**CONTACT LENSES :
An analysis of the results of use***

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CONTACT Lenses were first fitted and worn in 1887, and since that time the literature of the subject has steadily increased. It has been extensively reviewed by Dállos (1936), Bruce (1937), Mann (1938), Darcy Williams (1946), Cross (1947), and others, and comprehensive text-books have been written by Dickinson and Hall, Treissman and Plaice, Obrig and other authors. Few reports have, however, been published giving detailed results of the use of contact lenses. Williamson-Noble (1938), Gyorffy, I. (1940), Gyorffy, S. (1944), Mann (1944), and Ridley (1946), have described results, but in each series the number of cases has been small and has not provided the full information which is so widely desired regarding tolerance to these optical aids, and the results of wear in different circumstances. It was decided, therefore, to conduct an investigation into the results of wearing contact lenses in a large number of patients, and, in addition to seeking information about tolerance, to inquire into various other aspects of the use of these appliances.

Scope of the investigation.

The co-operation was obtained of Messrs. Clement Clarke, Ltd., Messrs. Theodore Hamblin, Ltd., and Messrs. Davis Keeler, Ltd., and permission was obtained from all ophthalmic surgeons who had referred cases to these firms to send a questionnaire to their patients. Mr. K. Clifford Hall, F.S.M.C., also gave permission for a questionnaire to be sent to patients fitted by him. All patients who were fitted up to the end of 1945 have had a questionnaire sent to them which was made up as follows:—

CONTACT LENS REPORT

Name.....	Age.....
Address.....	Date of fitting.....
.....	Ocular condition.....
Occupation.....	Referred by.....
Type of Contact Lens.....	
Time occupied in fitting of lens:	
1. Number of sessions.....	
2. Time over which the sessions extended.....	

Dedicated to Professor J. Meller.

* Received for publication, March 24, 1949.

- I. Do you, at the present time, wear your contact lenses ?
- II. If so:
 - (a) For what average periods are they worn?.....
 1. Are they worn every day?.....
 - If not, for how many days a week?.....
 2. What is the total number of hours they are worn per day?.....
 3. What is the interval between periods of wearing them each day?.....
 4. Are they worn at work?.....
 - (b) Why do you remove them?.....
 1. Is there any discomfort?.....
 2. Do you notice blurred vision while wearing the lenses?.....
 - If so, after how long of wearing the lenses, and is it equal in two eyes?
 - Does the blur persist after removal of the lens, and for how long?.....
 - If the lens is re-inserted immediately the blur clears, how long is it before it comes back?.....
 3. Is there any other reason for removal?.....
 - (c) Do you put the lenses into the eye dry?.....
 - If not, what fluid do you use?.....
 - Do you feel that the period without blurring is influenced by the strength or composition of the solution used?.....
 - (d) Are you aware of air bubbles?.....
 - If so, are they a help or a source of trouble?.....
 - (e) What conditions do you find:
 1. Most favourable for the wearing of contact lenses?.....
 2. Least favourable?
 - (f) When reading with the contact lenses, do you have to wear spectacles also?
- III. If you do not wear your contact lenses, why did you give them up?
- IV. What benefits do you appreciate most in contact lenses, and in what respects have you been disappointed with them?.....
- V. Knowing what you know now, would you go in for contact lenses again ?
- VI. How many times have the lenses been repolished?.....
- VII. Additional comments, criticisms or suggestions.....

1,850 copies of the questionnaire were sent out and 875 replies were received. These replies have been analysed and the results determined. In some of the tables addition of the percentages does not make a total of 100. This is due to various questions having been left unanswered by some patients. The four fitters have been designated A, B, C and D. The methods of each varied slightly in different patients, but essentially Fitters A and B have fitted glass lenses from ocular moulds, with slight modification of the moulds; Fitter C has employed moulding with modification, or the modification of a selected shell, for the provision of glass lenses; while Fitter D has employed an extensive fitting set for providing standard lenses in glass or plastic, and

has carried out modification of these standard lenses where necessary. Where standard lenses were not suitable, Fitter D has used the method of taking moulds.

RESULTS

The analysis of the results will be reported in the order in which the questions appeared in the questionnaire. Some of the questions have been answered in an indefinite way, but this number is small, and the percentages of the results obtained from the examination of the replies should be significant. Every analysis of the results has not been possible, but those that appear the most instructive have been worked out.

1. *Occupation* (Table I).

Three per cent. of the total number worked in such occupations as singing, acting and dancing, which are usually regarded as an indication for the use of contact lenses. Sixty-two per cent. performed indoor occupations, mainly of a clerical nature, while 12

TABLE I
OCCUPATION

	Occupations where contact lenses are required for cosmetic reasons %	Other indoor occupations %	Other outdoor occupations %	Unoccupied or occupation not stated %
Total ...	3	62	12	23
Men ...	1	55	24	20
Women ...	6	68	1	25

per cent. were occupied in outdoor jobs. In the occupations where contact lenses were employed for cosmetic reasons, women favoured contact lenses six times as frequently as men.

2. *Ocular Conditions* (Table II).

It is demonstrated that more than half of the contact lenses ordered were in cases of myopia, and that the next two largest groups were mustard-gas keratitis and keratoconus. The mustard-gas keratitis cases were, of course, almost entirely male, while the numbers of women in the keratoconus and myopia groups were much higher than the men, because of the recognised feminine antipathy to spectacles. Contact lenses have been

TABLE II

OCULAR CONDITIONS FOR WHICH CONTACT LENSES WERE ORDERED

	Keratoconus	Irregular astigmatism	Myopia	Hypermetropia	High astigmatism	Aphakia	Mustard-gas keratitis	Neuroparalytic keratitis	Pemphigus	Others
	%	%	%	%	%	%	%	%	%	%
Total ...	10	0.5	59	3	0.5	4	14	0.5	—	5.5
Men ...	3	0.5	46	3	1	5	29	0.5	—	8
Women ...	16	0.5	70	2	—	4	0.5	0.5	0.5	3
Younger than 30 years ...	5	1	80	3	—	2	—	—	—	6
31-50 years ...	14	—	53	2	1	5	14	1	—	6
Over 50 years	13	—	19	1	1	9	49	—	—	5

employed for myopia, especially in the young patients, while mustard-gas keratitis is confined largely to the older age groups, nearly all cases originating in the later years of the first world war. Patients suffering from other conditions are scattered more equally through all age groups, though both keratoconus and aphakia are slightly more frequent among the elderly.

3. Age (Table III).

It can be seen that very few contact lenses are ordered before the age of 18 years, and not many over the age of 60 years, and that the large majority are obtained before the age of 40 years, the peak period being between 20 years and 30 years. This is

TABLE III

THE AGE OF PATIENTS WHEN CONTACT LENSES WERE ORDERED

	Up to 18 yrs.	19-25 yrs.	26-30 yrs.	31-35 yrs.	36-40 yrs.	41-45 yrs.	46-50 yrs.	51-60 yrs.	Over 60 yrs.
	%	%	%	%	%	%	%	%	%
Total ...	1	19	18	10	9	7	8	12	4
Men ...	1	16	15	7	7	4	14	20	6
Women ...	1	22	21	12	10	9	3	5	3

especially noticeable in the case of women, in whom 66 per cent. of all contact lenses are fitted on patients younger than 40 years, and 43 per cent. between 19 years and 30 years. The older age-groups contain more cases among the men, largely as a result of mustard-gas keratitis.

4. Date of Fitting (Table IV).

The patients who have replied to the questionnaire have nearly all been fitted within the last 10 years, only a small number having worn contact lenses longer than 6 years. The maximum

TABLE IV

THE NUMBER OF YEARS SINCE THE CONTACT LENSES WERE FITTED

	Up to 1 yr.	1-2 yrs.	2-3 yrs.	3-4 yrs.	4-5 yrs.	5-10 yrs.	More than 10 yrs.
	%	%	%	%	%	%	%
Total ...	8	22	17	10	8	20	1
Men ...	6	20	16	9	9	22	0.5
Women ...	9	24	17	12	8	18	1

number has been fitted during the past 2 years, but this period of wear is, it is considered, sufficiently long for patients to give a reasoned opinion of their reactions.

5. THE NUMBER OF SESSIONS (Table V).

It was considered that it would be instructive to find out the number of fitting sessions which had been employed to fit the lenses in each case, in order to ascertain whether or not this varied materially according to the results attained. It is interesting to note how the technique of the various fitters varies in this respect.

TABLE V

NUMBER OF SESSIONS EMPLOYED IN FITTING

	Up to 5	6-10	11-15	16-20	21-30	31-40	41-50	51-60	Over 60
	%	%	%	%	%	%	%	%	%
Total ...	11	17	12	10	10	3	2	1	1
FITTERS									
A ...	5	9	5	9	18	18	5	—	9
B ...	31	58	3	1	1	—	—	—	—
C ...	2	12	18	15	15	3	2	1	1
D ...	36	—	—	—	—	—	—	—	64 did not answer

The time employed in fitting is a matter of extreme importance, because the expense of the lenses is intimately connected with this factor, and contact lenses for the masses cannot become an accomplished fact until the fitting-time can be reduced to a minimum. It is interesting to note that Fitter D usually fits in less than five sessions, and that Fitter B rarely employs more than ten. The other two require longer periods.

6. *Tolerance* (Tables VI, VII, VIII, IX, X, XI, XII, XIII, XIV, XV).

The most important aspect of the use of contact lenses concerns their tolerance, and it was to obtain some authoritative information on this matter that this investigation was primarily undertaken. Table VI indicates that of all the people who have answered the questionnaire, 875 in number, 33 *per cent.* have given up using their lenses. This emphasizes the great responsibility which rests upon anyone who orders or fits contact lenses,

TABLE VI
THE PERCENTAGE OF PATIENTS WHO ARE WEARING THEIR CONTACT LENSES AT PRESENT

	Yes	No	Occasionally Sometimes	One eye only
	%	%	%	%
Total	55	33	9	3
Men	49	38	9	4
Women	61	28	10	1
Up to 30 yrs. of age	60	30	9	1
31-50 yrs. of age ...	49	34	13	4
Over 50 yrs. of age	68	21	5	5
FITTERS				
A	35	42	19	4
B	56	34	8	2
C	58	30	9	3
D	57	33	9	1

because there is no doubt that efficient selection of patients should lower this figure considerably. Men have defaulted more frequently than women, possibly because of the greater determination of the latter to succeed for cosmetic reasons. The over-50-years age-group also shows a significantly lower number of non-wearers, which may be the result of the number of the mustard-gas keratitis cases in this section. There is no great difference in the results of the different fitters, the failures of whom vary between 42 per cent. and 30 per cent. Those persons who are still wearing their contact lenses were further questioned to ascertain the average periods for which they can be worn (Table VII). About one-third can wear them for eight hours or more, and only 16 per cent. for less than four hours. There is no marked difference between men and women, but the group over 50 years shows a higher percentage than the others who wear them for eight hours or more. Fitter B shows a lower number than the

TABLE VII

THE AVERAGE PERIODS (IN HOURS) FOR WHICH CONTACT LENSES ARE WORN, AMONGST PATIENTS WHO ARE STILL WEARING THEM

	One	Two	Three	Four	Five	Six	Seven	Eight	More than 8 hours to all day	Variable
	%	%	%	%	%	%	%	%	%	%
Total	1	7	8	18	7	4	2	2	30	18
Men	0.5	7.5	7	20	7.5	3.5	3	3	33	12
Women	1	6	10	16	6	4	1	2	27	23
Up to 30 years of age	2	6	11	15	8	4	3	3	30	17
31-50 years ...	1	9	9	18	8	4	1	4	24	16
Over 50 years	—	4	3	16	5	4	1	—	40	24
FITTERS										
A	—	—	5	27	9	5	—	5	27	18
B	3	9	20	15	3	3	—	3	14	30
C	1	5	5	17	8	4	3	3	32	18
D	2	16	15	13	4	3	2	2	30	10

average who can wear their lenses for eight hours or more. This fitter shows a large number of patients who state that they wear their lenses for varying times, possibly for special social occasions, etc., but it is unlikely that many of them would be as long as eight hours. The majority of people who wear contact lenses wear them every day (Table VIII). Some people, however, wear their lenses for more than one period in each day,

TABLE VIII

THE PERCENTAGE OF PERSONS WHO WEAR THEIR CONTACT LENSES EVERY DAY

	Yes	No	Usually
	%	%	%
Total	75	16	9
Men	74	18	8
Women	76	14	9

and the record of the total number of hours in which they are worn in the day differs from the record of the number of hours for which they can be worn at one time (Table IX). Fifty-eight per cent. of the wearers use their lenses for eight hours or more

TABLE IX

TOTAL NUMBER OF HOURS THE LENSES ARE WORN EACH DAY

	One	Two	Three	Four	Five	Six	Seven	Eight	More than eight hrs	Variable
	%	%	%	%	%	%	%	%	%	%
Total... ..	1	2	2	7	3	4	1	11	47	18
Men	0.5	3	2	5	4	5.5	1	13	49	13
Women ...	1	2	3	8	3	3	1	8	45	22
Up to 30 yrs.	2	2	3	6	2	4	2	8	51	18
31-50 yrs. ...	1	3	3	7	4	4	1	13	41	19
Over 50 yrs....	—	3	1	4	4	4	3	6	50	19
FITTERS										
A	5	—	—	—	—	—	—	9	72	9
B	2	2	3	9	10	6	1	9	29	29
C	1	2	1	5	3	4	2	12	47	18
D	—	7.5	7.5	12	—	3	—	3	54	12

in the day. There is no significant difference as between men and women or in the different age groups, but the various fitters show different results. Fitter A has 81 per cent. of his patients who still wear the lenses for eight hours or more a day, while only 38 per cent. of Fitter B's patients wear them for this period. It will be remembered that Fitter A, in spite of this successful tolerance, showed the highest percentages of failures. The

TABLE X

INTERVAL BETWEEN PERIODS OF WEARING

	Less than 1 hr.	1 hr.	2 hrs.	3 hrs.	More than 3 hrs.	Variable	Only worn once per day	Long enough to change fluid
	%	%	%	%	%	%	%	%
Total	8	13	11	4	6	11	33	4
Men	9	16	12	2	6	8	33	5
Women ...	8	11	11	5	6	14	32	2
Up to 30 yrs.	10	15	12	2	7	12	31	3
31-50 yrs. ...	6	11	14	5	5	12	33	5
Over 50 yrs.	8	14	12	1	6	6	32	5
FITTERS								
A	22	9	5	14	9	5	27	—
B	9	17	15	4	8	23	21	3
C	6	12	12	4	5	9	39	3
D	12	20	9	—	6	10	21	6

majority of patients who change their lenses favour an interval of about an hour between the periods of wear, though some prefer longer (Table X). A larger proportion of Fitter C's patients than those of the other fitters seem to use their lenses for one session only in the day.

Investigations were made into the number of patients suffering from keratoconus, myopia, aphakia, and mustard-gas keratitis who had given up wearing their lenses (Table XI). There were not sufficient cases of other pathological conditions to allow

TABLE XI
PERCENTAGE OF PATIENTS STILL WEARING THEIR CONTACT LENSES IN CERTAIN PATHOLOGICAL CONDITIONS

	Yes	No	Occasionally Sometimes	One eye only
	%	%	%	%
Keratoconus ...	74	15	5	6
Myopia...	51	37	11	1
Aphakia ...	46	32.5	15	6.5
Mustard Gas Keratitis	77	12	5	6

significant results. Fewer patients than the average had given up wearing their contact lenses among those with keratoconus and myopia, whereas among the purely myopic patients the number who are no longer wearing them is above the average. It was a surprise to realise that the percentage of aphakic persons wearing their contact lenses were even less than the myopes. It appears that though a contact lens reduces the size of the image in the aphakic eye and overcomes the prismatic effects of a strong

TABLE XII
AVERAGE PERIODS FOR WHICH LENSES ARE WORN IN VARIOUS PATHOLOGICAL CONDITIONS

	One hr.	Two hrs.	Three hrs.	Four hrs.	Five hrs.	Six hrs.	Sever hrs.	Eight hrs.	More than Eight hrs.	Variable
	%	%	%	%	%	%	%	%	%	%
Keratoconus...	—	—	4	9	2	2	—	2	37	31
Myopia ...	2	7	10	18	7	5	2	3	26	18
Aphakia ...	—	9	5	5	—	—	5	—	38	24
Mustard-Gas Kératitits	—	8	8	23	9	3	1	—	34	—

convex lens, this is not sufficient to allow fusion of images and comfortable vision in a very large proportion of cases. This is probably the result of absence of accommodation in the aphakic eye.

It was shown that, among those still wearing them, the lenses were worn for significantly longer periods in keratoconus, aphakia and mustard-gas keratitis than in myopia, where the reward was not so great (Table XII). The lenses were worn nearly every day in over 80 per cent. of cases of keratoconus, myopia and mustard-gas keratitis, but the aphakics did not seem to make such constant use of them (Table XIII). The lenses were worn for a longer total time in the day if the wearing hours

TABLE XIII

WHETHER THE LENSES ARE WORN EVERY DAY IN VARIOUS PATHOLOGICAL CONDITIONS

	Yes	No	Usually
	%	%	%
Keratoconus	83	9	6
Myopia	73	18	9
Aphakia	62	33	—
Mustard-Gas Keratitis	74	12	14

were divided into two periods than if single sessions were employed, about 55 per cent. of cases of keratoconus, myopia and aphakia being able to wear them for eight hours or more, while

TABLE XIV

NUMBER OF HOURS THE LENSES ARE WORN PER DAY, ACCORDING TO PATHOLOGICAL CONDITION

	One	Two	Three	Four	Five	Six	Seven	Eight	More than eight hrs.	Variable
	%	%	%	%	%	%	%	%	%	%
Keratoconus...	—	—	—	4	—	2	2	4	51	26
Myopia	1	2	3	7	4	4.5	1.5	9	46	20
Aphakia	—	5	5	9	—	—	5	9	43	19
Mustard-Gas Keratitis	—	3	1.5	1.5	.3	6	—	19	57	6

76 per cent. of cases of mustard-gas keratitis had a tolerance of eight hours or more in the day (Table XIV). The majority of these patients who wear their lenses for two sessions in the day allow an interval of about one hour (Table XV).

TABLE XV

INTERVAL BETWEEN PERIODS OF WEARING LENSES ACCORDING
TO PATHOLOGICAL CONDITION

	Less than 1 hour %	1 hour %	2 hours %	3 hours %	More than 3 hours %	Variable %
Keratoconus	8	20	9	2	—	7
Myopia... ..	12	13	13	4	6	13
Aphakia	5	14	—	—	—	14
Mustard-Gas Keratitis	18	15	12	5	11	3

It is natural that most people endeavour to wear their lenses both at work and during their social activities. It is demonstrated that only a very small proportion of contact lens wearers do not use their glasses at work (Table XVI), and consideration must be given to the question of whether it is justifiable to order contact lenses to be worn only for social activities.

TABLE XVI

PERCENTAGE OF CASES WHO WEAR THE LENSES AT WORK

	Yes %	No %	Sometimes %
Total	72	15	8
Men	72	14	8
Women	73	16	7
Up to 30 yrs. of age	69	19	9
31-50 yrs.	76	14	8
Over 50 yrs.	71	5	6

9. *Why are the Contact Lenses removed?*

The patients who answered this question gave a variety of answers. Thirty-nine per cent. stated that the contact lenses were removed because they noticed veiling, blurring, and fading vision, or a mist around lights; the problem of Sattler's veil which has persisted since contact lenses were first used is thus demonstrated as being the greatest obstacle to their continuous use. Thirty per cent. removed the lenses on account of pain, irritation, smarting, discomfort and watering, while 18 per cent. only removed them for cleaning, renewing the lotion and removing eyelashes. Smaller numbers have stated that they remove them on account of tiredness, nervous tension, or for a rest, and a few find difficulty in removing them if they remain in too long, or

they say that their lens fits badly. Bubbles necessitate removal in some cases. The analysis of the various groups demonstrates that veiling appears to be more common in the age group below 30 years, and that Fitter B and Fitter D appear to have a higher percentage of veiling than the other groups. Fitter A shows a low percentage of irritation but a higher number of cases who remove their lenses on account of bubbles than the other fitters.

10. *Is there any discomfort?* (Table XVII).

A small number of people gave an unequivocal affirmative to this question. Rather more gave a firm negative. Nearly half preferred to be indefinite and returned the answer that they sometimes had slight discomfort. It must be noted that in this question Fitter A showed a significantly smaller number of persons who admitted discomfort than the other fitters, which agrees with the finding that a large number of his patients were able to wear the lenses for long periods.

TABLE XVII
THE PERCENTAGE OF THOSE WHO ADMIT DISCOMFORT

	Yes	No	Sometimes
	%	%	%
Total	24	32	42
Men	21	32	45
Women	27	31	40
FITTERS			
A	14	41	41
B	29	35	33
C	25	27	46
D	22	40	36

11. *Blurred vision when wearing the lenses* (Table XVIII).

Blurring of vision while wearing contact lenses is due, in the majority of cases, to that oedema of the corneal epithelium which has been termed Sattler's veil. The answers reveal that 74 per cent. of patients are embarrassed by onset of blurring of vision after wearing their lenses for a variable period. Two per cent. admitted that this happened only when the contact lenses needed cleaning, or when the fluid required changing, while 2 per cent. found that blurring only occurred in a hot atmosphere or with fatigue. In these latter groups it is probable that the blurring was not due to a Sattler's veil but to mucus or other deposits on the lenses. Dimness of vision due to bubbles was specifically mentioned in 0.5 per cent. of cases.

TABLE XVIII

THE PERCENTAGE OCCURRENCE AND CAUSE OF BLURRING OF VISION

	Yes %	No %	Due to bubbles %	Dirty lens or fluid %	Hot atmosphere with fatigue %
Total	74	20	0.5	2	2
Men	76	18	0.5	2	1.5
Women	74	21	—	1	2
Up to 30 yrs. ...	76.5	18	0.5	2	2
31-50 yrs. ...	72	23	—	1	1
Over 50 yrs. ...	75	17	—	2	3
FITTERS					
A	87	9	—	4	—
B	85	7	—	3	3
C	72	22	—	1	3
D	79	19	—	—	—

There is no significant difference in the incidence of blurred vision between men and women or in the different age groups, but Fitter A and Fitter B appear to have a higher incidence than Fitter C and Fitter D. It should be emphasized that none of these patients had been fitted with perforated or grooved lenses, which have materially changed the frequency with which veiling occurs.

The onset of veiling occurs after varying periods of wear, but it commonly tends to happen after three or four hours. No

TABLE XIX

LENGTH OF TIME DURING WHICH CONTACT LENSES ARE WORN BEFORE VEILING OCCURS, IN CASES WHICH VEIL

	1 hour %	2 hours %	3 hours %	4 hours %	5 hours %	6 hours %	6-8 hours %	Over 8 hrs. %	Variable %
Total	4	11	14	13	7	7	3	5	20
Men	5	7	14	16	9	4	3	7	18
Women	3	15	14	10	5	8	3	4	22
Up to 30 years ...	4	10	12	13	11	7	5	7	21
31-50 years ...	5	15	17	13	6	5	2	2	22
Over 50 years ...	4	6	8	14	3	6	1	8	15
FITTERS									
A	—	—	10	35	10	10	—	5	25
B	7	23	24	3	3	5	3	—	25
C	4	7	9	13	8	6	4	6	20
D	2	18	24	17	6	7	2	4	18

important difference is present in the different age groups or between men and women, but there seems to be a difference between the different fitters. Fitter A and Fitter C show a peak at four hours, while Fitter B and Fitter D show their peak at the three-hour period. It is significant that only in 5 per cent. does veiling occur after periods of more than eight hours.

A material percentage show that there is a variation in the amount of veiling in the two eyes. This may indicate that variation in fitting is a factor. It is worthy of note that the two fitters whose patients show the peak of veiling at four hours seem to show a higher relative number who notice a difference in veiling between the two eyes.

TABLE XX
IS BLURRING EQUAL IN BOTH EYES?

	Yes	No	One lens only worn
	%	%	%
Total	40	28	10
Men	34	36	13
Women	45	22	8
Up to 30 yrs. ...	47	31	5
31-50 yrs. ...	35	26	13
Over 50 yrs. ...	24	35	15
FITTERS			
A	50	35	—
B	51	11	13
C	33	30	13
D	58	33	—

TABLE XXI
PERSISTENCE OF "BLURRING" AFTER REMOVAL OF LENS

	No per- sistence	Less than 15 mins.	15-30 mins.	31-45 mins.	46-60 mins.	More than 1 hr.	All the time	Vari- able
	%	%	%	%	%	%	%	%
Total	—	23	23	5	10	8	1	11
Men	—	16	21	6	15	11	2	11
Women	—	29	25	3	6	6	—	11
Up to 30 yrs....	—	28	27	3	10	7	—	13
31-50 yrs. ...	—	24	24	7	10	7	2	8
Over 50 yrs. ...	—	17	12	3	9	12	4	9
FITTERS								
A	—	15	40	—	—	5	—	35
B	—	42	21	5	5	2	—	15
C	—	20	19	5	10	12	2	10
D	—	13	37	4	18	4	—	2

TABLE XXII

RECURRENCE OF VEILING AFTER REINSERTION

	Up to half-hour	Half-hour-1 hour	1 hour	2 hours	3 hours	4 hours	5 hours	6 hours	More than 6 hours	Variable
	%	%	%	%	%	%	%	%	%	%
Total ...	6	4	5	10	6	6	2	1	2	9
Men ...	5	5	6	8	9	7	4	2	2	11
Women ...	8	2	5	11	4	5	1	—	1	7
Up to 30 years	6	5	5	10	10	7	3	1	3	6
31-50 years	6	2	7	13	5	6	3	1	1	5
Over 50 years	5	3	1	4	4	3	—	—	—	20
FITTERS										
A ...	10	—	10	10	—	10	—	—	—	25
B ...	8	5	12	20	3	2	—	—	—	8
C ...	5	3	4	6	5	6	3	—	1	10
D ...	9	7	4	15	17	9	4	4	4	—

Veiling takes place more rapidly following reinsertion of the lenses after clearing of a veil than when they are inserted for the first time in the day. There is no significant difference between the sexes or between the age groups, but the figures for the different fitters show that whereas Fitter A, Fitter B and Fitter D show a peak in their series at about two hours, the Fitter C series shows fairly equal figures up to four hours' wear.

Questioning indicated that after a second insertion veiling was the usual cause of subsequent removal, though 27 per cent. removed them because of irritation, smarting, discomfort and watering.

Fluid with which the lens is inserted.

Of the total persons using contact lenses at present 39 per cent. put them into the eye dry. Of this number the large proportion are fitted by one fitter, of whose patients 56 per cent. insert the lenses dry, while 44 per cent. use some fluid. Of the other fitters' patients only 2-4 per cent. insert the lenses without fluid of some kind. The fluid most commonly used was normal saline—by about 73 per cent. of all who did not insert the lenses dry. The remainder used 2 per cent. or $2\frac{1}{2}$ per cent. sodium bicarbonate solution, cold water, warm water, distilled water, boric acid solution, Optrex, various buffer solutions, and, in a few cases, saliva. The patients were asked to state whether the period of veiling was affected by the type of fluid. 25 per cent. thought it was, and 25 per cent.

TABLE XXIII

DOES THE FLUID AFFECT THE VEILING ?

Total	Yes	No	Doubtful or no reply
	25%	25%	50%
FITTERS			
A	25	45	30
B	46	24	30
C	9	23	68
D	72	24	4

thought it was not. The remaining 50 per cent. either did not answer the question or gave indefinite replies. No significant difference was apparent between the sexes or in different age groups, but the results of the various fitters show marked differences. The majority of patients of Fitter A and Fitter C did not consider that fluids affected the veiling, whereas the majority of the patients of Fitter B and Fitter D considered that the influence of fluid upon veiling was considerable. Several patients emphasized that they felt that sodium bicarbonate solution helped to prevent veiling, and that veiling was more common if the solution was not fresh. It may be that in this matter the patients tend to reflect the views of their fitters.

The influence of air bubbles.

Enquiry was made to ascertain whether or not the formation of air bubbles was a serious factor in the wearing of contact lenses.

TABLE XXIV

DO AIR-BUBBLES FORM WHEN CONTACT LENSES ARE WORN ?

	Yes	No	Sometimes
	%	%	%
Total... ..	44	19	36
Men	50	19	30
Women	39	19	42
Up to 30 yrs. ...	43	21	36
31-50 yrs. ...	42	19	38
Over 50 yrs. ...	50	16	33
FITTERS			
A	18	18	64
B	35	17	48
C	47	20	32
D	44	21	34

Table XXIV shows the results. The essential fact is that only about 20 per cent. of cases do not suffer from bubbles at times, and this seems to be constant in both sexes, at all ages, and with any fitter.

Those persons who suffer from bubbles while wearing contact lenses do not all find them a hindrance. A small proportion find them a help, and some do not consider them an embarrassment.

TABLE XXV
EFFECTS OF AIR BUBBLES

	Those affected regularly by bubbles	Those affected sometimes by bubbles
	%	%
Bubbles give no trouble ...	9	17
Bubbles a help	10	7
Bubbles cause great trouble ...	56	46
Bubbles cause slight trouble...	23	23

This feature is of some interest in that veiling appears to be less marked when a bubble is present, and those people who can tolerate a bubble without discomfort may be relieved of the greater trouble of blurring of vision.

Most and Least favourable conditions.

Questions were asked to elicit the most favourable and least favourable conditions for wearing contact lenses and this provided a multitude of replies, many of which were completely contradictory. It is not felt that any useful purpose would be served by analysing these answers but some report of them may prove helpful to the providers and wearers of contact lenses.

Some persons find contact lenses comfortable at all times, and others find them to be uncomfortable always. Most people find the ideal conditions to be moderate sunlight or soft artificial light, and state that strong sunlight and bright artificial light may produce discomfort. Bluish fluorescent lighting is also criticized by some wearers and defective illumination may cause discomfort. Cool weather, dry cold weather, dull days, and rainy days all find their adherents, but windy weather whether dry or humid, causes trouble to some people. Some persons are happier in the morning, and others in the evening. It may be interesting to flying personnel to know that the strong light that is present above the clouds causes intolerance with some persons. There seems

no doubt that clean dry non-dusty rooms without smoke in the atmosphere are much more comfortable for wearers of contact lenses than hot, dusty, smoky places. People with contact lenses often dislike seats near the fire, while cinemas and crowded restaurants are likewise sources of discomfort. The psychological aspect of contact lenses is stressed in the observation by some persons that contact lenses can be worn more easily when they are alone than when they are in company, while having "nothing to do" or having to "look about" cause difficulty in other subjects. Sleeping is an unsuitable pastime when wearing contact lenses, and many people say that they are at their best when they are relaxed and the eyes are not tired. Some patients consider the lenses to be ideal for use in the open air, and especially for open-air sports and exercise, while some prefer them for indoor sports and dancing. Some like to use contact lenses for close work, while others feel that they are less suitable for this occupation than for distance. Many housewives find contact lenses ideal for general use while doing their housework. Mild degrees of ill-health such as colds in the head seem to have a detrimental effect upon tolerance to contact lenses. It appears, therefore, that there are few absolute contra-indications for contact lenses, but that hot, dusty, smoky atmospheres reduce tolerance in a large number of wearers, and that they find their most satisfactory use in the open air in a temperate climate.

TABLE XXVI
PERSONS WEARING ADDITIONAL SPECTACLES

	Yes	No	Remove Contact Lens for reading
	%	%	%
Total	22	75	1
Men	34	61	1
Women	12	86	1
Up to 30 yrs. ...	3	96	1
31-50 yrs. ...	16	81	1
Over 50 yrs. ...	76	13	4

Wearing of additional spectacles.

Contact lenses are normally fitted for distance wear. It is unusual for patients to have a special pair for reading, owing to the difficulties of changing them, and the bifocal contact lens is not yet a practical proposition. Presbyopic patients find it most convenient to wear a reading addition in spectacles. Table XXVI

indicates the numbers of people who have to do this and illustrates the large number of people who do it among the elderly age groups, and also the natural distaste of women for spectacles.

Why were contact lenses given up?

It was considered that it would be useful to learn from those patients who have given them up the reasons for discontinuing their wear. The numbers giving different reasons are small, and it does not appear that the percentages of the different groups would be of statistical value.

Some people asserted that the lenses did not fit, but this can only be a statement of opinion, since in the opinion of the fitters they did fit or they would not have been supplied. Allied to this reason is the extreme discomfort claimed by some wearers, and the early onset of veiling which worried others. Persistent redness of the eyes (termed conjunctivitis) caused some patients to stop using their lenses. Some wearers who obtained them for use only in games, found that they were too much of a nuisance, and gradually ceased to use them, while others found discomfort with close work and similarly gave them up. General inconvenience and uncertainty regarding the length of time they could be worn caused some people to cease using them. A number of reasons given for the failure to continue wearing contact lenses seem to reveal lack of will to wear them. "Difficulty in finding opportunity for removal and reinsertion," "difficulty" or "nervousness" in inserting and removing the lenses, and finding that the lenses were "unsuitable for the optical condition." Other reasons seem to fall within the group of pure excuses with very little reasonable foundation. "No time to persevere and get used to them," "they seemed to be harming my eyes" and "they caused restriction of movement of the eyes" do not seem to offer a sound basis for giving up the lenses. Losing the lenses or breaking them and being unable to afford the expense of replacement seems a more reasonable excuse, even if it illustrates gross carelessness. Inability to get the lenses refitted or repolished suggests, again, an absence of keenness. A final group complained of difficulties with the fluid used, and this also does not appear to be a valid excuse. Suitable co-operation between the fitters and wearers should eliminate this whole group.

A study of the reasons advanced for giving up contact lenses confirms the orthodox opinion that for success in wearing these appliances there must be a *real* desire on the part of the patient to make them a success. In this respect a great responsibility rests on the ophthalmologist only to advise contact lenses for

people who have the correct mental approach to the difficulties involved. These difficulties should be exaggerated rather than underestimated at the initial examination.

Benefits of contact lenses.

Patients were asked to give their ideas of the benefits of contact lenses, and though the answers produce little that is new, they are of interest in providing the considered opinion of persons who have devoted considerable time and trouble to being fitted with, and wearing contact lenses.

Many people appreciate being able to avoid wearing spectacles, some for reasons of vanity or because they consider their appearance to be thereby enhanced. Some claim greater comfort with contact lenses, and others an increase of self-confidence. The wider field of vision is appreciated by some wearers, and is partly attributable to the fact that the lens moves with the eye. High myopes notice the absence of light reflections, in addition to their improved vision, while people with irregular astigmatism and conical corneae are impressed by the enormous visual improvement which occurs. A benefit which seems to have little solid foundation, though noted by a few patients, is that the lenses help to keep the eyelids open. The benefit of these optical aids in sports, such as swimming and hunting, is mentioned by several observers, and their advantages for actors and musicians are also stressed. The fact that the transparency of these lenses is not affected by rain, spray, sweat, or other moisture is a well-recognised feature which receives constant reinforcement.

Disappointments in Contact Lens wear.

The statements of patients regarding the points in which contact lenses have proved disappointing are interesting, and may be of value to contact lens workers when advising possible wearers in the future. Many of the disappointments are relative in type, and could perhaps have been avoided by more detailed advice before fitting was begun. There is some overlap between this group and that in which patients gave their reasons for discarding their lenses, and it appears that if the disappointment was too great, further wear was suspended.

Some people were disappointed that they could not wear the lenses the whole time, or that they could not wear them for longer periods, while others were disillusioned at the long time it took to get used to them. Persistent blurring was the cause of intolerance and disappointment in many cases. General discomfort, inconvenience and nuisance caused some disappointment, while other

people noticed aching with close work, or had hoped that the general vision would be better. The reddening of the eyes, and the intolerance to glare and bright sunshine, disappointed many people, while some people were annoyed to find that the glasses caused discomfort in enclosed smoky atmospheres and could not therefore be worn at dances. Some people were disappointed that the lenses could not be worn comfortably for sport as had been anticipated.

Would you go in for contact lenses again?

This question was asked in the full knowledge that a large number of patients could not be expected to admit that they had made an error of judgment, and would state that they would certainly be prepared to try them again. Table XXVII shows that the results were almost unanimous in the opinion that they would be prepared to go in for them again. There were, however, certain

TABLE XXVII

WOULD YOU GO IN FOR CONTACT LENSES AGAIN?

	Yes %	Doubtful %	No %	If fitting were improved %	Not if spec- tacles gave same vision %	If contact lenses were improved %	If cheaper %	Not for con- tinuous wear %	If can be used without lotion %
Total ...	88	5	3	—	0.5	—	1	1	—
Men ...	87	4	2	0.5	0.5	—	2	1	—
Women ...	89	5	3	—	0.5	0.5	—	0.5	0.5
Up to 30 years...	90	4	3	—	0.5	—	0.5	2	—
31-50 years ...	86	6	2	—	—	1	2	1	—
Over 50 years ...	89	3	1	1	—	—	—	—	—
FITTERS									
A ...	88	4	4	—	—	—	—	—	—
B ...	86	3	4	—	2	—	—	2	2
C ...	90	5	2	—	—	—	1	1	—
D ...	84	9	4	—	—	—	3	—	—

qualifications which should be mentioned. Some feel that the fitting could be better, or that they would not have the lenses again unless they were improved, or unless blurring and discomfort are eliminated. Some people feel that the lenses should be cheaper before they would go in for them again, and others that they would not have them again unless they could be used without lotion. A proportion of people think that contact lenses are a failure for continuous wear, but that they are useful for special purposes such as dancing, acting, etc.

Repolishing of lenses.

The questionnaire ended with an enquiry regarding the number of times the lenses had been repolished. This simple procedure increases the comfort with which the lenses can be worn and should normally be carried out about every 2 years. Table XVIII shows that more than half the patients had never had their lenses repolished. This figure is largely due to the fact that many of the patients had only been wearing their lenses for a year or less. It is noteworthy that the age-group showing the highest percentage of repolishing was the group "over 50 years," many of whom had worn their contact lenses for the longest time.

TABLE XXVIII
REPOLISHING OF LENSES

	Once	Twice	Three times	Four times	Five times	Six times	Seven times or more	Never
	%	%	%	%	%	%	%	%
Total	21	7	4	1	—	1	4	58
Men	23	4.5	2	3	—	1	3.5	59
Women	19	8.5	5	0.5	1	1	4	57
Up to 30 yrs.	19	5	4	0.5	0.5	0.5	2.5	65
31-50 yrs.	18	8	3	2	1	1	6	57
Over 50 yrs.	35	4	3	2	—	3	5	44

Contact lenses among Flying Personnel in the R.A.F.

Through the kind co-operation of Air Marshal P. C. Livingston, C.B., C.B.E., Director-General, R.A.F. Medical Services, and of Air Commodore J. C. Neely, Consultant in Ophthalmology, R.A.F., I have been allowed to examine the records of flying personnel who were fitted with contact lenses during the second world war. Their records show that 31 flying members of the R.A.F. were fitted with contact lenses. Most of them were pilots, but a few navigators and air gunners were in the number. Two of these men had unilateral aphakia, and the remainder suffered from defective vision due to myopia, myopic astigmatism, mixed astigmatism or hypermetropic astigmatism. The aphakic patients were pilots who had had traumatic cataract. One found his lens entirely satisfactory, and he flew 350 hours while wearing it, in single-seater fighters, and noticed no diplopia, while his judgment in flying was unimpaired. The other was able to wear his contact lens for 4 hours at a time before soreness

compelled its removal, but while wearing it he noticed diplopia for distant vision, and so flying was not possible.

Consideration of the men who wore contact lenses for visual defect reveals that in all cases where they were fitted, flying judgment and observation were unimpaired. More detailed analysis of the flying records reveals that 14 cases of the 29, just under 50 per cent., may be regarded as satisfactory. These men were able to take their full part in flying duties with unimpaired visual acuity. Certain observations are made by some of these cases which may be recorded. One noted that though he could fly in comfort in his lenses for up to 6 hours, his tolerance was reduced to 2 hours if he wore them in the house. One noticed slight discomfort from glare while he was training overseas. Another noticed slight irritation from fumes in the cockpit, and one pointed out the advantage of being able to fly in an open cockpit with contact lenses, without using goggles. This series contained a well-known fighter pilot, who had about 2 dioptres of myopia in each eye. He completed over 1,000 hours of flying, including 600 hours on operations, wearing his contact lenses, and won the D.S.O. and D.F.C. He could wear his contact lenses for up to 24 hours at a time.

The remaining 15 cases included one who was completely unsatisfactory. He never achieved more than one hour of tolerance, and was never able to fly with his contact lenses. The other 14 may be regarded as modified successes. Ten of them wore the lenses for flying and found them fully successful, so far as vision and visual judgment were concerned, but their tolerance was so reduced by veiling, that they could never become quite visually efficient. Three found that they could fly with the lenses perfectly well, but that heat and glare caused discomfort. One of these, a pilot in a Fighter Squadron, had to spend considerable spells in readiness for flying and be prepared to rush to his aircraft within seconds of receiving an alert. His tolerance was not very great, and long spells of "readiness" causes difficulty. Another pilot who flew many hours with contact lenses complained that they caused a sensation of weight in the eyes, and he also stated that when he pulled out of a power-dive he felt as though the lenses were being dragged out on to his cheek. A pilot who was wearing contact lenses was involved in a crash, and broke the goggles he was wearing, but his contact lenses were undamaged.

The records of this fairly small series of cases show that contact lenses can be employed for flying purposes by some persons, and that the difficulties which arise are the same as with other wearers, and associated especially with defective tolerance. Under present

circumstances they may be regarded as a possible assistance in keeping a trained man on flying duties, but probably not worth consideration for recruits.

CONCLUSIONS.

Contact lenses have been used for more than fifty years, and at the present time are being worn by rapidly increasing numbers of patients. Many are attracted to them by the thrill of using some new instrument, and some because they have an antagonism to spectacles which is almost pathological. These analysed results indicate that they are not entirely satisfactory as optical appliances. One-third of all the patients who answered this questionnaire have ceased to wear their lenses, although among those who wear them for pathological states of the eye this percentage is lower. Those persons who continue to wear their lenses may not be able to tolerate them for more than one or two hours a day, though the majority can use them for longer periods. The results obtained by some fitters are better than those of others, though the differences are not as great as might have been expected, and the satisfaction of the patients seems greater in some respects with one fitter, and some respects with another. There seems no doubt that the mental attitude of the patient to his lenses is an important factor, and it is most important that the greatest care should be taken in selecting patients who are suitable subjects, in order that the number of failures may be reduced to the lowest possible number. A survey of the use of contact lenses by the Royal Air Force indicates that here, as among civilians, the results were not uniformly satisfactory. In spite of the great amount of work which has been carried out on contact lenses, it appears that satisfactory fitting is still the major problem, and that, as improvements proceed in the technique, so will tolerance increase.

SUMMARY.

An analysis of the answers of 875 contact lens wearers to a questionnaire provides information upon the fitting of contact lenses, upon the indications for their use, and upon the problem of tolerance. The different aspects of tolerance are investigated, and the opinions of the wearers on the benefits and disadvantages of contact lenses are reported. It is shown that, of this series, one-third of the total number of persons fitted with contact lenses had ceased to wear them, and the various causes are discussed. A report is given of the use of contact lenses among flying personnel

of the Royal Air Force during the second world war. A plea is made for increased care in the selection of persons to be fitted with contact lenses.

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I wish to express my thanks to Sir Stewart Duke-Elder and Mr. F. A. Williamson-Noble for their help and advice, and to Air Marshal P. C. Livingston for permission to peruse the war-time records of the Royal Air Force.

I am greatly indebted to Messrs. Clement Clarke, Ltd., Messrs. Theodore Hamblin, Ltd., Messrs. Davis Keeler, Ltd., and Mr. Keith Clifford Hall for their co-operation, and to all ophthalmic surgeons who allowed me to write to their patients.

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THE NATURE OF THE MALIGNANT CHOROIDAL MELANOMATA*

BY

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LONDON

Writing in 1904, Parsons upheld Ribbert's (1911) view that malignant pigmented choroidal growths were sarcomata, and is still of the same opinion. Dawson (1925) re-affirmed Unna's (1893) suggestion that these growths were epithelial in origin and therefore carcinomata, but the great majority of authors now hold the neurogenic theory, and believe that choroidal melanomata are derived from the cells of Schwann belonging to the ciliary nerves.

I would like at the outset to return to certain well-known basic

Dedicated to Professor J. Møller.

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