DIFFERENTIAL FERTILITY BETWEEN WOMEN OF BLOOD GROUPS O AND A*

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INTRODUCTION

The discovery of the Rh blood groups by Landsteiner and Wiener (1940), and the subsequent demonstration by Levine and others (1941) of their role in the aetiology of haemolytic disease of the newborn, has re-opened the problem of incompatibility between mother and foetus with respect to the A-B-O blood group antigens. Levine (1943) reviewed a number of family studies of the inheritance of blood groups and reached the conclusion that there was a significant deficiency of offspring in matings between mothers of blood group O and fathers of group A, compared with those where the mother was of group A and the father of group O.

More recently Waterhouse and Hogben (1947) have made a detailed analysis of twelve published studies in which the A-B-O blood groups of parents and children have been listed. Their samples were carefully selected on the basis of reliability of technique and randomness of the population investigated. A significant deficiency of children was found in the mating group O-mother : A-father compared with the reciprocal group, this deficiency being due entirely to the selective loss of A children of the group O mothers. The effect was more marked at higher birth ranks. They concluded that provisional estimates suggest that A-B-O *iso*-immunization is responsible for the loss of about 25 per cent. of the A children expected from marriages between group O mothers and A fathers, or a loss of roughly 3 per cent. of all conceptions.

Race and Sanger (1950) point out the difficulty of reconciling a loss of this magnitude with the constancy of the frequencies for the A-B- and R genes over long periods of time, unless some compensatory mechanism is at work. At least two points require further study before our ideas on the possible nature of such compensatory mechanism can be clarified. These are:

(a) the provision of evidence of a collateral nature

to substantiate the magnitude of the iso-immunization effect with respect to the agglutinin A reported by Waterhouse and Hogben (1947),

(b) a more detailed investigation of the relative fertility of group O women and group A women in a socially homogeneous population.

The present paper records the results of an analysis of the blood-type and previous pregnancy experience of women giving birth to children in a large maternity hospital during the years 1948 to 1951. An effect of the magnitude of that reported by Waterhouse and Hogben for family studies should manifest itself in such a sample by a changing distribution of women of blood groups O and A with age and parity.

Since this work was started, Boorman (1950) and Bryce and others (1950) have published papers relating to blood group distributions in a series of mothers and infants, the data having been obtained from maternity hospitals in England and Australia. Bryce and others find a significant excess of group AB among the mothers compared with their children, both for their Australian sample only, and for the Australian sample combined with Boorman's English sample. They suggest that some A and B genes may be replaced by especially fertile AB mothers. Where the data of these workers has been presented in sufficient detail comparisons will be made with results obtained in the present investigation.

METHODS OF COLLECTING DATA

The data used in the present analysis was collected from the record cards of admissions to the King Edward Memorial Hospital, Perth. Selection was made for clinic patients; persons referred to the hospital by private doctors were rejected. In this way a comparatively socially-homogeneous group unselected for complications of pregnancy was made available for analysis. Details of previous pregnancy experience, together with information relating to age, outcome of present pregnancy, etc., is routinely listed on the cards.

The information relating to previous pregnancy experience, particularly miscarriages and to a lesser extent stillbirths, is likely to be misrepresented by the women concerned. We have assumed that the

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inaccuracies are distributed proportionately between the different groups. A-B-O and Rh blood group determinations are carried out on all clinic patients by workers in the Public Health Department Blood Group Laboratory attached to the hospital. A uniformity of testing technique is assured, and some of the patients are retested at monthly intervals during pregnancy.

The sample studied is a biased selection of women of the same age groups in the population in so far as all must be experiencing pregnancy when the records are entered. Those that miscarry after they have first attended the clinic, and who report their miscarriage, are appropriately listed.

ANALYSIS OF DATA

During the 4-year period under review the sample was changing slightly in blood group distribution and in age composition. Table I A gives the A-B-O blood group distribution for 6,121 mothers, Table I B records the corresponding Rh frequency (anti-D).

FIG. 1.—Difference in average number of pregnancies per woman, A-O

TABLE I A
A-B-O BLOOD-GROUP DISTRIBUTION BY YEAR
(Total Perth Sample)

Year			1948	1949	1950	1951	All Years
Group	O	Number Per cent.	437 46.0	621 43.5	816 45.2	871 45.0	2745 44.8
	A	Number Per cent.	407 42.9	619 43.3	756 41.8	778 40.2	2560 41.8
	B	Number Per cent.	84 8.8	151 10.6	178 9.9	216 11.2	629 10.3
	AB	Number Per cent.	21 2.2	38 2.6	57 3.2	71 3.7	187 3.1
All Groups		Number Per cent.	949 99.9	1429 100.0	1807 100.1	1936 100.1	6121 100.0

$$\chi^2 = 12.399 \quad 0.10 < p < 0.20$$

TABLE I B
Rh BLOOD-GROUP DISTRIBUTION BY YEAR
(Total Perth Sample)

Year			1948	1949	1950	1951	All Years
Group	Rh+	Number Per cent.	816 86.0	1,185 82.9	1,502 83.1	1,618 83.6	5,121 83.7
	Rh-	Number Per cent.	133 14.0	244 17.1	305 16.9	318 16.4	1,000 16.3
Total		Number Per cent.	949 100.0	1,429 100.0	1,807 100.0	1,936 100.0	6,121 100.0

$$\chi^2 = 4.696 \quad 0.10 < p < 0.20$$

The frequency of Group B and AB have tended to increase, and although the analysis of the complete table does not indicate a significant deviation

from expectation, a comparison of the combined group O-A with the combined group B and AB frequencies suggests that this trend is a real one ($\chi^2 = 8.137$, $0.02 < P < 0.05$). It is also clear that the change in the age composition of the 4-year samples in Table II, with a proportionate decrease in the under-20 age group and an increase in the 26-30 age group is also significant ($\chi^2 = 30.954$, $0.001 < P < 0.01$).

TABLE II
AGE-GROUP DISTRIBUTION BY YEAR
(Total Perth Sample)

Year			1948	1949	1950	1951	All Years
Age Group	20 and under	Number Per cent.	213 22.4	299 20.9	351 19.4	354 18.3	1,217 19.9
	21-25	Number Per cent.	349 36.8	501 35.1	653 36.9	692 35.7	2,195 35.9
	26-30	Number Per cent.	183 19.3	322 22.6	431 23.8	503 26.0	1,439 23.5
	31-35	Number Per cent.	113 11.9	176 12.3	221 12.2	211 10.9	721 11.8
	36-40	Number Per cent.	69 7.3	112 7.8	116 6.4	151 7.8	448 7.3
	Over 40	Number Per cent.	22 2.3	19 1.3	35 1.9	25 1.3	101 1.7
All Ages		Number Per cent.	949 100.0	1,429 100.0	1,807 99.9	1,936 100.0	6,121 100.1

$$\chi^2 = 30.954 \quad 0.001 < p < 0.01$$

The change in the frequency of group B and AB suggested that recent arrivals in Australia from countries with relatively higher frequencies of group B than for typical English and Australian populations were making a significant contribution to this effect. Accordingly, we have differentiated the sample on the basis of name (*cf.* Hart, 1944; Roberts, 1948) into two groups:

- (a) of English name, and
- (b) of non-English name.

The second group comprises people drawn from Eastern, Central, and Southern Europe in the majority with a fairly substantial number of Dutch migrants. The country of origin of these people all have frequencies for the B-gene higher than that in Great Britain. (Wiener, 1943.)

The tendency for the frequency of B and AB to increase in recent years in the total sample disappears if women of English name only are included. The frequency for A-O combinations against B-AB in this group (Table III A) shows no heterogeneity ($\chi^2 = 3.751$, $0.30 > P > 0.20$). Further, the heterogeneity of the sample with regard to age groups is considerably reduced if women of non-English name are removed, although there is still a slight

TABLE IIIA
BLOOD-GROUP DISTRIBUTION OF WOMEN OF ENGLISH
NAME BY YEAR

Year	..	..	..	1948	1949	1950	1951	All Years
Group	O	Number	388	558	665	716	2,327	
		Per cent.	47.0	43.9	45.7	47.0	45.8	
	A	Number	351	559	609	607	2,126	
		Per cent.	42.5	44.0	41.8	39.8	41.9	
B	Number	72	123	143	156	494		
	Per cent.	8.7	9.7	9.8	10.2	9.7		
AB	Number	15	31	39	46	131		
	Per cent.	1.8	2.4	2.7	3.0	2.6		
All Groups	Number	826	1,271	1,456	1,525	5,078		
	Per cent.	100.0	100.0	100.0	100.0	100.0		

TABLE IIIB
AGE-GROUP DISTRIBUTION OF WOMEN OF ENGLISH
NAME BY YEAR

Year	..	..	..	1948	1949	1950	1951	All Years
Age Group	20 and under	Number	190	275	296	314	1,075	
		Per cent.	23.0	21.6	20.3	20.6	21.2	
	21-25	Number	300	435	525	545	1,805	
		Per cent.	36.3	34.2	36.1	35.7	35.5	
	26-30	Number	162	291	329	370	1,152	
		Per cent.	19.6	22.9	22.6	24.3	22.7	
	31-35	Number	95	157	183	160	595	
		Per cent.	11.5	12.4	12.6	10.5	11.7	
36-40	Number	60	98	91	116	365		
	Per cent.	7.3	7.7	6.2	7.6	7.2		
Over 40	Number	19	15	32	20	86		
	Per cent.	2.3	1.2	2.2	1.3	1.7		
All Ages	Number	826	1,271	1,456	1,525	5,078		
	Per cent.	100.0	100.0	100.0	100.0	100.0		

tendency for the 1950 and 1951 sample of women of English name to contain a relatively higher proportion of women aged 21-30 than in the previous 2 years (Table IIIB). It seems reasonable to assume, therefore, that the women of English name are a socially homogeneous population with respect to their A-B-O blood group distributions, and at present there is no reason to suppose that socio-economic conditions will affect the child-bearing capacity of women in one blood group compared with those in another.

If, however, the figures for the average number of pregnancies experienced per woman in group O are compared with those for women in group A an interesting difference between the two groups emerges. Tables IVA and IVB (overleaf) record the pregnancy rank of Rh-positive women of English name in blood groups O and A. Although the overall pregnancy experience of women in the two groups is almost identical (being slightly, but not

significantly, higher for women of group A), there is a marked deficiency of pregnancies experienced by women of group O between 25 and 35, with a tendency toward a marked excess of pregnancies in the same group for women above the age of 35. Orthogonal polynomials were fitted to this series of differences in average number of pregnancies between women in group O and A for each year of age from 16 to 40 (see Figure). The result shows that the observed trend is highly significant, the bulk of the variance being attributed to the binomial expression.

FIGURE—Difference in average number of pregnancies per woman, A—O

The same trend is observable in the extremely heterogeneous group of women of non-English name (Table V). A polynomial analysis by each year of age of the Rh-positive women in the total sample again yields a highly significant result.

TABLE V
AVERAGE NUMBER OF PREGNANCIES IN Rh-POSITIVE
WOMEN

Women		Of Non-English Name (694) *		All in Perth Sample (4,444)	
Blood Group	..	O (343)	A (351)	O (2,273)	A (2,171)
Age Group	20 and under	1.3191	1.3617	1.3451	1.3750
	21-25	2.0887	1.9781	2.0961	2.1475
	26-30	2.5200	2.6526	3.0055	3.3460
	31-35	3.1351	3.2857	3.8706	4.1374
	36-40	4.1000	4.1200	5.1864	5.1074
	Over 40	5.4000	5.0000	6.5909	6.3448
All Ages	..	2.4461	2.4302	2.6912	2.7835

TABLE IV
NUMBER OF PREGNANCIES EXPERIENCED BY Rh-POSITIVE GROUP O WOMEN OF ENGLISH NAME

Age	Number of Pregnancies											Total Women	Total Pregnancies	Average Pregnancies per Woman
	1	2	3	4	5	6	7	8	9	10	10+			
Total (16 and under)	18	—	1									19	21	1·1053
17	30	6										36	42	1·1667
18	69	13	2									84	101	1·2024
19	85	32	5	2								124	172	1·3871
20	88	43	9	1	1							142	210	1·4789
Total (20 and under)	290	94	17	3	1							405	546	1·3481
21	81	50	16	2	—	—	1					150	244	1·6267
22	57	61	25	5	2	1	—					151	290	1·9205
23	33	54	31	11	1	—	—					130	283	2·1769
24	24	51	35	11	4	1	—					126	301	2·3889
25	20	46	33	16	3	2	—					120	302	2·5167
Total (21–25) ..	215	262	140	45	10	4	1					677	1,420	2·0975
26	15	34	41	12	6	3	2					113	316	2·7965
27	13	39	26	21	11	—	3					113	329	2·9115
28	12	16	28	15	10	5	1					87	275	3·1609
29	8	14	19	18	8	4	2	2				75	259	3·4533
30	8	12	8	9	10	4	3	1	1			56	204	3·6429
Total (26–30) ..	56	115	122	75	45	16	11	3	1			444	1,383	3·1149
31	5	5	9	9	12	2	1	—	—			43	157	3·6512
32	4	14	9	11	5	4	4	—	1			52	189	3·6346
33	3	5	17	10	5	4	3	3	1			51	207	4·0588
34	1	6	8	7	8	3	2	1	1			37	154	4·1622
35	2	4	4	7	7	3	3	5	—			35	164	4·6857
Total (31–35) ..	15	34	47	44	37	16	13	9	3			218	871	3·9954
36	2	4	11	10	4	7	5	—	4			47	216	4·5957
37	—	1	1	3	6	6	1	2	2	—	1	23	136	5·9130
38	1	3	3	7	2	3	2	3	1	3	—	28	149	5·3214
39	—	2	4	4	2	3	1	3	2	2	2	25	152	6·0800
40	—	2	4	1	6	1	3	3	1	2	1	24	142	5·9167
Total (36–40) ..	3	12	23	25	20	20	12	11	10	7	4	147	795	5·4082
Total (Over 40)	1	—	3	6	8	4	2	3	3	6	3	39	263	6·7436
Grand Total ..	580	517	352	198	121	60	39	26	17	13	7	1,930	5,278	2·7347

It would be expected that, if women of a particular age group are experiencing fewer pregnancies if they belong to group O than if they belong to group A, they will be underrepresented in a maternity hospital sample for those ages compared with a sample of all women. In the present series this is clearly the case. Table VI A (overleaf) records the ratio of O : A Rh-positive women in 5-year age groups. Table VI B (overleaf), based on Boorman (1950), reveals the same trend in this smaller sample. A poly-

nomial analysis by each year of age from 16–40 for women of English name in our own series indicates that the trend is significant. Under the age of 25, group O women appear in the sample in the same proportion as they do in the total sample. Between 25 and 35, group O is considerably underrepresented, and over 35 an increase in the proportion of group O takes place which compensates for the deficiency in the preceding 10-year period. Both in our own series and in Boorman's a notable feature is the

TABLE IVB
NUMBER OF PREGNANCIES EXPERIENCED BY Rh-POSITIVE GROUP A WOMEN OF ENGLISH NAME

Age	Number of Pregnancies											Total Women	Total Preg-nancies	Average Pregnancies per Woman
	1	2	3	4	5	6	7	8	9	10	10+			
Total (16 and under)	11											11	11	1.0000
17	36	3										39	42	1.0769
18	66	13	1									80	95	1.1875
19	72	44	4									120	172	1.4333
20	73	50	11	1								135	210	1.5556
Total (20 and under)	258	110	16	1								385	530	1.3766
21	51	54	26	4	—	1						136	259	1.9044
22	40	56	31	7	1	—						135	278	2.0593
23	35	54	28	12	—	1						130	281	2.1615
24	24	30	42	13	1	—	1	1				112	282	2.5179
25	25	54	27	12	3	2	—	—				123	289	2.3496
Total (21–25) ..	175	248	154	48	5	4	1	1				636	1,389	2.1840
26	10	28	26	18	7	2	—	—				91	263	2.8901
27	9	29	29	25	7	2	2	1				104	323	3.1058
28	11	20	20	12	12	5	2	3	—	1		86	297	3.4535
29	5	11	13	17	12	12	3	—	1	1		75	306	4.0800
30	1	13	14	15	16	10	4	—	1	—	1	75	319	4.2533
Total (26–30) ..	36	101	102	87	54	31	11	4	2	2	1	431	1,508	3.4988
31	4	5	13	10	11	6	4	2	1	—	—	56	237	4.2321
32	3	11	13	14	3	4	5	1	—	1	—	55	212	3.8545
33	2	7	8	10	7	4	6	1	—	1	—	46	199	4.3261
34	2	3	6	7	3	3	2	—	2	3	—	31	149	4.8065
35	5	—	5	5	7	4	3	1	—	1	1	32	149	4.6563
Total (31–35) ..	16	26	45	46	31	21	20	5	3	6	1	220	946	4.3000
36	—	4	7	4	5	5	1	2	3	2		33	170	5.1515
37	—	5	4	5	2	7	4	—	2	—	1	30	153	5.1000
38	—	—	4	6	7	2	3	2	2	—	—	26	138	5.3077
39	—	1	1	1	1	2	3	5	—	—	—	14	87	6.2143
40	—	2	4	4	3	2	1	3	1	—	1	21	110	5.2381
Total (36–40) ..	—	12	20	20	18	18	12	12	8	2	2	124	658	5.3065
Total (Over 40)	—	1	1	2	5	3	3	3	3	2	1	24	159	6.6250
Grand Total ..	485	498	338	204	113	77	47	25	16	12	5	1,820	5,190	2.8516

high ratio of O/A women for the group over 40 years of age.

A further indication of the difference in pregnancy experience in the two groups of women is to be found in the distribution of group O and A among women experiencing their first pregnancy compared with those who have experienced at least two. Both for the women of English name and for the total Perth sample there is a significant excess of group O women experiencing their first pregnancy. Table VIIA

(overleaf) gives $\chi^2 = 5.336$ ($0.02 < P < 0.05$) and $\chi^2 = 4.795$ ($0.02 < P < 0.05$) respectively.

The same discrepancy is observable in Boorman's sample, more than the total excess of group O women being found among the primiparae (Table VII B, overleaf). The difference for Boorman's sample, however, is not significant. This may be due solely to sample size, but the relatively smaller number of multiparous women in the English study

TABLE VI A
NUMBER OF Rh-POSITIVE WOMEN OF GROUP O AND GROUP A

Women		Of English Name			Total in Perth Sample		
Blood Group ..		O	A	O/A	O	A	O/A
Age Group	20 and under	405	385	1·052	452	432	1·046
	21-25	677	636	1·064	801	773	1·036
	26-30	444	431	1·030	544	526	1·034
	31-35	218	220	0·991	255	262	0·973
	36-40	147	124	1·185	177	149	1·188
	Over 40	39	24	1·625	44	29	1·517
Total All Ages ..		1,930	1,820	1·060	2,273	2,171	1·047

TABLE VI B
NUMBER OF WOMEN IN BOORMAN'S SAMPLE

Blood Group		O	A	O/A
Age Group	14-19	40	35	1·143
	20-29	487	490	0·994
	30-34	185	187	0·989
	35-39	107	114	0·939
	40-49	53	30	1·767
	Not Known	20	16	1·250
All Ages		892	872	1·023

TABLE VII A
NUMBER OF Rh-POSITIVE GROUP O AND A WOMEN EXPERIENCING THEIR FIRST PREGNANCY COMPARED WITH WOMEN EXPERIENCING SECOND PREGNANCY OR HIGHER

Women		Of English Name				In Total Perth Sample			
Pregnancy ..		First		Second or Higher		First		Second or Higher	
Blood Group ..		O	A	O	A	O	A	O	A
Age Group	20 and under	290	258	115	127	324	291	128	141
	21-25	215	175	462	461	260	228	541	545
	26-30	56	36	388	395	80	58	464	468
	31-35	15	16	203	204	24	18	231	244
	36-40	3	—	144	124	6	4	171	145
	Over 40	1	—	38	24	1	—	43	29
All Ages ..		580	485	1,350	1,335	695	599	1,578	1,572

TABLE VII B
BASED ON BOORMAN (1950)

Women		Primiparae		Multiparae	
Blood Group ..		O	A	O	A
All Ages		514	482	378	390

is undoubtedly of importance in masking any effect of birth rank.

MISCARRIAGES AND STILLBIRTHS

The information relating to the number of miscarriages and stillbirths is unreliable as far as previous pregnancies are concerned. Women are asked to record any miscarriages and stillbirths experienced previously when first attending the prenatal clinic: confusion over the nature of miscarriages and stillbirths is not uncommon, and miscarriages in particular are likely to be understated in some cases, and overstated in others. The available information for Rh-positive women of English name of the groups O and A in our sample is presented in Table VIII. The overall miscarriage and stillbirth frequency is identical for groups O and A women, and no significant difference by age can be demonstrated. If miscarriages and stillbirths are removed from the sample the number of live births

TABLE VIII
TOTAL NUMBER OF STATED MISCARRIAGES AND STILLBIRTHS EXPERIENCED BY WOMEN Rh-POSITIVE OF ENGLISH NAME

Experience		Miscarriage		Stillbirth		Miscarriage + Stillbirth	
Blood Group ..		O	A	O	A	O	A
Age Group	20 and under	21	14	10	10	31	24
	21-25	71	72	23	29	94	101
	26-30	88	102	22	26	110	128
	31-35	48	48	26	27	74	75
	36-40	44	22	16	15	60	37
	Over 40	13	9	10	5	23	14
All Ages		285	267	107	112	392	379

per woman in groups O and A follows the same distribution as that previously described for total pregnancies.

DISCUSSION

The selective loss of A children to group O mothers in the mating group O-mother : A-father demonstrated by Waterhouse and Hogben (1947), should result in an apparent reduction of the average number of pregnancies with increasing age in all group O women unless some form of compensation occurs. The present analysis of total pregnancy experience for Rh-positive women of groups O and A in a socially homogeneous maternity hospital sample suggests that at least one such compensatory mechanism may be operative.

The observed series for the difference in the average number of pregnancies with age between women of group O and group A could result from the operation of several factors:

- (a) Group O women in compatible mating groups have an innately higher fertility than group A women.
- (b) Group O women in incompatible mating groups prolong their attempts to have children, and meet with greater success above the age of 35.
- (c) Group A women also suffer from a reduction in fertility, starting at a later age than in women of group O but becoming relatively more severe by the age of 40.

These three alternatives are all capable of explaining the phenomenon. At the present time the evidence favours the hypothesis that group O women in compatible mating groups have an innately higher fertility than women of group A. In the study of Waterhouse and Hogben the average number of children in families where the mother is group O (3.38) is identical with that for families where the mother is group A (3.37). But it is much higher in O $\times$ O families (3.46) than in A $\times$ A families (3.17). The investigation of Boorman (1950) lends further indirect support to the view that group O women are innately more fertile than group A women unless married to a group A husband. Women under 20 years of age who are classed as incompatible for A-B-O groupings, *i.e.* mainly group O women, on the basis of the blood group of their last child have experienced slightly more pregnancies than women classed as compatible (1.43 as against 1.05). But the incompatible group, where the incompatible antigen is group A, suffer a marked deficiency in child-bearing above the age of 20 compared with the compatible group, the difference increasing steadily. At age of 40-49 the respective figures are 2.91 and 3.86. Finally, in the present series, group O mothers experience a higher number of pregnancies under age 19 than do group A mothers. This excess occurs before the effects of incompatibility have become apparent and probably represents a real excess on the part of group O women.

If this excess fertility of group O women in compatible matings is accepted, the following sequence of events would satisfy the observed facts.

Mothers of group O and group A occur in the total sample in the same proportions as do such women in the general population (Bryce and others, 1950).

Group O mothers show a slight initial excess in number of pregnancies experienced.

Some group O mothers belong to incompatible mating groups, the largest of these being incompatible for the A antigen (44 per cent. of all O mothers).

These women have a progressive reduction in relative fertility compared with group A women, so that, not only are there proportionately fewer women of group O in the sample between ages 25 and 35, but each of them experiences fewer pregnancies on the average. One hundred group O Rh-positive women aged 26-35 have on the average 36 children fewer than 100 group A Rh-positive women of the same age. The discrepancy would be more marked probably if incompatible group O women only were included.

Above the age of 35 women of group A tend to complete their families more quickly than the group O women in the compatible class, who continue to bear children past the age of 40 more frequently than do women of group A. In the Perth sample studied here 100 group O Rh-positive women above the age of 35 have on the average sixteen more children than 100 group A Rh-positive women of the same age.

This excess fertility of group O women in compatible mating groups could explain the replacement of O-genes lost through the selective elimination of heterozygous children in the mating group O-mother : A-father. It could not explain, however, the replacement of an equal number of A-genes lost at the same time. Further studies with larger samples to enable the accurate assessment of the contribution in other mating groups involving phenotypes B and AB may reveal the source of this replacement through the operation of a similar compensatory mechanism involving B and AB matings with women of group A. The excess of AB mothers noted by Bryce and others (1950) may play a part in this replacement.

SUMMARY

(1) Data are presented on the A-B-O and Rh blood groups, age, and pregnancy experience of women admitted to a large maternity hospital in Australia during the years 1948-51.

(2) A detailed analysis of the material relating to Rh-positive women of English name is given.

(3) Women of blood groups O and A exhibit a differential pregnancy experience with age. In the earliest age groups, group O women have had slightly more children than group A women. Between 25 and 35 years of age, however, group O women experience fewer pregnancies than those of group A, the position becoming reversed above the age 35. Orthogonal polynomials have been fitted to the differences in average number of pregnancies between women of groups O and A for each year of age from 16-40. The result shows the trend to be highly significant.

(4) The number of group O women in the sample follows the same trend, there being proportionately fewer women of group O between 25 and 35, and an excess above age 35, which is most marked above age 40.

(5) There is a significant excess of group O women who are experiencing their first pregnancy.

(6) A hypothesis is advanced which suggests that women of group O in a compatible mating group are on the average more fertile than either women of group O in an incompatible mating group or women of group A.

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REFERENCES

- Boorman, K. E. (1950). *Ann. Eugen., Camb.*, 15, 120.
 Bryce, L. M., Jakobowicz, R., McArthur, N., and Penrose, L. S. (1950). *Ibid.*, 15, 271.
 Hart, E. W. (1944). *Ibid.*, 12, 89.
 Landsteiner, K., and Wiener, A. S. (1940). *Proc. Soc. exp. Biol., N.Y.*, 43, 223.
 Levine, P. (1943). *J. Hered.*, 34, 71.
 —, Burnham, L., Katzin, E. M., and Vogel, P. (1941). *Amer. J. Obstet. Gynec.*, 42, 925.
 Race, R. R., and Sanger, R. (1950). "Blood Groups in Man." Blackwell, Oxford.
 Roberts, J. A. F. (1948). *Ann. Eugen., Camb.*, 14, 109.
 Waterhouse, J. A. H., and Hogben, L. (1947). *British Journal of Social Medicine*, 1, 1.
 Wiener, A. S. (1943). "Blood Groups and Transfusion", 3rd ed. Thomas, Springfield.