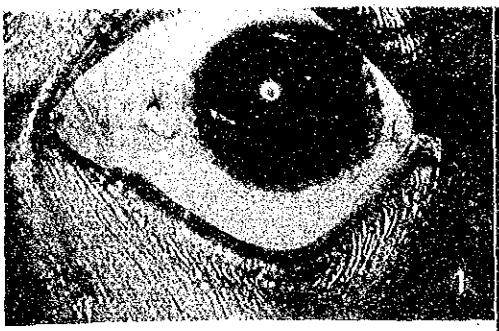

Fig. 1: Case No. 1, left eye. Sclerosing keratitis and acute and chronic uveitis

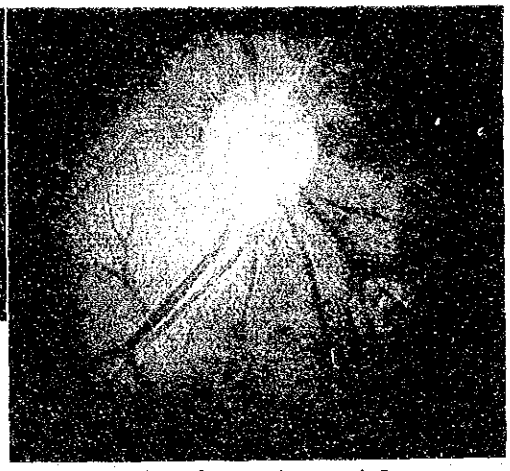

Fig. 2: Case No. 20, left eye. inflammatory membrane and small round scar

Fig. 3: Case No. 21, right eye. Scar formation in the posterior pole

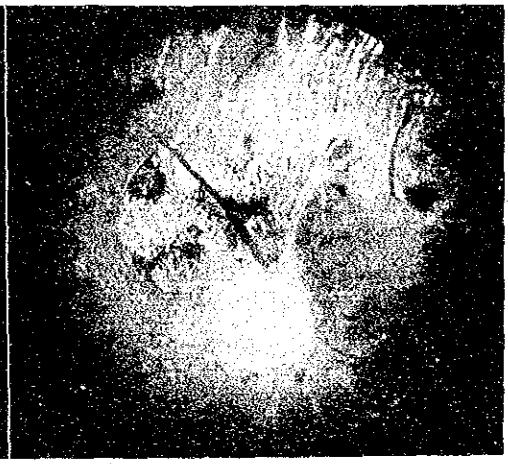

Fig. 4: Case No. 3, left eye. irregular large scar associated with optic atrophy and vessel changes

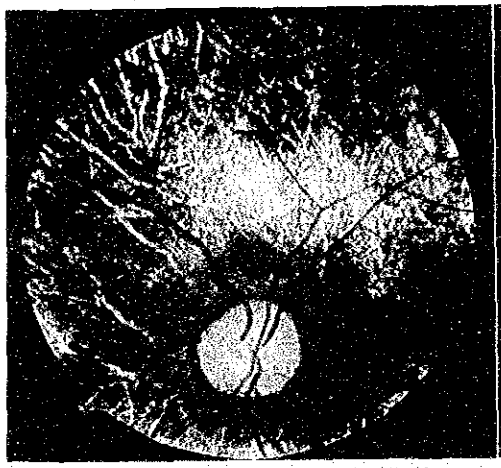

Fig. 5: Case No. 29, right eye. generalized degeneration

Fig. 6: Case No. 2, right eye. optic atrophy associated with vessel changes

[I-23] オンコセルカ症—ガーナでの観察を中心にして—

保坂明郎・山田宏圖・高野悟

HOSAKA, A., YAMADA, H., AND TAKANO, S.:
ONCHOCERCIASIS -- CLINICAL ASPECTS FOUND IN GHANA --
JAPAN OPHTHALMOL. 46, 315 - 321, 1975.

Onchocerciasis in one of the most seriously blinding filariasis in Africa and Central America. The authours had an opportunity to make ophthalmological study of the disease in University of Ghana Medical School, during the period of May 1973 to May 1974.

Forty-three cases (77 eyes) were examined. This paper briefly introduces hystology, distribution, definition, etiology, clinical aspects, diagnosis and treatment.

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学 術

オンコセルカ症—ガーナでの観察を中心にして—

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はじめに

私どもは昭和48年5月より49年5月までの1年間，西アフリカのガーナ共和国に派遣され，ガーナ大学医学部眼科において共同研究を行う機会に恵まれた。オンコセルカ症 (Onchocerciasis) はわが国には全く見られない疾患であるが，アフリカ及び中南米では重大な失明原因の1つであり，近年世界的に関心を持たれている。1年間に数十例を観察したに過ぎないが，私どもの経験を混え，本症について解説したいと思う。

オンコセルカ症とは

糸状虫類 (Filarioidea) の1種 Onchocerca volvulusがブユを中介としてヒトに寄生して起る疾患である。このように原因が確立されるまでには長い歴史がある。

O'Neil (1875) がガーナにおいて初めてヒトの皮膚の中に microfilaria を観察しているが，初めて明瞭に同定したのは Leuckart (1893) である。彼はやはりガーナで摘出したヒトの皮下結節から寄生虫を発見し，Filaria volvulus と命名した（後に分類学上 Onchocerca volvulus と呼ばれるようになった)。

Robles (1915) は以前からグァテマラで erisipera de la costa として知られていた病気が，O. volv. によって起ることを確認し，また (1919)，媒介虫(vector)は恐らくブユであろうとした。今日でも中南米では本症を Robles 病と呼ぶ所以である。その後Pacheco Luna, Calderon, Brumpt などによって，1920年台には本症と O. volv. とブユとの間の関係が明らかにされた。

一方，アフリカでは，以前から山間部の川の近くに住む人々に失明者が多く，River blindness として恐れられていたが，これが O. volv.に原因することが確認されたのは遅く，Hissette (1931) が最初であった。これにより先 Blacklock(1926) はブユの体内で microfilaria (以下 m. f.) が発育することを確認し，また1930年台には各地でヒトの眼内に m. f. が発見され (Strongら，1933)，簡単ながら病理組織の発表もあり，(Ochoterena, 1927, 30) 本症の原因が確立されるに至った。第二次大戦のため研究が一時途絶えたが，以後熱心な調査が行なわれた。本症の眼症状について初めて系統的に記載したのは Ridley(1945) である。

アフリカにおける現況

アフリカにおける本症の流行地帯はサハラ砂漠の南で，西から東へとベルト状に広い地域にわたっている。北限は北緯15°で，Senegal から Ethiopia に至り，赤道の南では西は Angola，東は Tanzania まで分布している。特に西アフリカの Volta 河流域のサバンナ地帯は世界中でもっとも endemic な地域で，面積はほぼ70万平方km，人口約1,000万人のうち，100万人以上が本症に罹患し，そのうち少くとも7万人が失明（3m指数以下）していると推定されている(図1)。

本症による失明は成人男子に多く，また生命に別条はないため，働き手が少くなるだけでなく，失明者に手がかかるという二重の負担によって，

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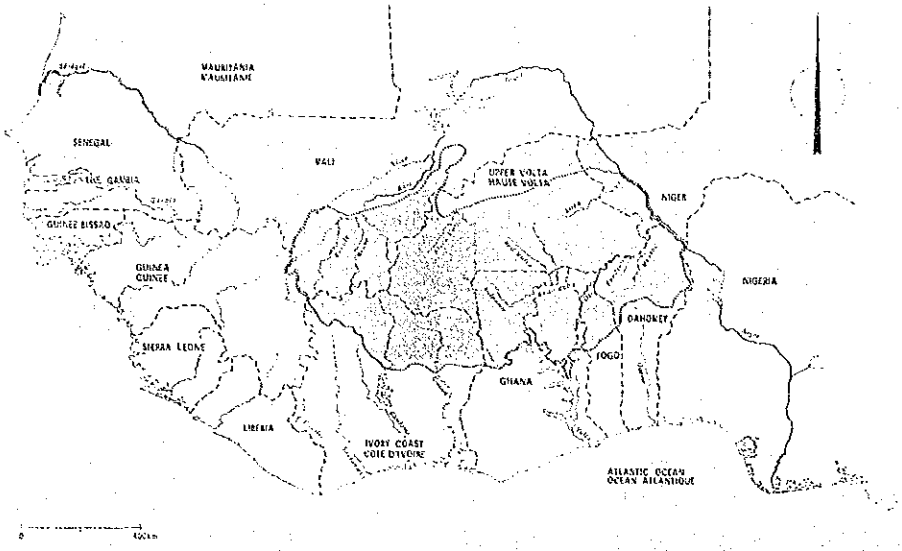


図1 西アフリカ7カ国のオンコセルカ撲滅計画地域 (OCP/73.1 1973による)

原始的農業協同体の機能が低下し重大な社会的経済的問題になっている。事実，集団的な失明のために豊穣な土地を放棄して住民が逃亡し，廃虚となった村落が屡々報告されている。上記の地区に関係する7ケ国(Dahomey, Ghana, Ivory coast, Mali, Niger, Togo, Upper Volta) は1970年に本症を撲滅するための共同調査機関を作り，1971年から73年にかけて流行度，患者数，疫学的研究などの基礎的調査を終っている。更に7ケ国政府の要請により，WHOを始めとしてUNDP, FAO, IBRD, などの機関が各国に協力を呼びかけ，その援助によって1974年より，この地域における大規模な撲滅運動が展開されている。

オンコセルカ症の感染と伝播

1. O. volv. の生活環と感染（図2）

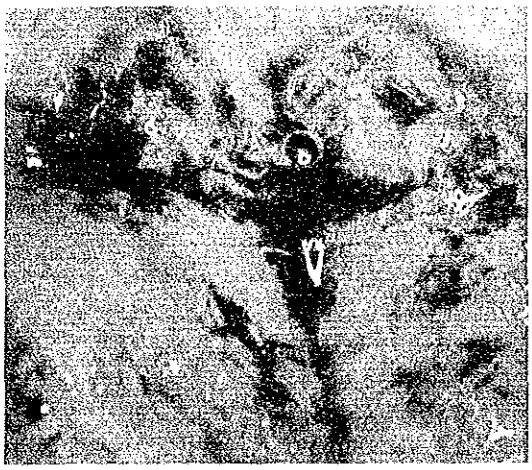
なお明確でない点もあるが，およそ次のようである。本症に罹患しているヒト宿主をブユが刺す時に m. f. がブユの消化管に入り大多数は消化されるが，一部は消化管壁を穿通して胸筋に達し，ここで成長する（一時は却って小さくなる)。次いで2回脱皮して感染形幼虫 (infective larva) となり，体腔を通って吻に移動し，次にこのブユがヒトを刺す時に吻からヒトの皮膚に侵入する。ブユの体内で感染形幼虫になるまでの期間は約1週間と言われる。ヒト宿主に入った感染型幼虫は皮下で徐々に成育し，恐らく1年ぐらいで成虫になる。成虫の体長は♂が2～5 cm，♀は30～50 cm にも達する。普通は皮下結節の中で♂♀がコイル状にからまっており，長年にわたって多数の m. f. を生産する。m. f. は長さ0.3mm 前後で通常皮膚の浅層に居るが，これがどのように移動し，また眼に侵入するかは明らかではない。m. f. の寿命は1～3年のオーダーにあり，成虫の寿命は少なくとも11年，恐らく15年程度と推定されている。

2. 媒介虫 (vector)

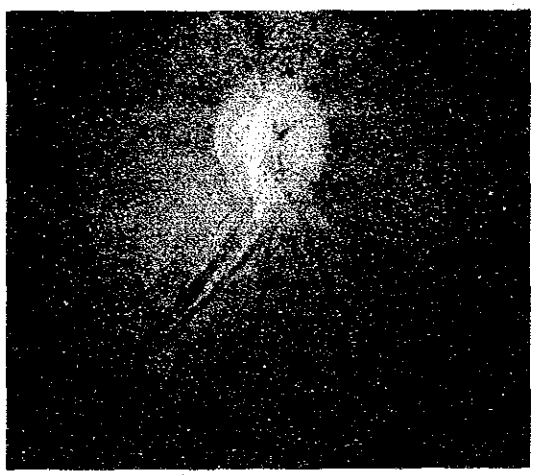
中南米では3種類のブユが本症を媒介することが知られているが，アフリカの媒介ブユは Simulium damnosum (以下 S. dam.) であるとされる。最近の研究では，ブユは地域によって多少異なるので，独立した1種でないかも知れず，S. dam. complex と言う方がよいとされている。一般には black fly と呼ばれ，標高500～1,500m の土地で，水流の速い (60～250cm/sec) 川の浅瀬に産卵する。卵は 36～48 時間で孵化し幼虫 (Larva)となり，5～13日で蛹 (Pupa)，さらに2～4日で成虫となって飛び立つ。このブユは条件さえよければ40km 以上遠くまで飛ぶことが出来るが，通常は産卵場所から5～10 km の範囲内に棲息してヒトを刺す。なお感染に関係するのは♀のブユのみで，♂は植物の汁などで生きてい

「オンコセルカ症」論文附図

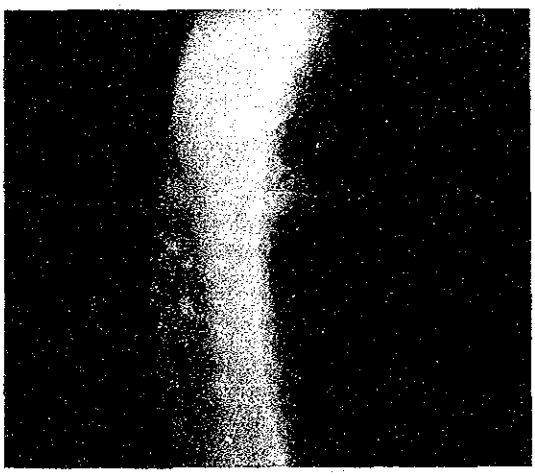
保坂　明郎・山田　宏圖・高野　悟



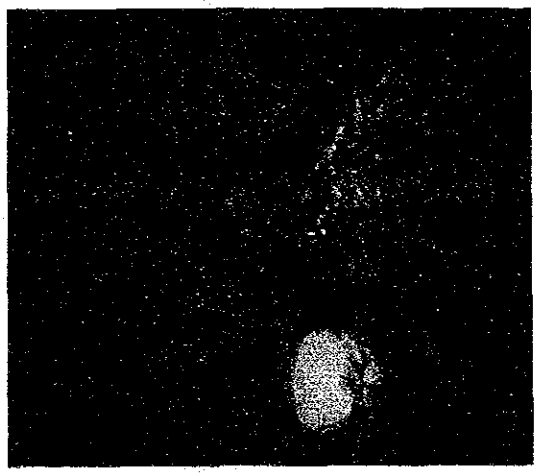
別図1　オンコセルカ性結節の断面



別図3　軽度の滲出性変化と小円形瘢痕



別図2　角膜の初期変化と輪部色素沈着



別図4　色素沈着を伴った眼底大瘢痕と続発視神経萎縮

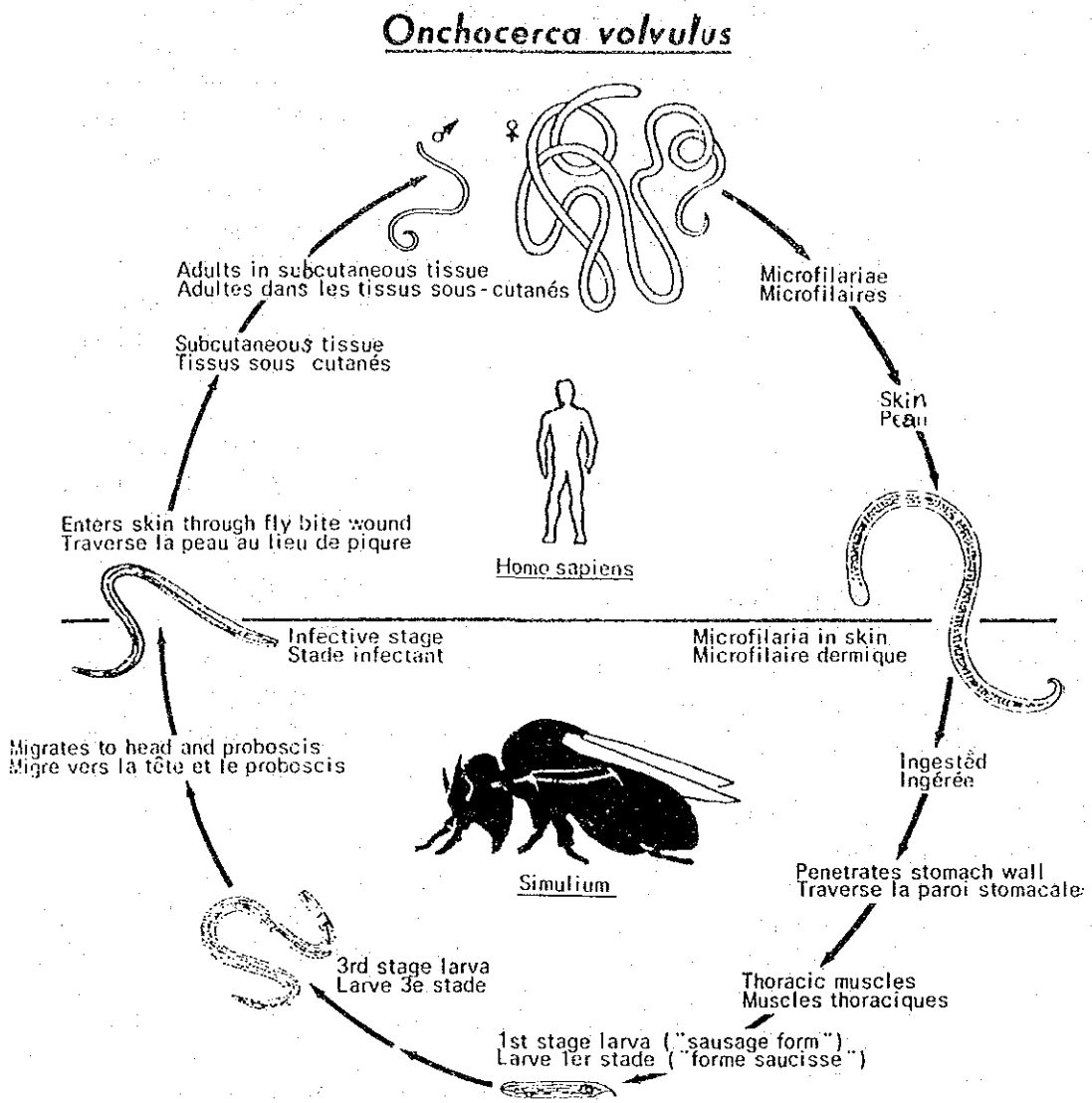


図2 Onchocerca volvulus の生活環 (OCP/73.1 1973による)

る。ブユの寿命は余り長くないらしいが，その生活条件は明らかでないことが多い。気温については17℃～30℃の範囲が必要な条件であるらしい。

以上のように，オンコセルカ症はヒトからヒトへの直接感染はなく，感染型幼虫になるためには媒介虫たるブユの体内を必ず通過しなければならない。またマラリアなどの場合と異なり，ヒトに感染が成立するためには，恐らく数百回または数千回以上ブユに刺されるという条件が必要であると推定されている。

症状と病期

A. 臨床症状

1. 皮下結節〔nodule, onchocercoma (ta)〕

皮下組織内に存在する成虫を中心としてセンキ性結節が形成される。結節の大きさは粟粒大から鶏卵大までいろいろで，やゝ弾力性で硬い。位置はブユの刺す場所に関係があるらしく，頭部，胸廓，肘部，腸骨陵，大転子部，仙骨部，膝，踝などに見られ，屡々骨の隆起部に見られる。普通は

筋膜や骨膜に癒着しているが化膿することは稀である。結節の位置は概して言えば，中南米では上半身，アフリカでは下半身に多い。別図1は定形的な本症患者の腸骨陵部から摘出した大結節の断面である。中心部に多数の成虫と m. f. が見られ，その周囲のミルク状の部分はやゝ軟く，リポイド・コレステロールなどが含まれている。古くなると結節内に石灰沈着を来すことがある。

2. 皮膚症状 (Onchocerca-dermatitis)

皮膚または皮下組織内の寄生虫の移動または死亡による刺戟症状，またはアレルギー反応と解釈されているが原因は不明である。

全身の皮膚を侵すが，臀部，背部，大腿部に多く，時には前腕，下腿，顔面にも見られる。初期は丘疹性の掻痒症であるが，特異な葦色を帯びた発疹を生ずることもある (Mal morado)。また重症の場合には紅斑と浮腫を来し，発熱を伴う (Erisipera de la costa)。皮膚症状が慢性化すると皮膚は光沢と弾力性を失い，萎縮乾燥して，しわが寄ってくる。この状態は Lichenification, Presbydermia, Pseudo-ichythyosis, Packydermia などと呼ばれる。更に萎縮が進み，脱色素斑が出来たり (cafe-au-lait area)，反対に汚い色素沈着が起ったりする。最終的には「とかげ様皮膚」または「くちゃくちゃなティシュペーパー」のようになる。このような皮膚症状はその形状から上述のようにいろいろ呼ばれるが，本質的には掻痒症に始まり，皮膚の高度の萎縮に終るもので，アフリカでは craw-craw と呼ばれる。また二次感染も屢々見られる。

3. 眼症状

m. f. が如何なる経路で眼内に侵入するかは全く不明である。地域の流行度が高く，頭部に結節の多い時，外眼角皮膚に m. f. が多い時などに眼病変が多い所から，恐らく m. f. が輪部附近から穿入するのだろうと想像されている。また一部は眼窩を通じて眼球後方から侵入するらしいとも言われるが確証はない。

1) 前眼部病変

球結膜の軽い浮腫と充血を伴った輪部の腫脹（輪部炎，Limbitis）が初期症状らしいが，この時期に患者を見ることが少ないためか，通常結膜には余り特徴的な所見はない。

角膜の初期症状としては上皮性及び上皮下の雲状の浸潤が見られ，またＥＫＣに類似した上皮下の点状混濁を伴うことがある（別図2）。報告者により，いろいろ名づけられているが，これらは Budden の言う fluffy opacity に属するもので，治療により大抵は痕跡なく治ゆする。この混濁とは別箇に硬化性角膜炎が生ずる。これは前者に引続き，またはこれにオーバーラップして起ることもあるが，多数の m. f. が何年にもわたって死んだ場合に起るとされる。3時または9時位に初発する舌状の混濁で，遂には角膜全体に拡がる実質性の病変で永久的な角膜瘢痕を残す。また，この進行途中から既に角膜上皮の変性や色素沈着が合併して来る。

硬化性角膜炎を生ずる頃には前部ブドー膜も侵される。報告により，急性重症，慢性軽症などまちまちであるが，要するに感染程度の差によるものであって特異的なものではなく，後遺症として虹彩癒着，虹彩萎縮，瞳孔変形，併発白内障などを起す。中でも続発緑内障は重大な合併症である。

2) 後眼部病変

古くから論争があり，また文献上，他の疾患との明らかな混同もあって（例えば Choyce, 1958），混沌としていたが，Rodger(1957～60) は滲出型 (exudative type) と変性型 (degenerative type) とを区別して病像を整理した。彼によると，滲出型は前眼部病変と同様に脈絡膜またはその附近に居た m. f. が死亡することによって起る急性の炎症性変化であるのに反し，変性型は病因不明（恐らくは成虫の毒素とビタミンAの欠乏の併存によると推定している）ではあるが，慢性の変性々変化であるとしている。これに反し，Budden (1962) は一原説を唱え，次のように主張した。すなわち重症感染では Rodger の記載したような，focal exudative choroiditis が起り，烈しい場合には眼底全体に及ぶ。一方軽症感染では炎症状態がほとんど見られずに変性に陥って行くが，本質的には炎性脈絡膜硬化症である。もっとも普

通に見られるのは，この両者の中間の形で，種々な程度の血管周囲炎と血管硬化を伴う円形細胞浸潤から成る病型である。最近 (1973) Neumann and Gunders は，これを裏づけるような組織像を発表した。いずれにしても末期には網脈絡膜変性に陥り視神経萎縮を併発して失明するのであるが，私どもの経験では Buddenの主張の方が正しいように思われる。

別図3は29才男。左眼視力 6/12 (n. c) の眼底所見である。この例は角膜の fluffy opacity，前房に多数の m. f. と多量の浮遊物があり，眼底には多少の滲出物と円形の瘢痕巣が見られた。別図4は35才男。左眼視力 m. m. の眼底所見である。この例は前眼部に異常なく，眼底には図のような炎症を経過したと思われる不規則な大変性巣が見られ，視神経萎縮を伴っている。図版の都合上，他のカラー写真を示せないが，更に進行すれば眼底全体が侵され，遺伝型変性症に類似した所見を呈するが，詳細に見ると，変性巣の状態は一様でなく，むらがある点，また色素沈着の状態などは遺伝型変性とは明らかに異なるのである。

付) 視神経の単独萎縮

前述の網脈絡膜変性に伴なう視神経萎縮とは全く異なり，単独に視神経萎縮のみを来す症例がある。これが本症によるものかどうかは意見が分れている。私どもも数例経験したが，アフリカには原因不明の視神経萎縮も多く，また栄養状態その他の検査が不十分なので今後の問題である。

B. オンコセルカ症の進行と失明

1. 病 期

ヒトでは皮膚及び眼以外の組織に O. volv. の成虫も m. f. も発見されていないし，末梢血中に m. f. が証明されたこともないので，未だ謎に包まれた部分が多い。Budden (1957) は疫学的並びに臨床的見地から次のように分けている。新事実の発見されない限り，この分類は便利であり役に立つと思う。

(1) 潜伏期

皮膚または眼に寄生虫が認められない時期。15～18ヶ月とされる。

(2) 局所性軽度感染期(regionally localized light infection

身体の1部に少数の m. f. が発見される。同じ場所に結節があり，附近に皮膚症状がある。多くは眼症状はないが，少数例で結膜炎や角膜表層炎が起る。

(3) 汎発性重度感染期 (heavy generalized infection)

m. f. は下肢にもっとも多いが頭部にも居り，眼にも侵入し，すべての眼組織が侵される。結節数は増加し，皮膚の苔藓化が著明となる。

(4) 退行期 (regression)

皮膚の m. f. 数は(3)より少ない。結節数は(3)より多いが，皮膚は苔藓化から萎縮性変化に移行する。前眼部に m. f. は見られず，眼には活動性病変がなく，後遺症が残る。

これらの病期は地域の蔓延状況によって異なる。高度流行地では20才頃に(3)になり高率に失明するが，軽度流行地では30～40才台に(2)または(3)になる例が多く，老年になってからの失明が多いことになる。

2. 眼病変と失明との関係

報告者によって統計は全くばらばらである。これは主として調査地区の流行度や個人の感染度による差であろうが，検査方法の不備なども関係しているらしい。或る地区では前部ブドー膜炎が主要原因であるとし，他の地区は網脈絡萎縮が大多数であるとしている。ほゞ一致した見解は，罹患後失明するまでに10年以上要するだろうという点である。私どもは field work を実施しておらず，大学眼科を受診し，治療中の患者についてだ

表1 矯正視力と主要病変との関係 (43例，77眼)

	角膜病変	前部ブドー膜病変	続発緑内障	網脈絡膜病変	視神経萎縮	
6/5～6/12	11	10	1	2	4	28
6/18～6/60	3		1	3	2	9
指数弁			2	3	1	6
手動弁以下			5	26	3	34
	14	10	9	34	10	77

け観察しているので事情は異なるが，前眼部にも後眼部にも病変を持つ例が半数以上を占め，次いで前眼部のみ，後眼部のみの順であった。77眼について矯正視力と主要病変との関係を見ると表1のようである。こゝでは白内障や角膜・硝子体の混濁などで，どちらとも判断出来ない例は除外してある。

この表から言えることは，前眼部病変は治療によって，かなり回復する可能性があるが，後眼部病変は難しいということである。なお如何なる時期でも続発緑内障は警戒せねばならない。

オンコセルカ性眼疾患の診断

患者が流行地に長期間居住していた既往があり，皮膚症状や皮下結節があり，皮膚から m. f. を検出すればオンコセルカ症の診断は比較的容易である。しかし眼症状のそれぞれは必ずしも本症に特異的な所見とは言えないので，厳密には眼内に m. f. を発見しない限り，オンコセルカ性眼疾患と断定することは出来ない。しかし m. f. が少ない場合は発見出来ない場合もあり，また末期には却って減少するという事実もあるので，流行地において身体症状に加えて眼症状が出現し，特に前述のうちの幾つかの所見が出て来れば，先ず本症と診断して間違いない。

1. 結節の発見

結節の少ない時は見落す危険があるので患者を裸かにして十分な視診と触診を行う。

2. 皮膚の m. f. の検出 (Skin snip)

ガーナでは腓部からサンプルを採取するのが普通である。正確には身体各部5ケ所から採取するよう薦められているが，普通は下半身の1ケ所から採取すれば十分である。もし疑わしい例で結果が(−)の場合には他の部位からも採取する。

皮膚を軽く引き上げておいて，カミソリの刃または剪刀で2～3mm径に切除する。この際表層を切除するのが「コツ」で，出血するようではいけない。オブジェクトグラスの上に水道水または食塩水をたらして，採取した皮膚片を載せ，5～10分後に10～20×で鏡検すると，m. f. が皮膚から水中に出て来て動き廻るのが見える。正確に m. f. を同定するには，これを乾燥した上，ギムザまたはヘマトキシリン染色を行なう。

3. 眼内の m. f. の発見

細隙灯で検査するのがもっとも簡単確実である。通常，前房の中を元気よくはねるように泳ぐ多数の m. f. が観察される。m. f. は光を嫌うらしく，散瞳すると虹彩の後に隠れるので少数の場合は見落すことがある。また余り長く照明しても同様なことが起るので手早く観察する必要がある。細隙灯の設備がなければ直像鏡を用い，+25Dぐらいのレンズを通して見るとよい。Diallo (1969)は検査前に眼球をマッサージすると検出成績が上昇するという。なお稀には角膜，水晶体，硝子体の中にも発見される。

4. その他

1) 末梢血液像で10%以上の好酸球増多

2) Mazzotti test：25～50mg の Diethylcarbamazine を内服させ，皮膚炎や掻痒が起れば(+)とする。

3) 免疫学テスト(皮内反応)：牛の Onchocerca gutturosa から作った抗原による。注射後5分以内に丘疹が出現すれば(+)

これらは補助的意義しかなく，2)，3) は本症に特異的でなく，フィラリアに対する反応であり，また2) は患者に不快を与え，3) は実用的価値に疑問がある。

5. 鑑別診断

症例を或る程度経験し，また経過を観察すれば鑑別は難しくないが，次のような疾患と区別する必要がある。

1) 前眼部疾患

トラコーマ，痘瘡，麻疹，癩，時には春季カタル

2) 眼底疾患

原発性網脈絡膜変性症，梅毒性網脈絡膜炎，結核性網脈絡膜炎，黄斑部円板状変性

治療と予防

オンコセルカ症は前述のような感染形式なのでヒト宿主の治療と媒介虫であるブユの駆除とを同時に行わないと根本的な解決にはならない。しかし薬剤の副作用が強いので治療には医師の監視が絶対必要なため，今のところ，僻地における集団

治療は難しく，西アフリカ7ケ国の今回の計画はブユの幼虫撲滅を目標としている。この方が経済的である。とは言え，比較的孤立した小さいfocusならば集団治療を行なう方がむしろ有効であり，かつ経済的でもある。流行地の規模や流行度によって，その場にもつとも適切な対策を立てる必要がある。

1. 治療法

1) Diethylcarbamazine

内服薬，主としてm. f.に有効。副作用をなるべく避けるため，漸増投与法があり，抗ヒスタミン剤や副腎皮質ホルモンを併用することもある。普通は1日量300mgを2～3週間程度連用する。なお前眼部病変に対しては5%点眼液も有効との報告がある。

2) Suramin

静注用。主として成虫に有効。週1回1g静注を5週間続ける。

3) Mel w

筋注用。成虫に有効。1日200mg筋注を4日間連続し，10～14日後に再びクールを行う。500mg以上の筋注1回でも，かなり有効であるという。

2), 3)は時に死亡事故もあるので，現在は1)が主に使用されており，今後の新しい薬物の開発が望まれる。

4) 結節摘出

頭部の結節を摘出してしまうと眼疾患が減少するという報告があるが，効果は不十分である。

2. 予防法（ブユの幼虫の殺虫剤）

以前から0.5～1.0 p.p.m. の D.D.T. の河川への散布が行われ，東アフリカなどでは予防にかなり効果が上っているが，D.D.T. は安定で長く残溜し，魚その他に影響を及ぼすことが問題にされ，最近は Methoxychlor や Temephos の使用が考慮されている。

おわりに

オンコセルカ症についての文献は多数あるが，疫学的調査が大部分であり，眼症状について正確な記載がなされるようになったのは比較的近年のことである。O. volv. が発見されてから約100年になろうとする現在，なお不明な点が少くないのは（私どもも含めて），多くは外国人による短期間の散発的研究であり，現地人専門家の長期にわたる研究が少いためである。あらゆる分野の専門家を擁えた系統的研究と，その成果にもとずいた適確な対策が必要であり，このためには莫大な費用を要するであろう。国際的関心が急速に高まっている現在，わが国でも本症に対する理解が深まれば幸いである。

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[I-24] Ecology of Enteroviruses in Tropics

I. Circulation of Enteroviruses in Healthy Infants in Tropical Urban Area

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ABSTRACT

A continuing surveillance on enterovirus infection in healthy infants was conducted from October 1971 through February 1973 in urban areas in Ghana, West Africa. About 40 infants were visited in every two months for collection of faecal specimens and examined for infection. Enteroviruses were recovered in tissue culture. The overall isolation rate of enteroviruses was approximately 44%, and there was no seasonal difference between rainy and dry seasons. The rate of virus isolation in urban areas was significantly higher than in rural areas. Within the urban areas, however, no difference in the rate of virus isolation was detected between densely populated and sparsely populated areas. The results of virus identification revealed that all three types of Poliovirus, many types of Echovirus and a few Coxsackieviruses were isolated during the course of the study. It was observed that improvement of sanitary facilities decreased the frequency of virus infection among infants, but the condition of water supply did not influence the virus infection rate. Neither the age of infants nor the size of siblings showed any relation to the virus isolation rate. It was suggested from the results that many types of enteroviruses have been circulating continuously in the tropical urban community throughout the year.

With regards to the mode of spread of enteric viruses, results of community-wide or longitudinal studies have been reported by a number of investigators during the past two decades [3, 6, 7, 23, 25]. These cumulative data have provided valuable information on the prevalence of enteric viruses in general population. It was reported that epidemics of enteroviruses have occurred during summer and autumn seasons in temperate zones, while in the tropics enteroviruses appear to be endemically prevalent throughout the year with high incidences. In West Africa, however, little is known of the enterovirus infection of general population [2, 13, 20, 21]. No data have been available until recently as to what types of enteroviruses have been prevailing in general population in that area, nor as to how children have suffered from enterovirus infection.

From October 1971, a continuous survey set out to obtain basic data on the enterovirus infection in healthy infants in Accra, Ghana. A preliminary paper describing the results so far obtained until September 1972 was published elsewhere [15]. In that communication it was reported that more than 40% of infants were excreting enteroviruses, and that no seasonal difference in the virus isolation rate was observed during the study. It was also stated that there was no significant difference in the virus isolation rate between densely and sparsely populated areas, although improvements of hygienic conditions such as water service and toilet facilities seemed to decrease the frequency of virus

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infection among infants. The majoriy of the isolates consisted of Polioviruses and Echoviruses.

The study ended in the middle of March 1973 after 18 months of continuous survey. The aim of the present communication is to review and complement the results of enterovirus isolation among healthy infants in urban areas of Ghana, and to analyze the data according to the season, population status, hygienic conditions and so on. The results of virus identification are summarized for each virus group or serotype. The mode of spread of enteroviruses in the tropics is also discussed.

MATERIALS AND METHODS

Forty-five infants, aged 1 to 10 months (an average age at the beginning of the study, October 1971, was 4.2 months) were selected from a number of infants attending two Urban Health Centers, Ussher and Kaneshie polyclinics, Accra. The former polyclinic caters to patients from Ussher and James Town areas, which are comparatively densely populated [1]. The latter polyclinic, located in the suburbs, caters to patients from Kaneshie Estate area, which has recently been developed and therefore enjoys some modern amenities. This area is sparsely populated in contrast to the former area. From December 1972, one year after the beginning of the study, a few infants were recruited from Korle Gono area, near the Korle Bu Teaching Hospital, University of Ghana Medical School, Accra. Not more than one child was selected from a family, and only one family was selected from each street.

From October 1971 to February 1973, faecal specimens were collected from infants in the study group after every 2 months. Plastic containers for faecal specimens were delivered to houses on the previous day and specimens were collected the next morning. If a child defaulted, he or she was visited again the following morning. The specimens collected were kept at −20 C until processed for inoculation. In the laboratory, 10 to 20% suspensions of faeces were prepared in cold transportation medium (Earle's BSS containing 0.5% lactalbumin hydrolysate, supplemented with 0.1% bovine plasma albumin and with antibiotics). They were then centrifuged in the cold at 2000 rpm for 15 to 20 min for clarification. Duplicate tubes of HEp-2, HeLa and Vero cells cultured in tubes, fed with Eagle's minimum essential medium (MEM) supplemented with 1.0% calf serum, were inoculated with 0.1 ml per tube of each faecal extract. Human embryonic cells (of lung or kidney) were also employed occasionally. The inoculated cells were incubated at 37 C and observed daily for cytopathic effect (CPE) for a period of 7 to 10 days. Cultures were harvested and passaged at least twice when no CPE was observed. Cells showing CPE were harvested at the time CPE reached a maximum, and they were stored at −20 C until the next passage.

Virus isolates were identified using WHO intersecting serum pools or LBM pools [24] which were kindly supplied by Dr. H. von Magnus of the Statens Seruminstitute, Copenhagen. Isolates were identified either by the conventional tube method [24] using HEp-2 cells or by a microtransfer method [5] using human embryonic fibroblasts (HEF). The tube method was employed in the early half of the study. An appropriate amount of each serum pool was mixed with an equal volume of a test virus diluted so as to contain 300–500 TCD_{50}/0.1 ml. Each mixture was incubated at 37 C for 2 hr and 0.2 ml thereof was inoculated into two tube cultures. Observation was made daily for 3–5 days and final readings were usually made one day after virus controls showed complete CPE.

Prior to applying the microtransfer method [5] to virus identification, isolates were passaged once in HEF and titrated for infectivity in the same cells. A small amount (0.025 ml) of each serum pool was distributed in duplicate into a piggy-back transfer-plate (Cooke Eng. Inc.) and mixed with an equal amount of a test virus dilution containing approximately 1000 TCD_{50}/0.1 ml. The mixtures in the transfer-plate were kept at 37 C in a moist CO_2 incubator for 2 hr and then transferred onto HEF cultured in a flat-bottomed microplate (Cooke Eng. Inc.) and incubated at 33 C in a CO_2 incubator. The plates were observed for CPE twice a day for 3–7 days. When the result of the neutralization test of an isolate was equivocal, the

isolate was purified by two cycles of limited dilution passage and then tested again for identification by a similar procedure.

RESULTS

Virus Isolation Rates According to Months

The overall numbers and rates of enterovirus isolation are arranged in Table 1 according to months of the year. Totally 169 isolates were obtained out of 386 faecal specimens collected from infants in Accra. The average rate of virus isolation was 43.8%, with standard deviation of 13.93. As shown in Table 1, the results of virus isolation in the earlier half of the study were quite irregular, so that the virus isolation rates fluctuated beyond the standard deviation to the higher and lower range alternately. The highest virus isolation rate, 61.4%, was scored in April 1972, and the lowest one, 26.7%, in October 1971. The results of virus identification testified that a high rate of virus isolation at the end of 1971 was due to a "silent spread" of Echovirus type 19, probably occurring throughout the city. The frequency of virus isolation from individual

Table 1. Rates of enterovirus isolation according to months of the year among healthy infants in Accra

Month	No. of specimens	No. of isolates	Percent of isolation
1) Oct. 1971	45	12	26.7
2) Dec.	43	26	60.5
3) Feb. 1972	44	12	27.5
4) Apr.	44	27	61.4
5) Jun.	42	12	28.6
6) Aug.	34	14	41.2
7) Oct.	38	21	55.3
8) Dec.	48	22	45.8
9) Feb. 1973	48	23	47.9
Total	386	169	
Mean	42.9	18.8	43.8% (S.D.=13.93)

Table 2. Rates of enterovirus isolation among healthy infants in urban and rural areas in rainy and dry seasons

Season	Virus isolation rate in		χ^2 for difference of virus isolation
	Urban area	Rural area[a]	
Rainy (Apr.–Oct.)	86/203[b] (42.3%)	40/160 (25.0%)	6.78 ($p<0.01$)
Dry (Nov.–Mar.)	83/183 (45.3%)	22/134 (16.4%)	19.70 ($p<0.001$)
Total	169/386 (43.8%)	62/294 (21.1%)	11.75 ($p<0.005$)

[a] Specimens were collected in July–August (rainy season) and in February–March (dry season) in three villages around Accra.

[b] Numerators indicate positive numbers, and denominators numbers of faecal specimens examined.

Table 3. Rates of enterovirus isolation among healthy infants in Accra according to areas and months

Month	Ussher Town		Kaneshie Estate		Korle Gono	
	Specimens	% positives	Specimens	% positives	Specimens	% positives
1) Oct. 1971	4/20[a]	20.0	8/25	32.0		
2) Dec.	13/19	68.4	13/24	54.2		
3) Feb. 1972	6/20	30.0	6/24	25.0		
4) Apr.	11/20	55.0	16/24	66.6		
5) Jun.	6/19	31.6	6/23	26.1		
6) Aug.	8/15	53.3	6/19	31.6		
7) Oct.	8/18	44.4	13/20	65.0		
8) Dec.	10/18	55.6	6/17	35.3	6/13	46.2
9) Feb. 1973	7/17	41.1	8/14	57.1	8/17	47.1
Total	73/166	44.0 (S.D.=14.92)	82/190	43.2 (S.D.=16.88)	14/30	46.6

[a] Numerators indicate positive numbers, and denominators numbers of faecal specimens examined.

infants ranged mostly between 0 and 7, about 4 on the average.

Virus Isolation Rates According to Seasons

As summarized in Table 2, virus isolation rates in dry (from November to March) and in rainy (from April to October) seasons were 45.3% and 42.3%, respectively. Thus, no seasonal difference was recognized.

Virus Isolation Rates in Urban and Rural Areas

To compare with the virus isolation rates in urban areas, faecal specimens were collected from children in rural areas in August 1972 and in February 1973, and the rate of virus excretion was examined. It is shown in Table 2 that there was no significant difference between the rainy and dry seasons in rural areas, and that the overall virus isolation rate in rural areas was lower than in urban areas, particularly in February 1973, that is, in the midst of the dry and hot season. A statistical comparison of the virus isolation rates in urban and rural areas revealed that there was a significant difference both in rainy ($p<0.01$) and in dry ($p<0.001$) seasons.

There was no significant difference in virus isolation rate among the study areas, i.e., Ussher Town, Kaneshie Estate and Korle Gono areas, as recognized in Table 3.

Table 4. Groups and serotypes of virus isolates

Virus group	Serotype	No. of isolates
Poliovirus	1	11
	2	2
	3	3
	(Sub-total 16)	
Coxsackievirus		
group A	16	2
group B	5	2
	6	2
	(Sub-total 6)	
Echovirus	1	4
	3	8
	4	1
	5	3
	6	18
	7	17
	9	1
	11	14
	12	2
	13	6
	17	1
	19	17
	20	10
	25	3
	29	6
	30	2
	31	1
	32	1
	33	1
	(Sub-total 116)	
Untypable by WHO serum pools		10
Remain to be typed		8
Missing during storage or transportation		13
Ground total		169

Groups and Serotypes of Virus Isolates

From the urban areas, many types of enteroviruses were isolated during the study period. All three types of Poliovirus, three types of Coxsackievirus and 19 types of Echovirus were identified. The number of isolates was presented by serotypes in Table 4. So far, 138 strains out of 156 isolates (13 isolates were missed during storage or transportation) were identified serologically, ten isolates could not be identified by any pool of WHO intersecting serums, and eight isolates, producing CPE of adeno-like or another type CPE, still remain to be typed. Figure 1 represents the distribution by month of enterovirus types which were frequently isolated during the study. Poliovirus type 1 and Echovirus type 3 were isolated in the later half of the study period, whereas Echovirus types 6, 7, 11, 13 and 20 were frequently isolated throughout the study course. The majority of Echovirus type 19 strains were isolated in December 1971 and a few in February 1972. It appears likely that there was an outbreak of a silent epidemic of Echovirus type 19 among children in Accra at the end of 1971 and the beginning of 1972. The changes of prevalent enterovirus types such as Poliovirus type 1, Echovirus types 6, 7, 11, 19 and 20 are illustrated in Fig. 2. Noticeable changes were observed in the prevalence pattern of certain types. For example, Echovirus type 19 showed a single, high peak in an early period of the study, while Echovirus type 7 showed a low plateau lasting for a few months.

Virus Isolation and Hygienic Facilities

The virus isolation rate among infants living in houses with flush lavatories was significantly lower than that among those living in houses having non-flush lavatories or those who depended upon public facilities.

The results are shown in Table 5. However, as shown in Table 6, we could not find a significant difference in virus isolation rate between people utilizing house-connected private and common-use standpost water taps.

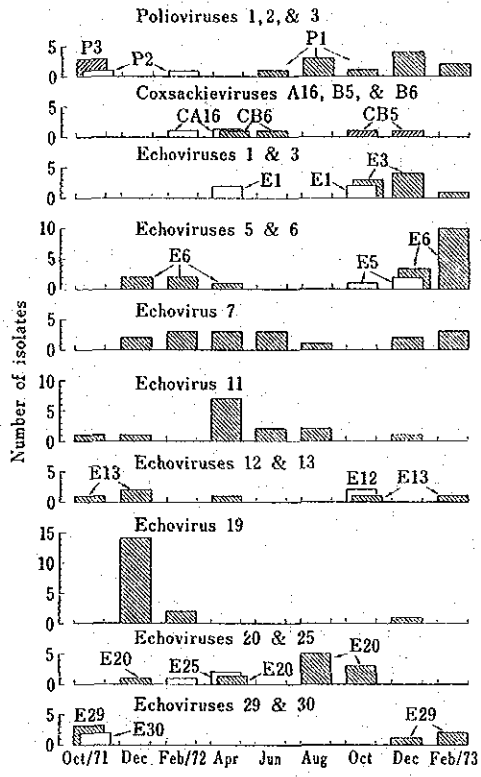

Fig. 1. Enterovirus types in which there were two or more isolates from healthy infants in Accra by virus type and month.

Virus Isolation and Age of Infants

At the first sampling in this study in October 1971, the virus isolation rate among infants under 4.1 months of age (average age of infants was 4.2 months) was higher than among infants aged over 4.2 months. However, from the second sampling on which was performed in December 1971, the results were so irregular that we failed to find any particular relationship between the age of infant and the virus isolation rate.

Virus Isolation and Size of Siblings

The rate and frequency of virus isolation among infant groups that had 2 to 3 siblings seemed to be higher than among groups with 0 to 1 sibling. This difference seemed to be statistically significant ($p<0.02$). However, inclusion of another group with more siblings indicated no significant differences in the rate of virus isolation among the above groups. The results are shown in Table 7.

DISCUSSION

As stated by many authors [10, 22, 25, 26], it has been known that enteroviruses are prevalent throughout the year with high incidences in tropical community. This fact has been confirmed in this study carried out in Accra, the Capital of Ghana, too. The overall rate of enterovirus isolation obtained in this study was similar to that obtained among healthy children in Ibadan, Nigeria [13, 20, 21], and was higher than the results in Bangui, Central Africa [8] and Yaundi, Cameroon [4], but was lower than those of India [9] and other countries [11, 23].

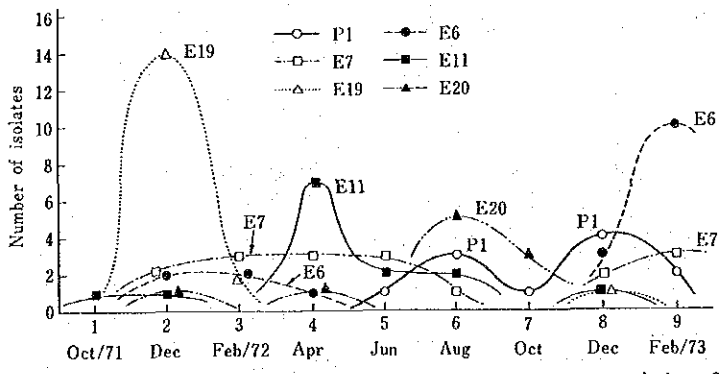

Fig. 2. Changes of prevalent enterovirus types in which there were ten or more isolates from healthy infants in Accra by month.

Table 5. Rates of virus isolation among healthy infants in Accra living with different sanitary facilities of household

Condition of facility	No. of infants	Specimens	% positives	Frequency per infant	χ^2 for difference of virus isolation rate
a) Flush toilet	9	20/67[a]	29.9	2.22	
b) Non-flush toilet	9	40/72	55.5	4.44	a/b 8.94 ($p<0.01$)
c) Public toilet	21	86/182	47.3	4.09	a/c 5.99 ($p<0.02$)
b)+c)	30	126/254	49.6	4.23	a/(b+c) 8.30 ($p<0.01$)
Total	39	146/321	45.6	3.74	$\chi^2_{[2j]}= 9.63$ ($p<0.01$)[b]

[a] Numerators indicate positive numbers, and denominators numbers of faecal specimens examined.
[b] Calculated from $2\times j$ contingency table.

Table 6. Rates of virus isolation among healthy infants in Accra using different water supply systems

Condition of facility	No. of infants	Specimens	% positives	Frequency per infant
House connection (private tap)	12	39/94[a]	41.5	3.25
Stand post (common use)	27	107/227	47.1	3.96
Total	39	146/321	45.5	3.74

[a] Numerators indicate positive numbers, and denominators numbers of faecal specimens examined.

Table 7. Rates of virus isolation among groups of healthy infants in Accra with different numbers of siblings

No. of siblings	No. of infants	Specimens	% positives	Frequency of virus isolation per infant
0–1	15	46/117[a]	39.3	3.07
2–3	15	68/125	54.4	4.53
4–6	9	32/79	40.5	3.55
Total	39	146/321	45.5	3.74
			$\chi^2_{[2j]}= 6.5899$[b] ($p<0.05$)	

[a] Numerators indicate positive numbers, and denominators numbers of faecal specimens examined.
[b] Calculated from $2\times j$ contingency table.

There was, however, a remarkable difference between our results and those obtained in countries of temperate zone [6, 7].

Concerning the seasonal distribution of virus isolation, it was found that there was no particular difference according to months of the year such as recognized in temperate climate countries. In Ghana, there are two rainy seasons [12]—a large and a small one. The large rainy season starts in April and ends in June. After 2 months of intermediate cooler season, the small rainy season comes in September and October. From November, the dry and hot season begins and continues until the end of March. Although we have experienced only two dry seasons and one rainy season during this study period, we found no influence of a particular season on the rate of enterovirus isolation, at least in urban areas. Of course, it should be noted that a small-scale survey covering only an 18-month period would not permit any definite conclusion as to whether the various seasons have any influence on the prevalence of enteroviruses among infants in the tropics.

It was suggested from the results of virus identification that many types of enteroviruses were circulating in the study population. Six or more types of virus on the average were isolated in each sampling time.

Unfortunately, due to insufficient supply of mice and monkeys, we could not inoculate the specimens into suckling mice or primary monkey kidney cell cultures. Therefore, only a few of Coxsackievirus groups A and B were isolated. Nevertheless twenty-five types of enteroviruses were identified after nine samplings. Among them, Poliovirus type 1 and Echovirus types 6, 7 and 11 were frequently isolated during the study. These viruses together with Echovirus type 19 accounted for more than half of the total enteroviruses identified. But they were isolated under different patterns. Echovirus types 6, 7 and 11 were commonly isolated in all samplings. On the other hand, the majority of strains of Echovirus type 19 were isolated in December 1971. This result suggested that there was a "silent spread" of Echovirus type 19 among children in Accra in December 1971, and it might be possible to presume that Echovirus type 19 was a new invader among the population studied. We could isolate Echovirus type 19 and Echovirus type 7 simultaneously from sewage samples collected from various areas in and around Accra. These findings suggested that there was a wide dissemination of these viruses in Accra at that time. Echovirus types 4, 9, 14 and 30 were frequently isolated in temperate zones [3] but few or none were isolated in this study. In the case of Poliovirus type 1, 11 infants were excreting that type in the period of the 5th to 9th samplings. At the same time, a number of poliomyelitis patients hospitalized in the children's block, Korle Bu Teaching Hospital, Accra, and more than 50 specimens requesting for virological and serological confirmation reached our laboratory between May and October 1972. Virological and serological examination of these specimens revealed that eight of the children turned out to have Poliovirus type 1, eight type 2, and four type 3. Besides infants in urban areas, healthy children in rural areas were frequently excreting Poliovirus types 1 and 2 at that time. Significantly, most of the children in a village (Akramaman) excreted Poliovirus type 2 in February 1973 (Otatume in preparation).

In 1963, Sabin [22] pointed out that paralytic poliomyelitis had been increasing at epidemic as well as at endemic rates in the tropics. Since then efforts have been directed toward mass vaccination of susceptible infants in many tropical countries; similarly, there appears to be a slow but steady increase in the average annual number of cases in many African countries [26]. In Ghana, the incidence of poliomyelitis in 1970 was higher than the annual average for the period 1966–1969, and the number of reported cases were increasing gradually for 1971 and 1972 [14]. Of course, we are aware of various factors which make it extremely difficult in tropical countries, including Ghana, to embark on a nationwide mass vaccination program geared toward eradication of poliomyelitis; as typical examples for this can be cited traditional and religious customs and beliefs, socio-economic problems, lower senses of public health or hygiene, insufficiency of appropriate manpower, lack of an infrastructural system and deficiency of information on the prevalence of various viral diseases in the community. It is to be regretted, however, that poliomyelitis has not yet been considered as a major public health problem in these countries because there have been too many infectious diseases to meet this very urgent situation [12, 14].

It is well known that improvement of hygienic or sanitary conditions such as water supply or lavatory facilities reduce the prevalence rate of enteric parasites, bacteria and viruses in the community. The present study showed that improvement of lavatory facilities resulted in a significant decrease of the virus isolation rate even in tropical Africa. But we could not find any recognizable difference between the virus isolation rate among infants coming from houses with connections for private water-tap and those utilizing standpost water-tap for common use. This conclusion was the only deviation from our preliminary report [16]. The infants living in houses with both flush toilets and private water-taps excreted viruses at the lowest frequency. The infants living in houses with private but non-flush toilets showed the highest virus isolation rate.

There was no correlation between the virus isolation rate and the age. It was suggested from this result that the infants in tropics are

exposed to a high risk of infection of enteroviruses within a few months after birth. In fact, some infants were excreting viruses one month after birth. We could not observe any particular connection between the virus isolation rate and the number of siblings. In Ghana it is traditional customs that many relatives visit and live within a house mutually so that the family size is quite flexible. Accordingly, it was impossible to find a correlation between the virus isolation rate and the size of family.

In this study, the microtransfer method using human embryonic fibroblasts (HEF) was employed to identify the isolates in the later half of the study. The results obtained by this method were entirely satisfactory. As reported previously [17], human embryonic cells were highly susceptible to enteroviruses except some group A and B Coxsackieviruses. These cells were quite useful for titration of neutralizing antibody against a certain types of Echoviruses [18].

Pacsa and Afoakwa [19] reported that the natural state of enterovirus flora of the general population had not changed in Ghana, based on their sero-epidemiological study of poliovirus. The present communication has supported their result virologically.

In summary, the present investigation revealed that nearly half of healthy infants in urban areas of tropics were infected with enteroviruses in all seasons. Hence, it may be concluded that various types of enterovirus were circulating continuously in the infantile population of tropical urban communities throughout the year.

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[I-25] 22. ガーナ国における特異なる視神経黄斑網脈絡膜症について (図25, 表14)

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A possible and probable new Maculopathy with Chorioretinal Disorder found in Ghana.

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A previous report presented a type of Macular Disease found in Ghana. This present report is out of 52 suspected cases (male 34, female 18) of this disease who are selected for reexamination. This examination showed that out of the 52 cases some patients had interesting and characteristic findings with the Fundus Fluorescein Angiogram (FFA) and Electroretinogram (ERG). The characteristics of this Maculopathy with Chorioretinal Impairment are as follows:

1. This disease in both it's progressive and stationary form is divided into 5 types in each lesion.
2. There are no differences in the disease incidence found in the male and female respective of age and lesions.
3. This is fluorescene leakage from retinal capillaries.
4. ERGs in 39 eyeballs show reduced amplitude of scotopic a, b wave and/or oscillatory potentials.
5. Some cases show nothing in FFA in spite of their macular swelling. However, some other cases with no leakage at macula show suspected chorioretinal degeneration from the investigation of ERG and FFA.
6. Quickened degenerative disorder at macula and pigment epithelium is supposedly caused by edema in sensory retinal layer and a certain debility factor existing in pigment epithelium itself or choroidal disorder suspected with circulative disturbance. These factors accelerate the spreading and degeneration especially of the macular area.

(self-abstract.)

I 緒　言

西アフリカ，ガーナ共和国で経験した黄斑部に初発すると考えられる疾患で，分類上帰属不明な黄斑疾患を予報[1]で報告した．その後症例の再検討，文献的考察をした結果，蛍光及びERGに本症の特徴と考える知見を得たので報告紹介する．

II 対　象

研究対象は次の条件を満たすもので，

(1) 外傷の既往がないこと．(2) 高度の屈折異常がないこと．(3) 高血圧，糖尿病等の全身的疾患がないこと．(4) Onchocerciasis, Sickle cell disease, Toxoplasmosis でないもの．(5) 細隙灯検査で前房内に変化のないもの．

III 検査器具および条件

(1) ズーム式細隙灯 Hruby レンズ (ニコンI)．(2) 眼底カメラ：オリンパス (GRC-Ⅱ-C, 蛍光眼底撮影装置：レチナパン45, (3) ERGスコープ(半田屋)．(4) ゴールドマン型視野計 (高田 MT-401)．(5) 使用薬剤：ミドリンP10%フルオレスチン Na 注射液．

Table 1 Selected cases suspected this disease for reexaminaton.

Table 1

Case No.	Age	Eye	Corrected visual acuity	ERG	FFA	Type	Fundus
1	69	B	6/60 CF	sub. sub.	leak at lesion	MCR MCR	M(deg.),Chr.(lesion) M("),Chr.(")
2	10	L	6/5 CF	nor. sub.	Chr.(deg.)	MCR	M(deg.),Chr.(lesion)
3	19	R	CF 6/5	sub. nor.	leak at lesion	MCR	Chr.(scar)
4	44	B	6/6 6/6	sub. ab.	Chr.(deg.)	M M	M(deg.) M(")
○5	19	A	6/18 6/12	sub. sub.	Chr.(deg.) Chr.(deg.)	Mp	M(edema),Paramacular lesion in both
6	19	B	6/12 6/12	nor. nor.	D/ua leak at M.	MCR MCR	M(edema) M(edema)
7	16	A	CF 6/36	ab. nor.	leak at lesion	MCRO Mp	M(scar)+O(atrophy) M(deg.)
○8	20	R	6/5 CF	nor. nor.	no findings leak?	M M	M(deg.) M(hole)
9	20	L	6/5 6/12	nor. sub.	Chr.(deg.)	MO	mov. M(edema),O(atrophy)
○10	15	R	CF 6/6	nor. nor.	leak from cap.	M	M(edema)
11	11	B	6/36 6/24	- -	leak at M.	MCR MCR	M(haze), Chr. M(edema),Chr.(scar)
12	18	B	6/60 6/60	nor. sub.	Chr.(deg.)	MO MO	M(ab.),O(blurred) M("),O(")
13	27	R	6/36 6/6	ab. nor.	M(dull)	M	M(red)...(hole?)
14	17	B	6/6 6/6	nor.	no leak	M M	crystal silver brilliant spots in both
15	26	R	6/36 6/6	nor. nor.	no leak	M	M(ab.),O(blurred)
16	35	R	6/9 6/18	-	leak at M	M	M(deg...hole) corneal leucoma
17	35	R	6/18 6/5	nor. nor.	no leak	M	M(deg.)
18	34	B	6/60 6/60	sub. sub.	leak at M Chr.(deg.)	MO MO	M,O(atrophy) M,O(")
19	26	B	6/12 6/12	sub. sub.	no leak	M M	M(ab.) M(ab.)
20	22	B	6/36 6/36	nor. nor.	no leak	M M	M(ab.) M(")
21	26	L	6/6 6/36	nor. nor.	leak	M	M(capillary abnormality?)
22	43	B	6/5 6/6	nor. nor.	no leak	M M	M(ab.)crystal spots M(ab.) "
23	30	L	6/9 6/9	-	no leak	M	M(ab.)dull
24	43	B	6/60 6/18	sub. ab.	no findings Chr.(deg.)	MO MO	M(ab.)O(atrophy) M(")O(")
25	45	B	6/9 6/12	sub. sub.	Chr.(deg.)	MCR MCR	M(deg.) M(deg.)
26	28	L	6/6 CF	nor. sub.	-	M	M(hole)
27	21	B	6/9 6/9	nor. nor.	no findings	M M	M(ab.) M(ab.)
28	35	R	6/12 6/5	ab. nor.	no findings	M	M(edema)
29	23	B	6/36 6/9	ab. nor.	no findings	M M	M(ab.) M(ab.)
30	19		6/12 6/12	sub. nor.	Chr.(deg.) Chr.(deg.)	M M	M(ab.) M(ab.)
○31	24	L	6/5 6/9	nor. nor.	leak	MCA	M(deg.),Chr.
32	20	L	6/6 6/60	nor. nor.	leak	MCR	M(edema)+Chr.
33	21	B	6/9 6/6	nor. sub.	- -	M M	M(deg...hole) M(ab.)
34	25	B	6/9 6/9	sub. sub.	Chr.(deg.) Chr.(deg.)	MO MO	M(ab.),O(atrophy) M(ab.),O(atrophy) copperwired capillary
○35	21	L	6/5 HM	sub. sub.	Chr.(deg.) leak at M	MO	M(deg.),O(atrophy)
36	23	R	HM 6/5	sub. nor.	Chr.(deg.)	MCRO	M(deg.),Chr,O(atr.)
37	14	R	6/36 6/6	hor. nor.	no findings	M	M(ab.)
38	49	B	HM CF	nor. neg.	-	MCRO MCRO	
○39	19	R	CF 6/5	sub. nor.	Chr.(deg.)	MCRO	M(deg.),Chr,O(atr.)
○40	25	L	6/6 6/36	nor. ab.	no findings	MO	M(ab.),O(neuritis)
41	32	B	6/5 6/5	nor. nor.	no findings	M M	M(ab.) M(ab.)
42	40	B	6/6 6/6	ab. nor.	no findings no findings	M M	M(ab.) M(ab.)
43	20	B	6/18 6/18	nor. nor.	no findings	M M	M(ab.) M(ab.)
44	44	R	6/9 6/5	nor. nor.	no findings	M	M(edema)
45	16	B	6/12 6/18	ab. ab.	no findings no findings	M M	M(ab.) M(ab.)
46	16	B	6/24 6/60	nor. sub.	leak at lesion Chr.	MCR MO	M(scar),Chr M(ab.),O(atrophy)
47	34	L	6/9 CF	nor. nor.	Chr.(deg.)	M	M(edema)
48	52	R	6/18 6/9	nor. nor.	no findings	M	M(edema)
49	20	L	6/6 6/36	- -	no findings	Mp	M(edema)
50	51	B	6/12 CF	nor. nor.	- -	M M	M(ab.) M(hole, exudate)
51	42	L	6/6 6/6	nor. nor.	no findings	M	M(ab.)
52	51	L	6/6 CF	- -	M(dull)	M	M(hole?)

(6) ERGの条件：Sensitivity 100μV/cm, Sweep time 10msec/cm, Time constant 0.3, Callibration 2cmfor 100 μV/cm, Xenon flash, Stimulus intensity 20 Jouls. これらについての詳細は国際協力事業団の報告書[2]，又ERGはガーナにおいて掲載予定である[3]．

IV 結　果

1. 性別，年齢，病眼の構成（表1，2）（図1，[1]）

表1は52例について年齢，片眼又は両眼の有無，矯正視力，ERGと蛍光所見，病型，眼底所見を示した．男女比は2：1である．年齢は10～69歳までで，男女共15～25歳台に peok がある（図1）の病眼の左右差は認めないが男では両眼性障害が，女では片眼性障害が多い

Table 2 Distribution of both sex in age, either or both eyes disordered and No. of eyeballs.

Table 2

	Cases	Age	Unilatoral group	Bilateral group	Eyeballs
Male Case No. 1-34	34	10-69	14 (R:7, L:7)	20	54
Female Case No. 35-52	18	14-51	11 (R:5, L:6)	7	25

（表2）.性別の年齢別病眼（片眼性，両眼性）には特に著明特徴はない．図1′は片眼性の分布を示す．

2. 性別における視力障害の程度及び片眼性，両眼性とにおける障害程度別分布（表3，4，5）

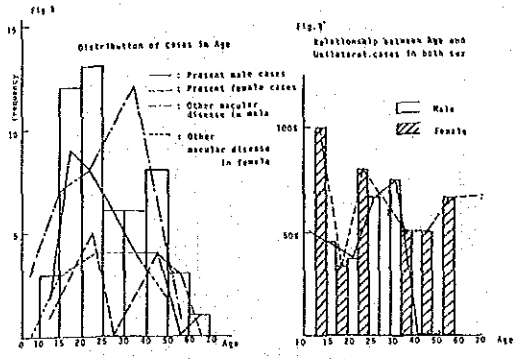

Fig. 1 Distribution of cases in age.
Fig. 1' Relationship between age and unilateral cases in sex.

Table 3 Groups (I, II, and III) with the each visiual acuity.

Table 3

Visual acuity
I : - 6/9
II : 6/12 - 6/36
III : 6/60 -

Table 4 Distribution of eyes divided into 3 groups in sex.

Table 4

	I	II	III	total
Male	18 (33.3)%	22 (40.7)	14 (25.9)	54
Female	6 (24)	10 (40)	9 (36)	25
Total	24 (30.4)	32 (40.5)	23 (29.1)	79

表3に視力障害の程度の分類を表わした．Ⅲ群に属する割合は男25.9%，女36%である（表4）．片眼と両眼性での分類では男女共片眼の時がⅢ群に属する割合が夫々35.7%，45.5%で片眼性の方が視力の程度の悪いものが多く特に女の方がこの傾向が強い（表5）．

Table 5 Distribution of eyes divided into 3 groups in sex and bilateral or unilateral disturbed vision.

Table 5

	Bilateral Group			No. eyes	Unilateral group			No. eyes	total eyes
	I	II	III		I	II	III		
Male	15 (37.5) %	16 (40)	9 (22.5)	40	3 (21.4)	6 (42.9)	5 (35.7)	14	54
Female	4 (28.6)	6 (42.9)	4 (28.6)	14	2 (18.2)	4 (36.4)	5 (45.5)	11	25
Total	19	22	13	54	5	10	10	25	79

Table 6 Distribution in each type in sex.

Table 6

Type	M	F	-25 M	-25 F	26- M	26- F
1) Macular lesion only : M	27	16	16	5	11	11
abnormal reflex - edema : M(ab)	(13)	(14)				
scar - hole : M(hole)	(4)	1				
degeneration : M(deg)	(6)	0				
crystal like substance : M(ab)	(4)	0				
2) (1) + Paramacular lesion : Mp	4	1	3	1	1	0
3) (1) + Chorioretinal lesion : MCR	12	1	8	1	4	0
4) (1) + Optic atrophy : MO	10	3	5	3	5	0
5) (3) + Optic atrophy : MCRO	1	4	1	2	0	2
total No. eyes.	54	25				

Table 7 No. of eyeballs in each item.

Table 7

	sex	I	II	III	total	Abnormal appearance of each wave a	b	Os	normal ERG	not taken ERG
M	male	14	10	3	27	5	8	6	12	4
	female	6	7	3	16	1	3	2	11	1
Mp	male	0	4	0	4	0	2	2	2	0
	female	0	1	0	1	(-)	(-)	(-)	(-)	1
MCR	male	2	5	5	12	7	6	4	2	3
	female	0	1	0	1	0	0	0	1	0
MO	male	2	3	5	10	3	5	7	0	0
	female	0	1	2	3	2	2	3	0	0
MCRO	male	0	0	1	1	0	1	0	0	0
	female	0	0	4	4	2	2	2	0	0
	male	28	22	14	54	15	22	20	17	7
	female	6	10	9	25	5	7	7	14	2
total		24	32	23	79	20	29	27	31	9

3．病型と視力との関係（表6，7）（図2）

病型は表6に示し，5型に分類した[1]．黄斑部型(M)は男に50%，女に64%と多い．視神経萎縮（炎症性変化を示す3眼を含め）型は男20.3%，女28%で炎症性の変化は全て男であるのでこれから考慮して女が多いことが分る．傍黄斑型と網脈絡膜型（MCR）は男は22.2%，女は4%で圧倒的に男が多い．25歳で分けると，以下では男はM>MCR>MO>Mp>MCROの順，女はM>MO，MCRO，Mp=0で進行状態と一致しない．以上になると男女共表現型は一定せず，特に女では黄斑徴候のみが圧倒的（84.6%）に多い．

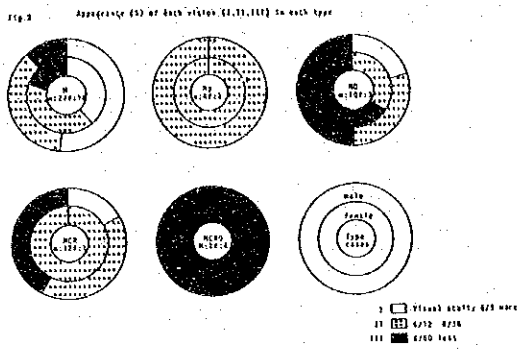

Fig. 2 Apperence (▮▮) of each vision in each type.

Table 8 Amplitudes of scotopic ERG in normal Ghanaian.

Table 8

	Mean value μV	Standard deviation μV	No. eyeballs
a	361.2	47.7	51
b	514.2	56.1	50
Os	319.1	61.4	42

Standard amplitude of each scotopic wave in normal Ghanaian

Table 9 Amplitudes of scotopic ERG in the present cases.

Table 9

	Mean value μV	Standard diviation μV	No. eyeballs
a	309.43	69.96	70
b	408.71	119.96	70
Os	232.17	110.58	70

Amplitude of each scotopic wave in present cases

4. ＥＲＧ所見（表7，8，9）（図3，4，5）

ガーナ国での正常人のＥＲＧについては既に報告した[3]．本報告では Scotopic ERG に著明な変化を認めるので Scotopic ERG における a,b 波，律動様小波(Os)を正常ガーナ人のＥＲＧのそれらと比較した．律動様小波[4)5)6)]の計測法は[7)8)9)10)]宇佐美[9)]に従い図5に示す如くである．正常ガーナ人のＥＲＧから得られた a,b 波，Os については表8に平均値（m），標準偏差（sd）を示す．本症例52例70眼のＥＲＧ各成分の平均値，標準偏差を表9に示し，夫々の分布をグラフに表わしたものが図3，

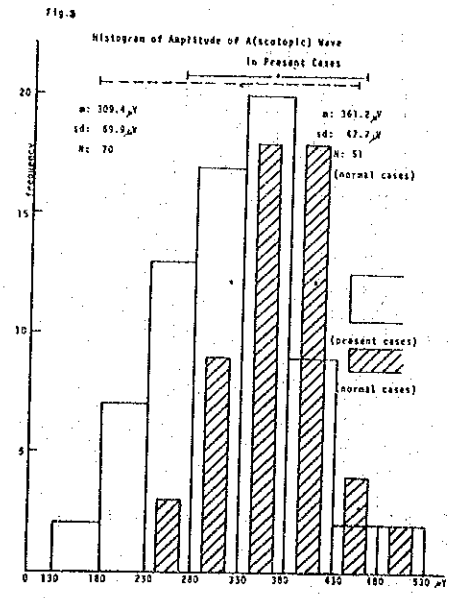

Fig. 3 Histogram of each ERG component and comparison in normal Ghanaian and the present cases.

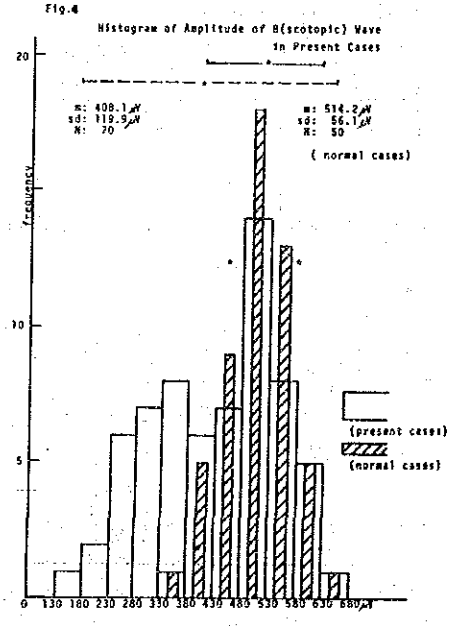

Fig. 4 Histogram of each ERG component and comparison in normal Ghanaian and the present cases.

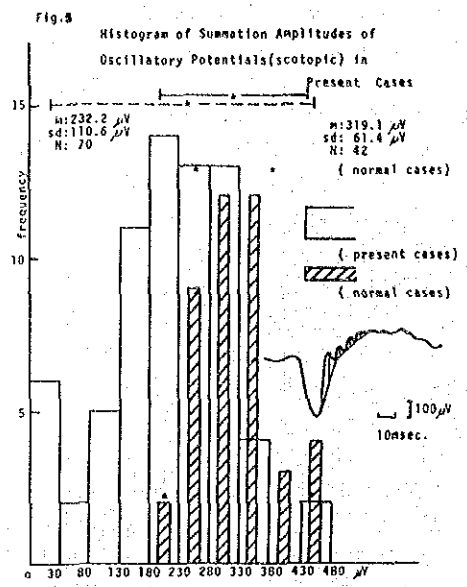

Fig. 5 Histogram of each ERG component and comparison in normal Ghanaian and the present cases.

4，5であり，本症例でのバラツキが大きく，又平均値も減じていることが分る．興味深いことは黄斑のみに異常を認める例にも abnormal ERG を認めることである．正常範囲を逸脱するものは a：20，b：29，Os：27（表7）で正常ERGは31眼に認める．推計学的に本症例の各波の振幅と正常者の振幅との差に有意性があると認められた（$P<0.05$）．

5. FFA所見とERG所見（表10，11）

蛍光眼底撮影（FFA）は61眼に行われ，各病型と異常蛍光所見との関係は表10に示す．異常蛍光所見として

Table 10 Findings and No. of eyeballs in each type.

Table 10

FFA \ Type	H	Hp	HCR	HO	HCRO	Total	% /61	% /36
Background fluo. Abnormality	9	1	3	7	2	21	34.4	58.3
leak at macula	3	0	3	2	0	8	13.1	22.2
leak at other lesion	0	0	6	1	2	9	14.8	25.0
leak from capillary	6 (3)	0	0	1	0	7 (4)	6.6	11.1
hemorrhage	0	0	1	0	0	1	1.6	2.8
Optic atrophy	0	0	1	7	3	11	18.0	30.6
Other findings	5 (hole)	1	0	0	0	6	9.8	16.7
Nearly normal findings	23	1	0	1	0	25	41.0	-
Total eyeballs taken FFA	33	3	10	12	3	61	100.0	-

Table 11 Relationship between ERG and abnormal FFA (esp. abnormal back ground fluo.

Table 11

	Abnormal ERG	No. of Background fluo. abnormality	No. of no findings	No. of not taken FFA
Abnormal a, b and/or os	39	18 (60%)	12 (40%)	9
Abnormal b and/or os	34	18 (69.2%)	8 (30.8%)	8

特に，Geographic choroidal fluo. の異常遅延，色素上皮層の障害によると考えられる背景蛍光の異常，脈絡膜循環不全を予想される網膜血管の狭細化等を Abnormal back ground fluo. とし，これらが本疾患の1つの基礎をなすものと推定される．蛍光色素の漏出は図7で示す如く網膜毛細血管からで，色素の流入増強等の所見はない．興味あることは黄斑限局型で背景蛍光の異常所見を27.3%に認めることで，加齢による頻度の差は認めない．傍中心窩の異常陰影（図13，14）等特徴ある所見を呈した．表11は異常ERGと蛍光所見（特に背景蛍光）との関係で，b波，Os の異常を示す34のERG中69.2%の割合で背景蛍光に異常を認めた．

7. 本疾患の病型および病勢

本症の代表的特徴を示す症例を以下の順で述べる．

（1）初期の病像（case No. 10），（2）(a) 中心窩のみに変化を示す（case No. 40），(b) 黄斑裂孔を対眼にもつ（case No. 8）3黄斑部に Rieger[11] 型の病変を示し，背景蛍光異常のある（case No. 5）黄斑周辺網脈絡膜に病変の拡大した (a)（case No. 35, (b) case No. 31 (5) aberrant macular vessels に本症が合併した（case No. 21）ERGの律動様小波の回復を認めた（case No. 42）図25のみ．

（1） case No. 10（図6，7，8，9，10，11，12—1）

初診時（10月16日），RV: CF (n.c), LV: 6/6 (n.c) 主訴右視力低下である．黄斑部に浮腫性の腫張を認め（図6），左眼底は正常（図12—1）である．蛍光所見（図7，8）は蛍光色素が網膜毛細血管から漏出し，後期静脈相で最大となるが“漏出は淡くあたかも血管壁にまとい付くような”形である．漏出毛細血管自体の蛇行が認められる．黄斑内に蛍光色素が貯溜されているのが分る（図8）．ERGは正常であった．約2カ月後の12月6日 RV：$^{6}/_{36}$と改善を示したが，黄斑部所見は同様に改善されている（図9）．蛍光所見（図10，11）からは特徴

的，興味ある病像を呈した，即ち黄斑域内の変性像と思われる背景蛍光の異常があり，脈絡膜側からの蛍光色素の流入による増強する像である．又漏出を起していた毛細血管からは既に漏出もなく，又これらの毛細血管の狭細化を認める（図11）．

(2)　(a) case No. 40 (12—2，—3，13，14)

初診時（9月26日），RV: 6/5 (n.c), LV: 6/36 (n.c) 主訴は両眼の視力低下で：検査上異常所見はない．10月30日 LV: 10cm CF (n.c) 眼底（図12—2，—3）には異常がない，しかし蛍光所見（図13，矢印）では中心窩に人工的産物でない輪状の異常陰影を認める．図14（矢印）は約1カ月後でその病巣の拡大が認められる．(b) case No. 8, RV: 6/5 (e.c), LV: CF (n.c) で蛍光写真上同様な所見（図15）を示した．眼底には黄斑部に変性を認める（図12—4）更にこれは黄斑裂孔を形成した．ERGは (a) subnormal, (b) normal ERG であつた．

(3)　case No. 5 (図16—1，17，18)

両黄斑部領域に不規則な異常反射があり，皺壁を形成しているようであつた（図16—1）．RV：6／18，LV：6／12で，蛍光所見（図17）には背景蛍光の異常があり，ERGではb波の減弱が著明であり，律務様小波も減弱している（図17—4），右眼にも同様な蛍光所見（図18）を示した．

(4)　(a)case No. 35 (図19，20) (b) case No. 31 (図21，22)

進行型の症例で，（a）黄斑部に滲出性の黄白色斑（図16—3），（b）色素沈着と白斑を認める（図16—2）．蛍光所見は両者共（図19，20）及び（図21，22）広範な色素上皮の障害を認め，図22矢印の如く，脈絡膜からの蛍光色素の増強が認められる．（a）のERGでは $\dot{O}s$ の減弱が著明である．

(5)　*case No. 21* (図23，24)

aberrant macular vessels と考えられる症例に本症が合併したもので（図24矢印）脈絡膜側からの蛍光色素の増強が認められる．尚眼底には colloid boby と思われる所見があり，血管奇形と思われるがしかしこの障害部での蛇行が特に著明となるようである．矢印は3分板の部分と動静脈の場合を示す．ERGは正常であつた．Case No. 42（図25）は Os の回復を示す．

V　考　按

本症例の考按に入る前に論旨上関連が深いと考える問題を述べ本症について言及する．

1：黄斑部腫張，浮腫に関する問題点．

黄斑部に浮腫をもたらす直接の原因については血行不全であることは既に知られている．しかし黄斑部浮腫を伴う疾患に関する研究の文献的考察をするには枚挙のいとまがない．概略について述べると分類の面では Maumenee,[12][13] Gass[14]が従来の分類と異なる分類を行つている．Maumeneeは網膜各層，脈絡膜の病変の位置によつて分類した．Gassは漿液性中心性網脈絡膜症（増田型）が色素上皮剝離又は色素上皮下の剝離に伴う疾患とし，これらは蛍光色素が脈絡膜側からの滲出液の色素上皮破綻部位からの流入であることは周知のことである[15][16][17]．Gassの色素上皮剝離（P.E.D）を知るには以前より細隙灯検査が有効であることは知られているが前置レンズの改良がこの面での診断に重要な役割を示してきた．掘浦[18]はEl-Bayadi レンズの改良を行い，鮮明で，肉眼的所見に近い解像率を示すことを報告している．本症では明らかな色素上皮の剝離を認める例はなく，Rieger型であることが少ない例だが予想され，その障害の部位は一応網膜側に存在すると推定される．

2：網膜色素上皮層に関する問題点

血液網膜柵（blood-retinal barrier）のうち網膜色素上皮が重要な機能を営んでいることは既に知られている．Hogan[19][20]はこれらに加齢的変化を認め，色素上皮は30歳から，Bruch 膜は20歳から加齢的な変化を示すと報告している．これが老人性黄斑部変性症の1つの原因であるとし，又漿液性の黄斑部疾患は液移動に対する血液網膜柵が破綻して生ずることと，黄斑疾患のいくつかの型は説明可能であることを示した．血液網膜柵に重要な役割をなす zonula occludens か色素上皮細膜基底板の異常がこの血液網膜柵の異常をもたらすものであるとした．zonula occludens の所で蛍光色素が留まる，即ち正常では網膜内層へ蛍光色素が拡散しないという実験報告があり[21][22][23][24]，これに反する報告もあるが趨勢は前者のようである．Hogan[25]は脈絡膜血管に於ける原発性の障害によつて黄斑部に変性をもたらす証拠はなにもないと主張し，色素上皮自体の異常に基くものであることを予想し，本疾患も色素上皮自体に何らかの障害か又は障害をひき起し易い因子が存在することが予想されている．

(3)　ERGに関する問題点

米村[4][5][6]らの研究によりERGの律動様小波がある疾患で特異物に減弱することが分つた．律動様小波の由来も内顆粒層の双極細胞がその近傍であるとされ，律動様

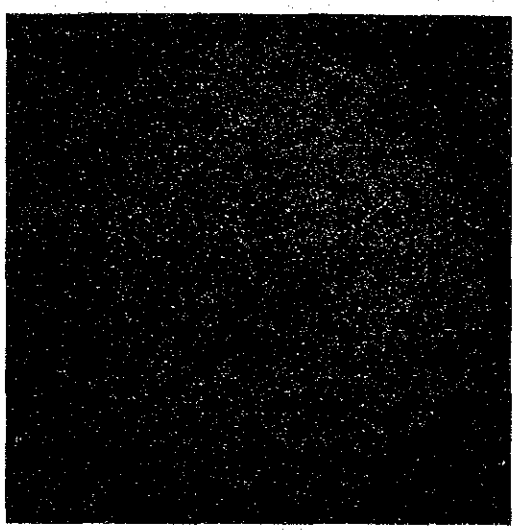

Fig. 6 Fundus photograph of case No. 0 at 6/Oct. Irregular reflex at macular area. RV: 6/5, LV: CF.

Fig. 9 F-P of same case at 6/Dec. RV: 6/36, LV: 6/6.

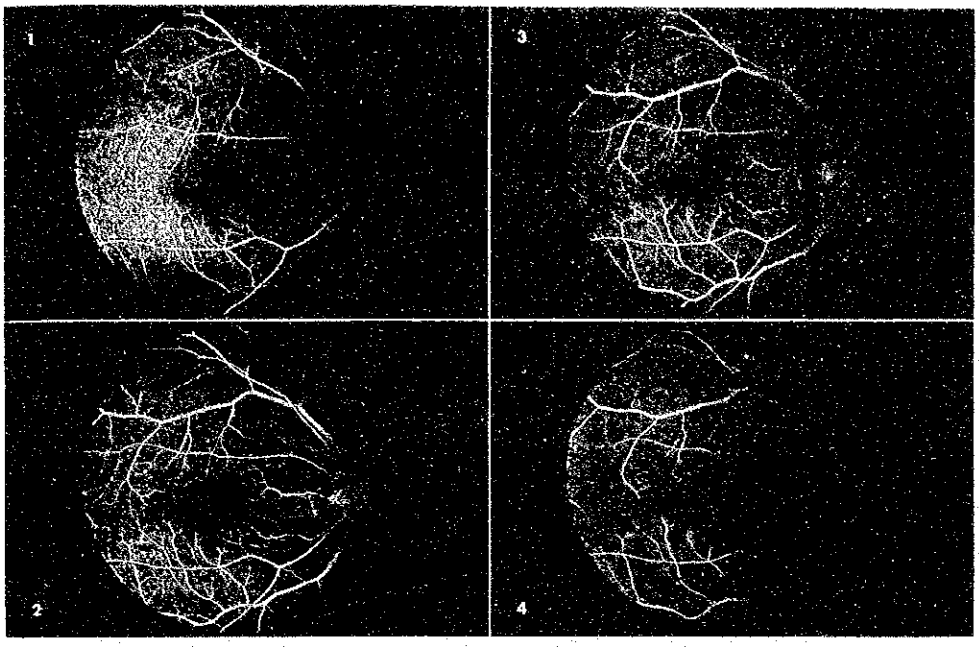

Fig. 7 FFA of Fig. 6. Permeability of retinal capillaries.

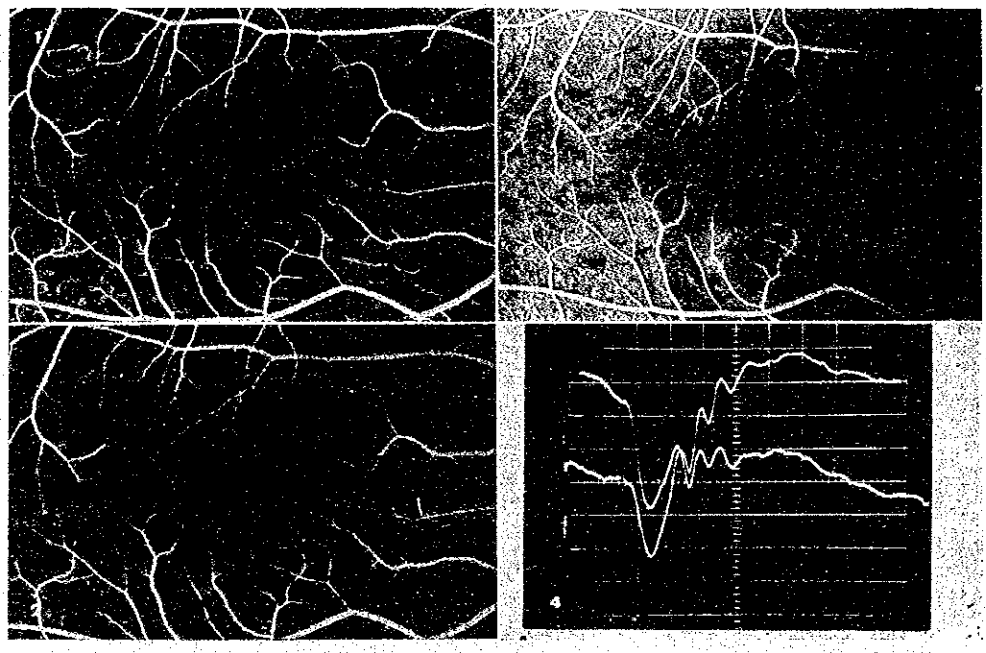

Fig. 8 Magnification of Fig. 7 and ERG. Permeability of the capillaries at late venous phase and diffuse fluorescein at macula. Dilatation and tortuosity of the capillaries.

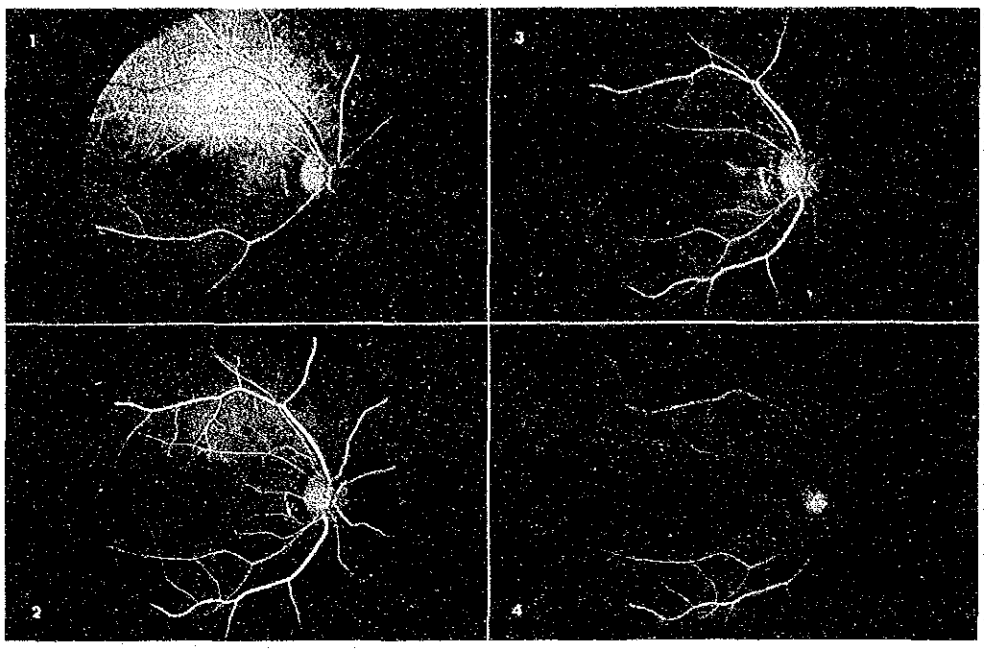

Fig. 10 FFA of Fig. 9. No permeability at all. Fluo. in the lesion.

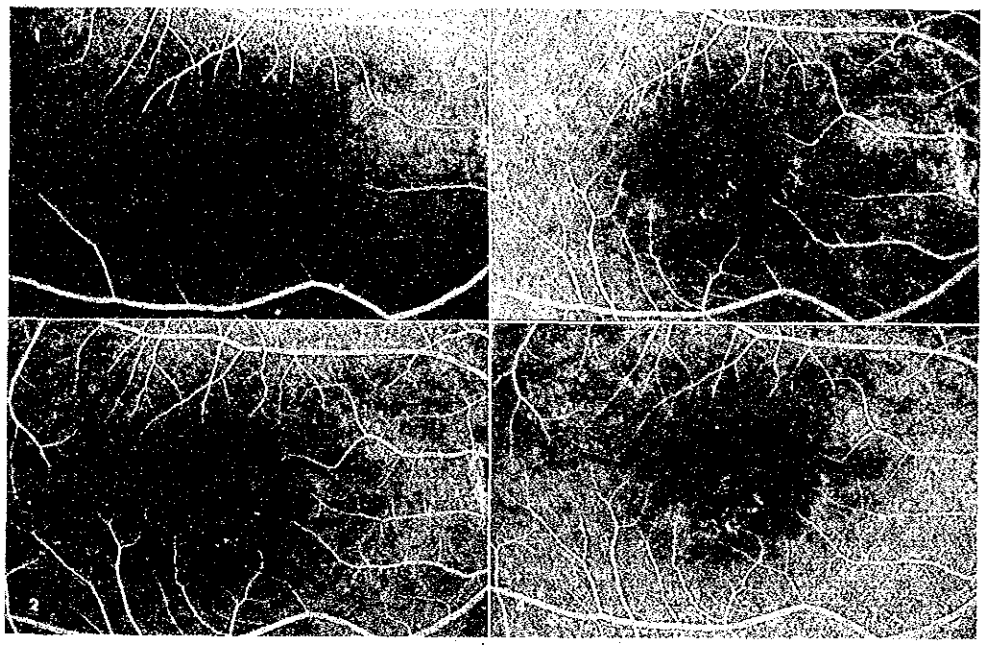

Fig. 11 Magnification ofFig. 10.

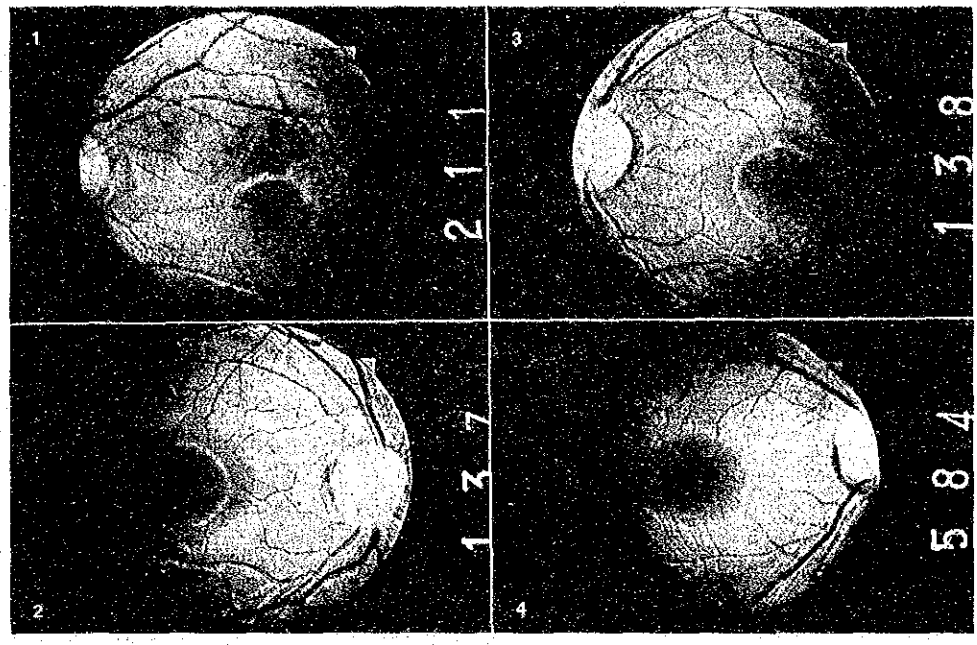

Fig. 12 1: F-P of case No. 10 in left fundus. 2: F-P of case No. 40 in right fundus. 3: F-P of the above in left. 4: F-P of case No. 8 in right.

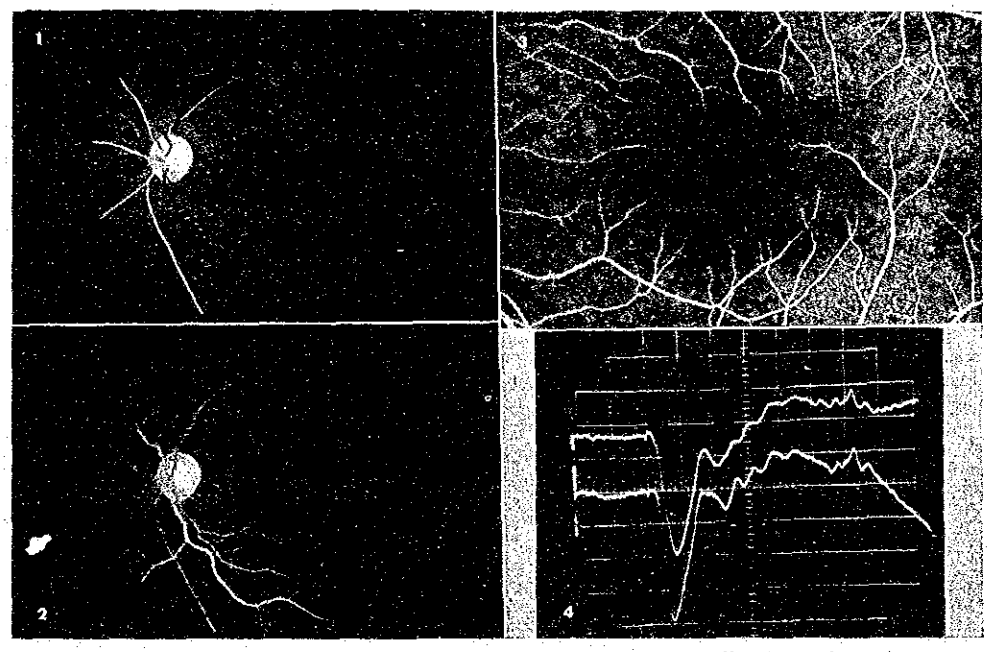

Fig. 13 FFA of Fig. 12-3 at 26/Sep. Circinate abnormality surrounding fovea (arrows).

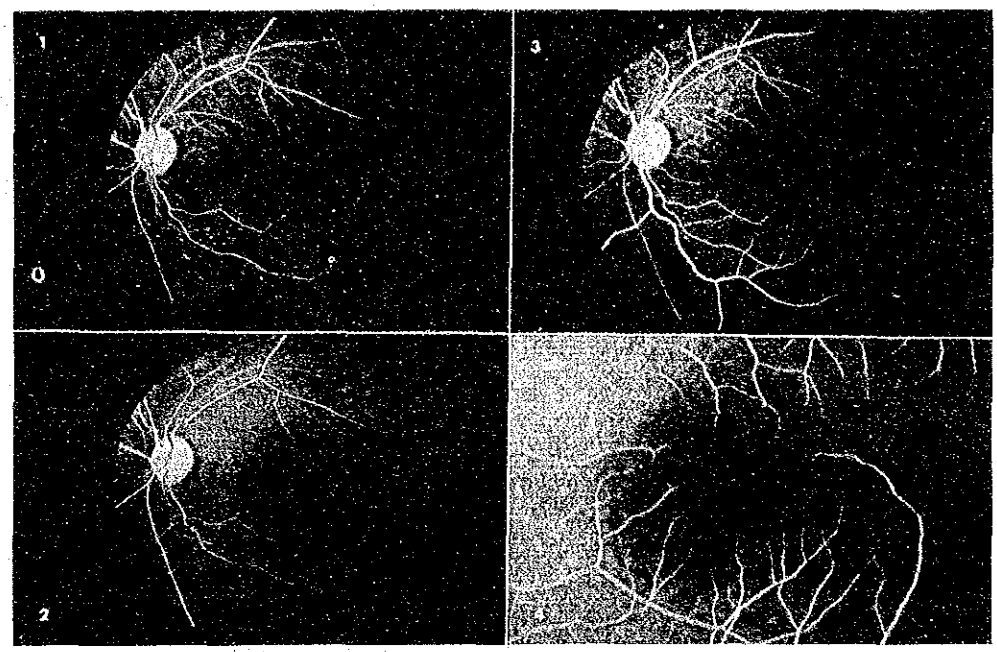

Fig. 14 *FFA of the above at 26/Oct. Enlarged the abnormality (arrows).*

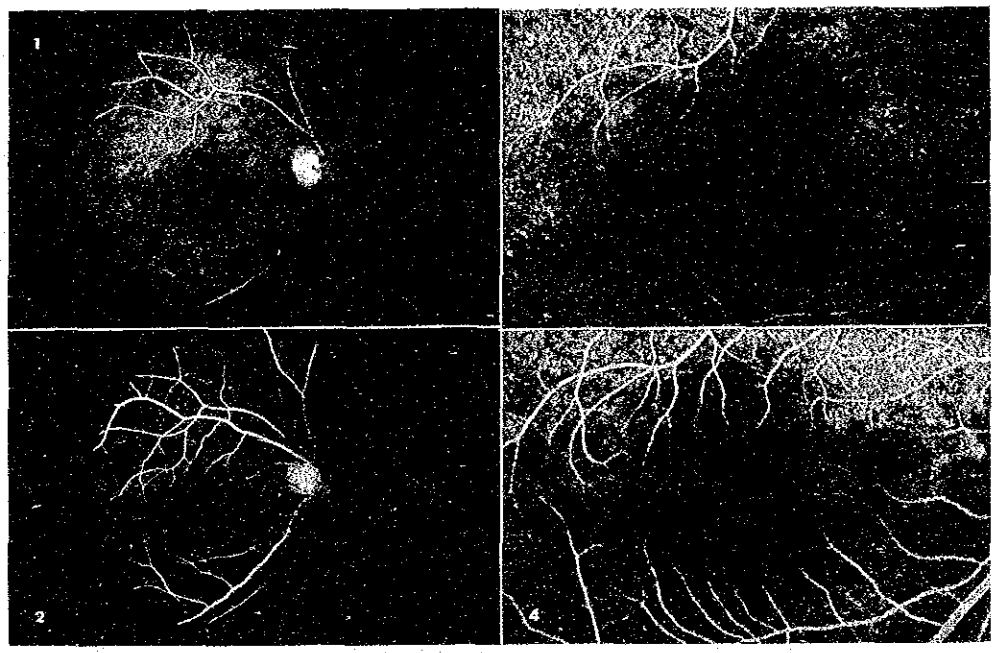

Fig. 15 F-P of case No. 8 in right.

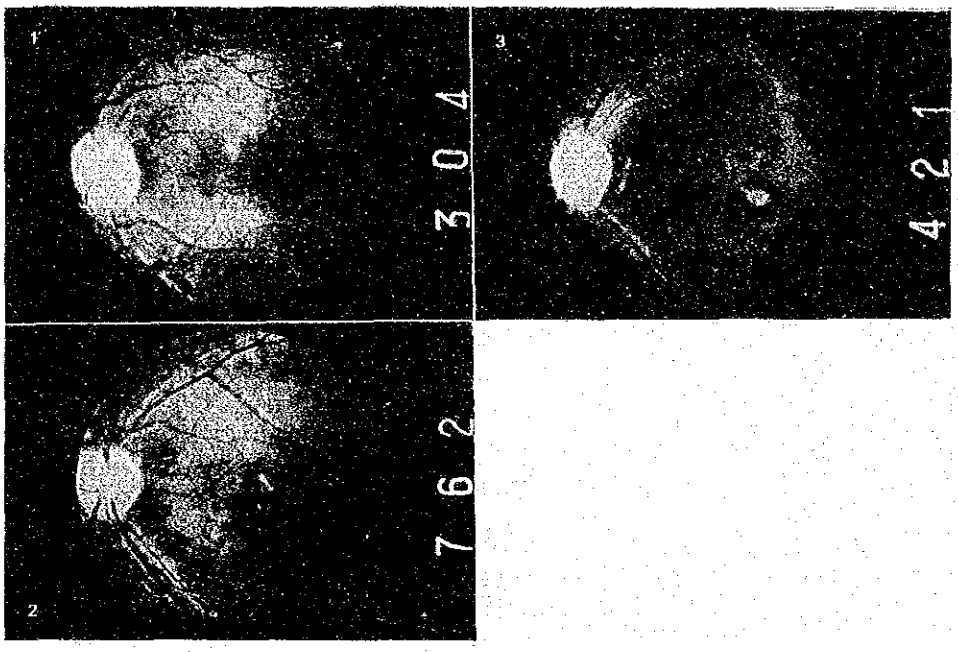

Fig. 16 1: F-P of case No. 5 in left. 2: F-P of case No. 31 in left. 3: F-P of case No. 35 in left.

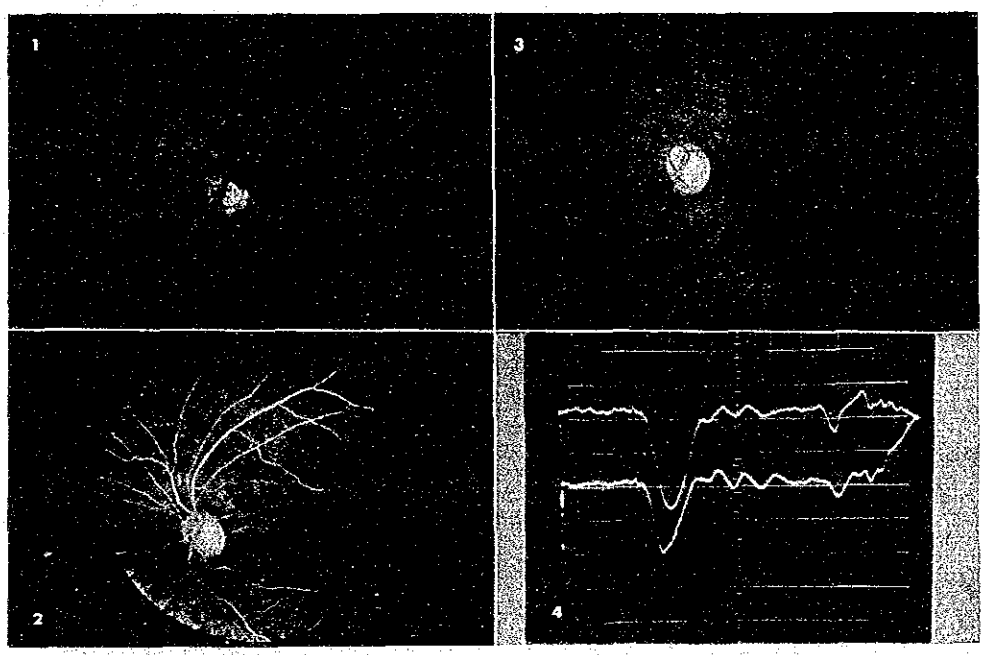

Fig. 17 FFA of Fig. 16-1. ERG; reduced every waves. Abnormal background fluorescence.

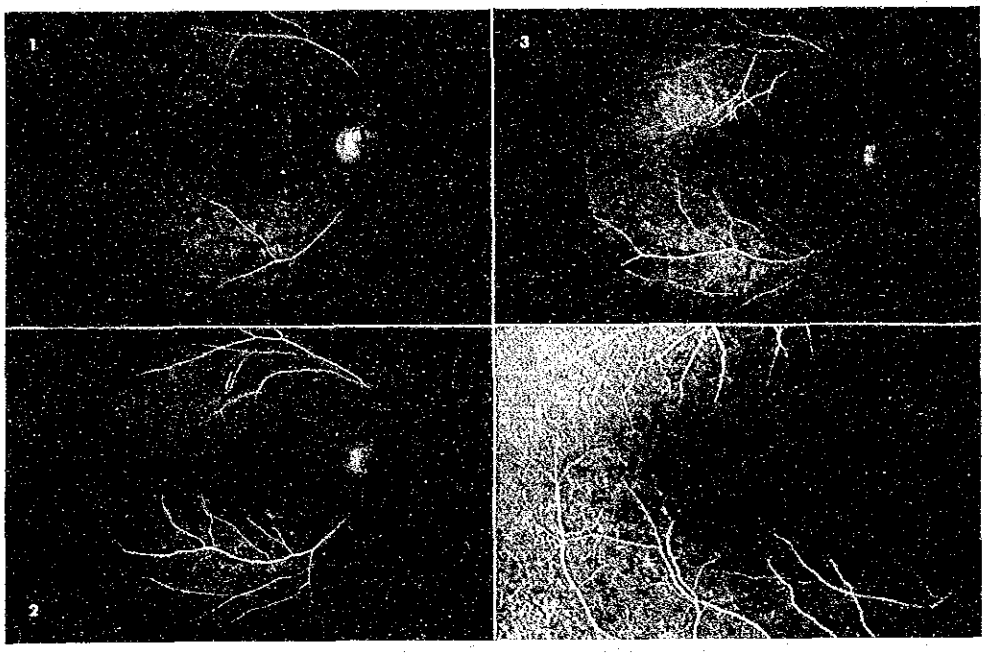

Fig. 18 FFA of case No.5 in right. Same finding in parafoveal site.

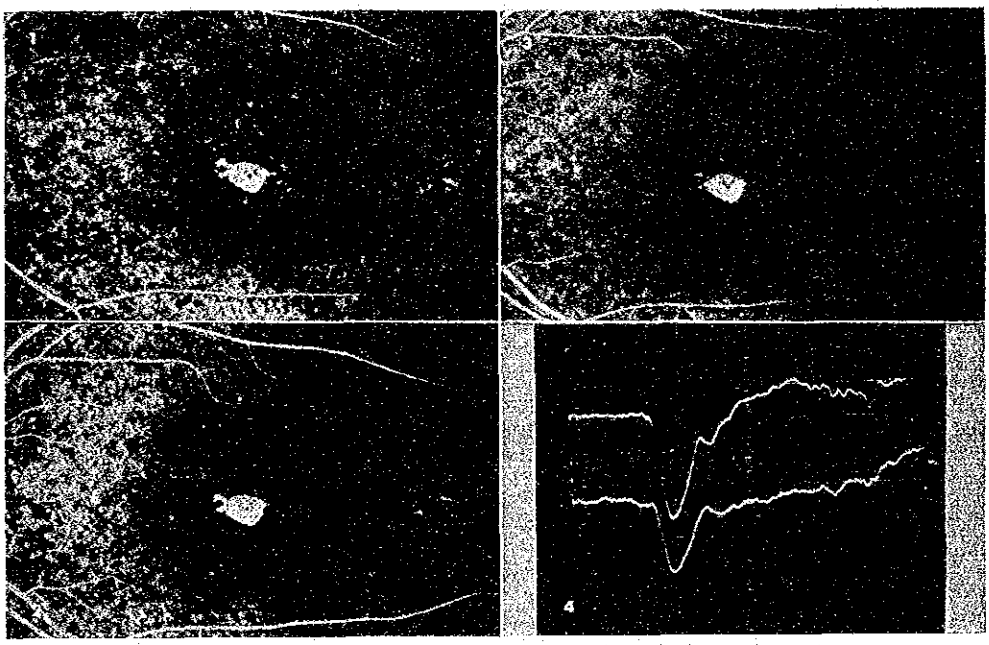

Fig. 19 FFA of case No. 35. Magnification of Fig. 20.

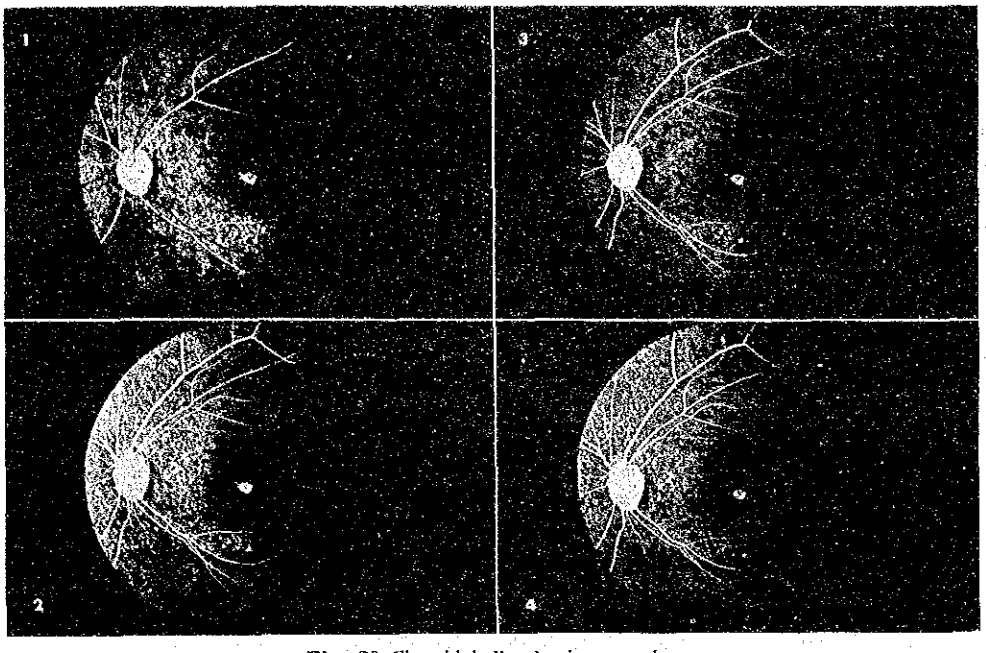

Fig. 20 Choroidal disorder in general.

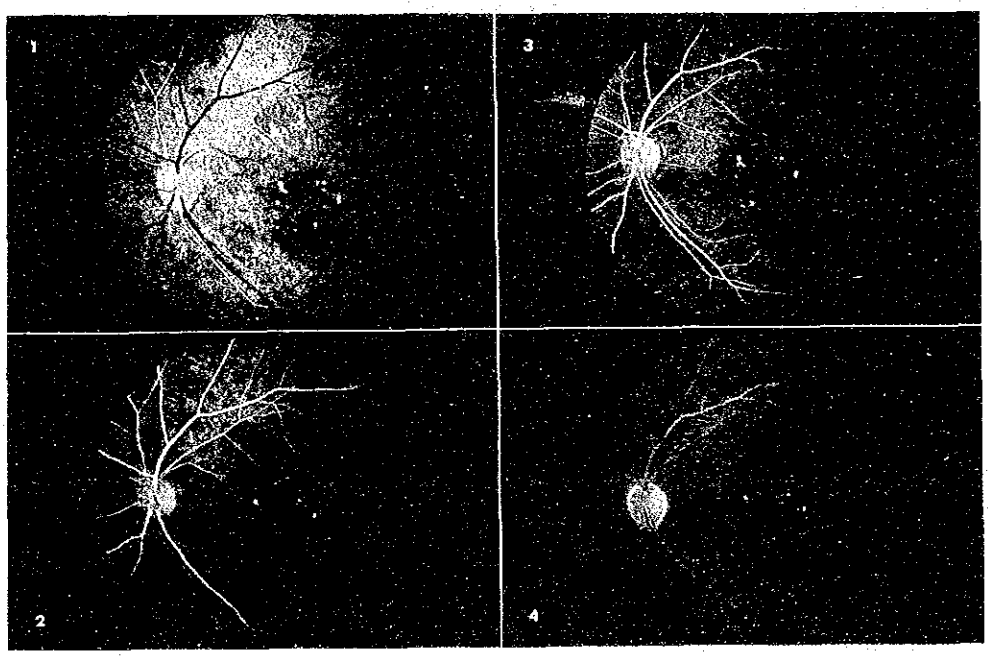

Fig. 21 FFA of pigmented scar. Fluo. at site of lesions.

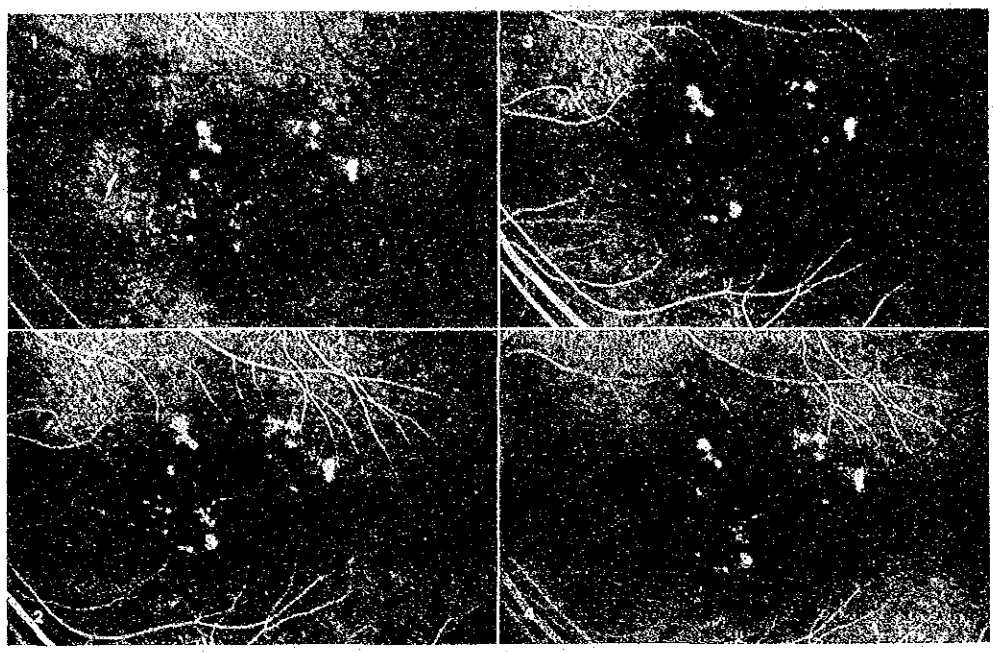

Fig. 22 Magnification. Increased intensity and the size of fluorescent spot from choroidal origin.

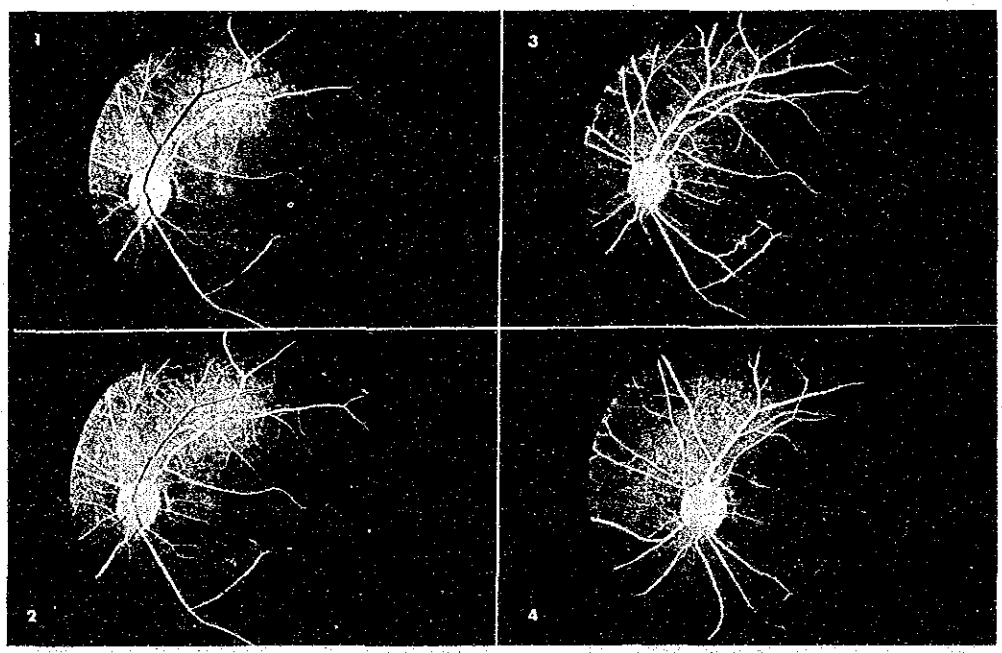

Fig. 23 FFA of case No. 21 complicated aberrant macular vessels. Colloid bodies. Fluo. increasing arrowed site. A-V anastomosis? and abnormal branches of retinal art.

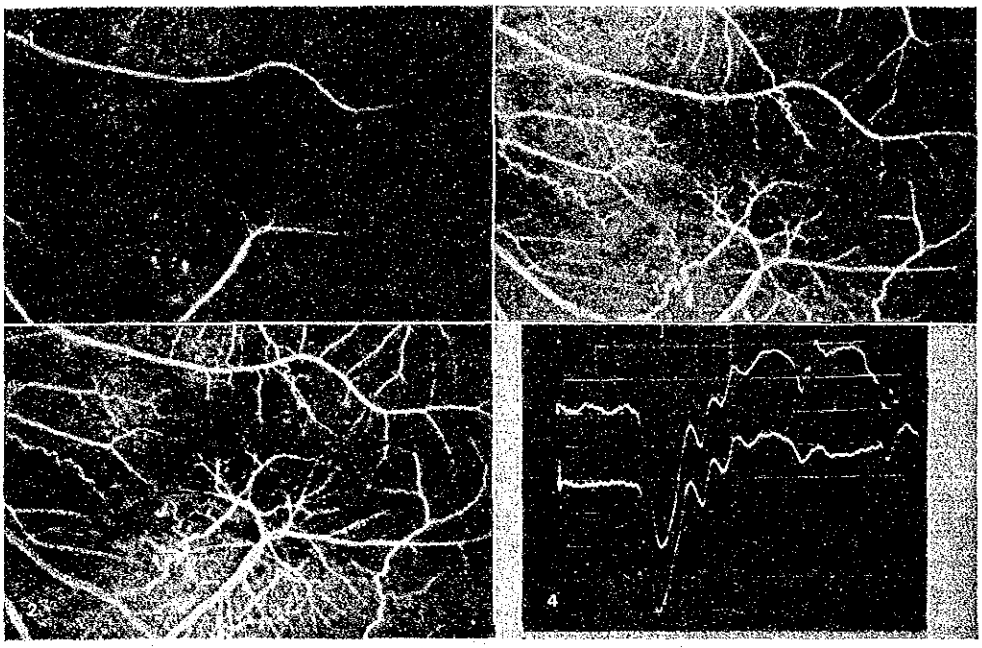

Fig. 24 Magnification of the above.

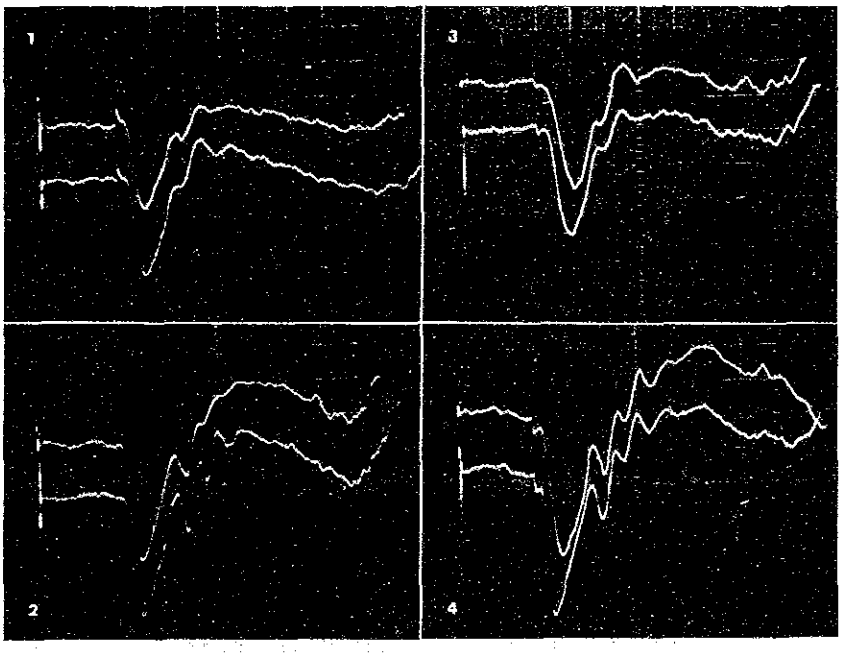

Fig. 25 Recovery Oscillatory potentials in case No. 42.

Table 12 Cassification and features in different macular diseases.

Table 12

	Classification by Perkins.	Pathogenesis by Maumenee.	Epidemiology.	Eye and/or general features.	Investigation.
1	Chloroquine retinopathy.	Pigment epithelium.	Chloroquine.	Bull's eye pigmentation.	ERG and FFA.
2	Stargardt's disease.	Neuro-epithelium	8-14 years of age.	Bilateral lesion with some degree of symmetry.	Famillial history.
3	Progressive cone dystrophy	Neuro-epithelium.	Rare.Familial.	Photophobia.color vision.	Cone-ERG.
4	Central serous choroidopathy.	Pigment epithelium.	Common in adults (30-50).M:F=3:1.	Ring-shaped reflex.Edema at macula. P.E.D.	Slitlamp.FFA:leaking area. Visual recoverv.
5	Fovea-macular retinitis.		Rare. Solar Burn.	Yellow exudates at macula followed by hole.	Early history.
6	Disciform degeneration.	P.E.-Bruch's-choriocapillary	Young adults.M:F=4:1 Unilateral.	Serous detachment beneath P.E. Complicated hemorrhage.	Slitlamp.FFA. Juvenile form.
7	Toxoplasmosis	Miscelleneous.	Common in Ghana. Reccureces.	Vitreous opacities. Typical lesion at macula.	Toxoplasma dye test. Hemagglutination. FFA.
8	Histoplasmosis.	Choroid.	Rare in Ghana?	Cystic hemrrhagic or atrophic lesion at macula with peripheral punchedout lesions	Chest X-ray FFA.
9	Onchocerciasis.	Pigment epithelium?	Common in Ghana. Northern area.	Degenerative or atrophic lesion.Microfilaria.	ERG,FFA. Skin snip test.
10	Sickle cell disease	Bruch's membrane.	Relative common in Ghana.	Abnormal vascularization.	FFA. Sickling test.
11	Para planitis	Outer plexiform layer.		Vitreous opacities.	Slitlamp.
12	Serous detachment of sensory epithelium.	Outer plexiform layer.		Macular edema.	Slitlamp.

小波が網膜の血行不全に鋭敏に反応することも知られている．b波の由来も以前より双極細胞由来と考えられている．黄斑部疾患に対するERGの応用は永田の局所ERG等の特殊ERGも研究されているが Strgos[27] は赤色光ERGを用いて Stargardt's disease の症例77%に異常を認め，単に検眼的所見の変化よりも病巣が網脈絡膜に広範囲に存在することを示し，蛍光的所見からもこれを裏付けている．本症例でも似た様な所見を呈するものがある．網膜色素変性症では extinguished ERG であることが多いが本症にはこれを認めない．更に網膜色素変性症の carrier[30] の問題は残るが，矢野[28][29]は実験的 B_1B_2 の網膜への影響をERGでとらえ，c波の異常を認め，色素上皮との関連性を示した．c波の検出は臨床的ERGでは artifacts が混入し易いため困難であり，色素上皮に関する検査としてEOG（網膜静止電位）が必要である．本症をも含めて Onchocerciasis の研究にも重要な検査法の1つであろう．

(4) 視神経萎縮の問題点

Rodger[31] は Onchocerciasis の研究の中で，西アフリカ諸国での視神経萎縮に言及し，これが慢性的な栄養障害，ビタミン B_1B_2 の欠乏による単性萎縮としている．この点に関して著者の見解[32][33][34]は異なるが，意見を述べる機会は次に譲る．Moore[35][36] はアフリカ人の主食の1つである Kasava を摂取する上での A avitaminosis, B complex avitaminosis が起るとしているがこの場合，角膜軟化症，pellagra 等の症状を伴つている．又女に多いことを記している．

(5) 鑑別すべき疾患

ガーナの風土，気候，疫学，栄養状態，病理，細菌ウイルス学，遺伝等に関する研究報告は部分的なものを除いてはほとんどないと考えて良い．著者の経験，又ガーナ人スタッフの意見を参考として鑑別すべき疾患をガーナの特殊性と関連させながら Perkins[37] Maumenee[12] らの分類，鑑別疾患を表12に示す．鑑別点は本症の特徴，病態を述べる中で自づから明らかになるので特には述べない．

(6) 本症の特徴および病態

男女共15～25歳に多く発病する傾向があり男では多くは両眼性，女では多くは片眼性障害を示す．発症に際し，視力の障害を伴なわずに経過する型と急激な視力障害を黄斑眼局内の病巣の存在にもかかわらず示す型があり，特に片眼性に発症している場合視力障害が両眼性と比較して著しい．これまでに報告されているいわゆる黄斑変性，萎縮などは示さずに検眼的には黄斑部の炎症性の変化が褐色調の spot 又は輪状の変性像であり，周辺網脈絡膜に骨小体様の色素沈着，脱色素斑，脈絡膜萎縮等の所見はなかつた．視神経萎縮を合併するのは女に多い傾向があり，Moorte のナイジェリヤでの児童において男より女の方がビタミンの欠乏症が多いこと，又治療に抗するという点から著者は非常な関心を持つた．年齢別によると本疾患の発症に際し，経年的に病状が悪化するということはなく，かえつて若年層の方が病状は悪いこ

とが炎症の影響があると思われた．ERG検査では，全く正常ERGのものと，異常ERGが示され，異常ERGについてはa,b波，律動様小波の振幅が減弱し，網膜神経上皮層内に障害が存在すると考えられる．ERG上，又蛍光所見上色素上皮の異常に伴う網膜内層の疾患であることが予想され，ERGの方が先行していることもこの点を裏付けてくれるものの1つであろう．蛍光所見上の特徴は，(1) 黄斑部内の腫張に対して異常を示さぬものが多く，(2) 背景蛍光に異常を示すものがこの中にあることがある．(3) 中心窩傍に微小な異常を示す例があり，この像の拡大性の変化を認める．(4) 黄斑内，網膜内層に存在すると考えられる浮腫を網膜毛細血管からの色素の漏出，浮腫内への拡散から予想される．黄斑部の変性は急激におこること，(5) しかしこの浮腫が脈絡膜側からもたらされると考えられる所見を矢張り早期の症例に認めることは滲出液の由来についてまだまだ議論の予地はある．(6) 黄斑部に変性が既に存在しているものでは，障害の範囲は更に拡大し網脈絡膜障害となつてくる蛍光所見がある．この場合でも他の型の疾患と異なり明らかな漏出点および拡散現象がない．色素上皮の障害によると考えられる異常背景蛍光の範囲は広く，特に視神経，黄斑を中心に周囲に波及していくかのように推定される．

以上の所見から本症の病態を論ずることは出来ないが，著者は次のような推察を行つた．初感染？の時期を決定することは Toxoplasmosis 像と同様に問題となるが，型から限局型，中間型，末期型と分け（表13），各型と各検査所見から主病変又は発現の形は黄斑部であり，これに先行する色素上皮障害又は脈絡膜側の欠陥があるかもしれない可能性があることを示す所見である．図14

Table 13 Summerised the results and affected lesions.

Table 13

Type		H.(43)	Mp,MCP.(18)	MO,MCO.(18)
Stage	Onset	early?	middle?	late?
Fundus change Macula	edema?	edema	hole?	degeneration
Chorioretina	-	?	inflammatory impairment?	scar,pigmented scar.
Disc	—	-	-	+
ERG	?	nor.(60%) abn.(40%)	nor.(36%) abn.(64%)	nor.(0%) abn.(100%)
Abnormality		a:6 b:11 Os:8	a:7 b:8 Os:6	a:7 b:10 Os:12
FFA	?	nor.(70%) abn.(30%)	nor.(8%) abn.(92%)	nor.(7%) abn.(93%)
Site of lesion				
Sensory retinal layer	affected	*	*	**
Pigment epithelium	affected?	- or +	affected	**
choroid	affected?	*?	affected	**

Table 14 Considerable factors tof this impairment.

Table 14

Factor 1	A; affects to all layer?
	B; affects mildly to retinal layer and severely to pigment epithelium.
Factor 2;	C; Debility factor in pigment epithelium itself.
Factor 3;	Choroidal factor followed by disorder of pigment epithelium.

に示す如く種々の Factor が考えられるが，各眼組織を広範に障害する Factor は考え難く，黄斑部の腫張は mild な炎症性の影響 Factor によつてもたらされ，この時期は網膜内層にもある程度の変化があると考えられる．又色素上皮自体を障害し易い Factor 2 が網膜内部の障害によつて加重的に色素上皮へ影響を及ぼして比較的広範囲な色素上皮の障害をもたらすと推定されるこの Factor 2 ではなく Choroid 側からの色素上皮に影響をおよぼすような Choroid 又は Choriocapillary の障害が (Factor 3), Factor 1,2 に関連しておこるか否かを推測する所見はないが脈絡膜循環不全をおこすような大きな Fcctor は想像し難いし Hogan[25] の脈絡膜の一時的障害がすぐに黄斑部疾患に結びつかないという説に従えば，色素上皮の早期の障害から矢張り Factor 2 の存在の可能性が充分に予想される．本疾患の解明には現在も引き続き協力研究がなされている[3]．成果がでる時に強い示唆を与えているものと考えるが毛細血管原性の黄斑部を障害し易い疾患が予想され，夫々の Factor について考按した．

VI 結　論

黄斑部を主病変とする視神経，網脈絡膜の障害を伴う疾患であり，発症には年齢的に特異な傾向はないが15～25歳に多い．蛍光所見上の特徴は網膜毛細血管からの蛍光色素の漏出であり，毛細血管の変化があり，急性に黄斑部変性に陥入るもので，色素上皮の黄斑部を超えた異常があり，これは本疾患の病態の1つの基礎となるものと推定されERGからもこれらが裏付けられ，本疾患はこれらの特異的所見から現在まで報告を見ない疾患の1つであると思われる．

稿を終るにあたり御懇篤なる御指導，御校閲を賜つた恩師梶浦睦雄教授に深く感謝致します．又研究期間を通して御指導戴きました保坂明郎助教授に深く感謝し，熱心なる協力を戴いたガーナ大学 Dr. C.O. Quarcoopome およびそのスタッフに感謝します．技術面で援助を受け

た高野悟技師及び教室各員に対し厚く御礼を申し上げ，最後にこの研究が国際協力事業団のガーナ国に対する研究協力の一環としてなされたことを記す．

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討　論

近藤　聖一（追加）本大学小児科で研修中のガーナ人で，33歳，男子の例を追加します．

視力は 1.0，ＥＲＧは normal. retina 内の pigment 含有量のちがいにより，日本人とガーナ人に背景蛍光の差がみられるかの観点より撮影した例ですが，本邦人とあまり大差がないようである．

荒木　誉達　血清学的検査は行われましたが，例えばトキソプラスマ症，真菌症，或いは，ガーナの風土病等との因果関係についてどの様にお考えですか．

山田　宏図（答）血清学的検査についてはアポロ結膜炎の場合で本邦での甲野氏がこれらの血清をガーナからとりよせそのウイルス学的検査を行つていますが，ガーナ大学では本邦の医療実情はまだ本邦における中央検査部の確立が弱く，血清の検査は困難でした．

Toxoplaspnosis, sicklecell disease, Onchocerciasis 等のガーナでの特有な疾患と本症は凝集反応Sickling tast, skin snip test 等で一応否定し，又病像も異なると考えます．

4. [I-26] **ECOLOGY OF ENTEROVIRUSES IN GHANA**

Isolation of Poliomyelitis and Other Enteroviruses from Water and Sewage

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Introduction

Mass and prolonged excretion of enteroviruses in faeces of sick and normal, healthy carriers can cause heavy contamination of surface waters and sewage. Hence, these must be regarded as one of the main reservoirs of enteroviruses in the outer environment and potential sources of pollution of drinking water, soil and irrigated farm cultures (Bagdasaryan and Kazantseva, 1967). The detection of viruses in sewage and other natural waters is of signal importance to health authorities (Mosley, 1965). The public health importance of detecting enteroviruses in water and sewage has been recognized by various investigators and the numerous literature on the subject is a clear testimony to this fact (Paul *et al.*, 1939; Melnick, 1947; Kelly, 1957; McLean *et al.*, 1961; Wallis *et al.*, 1969; Duff, 1970).

The present study describes enterovirus isolations made from water and sewage in the Greater Accra Region. We did not set ourselves the task of determining the quantity of enteroviruses detected. An attempt was, however, made to relate our isolates with known clinical syndromes associated with enteroviruses.

Materials and Methods

Sample Collection Points:

Collection of samples was undertaken from October, 1971, through April 1972. No samples were collected in March, 1972. A total of 67 water and sewage samples were collected from 23 rivers, 7 streams, 21 ponds, 2 lagoons, 8 wells and from 6 gutters in the Greater Accra Region. Of the 67 samples collected 42 (62.7%) were from rural waters. 33 of the sample sources served as sources of water for drinking, washing and bathing; animal pollution was contended by inhabitants to be very minimal. Sixteen (16) sample sources formed part of the sewage system of the Greater Accra Region. 51 samples, therefore, were for human and for animal consumption.

Sampling and Treatment:

Specimens were collected in sterilized 1½ litre Winchester bottles, chilled in wet ice and salt prior to their transportation to the laboratory.

Particles in the raw samples were allowed to settle a the bottom of the bottle and the supernatant was passed through serum-treated filter membrane to remove bacterial contaminants. 100 ml. aliquots of the filtered materials were centrifuged in the cold at 3 x 10^3 rev./min. for 15 mins. After discarding the sediment, the supernatant of the various aliqouts were centrifuged at 14 x 10^3 rev./min. for 2 hours. The supernatants were discarded, the sediments suspended in 1 ml. aliquots of PBS (Phosphate Buffered Saline) and stored at–20°C or–70°C until used.

Tissue Cultures:

HEp–2 cell line was grown in Eagles MEM with 10% calf serum and maintained in Eagles MEM with 5% calf serum. Concentrations of antibiotics in both media were as follows:— Penicillin 200 Units/ml.; streptomycin 200 µg/ml.

Isolation of Viruses:

Each of the reconstituted sediments obtained by the centrifugation method described above was inoculated into HEp-2 cultures containing 1ml. of maintenance medium, using 0.2ml. per culture tube. Six culture tubes were used per sample. The cultures were incubated at 37°. C and examined at 3rd, 6thand 10th days for cytopathic effect. Viral, cytopathogenic effects (CPE) were scored on 3rd, 6th and 10th days post inoculation. Cultures showing CPE were harvested and stored at–20°.C or titrated on 3rd passage to determine virus end-titres. Virus titres were calculated by the Reed and Muench method (Reed and Muench, 1938). Those showing no CPE were passaged 3 times before discarding as negative.

Identification of Isolates:

This was performed on 3rd passage isolates by the tube neutralization method using WHO Intersecting Serum Pools Scheme (Schmidt et al., 1971), and by determination of the neutralization indices as described elsewhere (Addy et al., 1970; Addy, 1973).

Results

From 67 water and sewage samples collected from rivers, streams, ponds, Lagoons, wells and gutters in the Greater Accra Region, 22 virus isolates from

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TABLE 1: *Description of Habitats, with positive Enterovirus Isolation Sampled*

Sample	Locality	Habitat	Source	Isolate(s)
S- 1	Mendskrom (Urban) ..	Open running water carrying liquid discharge of public utility; polluted with human and/or animal faecal matter	River	B-3
S- 3	Bortianor (Urban) ..	Stagnant water used for washing and bathing	Pond	B-1
S- 4	Bortianor (Urban) ..	Open running water containing fish; used for drinking, bathing and washing; carries also waste water from the villages lying along it	Stream	B-3
S- 8	Denkyira (Rural) ..	Uncemented shallow well dug out for drinking purposes; shaded by trees	Well	B-3
S- 9	Denkyira (Rural) ..	Drinking water from an uncemented well; surface covered by algae	Well	B-3
S-11	Abakrowa (Rural) ..	Open stagnant pool of water, clear but with mosquito larvae. Served as drinking water source.	Pond	E-3
S-19	Akramaman (Rural) ..	Dug-out uncemented shallow well; for drinking, cooking, washing, etc.	Well	P-1
S-20	Obom (Rural)	River, shaded by bamboo trees; carries waste discharges from nearby villages. Used for house-hold purposes	River	B-3
S-21	Tenbibian (Rural) ..	Pool of stagnant water, inhabited by tadpoles. Shaded by trees.	Pond	B-3
S-36	Liberation Circle Accra (Urban)	Open street gutter in a densely populated area, carrying household liquid wastes into the Odor River	Gutter	E-7
S-37	Alardzo, Odor River (Urban)	Concrete lined deep sewer, carrying mainly house-hold discharge from densely populated urban areas. Bathing and washing are done by some inhabitants in this river. Faecal pollution is heavy.	River	B-3
S-38	Achimota, OdorRiver (Urban)	As described for S-37	River	E-19
S-39	Kokomlemle, Ring Road North (Urban)	Open gutter carrying waste from over 20 to 40 residential buildings.	Gutter	B-3
S-46	Nungua (Urban).. ..	Stagnant pool of water. Serves as drinking water for cattle. Cattle herdsmen drink from and wash into the pool.	Pond	P-2
S-48	Ridge/Ambassador Hotel Area (Urban) (Near Ambassador Hotel)	Concrete lined gutter, carrying waste from residential buildings and from the Ambassador Hotel. Likely to be polluted with human as well as animal excrements.	Gutter	P-2 E-3
S-49	Ridge/Ambassador Hotel (Urban) Between Ridge Circle and Police Station	As decribed for S-48	Gutter	A-16, B-5 E-27
S-50	Roman Ridge (Urban) ..	Muddy unlined pool, carrying waste water from nearby houses.	Pond	P-2
S-66	Odumase (Rural) ..	River, serves as drinking water for man and animal; also used for washing and bathing	River	E-3
S-67	Odumase (Rural) ..	As described for S-66	River	P-2

TABLE 2: *Distribution of Enterovirus Isolates in Relation to Sample Sources.*

Sample Sources	No. of Samples Collected	No. of Positive Samples	Percentage of Positive Samples	Enterovirus Strains Identified
Rivers ..	23	6	26.1	P-2, 2E-19 3B-3
Streams ..	6	1	16.7	B-3
Ponds ..	23	5	21.7	P-1, 2P-2, B-3, E-3
Lagoons ..	2	0	0	—
Wells	8	3	37.5	P-1, 2B-3
Gutters ..	5	4	80.0	P-2, A-16, B-3, B-5, E-3, E-7, E-27
Total	67	19	28.4	—

TABLE 3: *Enterovirus Isolates Distributed According to Month and Year of Sampling*

Year	Month	Sample Size	No. of Positive Samples	Percentage of Positive Samples	Enterovirus Strains Identified
1971	October ..	5	3	60.0	P-1, 2B-3
	November ..	30	6	20.0	P-1, 4B-3, E-3
	December ..	4	4	100.0	2B-3, E-7, E-19
Sub-total (1971)	.. .. ..	39	13	33.3	—
1972	January ..	8	1	12.5	P-2
	February ..	11	3	27.3	2P-2, A-16 B-5, E-3, E-27
	March ..	Sample collection	was suspended		
	April	9	2	22.2	P-2, E-19
Sub-total (1972)	.. .. ..	28	6	21.4	—
Grand Total	.. .. ..	67	19	28.4	—

19 samples were made, thus giving an isolation rate of 24.8%. Coxsackie B-3 viruses were isolated from 8 samples, giving an isolation rate of 11.9%. Poliovirus isolation rate was 9%. Two samples were found to be mixtures of Poliovirus type 2, Echo-3 and Echo-27 and Coxsackie A-16 and Coxsackie B-5, respectively. Table 1. gives the description of the samples yeilding positive enterovirus isolation. On the whole, 8 Coxsackie B-3, 2 Poliovirus type 1, 4 Poliovirus type 2, 2 each of Echovirus types 3 and 19 and one each of Echovirus types 7 and 27, Coxsackie B-5 and Coxsackie A-16 were identified. The distribution of the isolates according to sample sources is indicated in Table 2.

11 out of 16 sample sources forming part of the sewage system (lagoons, streams, rivers and gutters) of the Greater Accra Region, yielded 13 isolates. Seven isolates identified as Poliovirus type 2, Echo-3, Echo-7 Coxsackie A-16, Coxsackie B-3 and Coxsackie B-5, were from samples collected from gutters (80% virus isolation rate) in the City of Accra; one isolate, Coxsackie B-3, was made from a stream near Bortianor, a suburb of Accra, and two isolates, Poliovirus type 2 and Echo-19 were made from samples collected from the Odor River in the City of Accra. The remaining 3 isolates, Coxsackie B-3, Poliovirus type 2 and Echo-3, were recovered from samples collected from two rivers, flowing through Odumase and the other through Obom, both rural areas. Of the 67 sample sources, 51 served as sources of water for drinking by man and/or animals, for bathing and/or for washing. From the 51 utility waters, that is, rivers, streams, ponds and wells, a total of 15 isolates comprising two Poliovirus type 1, four Poliovirus type 2, two Echo-19, six Coxsackie B-3 and one Echo-3 were obtained; the rate of virus isolation was 29.4%.

From Table 2, it can be seen that the percentage of virus isolated from wells dug out specifically for human consumption was as high as 37.5%. For rivers, ponds and streams which serve outlying villages, in most cases as the sole source of water, the respective rates of isolation were 26.1%, 21.7% and 16.7%. Amongst the isolates from these sources were 4 Poliovirus type 2 and one Poliovirus type 1, both casual agents of Poliomyelitis.

The distribution of isolates per month of the study period, October, 1971, through April, 1972, is shown in Table 3. In 1971, 39 samples were collected out of which 13 isolates were obtained. These included two Poliovirus type 1, eight Coxsackie B-3 and one each of Echo-3 and Echo-19. The percentage of virus isolation for that year was 33.3%.

From the 1972 isolates, for which the percentage

TABLE 4: *Enterovirus Isolates Related to Known Enterovirus Clinical Syndromes.*

Clinical Syndromes	Enterovirus Types	Outbreaks
Paralytic Diseases	P-1, P-2, B-3, E-7	P-1, P-2
Encephalitis and Meningoencephalitis	P-1, P-2, B-3, B-5, E-19	—
Cerebellar Ataxias	P-1, P-2	—
Aseptic meningitis	P-1, P-2, A-16, B-3, B-5	P-1, P-2, B-3, B-5
Epidemic myalgia	B-3, B-5	B-3, B-5
Conjunctivitis	A-16, B-5	—
Respiratory Syndromes:		
Upper Respiratory Illnesses Group	B-3, B-5, E-3, E-7, E-19	
	B-5	—
Lower Respiratory Illness	A-16, B-5, E-19	—
Gastrointestinal Syndromes	B-3, B-5, A-16, E-7, E-19	—
Cardiovascular Syndromes:		
Myocarditis	B-3, B-5	—
Pericarditis	B-3, B-5, E-19	—
Lymphadenopathy	A-16, B-5	—
Splenomegaly	B-5	—
Orchitis	B-5	—
Cutaneous Syndromes:		
Skin Rashes	B-1, A-16, B-3, B-5, E-3 E-7, E-9, E-19	A-16, B-5, E-9
Vesicular Dermatitis	A-16, B-3, B-5, E-9	—
Petechiae	B-3	—
Neonatal Infection:		
Encephalomyocarditis	A-16, B-3	—
Gastroenteric cum Respiratory Syndromes	E-19	—

of isolation was calculated to be 21.4%, four Poliovirus type 2 and one each of Coxsackie A-16, Coxsackie B-5, Echo-3, Echo-19 and Echo-27 were the enterovirus strains identified.

From the 42 samples collected from rural waters, 8 samples yielded 8 viral isolates as against 14 isolates obtained from 11 samples out of 25 samples collected from urban and sub-urban waters. The rates of virus isolation from rural and urban-sub-urban waters were 19.0% and 44.0% respectively.

Apart from the isolates common to both rural and urban-sub-urban waters, namely, Poliovirus types 1 and 2, Coxsackie B-3, Echo-3 and 19, Coxsackie A-16, Coxsackie B5, Echo-7 and 27 were isolated from urban-suburban waters only.

Discussion

The examination of sewage for the presence of viruses has been undertaken for several years (Paul *et al.*, 1939; Gard, 1950; Melnick, 1947; and many others), and the fact that human and animal viruses pollute surface waters is well recognized (Kelly, 1957; Clarke and Chang, 1959; Lamb *et al.*, 1964; Grinstein *et al.*, 1970; Wilterdink *et al.*, 1970). The knowledge of the occurence and distribution of enteroviruses and other enteric viruses pathogenic for man in natural waters as well as in sewage is of immense public health importance (Brison, 1968, Wilterdink, *et al.*, 1970), for these represent a useful group of animal viruses for studying in detail the transmission of enteric virus infections of man and animals.

Systematic virological investigations of water and sewage, therefore, are an indis-

pensable method ofsurveillance of enterovirus circulation amongst the population as well as a control of their circulation in sewage.

To detect viruses in surface water and sewage, concentration of the sample is necessary (Metcalf and Stiles, 1968; Duff, 1970; Grinstein *et al.*, 1970;) Ultracentrifugation as applied in our survey facilitates efficient concentration with a minimum of handling of viruses in water and sewage. The number of concentrates yielding positive results was most acceptable. Yet this alone, to our minds, is not enough; the method of virus assay is equally important as the concentration of the sample.

The tube method when compared with the plaque assay method is found to be the cheaper and the much more commonly employed method, yet, from our experience, it is, for quantitative studies, somewhat limited by its failure to:

1. reveal virus concentrations in a given quantity of sample;
2. provide means of selection of individual virions present in the sample, and therefore, imposes a limitation on the chances of picking out virulent, vaccine and/or intermediate poliovirus types, let alone picking other enteric viruses present in the sample.

It is, therefore suggested that in addition to the concentration of samples for virus surveys of water and sewage, both the tube and the plaque assay methods should be employed. The plaque assay method alone may fail to reveal enteroviruses which do not plaque at all or plaque only very slowly.

The isolation rate achieved with our method of concentration and virus assay was 28.4%. In view of the fact that the rate of virus isolation and concentration of virus from surface water and sewage are subject to seasonal variations, and that the source of sample collection, quantity of circulating viruses and the grade of pollution of samples differ from country to country and even within the same country, a comparison of our findings with findings of other workers from different countries cannot and should not be made.

Data obtained from our survey indicated that the pattern of enterovirus isolation from water and sewage seemed to vary from the one year to the other; so also varied the rate of enterovirus isolation. Thus, it was found that whereas in the 1971 study period, poliovirus isolates were all of the serotype 1, the serotype identified in specimens examined in 1972 were all poliovirus type 2. It was also observed that in 1971, when 8 Coxsackie B-3 strains were isolated from water and sewage, none was isolated in 1972. The isolations made in 1972 were Coxsackie A-16, Coxsackie B-5 and Echovirus type 27. Echovirus types 3 and 19 were isolated in both study years.

A similar finding was made, when virus isolations were made from stool samples collected from infants in the Greater Accra Region during the same period, 1971 - 1972 (Otatume and Addy, 1973). There is, therefore, a correlation between enterovirus isolation from faeces and from water and sewage in the given space of time. Human infections could, therefore, be reflected in virus contents in water and sewage.

Whether or not virus will be demonstrated in water and sewage is determined by the number of virus excretors. It has been postulated that poliovirus is demonstrable in water and sewage when between 0.27% and 0.4% of the local population excretes the virus (Chin *et al.*, 1967; Weiland, 1968). This means, therefore, that for a population of 370 people only one person needs secrete virus and the surrounding surface waters become polluted with enteroviruses potentially capable of causing disease in man. This, however, will depend upon the defaecation habits, the number of passive vectors, (the housefly) present at the time and the recreational practices of that individual.

It was found that the incidence of enteroviruses in water and sewage samples was at its peak in December. This finding is in agreement with those of Addy *et al.*, 1973, who indicated that the incidence of enteroviruses reached peak level during the hottest months of the year, namely, between December and February. Since there is no large scale poliomyelitis vaccination in the country and for that matter within the last three months prior to the present survey, our finding should be considered a true reflection of enterovirus circulation in the area surveyed.

Furthermore, the high incidence of enteroviruses during this period can be attributed to three major factors (Addy *et al.*, 1973; Otatume and Addy, 1973), namely to:-

1. the over-abundance of houseflies in the country during the hottest months of

the year. Food contamination at this time is high and so will be human infection;

2. the unhygienic practices of quite a sizeable proportion of the population in the study area. Infection rate during this period must be high, so also will the rate of virus dissemination; and
3. the big numbers of bathers who find their way to pools, ponds, lakes, rivers and lagoons during the hot periods of the year. There could be no doubt that a good number of them would be enterovirus carriers (excretors). The percentage of virus excretors will definitely be more than 0.27%. Hence, pollution of water by these bathers should be high.

Our survey further revealed that the rate of virus isolation from urban/suburban waters was higher than that found for rural waters. Population densities of urban/suburban areas are bigger than population densities of rural areas. This factor may be contributory to the higher incidence of enteroviruses recorded for urban/suburban waters. Population densities, therefore, play a role in the concentration and rate of dissemination of enteroviruses in a given area.

Within the same period 1971–1972, 48 poliovirus strains were isolated from faecal samples obtained from infants and children aged 0–15 years in the Greater Accra Region, and out of the 38 strains, all of which were poliovirus type 1, subjected to the rct/40 marker test, 76% were found to be virulent (Addy *et al.*, 1973). Because no large scale vaccination against poliomyelitis has ever been carried out in the country, and to the best of our knowledge not before or during the survey period, it can safely be speculated that the polioviruses isolated in this survey could be mostly the wild type. The public health significance of our present findings and those of Addy *et al.*, 1973, and of Otatume and Addy, 1973, cannot, therefore, be overemphasized.

All poliovirus types, some Coxsackie A and B viruses and some Echovirus serotypes are capable of causing sporadic as well as epidemic diseases in man. The enteroviruses are known to cause a large array of diseases from mild respiratory illness to encephalitis and paralysis which may occur either in sporadic or epidemic form.

It can be seen that Coxsackie B-3, which was isolated 8 times in three months of the study period in 1971, has been found to cause, apart from aseptic meningitis, epidemic myalgia (Bornholm Disease), acute benign pericarditis and myocarditis, also paralytic illness, encephalitis, meningoencephalitis as well as encephalomyocarditis, the last mostly in infants. It is also associated with enteroviral exanthemata (Grodum and Dempster, 1959;, Kibrick *et al.*, Lerner *et al.*, 1942; McLean 1966).

Coxsackie B-5 is mostly associated with respiratory tract infections. It is, however, capable of causing all the disease syndromes associated with Coxsackie B-3 virus infections (McLeod *et al.*, 1956; McLean *et al.*, 1961; Clemmer *et al.*, 1966).

Coxsackie A-16 is known as the aetiologic agent of Hand-Foot-and-Mouth disease, a disease characterized by fever, shallow ulcerative lesions or vesicles in the oropharynx or fauces and by a macolopapular rash which later becomes vesicular on the hands and feet including the palms and soles. The chief victims of this illness are children aged 1–7 years (Robinson *et al.*, 1958).

Amongst the Echoviruses isolated in thi[8] survey, Echovirus types 7 and 19, have frequently been associated with gastroenteritis. Echovirus 19 may also cause encephalitis, upper respiratory and cutaneous diseases (La Forest *et al.*, 1957). Echovirus types 3 and 7 are responsible for certain cases of aseptic meningitis. To the best of our knowledge, no disease syndrome has so far been ascribed to Echovirus type 27.

The public health importance of poliomyelitis, particularly, that associated with the serotypes 1 and 2 which are the most frequently isolated strains in Ghana, has previously been discussed elsewhere (Addy *et al.*, 1973; Addy *et al.*, in press).

We would like to stress, at this juncture, that this survey which does not purport to be anything more than a pilot one, suggests that human to human spread of polioviruses as well as other entero-viruses in Ghana is reflected in the yield of enteric viruses in surface water and sewage, and therefore, any future poliovirus survaillence in the country should include water and sewage. Furthermore, the 29.4 rate of virus isolation from utility waters (wells, rivers, ponds and streams), is high; but what is more alarming is the 37.5% virus yield from

wells which are specifically dug out to provide water for human consumption. As already pointed out, frequent surveillance of enteric viruses in water and sewage is called for. It is one of the most appropriate sources of information on the circulation not only of polioviruses but also other entero- and enteric-viruses.

Summary

During the period 1971 through 1972, the distribution of enteroviruses in Ghana (the Greater Accra Region being the selected study area) was studied by virological examination of water and sewage collected from 67 sources. The rate of virus isolation was 28.4%. The type of enteroviruses isolated and the rate of virus isolation was found to vary from the one year to the other.

The percentage of virus isolation from utility waters was as high as 29.4% and that from wells was even higher, standing at 37.5%. Urban waters were found to be more contaminated with enteroviruses than rural waters. A correlation was found between enterovirus isolation from water and sewage and from stools. Maximum enterovirus isolation was found during the hottest months of the year. An attempt was made to relate isolated enteroviruses with known clinical syndromes and to stress the public health importance of our findings.

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[I-27] オンコセルカ症

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HOSAKA, A.:
Onchocerciasis;
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オンコセルカ症

糸状虫の一種 Onchocerca volvulus (以下 O. volv.) がヒトに寄生して起こる感染症である．わが国での報告はないが，全世界で2,000万ないし3,000万人の罹患者がおり，その5～10%が失明していると推定されている．主な流行地は中南米とアフリカ大陸であり，それぞれ Robles 氏病，River-blindness として恐れられている．本寄生虫は約100年前に発見されているが，その対策が開始されたのは1920年代以後である．

感染経路が確認されたのは比較的近年のことで，ある種のブユが中間宿主であり，ヒトは最終宿主である．罹患者をブユが刺す時に仔虫がブユの消化管に入り，大部分は消化されるが，生き残った一部の仔虫が体内で2回脱皮して感染型仔虫となり，次にブユがヒトを刺す時に仔虫がヒトの皮下に入って成虫となる．成虫はオスが2～5cm，メスは30～50cm にも達し，盛んに仔虫を生産する．その寿命は16～18年とされている．仔虫は主として皮膚に存在するが，長期間の罹患者では眼内に侵入し，角膜炎，前部ブドウ膜炎，網脈絡膜炎，視神経炎などを起こして失明の原因となる．この仔虫は0.3 mm ほどで，細隙灯顕微鏡で容易に観察することができる．仔虫はブユに摂取されない限り生存期間は1～3年と推定される．

臨床症状としては，成虫を中心として形成される非特異性の皮下結節(粟粒大～鶏卵大)，瘙痒性の皮膚炎（後に高度の皮膚萎縮)，眼病変があげられるが，成虫は重大な障害には無関係で，仔虫の局所死亡による毒素や組織の反応が，症状発現の主因であることがほぼ確認されている．仔虫の眼内への侵入は穿通によるらしいが，眼部に到達するまでの経路は未だ謎に包まれている．しかし近年，肝・肺・腎・脾などの内臓のみでなく，血管・リンパ管にも仔虫が発見されており，また血液・髄液・尿・喀痰・腟スミアーに仔虫が検出されていることから，皮膚または皮下を通じての移動だけでなく，血管やリンパ管を経由することが疑われてきた．古典的には失明が最終結果と考えられていたが，全身病の可能性があり，この方面にも関心が持たれつつある．

本症の診断は流行地に居住している者で，上記の臨床症状があり，Skin Snip で仔虫が検出されれば確実である．腓部，殿部，肩甲部などから小皮膚片を切除し，オブジェクトグラスの上に滴下した水に浸して10分後に低倍率（20～30× で十分）で鏡検すれば，無数の仔虫が水中で動き回るのが見られる．定量法では蒸留水を用い，皮膚片1 mg 中の仔虫数を数えるが，フィールドでの診断には，上記の定性法で十分である．その他免疫学的診断法の研究が進められているが，未だ実用段階ではない．

本症の対策はその感染経路から考えて，罹患者の治療と媒介ブユの撲滅の両面作戦が必要である．古くからフィラリアの治療薬として知られている Diethylcarbamazine (DEC，日本では Spatonin として発売) の内服が行われているが，副作用が強く，新薬の開発が強く要望されている．Suramin (Germanin) 筋注も補助的に使用されるが，これも副作用その他問題がある．媒介ブユは中南米では Simulium ochraceum, S. metallicum など，アフリカでは S. damnosum が主で，生態学的に多少異なるが，海抜500～1,500 m 程度の土地で流れの速い川岸に産卵するので，現在のコントロール計画は主としてこれらのブユの幼虫を撲滅することに向けられ，Abate の散布が行われている．とくに最大の浸淫地である西アフリカでは WHO の支援により1974年より20年計画が大々的に開始され，既に局地的には成功をおさめている．また中南米へは日本から調査団が派遣され，撲滅計画が立てられつつある．

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[I-28]

STANDARD PATTERNS OF IMPEDANCE CYCLOGRAM IN NORMAL GHANAIANS

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Summary: Ciliary muscle activity was studied by means of impedance cyclography in 72 normal Ghanaians of various age groups. Changes in the impendance in the anterior eye segment were recorded for various degrees of accommodative stimuli and the impedance change was found to parallel the degree of accommodation. The impedance change per diopter of accommodation was called amplitude of impedance change which remained nearly constant in all age groups. Latency period of impedance change to accommodative stimuli remained unaltered by increasing age. Speed of accommodative response was expressed by time constant of the impedance changes. It remained essentially the same in male subjects of various age groups but it was larger in older than in younger female subjects. The time constant had no correlation with degree of presbyopia up to 3 diopters.

Key Words: Impedance cyclography, accommodation, presbyopia, ciliary muscles, Ghanaians

Introduction

Studies on accommodation have been carried out largely by subjective methods or optical measurements of ocular refractive changes. Activities of the ciliary muscles accompanying accommodation were investigated through direct recordings of electrical potentials of the muscles[1-3]. These electro-physiological methods cannot, however, readily correlate the muscle activities and overall accommodative function of the eye. An ingenious method of Swegmark[5] enabled objective invetigations of the overall activity of the ciliary muscles by recording impedance changes in the anterior eye segment. This method was called impedance cyclography and by it he correlated impedance changes with diopters of accommodation. Age changes in cyclography in Scandinavians were also studied. It has been stated that in Ghanaians presbyopia commences as early as at the age of 35 years. It was therefore thought worthwhile studying age changes in impedance cyclography in normal Ghanaians of various age groups. Swegmark's contact lens electrode was modified and used in this study.

Materials and Methods

A total of 72 normal Ghanaians, 39 males and 33 females participated in this study. They were emmetropic, their refraction being from + 0.5 diopters (D) to −0.25 D and had no

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ocular abnormalities. Their age distribution is given in Table 1.

Apparatus for measurements

The electrode for impedance cyclography consisted of 2 pairs of electrodes mounted on a contact lens (Figure 1). The specification of the electrodes was similar to that described by Swegmark but the contact lens had no suction device. The center of the contact lens had no

Table 1. Subjects

Age group	Male	Female	Total
10~19	7	3	10
20~29	10	6	16
30~39	12	10	22
40~49	5	12	17
50~59	4	1	5
60 or more	1	1	2
	39	33	72

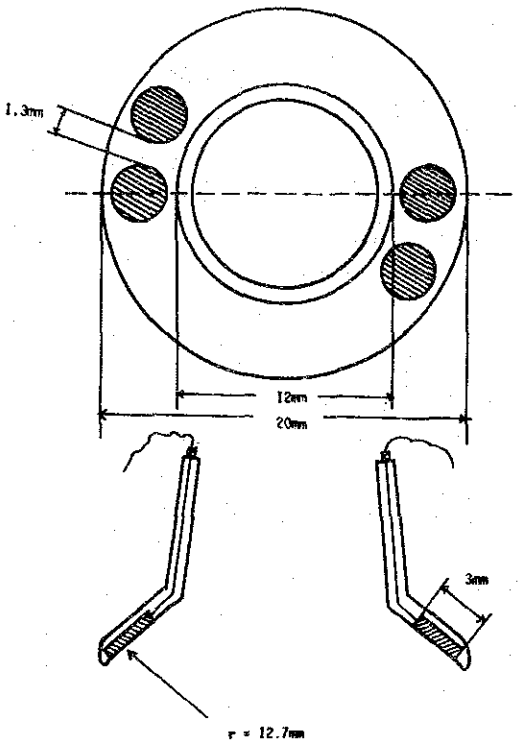

Figure 1. Sclero-corneal type four electrodes.

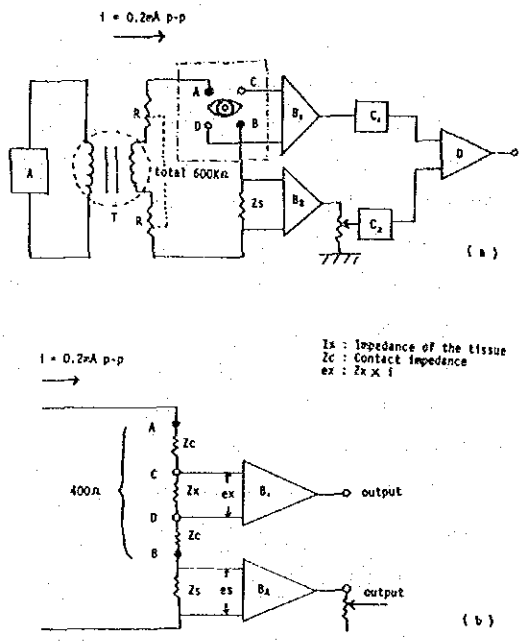

Figure 2. Schematic drawing of the measuring apparatus
A: constant current source
B_1, B_2: amplifiers
C_1, C_2: detectors
D: differential amplifier
A,B: driving electrodes
C,D: sensing electrodes

dioptric power so that the subject could see well through this part. The dimension of the lens and the electrodes was such that the latter came in close contact to the bulbar conjunctiva in the region of the ciliary body. Since contact lens fitting by suction was thought to increase the intraocular pressure which might affect the recording, suction was avoided. Good contact lens fitting could be achieved, however, by fixing the fine cables from the electrode to the forehead and cheek with zinc oxide plaster.

A constant 50 kHz current is fed to a pair of diametrically placed driving electrodes and voltage changes caused by the eye tissue were measured by means of another pair of electrodes. The voltage changes were amplified and recorded. A diagram of the measuring apparatus is shown in Figure 2. The measuring apparatus (Toa Electronics Ltd., Tokyo) had the following characteristics: Impedance range: 100–500 Ω, Sensitivity: 5 mV/2 Ω, Measuring frequency: approximately 50 kHz, Measuring current: max. 0.2 mA, Power source: A.C. 230 V., 50 Hz.

The recorder (WTR-751, Watanabe Sokki Co., Tokyo) had the followeing specifications: Method for recording: heat pen, Measuring range: 5 mV/20 mm–100 V/20 mm, Frequency character: 0–50 Hz ± 10 per cent, Chart speed: 2.5, 5.0, 25, 50 mm/sec.

The Methods of Measurements

The subjects were seated in a quiet room under a constant room illumination with their heads fixed on a chin rest. Under topical anesthesia with 0.4 per cent benoxinate, the contact lens electrode was fitted to one eye and the electrode cables were fixed to the skin as described above. The fellow eye was covered, and the subjects were asked to fixate to a target consisting of a small electric bulb placed at a distance of 2 m. The targets to induce accommodative stimuli consisted of small electric bulbs placed at distances of 2, 1, 0.50, 0.33 and 0.20 m from the eye. Accommodative stimuli were given by switching on and off the bulbs and asking the subjects to fixate. The distances of the targets were recorded together with impedance changes on the recorder described above. Prior to the measurements, instrument calibration was carried out by means of + 2 Ω on-off switch. Target distances were also calibrated. Usually, contact lens electrode fitting was good, but some subjects often squeezed the eye permitting no constant impedance recording. Some subjects also failed to fixate the targets and these cases were discarded from the results.

On confirmation at good electrode fitting the subject fixated 2 m target and the impedance was recorded. The subject was then asked to fixate the targets at various distances and the impedance was recorded. In most cases the repeated recordings were carried out using targets at 2 and 0.20 m, but in a few cases targets at 2 and 0.33 m were used. The impedance differences per diopter of accommodation were calculated and they were called amplitude of impedance changes. The latency period and the time constants of accomodation

were also calculated for far-to-near and near-to-far accommodations. For these analyses chart speeds of the recorder of 5 mm and 25 mm per second were found to be adequate.

Results

A typical recording is shown in Figure 3 where chart speed was 5 mm per second. The impedance recording has little noise and changes at the time of fixating at different distances. On fixating at constant distance the impedance recording reaches quickly a steady level. These results indicate good fixation of the contact lens electrode since failure of adequate fixation resulted in large fluctuation or extreme irregularity of the impedance recording. Changes in the impedance level parallelled changes in the degree of accommodation. Thus impedance change per diopter of accommodation was calculated and it was called the amplitude of impedance change.

There were individual differences in accommodative responses and 3 examples of the impedance cyclogram are shown in Figure 4. On alternating distances of fixation target impedance change occurred with some latency period which was measured. From the recordings of the cyclogram, time constant of its change was also calculated.

1. *Amplitude of impedance changes*

The amplitude of impedance changes ranged from 0.79 to 4.86 Ω per D, the mean values being 2.17 ± 0.87 (S.D.) Ω per D in males and 2.07 ± 0.86 Ω per D in females. The mean value for all subjects was 2.12 ± 0.85 Ω per D. The mean amplitudes of impedance changes in various age groups are illustrated in Figure 5A. No significant difference can be found among the age groups or between both sexes.

2. *Latency period*

The latency period was measured for far-to-near as well as near-to-far accommodations.

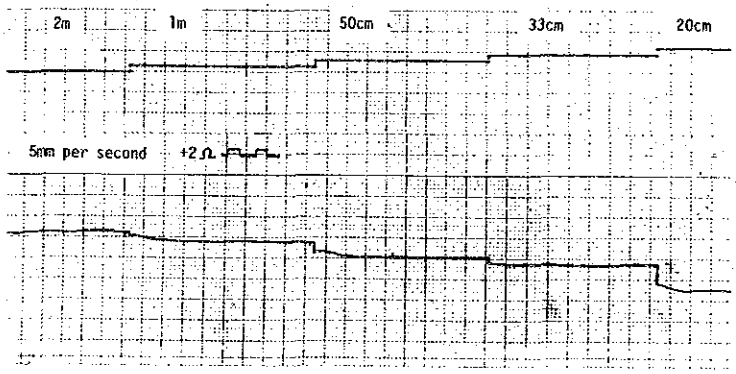

Figure 3. Typical impedance change associated with accommodative stimuli.

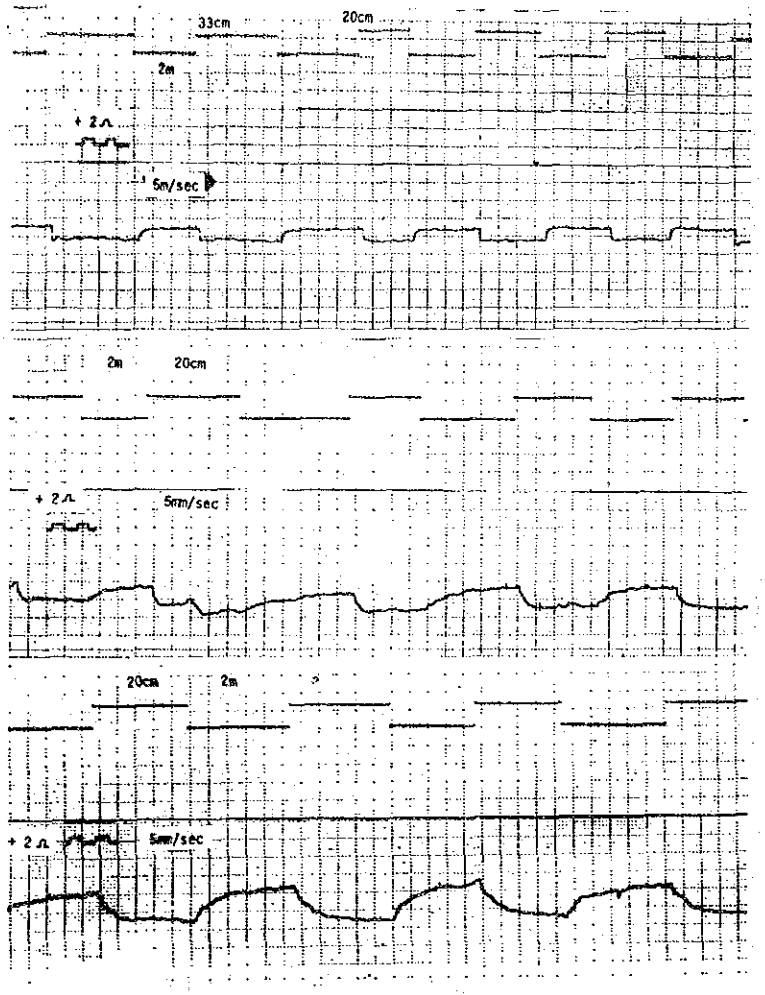

Figure 4. Various patterns of Impedance Cyclogram in normal Ghanaians.
upper: rapid response. 39 year old woman, time constant (F-N) and (N-F): 0.03 and 0.11 sec respectively.
middle: delayed response. 50 year old woman, time constant: 0.22 and 0.96 sec.
lower: much delayed response. 60 year old woman, time constant: 1.01 and 0.74 sec.

A. *Latency period for far-to-near accommodation*

The latency period ranged from 0.13 to 0.51 sec with an average of 0.23 ± 0.07 (S.D.) sec: the mean value in males was 0.23 ± 0.05 sec and in females it was 0.24 ± 0.08 sec. No sex difference could be found. The latency periods in various age groups are shown in the upper figure of Figure 5B: no significant difference could be found among age groups.

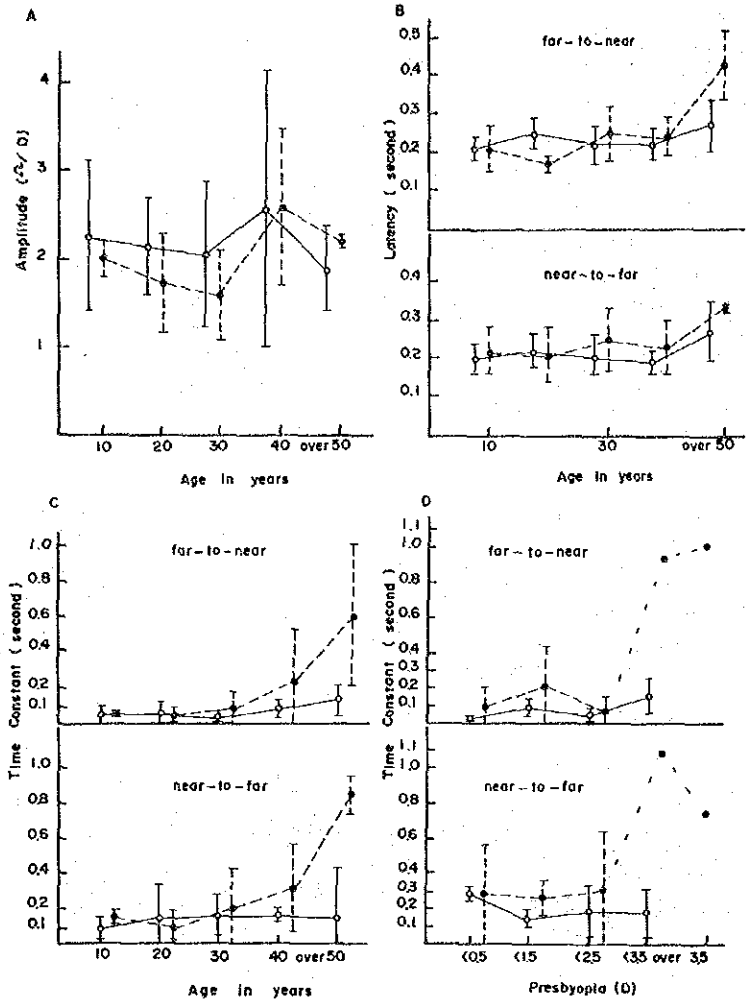

Figure 5. —○—: male subjects and ---●--- female subjects.

A. Amplitude of impedance change shown by ohm per diopter stimulus in various age groups

B. Latency of response to accommodative stimuli in second in various age groups

C. Time constant of ciliary muscle activity to accommodative stimuli in second in various age groups

D. Relation between time constant of response and degree of presbyopia

B. *Latency period for near-to-far accommodation*

The latency period ranged from 0.13 to 0.38 sec giving a mean value of 0.23 ± 0.06 sec: the mean value for males was 0.22 ± 0.05 sec and for females it was 0.24 ± 0.07 sec. No sex difference could be found. The latency periods for various age groups are shown in the lower figure of Figure 5B: no significant difference could be found among age groups.

3. *Time constant*

When target distance was changed suddenly and the subject was asked to accommodate, the impedance changed to a new level (Figure 3). The time required to reach 63.2 per cent of the maximum change was calculated as the time constant of the response. The time constants were calculated for far-to-near as well as near-to-far responses. In 90 per cent of the subjects, i.e. 65 cases, the time constant for near-to-far response was larger than that for far-to-near responses.

A. *Time constant for far-to-near response*

The time constants in various age groups are shown in the upper figure of Figure 5C. It appeared, particularly in females, that the time constant becomes larger in aged groups. In male subjects the time constant was compared between those over and under 40 years of age. It averaged 0.10 $\pm$ 0.08 (S.D.) sec in the aged and 0.05 $\pm$ 0.05 sec in the young age group. In female subjects the time constant in those over 36 years of age averaged 0.23 $\pm$ 0.30 sec and 0.04 $\pm$ 0.03 sec in those younger than the above age. In both cases, differences between the young and aged groups were statistically significant ($P<0.05$ in the former and $P<0.01$ in the latter). Furthermore, difference between male and female subjects was significant, particularly in the aged group.

B. *Time constant for near-to-far response*

The time constants in various age groups are shown in the lower figure of Figure 5C. In male subjects no significant difference can be found among age groups but in female subjects the time constant was larger in those older than 36 years (0.35 $\pm$ 0.29 sec) than in younger subjects (0.11 $\pm$ 0.09 sec). The mean time constant for all age groups was 0.15 $\pm$ 0.12 sec in male subjects and 0.26 $\pm$ 0.26 sec in female subjects: the sex difference was statistically significant ($P<0.05$).

4. *Presbyopia and time constant*

For subjects older than 36 years, the time constant of the impedance response was correlated with the degrees of presbyopia and the results are shown in Figure 5D. In both far-to-near and near-to-far responses the time constant did not vary significantly depending on the presbyopia up to 3 diopters of the reading glasses. Because of only a small number of cases, results in presbyopes over 3 diopters could not be treated statistically.

Discussion

Swegmark used suction cup system to ensure close electrode fitting to the eye. Our preliminary experiments showed that increased intraocular pressure, which is likely to be induced by a suction cup, might affect the ciliary muscle activity and also change the basal impedance level. For this reason we avoided suction cup method but this had a disadvantage

of unstable electrode fitting in which case impedance recording showed irregularity. Therefore some of our data had to be discarded. Fortunately, however, in most cases, stable electrode fitting could be achieved by fixing the electrode cables to the skin, since the contact lens was designed to fit most of the Ghanaian subjects. In fact, stable impedance level and its consistent changes accompanying accommodation could be recorded in most cases. In agreement with previous reports[4,6] of Swegmark and Saladin, impedance changes parallelled the degree of accommodative stimuli. The amplitude of impedance change was therefore expressed as ohm per diopter. The average amplitude for normal Ghanaians was 2.12 $\pm$ 0.85 ohm per diopter whereas Swegmark's data show about 0.2 to 0.4 ohm per diopter. The large discrepancy in the amplitude cannot be readily explained but it can be either due to increased intraocular pressure lowering ciliary muscle activities in Swegmark's study or loose electrode contact increasing impedance in our study. Thus difference in the absolute value of the impedance and its amplitude may not be stressed. Swegmark[8] recently suggested that further studies are necessary to compare the amplitude at various basal impedance levels. Swegmark[5] described the median reaction time in impedance to be 0.3 sec. This value is in fair agreement with the latency time obtained in the present study.

Of particular interest is the age change of the ciliary muscle activities. Swegmark[6] pointed out that the contraction speed of the human ciliary muscles remains unaltered at least up to the age of 60, but relaxation of the ciliary muscles is slower in older subjects than in younger subjects. In the present study the time constant of the impedance response remained essentially the same in various age groups of male subjects but it was greater in aged female subjects than in younger females. The reason for the sex difference is not clear. It is stated that in Ghanaians presbyopia begins at the age of about 35 years. The degree of presbyopia had no correlation with the time constant of the impedance response. No age dependence of the amplitude of impedance changes and latency time together with the above results indicates, in agreement with Swegmark's conclusion, that the ciliary muscles maintain their activity, and reduction in accommodation is attributed largely to changes in the crystalline lens.

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