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BLOOD GROUPS AND THE AFFINITIES OF THE CANARY ISLANDERS

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Introduction

When the Spaniards invaded and with difficulty conquered the Canary Islands in the early years of the fifteenth century, they found in existence an essentially European population of which contemporary or nearly contemporary accounts remain (e.g. those of Bontier & Le Verrier (1872), writing in the first decade of the fifteenth century, and the Dominican, Espinosa (1907), writing in the latter half of the sixteenth century). From these it is clear that, while there were local cultural differences between the islands, they nonetheless formed a basically homogeneous cultural entity characterised by pastoralism, fishing, barley cultivation, stone and bone working, pottery, kingship and social stratification, cave burial: in short, a fairly advanced neolithic culture (Hooton 1925). After the conquest the Spaniards converted the surviving inhabitants to Christianity and settled and intermarried with them (Wolfel 1930), and from this mixture, it is thought, the present Canary Islanders largely derive.

The origin and affinities of the pre-conquest inhabitants, the Guanches, have been subjects of considerable discussion. A potential line of evidence of which little use has so far been made is that provided by genetic analysis of the living Canary population, a blood group study by Guasch *et al.* (1952) of a predominantly urban sample being the only one so far available. The present blood group survey in Gran Canaria was undertaken in an attempt to fill this lacuna.

Materials and methods

The blood specimens used for the present investigation were collected on the island of Gran Canaria by members of the Oxford University Women's Expedition to the Canary Islands in the summer of 1962. With the co-operation of local doctors, specimens were obtained from men, women and children, mostly in villages in the north and central parts of the island. Specimens were also obtained on special visits to the sparsely populated southern and western regions, and a few were collected at out-patient clinics at Las Palmas hospitals.

The inquiry was of a dual nature. First, for comprehensive blood grouping, 182 venepuncture specimens were taken from adult inhabitants whose grand-

parents had all been born on Gran Canaria. These specimens were collected in sterile venules, packed in ice-filled vacuum flasks, and sent by air to London for examination at the Blood Group Reference Laboratory. These specimens were tested by standard methods for the antigens A, A₁, B, M, N, S, C, C^w, c, D, D^u, E, e, P₁, K and Fy^a. Secondly, for guidance as to whether the sample taken for intensive blood group investigation was representative of the population of the island as a whole, blood specimens were obtained from a much larger number of subjects residing in different parts of the island. After elimination of close relatives, there remained a total of 1,001 individuals, which can be regarded as a satisfactory sample. These specimens were tested in the field for ABO groups, using liquid anti-sera provided by the Blood Group Reference Laboratory. A questionnaire was completed for each subject at the time of collection, recording details of place of birth, number of siblings, place of birth of spouse, relationship of spouse, and number of children. Since this work was done in the villages, where relatives could refer to each other for confirmation, it was felt that information on relationship could be taken as reliable. The villages sampled are shown on the map (Fig. 1).

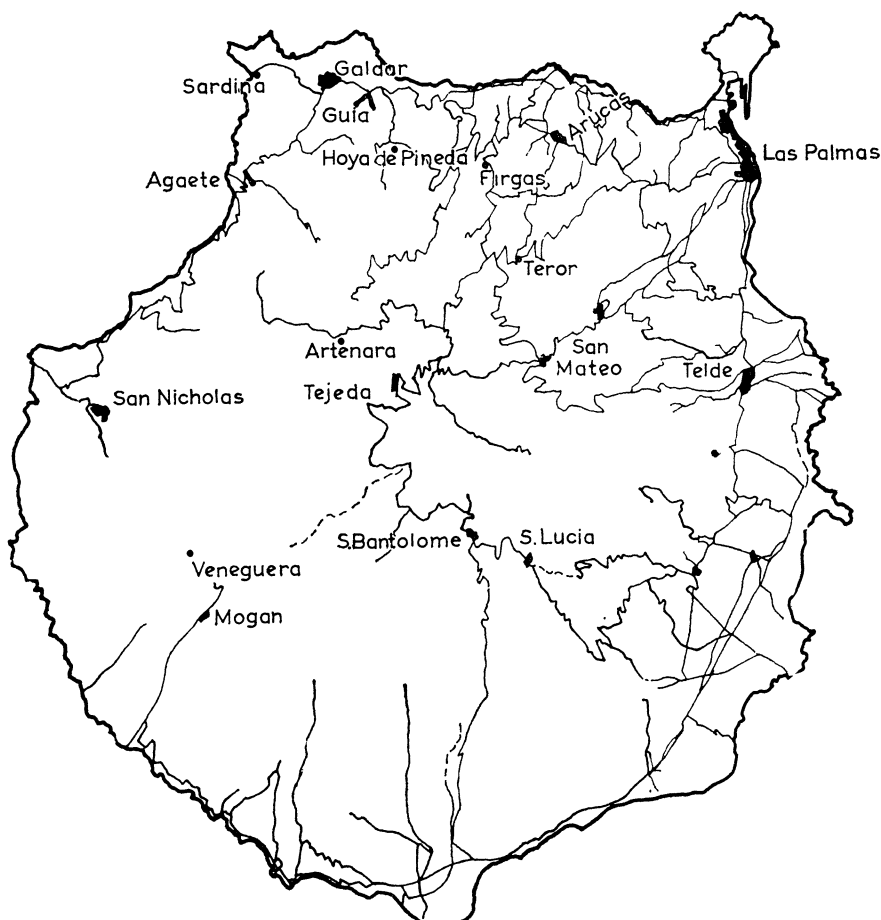


FIGURE 1. Map of Gran Canaria.

Results

1. *Comprehensive blood group survey.* The results of the tests on ABO, MN and rhesus groups for those specimens examined in London are set out in tables 1 to 3, together with the expected frequencies, the expected numbers and the frequencies of genes and gene complexes. Table 4 gives results for the P, Kell and Duffy groups. The 182 specimens which were fully tested in London gave ABO results which do not differ significantly from those for the total sample tested in the field.

TABLE 1. The A₁A₂BO blood groups of Canary Islanders.

Group	Number observed	Frequency observed	Frequency expected	Number expected
O	87	·4780	·4662	84·86
A ₁	52	·2857	·3010	54·79
A ₂	12	·0659	·0632	11·50
B	21	·1154	·1290	23·47
A ₁ B	9	·0495	·0326	5·93
A ₂ B	1	·0055	·0079	1·45
Total	182	1·0000	·9999	182·00

Gene frequencies

P ₁	..	..	..	..	..	·1837
P ₂	..	..	..	..	..	·0448
q	..	..	..	..	..	·0887
r	..	..	..	..	..	·6828
Total	..	..	..	..	..	1·0000

TABLE 2. The MNS blood groups of Canary Islanders.

Phenotype	Number observed	Frequency observed	Frequency expected	Number expected
MMS	44	·2418	·2352	42·81
MsMs	14	·0769	·0758	13·79
MNS	49	·2692	·2776	50·52
MsNs	38	·2088	·2157	39·26
NNS	8	·0440	·0421	7·67
NsNs	29	·1593	·1535	27·94
Total	182	1·0000	·9999	181·99

Frequency of gene complexes

MS	..	..	..	..	..	·2824
Ms	..	..	..	..	..	·2753
NS	..	..	..	..	..	·0505
Ns	..	..	..	..	..	·3918
Total	..	..	..	..	..	1·0000

TABLE 3. The Rh blood groups of Canary Islanders.

<i>Phenotype</i>	<i>Number Observed</i>	<i>Frequency observed</i>	<i>Frequency expected</i>	<i>Number expected</i>
CCDee	36	·1978	·1902	34·62
C ^w C ^w Dee	—	—	·0000	0·00
C ^w CDee	—	—	·0024	0·44
CCD ^u ee	—	—	·0006	0·11
CcDee	20	·1099	·1004	18·28
C ^w cDee	—	—	·0006	0·12
CcD ^u Ee	—	—	·0004	0·07
CcDeeV*	9	·0495	·0306	5·56
CcDeevv*	55	·3022	·3420	62·25
C ^w cDeeV	—	—	·0002	0·03
C ^w cDeevv	1	·0055	·0023	0·41
CcD ^u ee	3	·0165	·0162	2·95
ccDEE	3	·0165	·0132	2·41
ccD ^u EE	—	—	·0001	0·01
ccDEeV	—	—	·0081	1·47
ccDEevv	15	·0824	·0892	16·24
ccD ^u Ee	1	·0055	·0054	0·98
ccDeeV	4	·0220	·0299	5·44
ccDeevv	13	·0714	·0564	10·27
ccD ^u ee	1	·0055	·0051	0·92
ccddee	21	·1154	·1067	19·41
Total	182	1·0001	1·0000	181·99

* V is an antigen produced jointly by the genes *c* and *e^s* when present together on one chromosome. It is convenient to express the presence of V by adding that letter to the phenotype symbol, and its absence, in relevant types, by *vv*.

Frequencies of gene complexes

CDe	..	..	..	..	..	·4125
C ^w De	..	..	..	..	..	·0027
CD ^u e	..	..	..	..	..	·0243
cDE	..	..	..	..	..	·1073
cD ^u E	..	..	..	..	..	·0081
cDeV(cDe ^s)	..	..	..	..	..	·0350
cDe	..	..	..	..	..	·0758
cD ^u e	..	..	..	..	..	·0077
cde	..	..	..	..	..	·3266
						1·0000

TABLE 4. Sundry blood groups of Canary Islanders.

<i>Group</i>	<i>Number observed</i>	<i>Frequency observed</i>	<i>Gene</i>	<i>Frequency</i>
P ₁ +	120	·6593	P ₁	·4163
P ₁ —	62	·3407	P ₂	·5837
K+	15	·0824	K	·0421
K—	167	·9176	k	·9579
Fy(a+)	91	·5000	Fy ^a	·2929
Fy(a—)	91	·5000	Fy ^b + Fy	·7071

2. *Local ABO survey.* The results of the field tests are set out in Table 5 by villages or localities of residence, together with the number of subjects and the total population in each, from which it is apparent that the total sample represents about 1 in 275 of the population of the areas sampled, or about 1 in 125 when urban Las Palmas is excluded.

TABLE 5. Canary Islands. Local ABO blood group results.

Region	Village	No. A	No. B	No. AB	No. O	A O+A	No. of subjects	Total population
North	Agaete	45	13	3	43	·511	104	4,366
	Galder	42	13	4	49	·462	108	13,704
	Guia	11	5	4	29	·275	49	11,851
	Sardina							
	Hoya de Pineda							
	Arucas	67	15	2	97	·409	181	25,010
	Firgas	19	1	1	22	·463	43	4,934
	San Mateo	58	12	2	41	·586	113	8,327
	Teror	4	3	1	15	·211	23	
	Las Palmas	11	5	2	27	·290	45	
West Centre	Telde	13	2	0	9	·591	24	153,262
	San Nicolas	27	5	3	21	·563	56	23,780
	Artenara	8	2	0	18	·308	28	5,440
	Tejeda	15	6	5	36	·294	62	1,890
	Mogan	12	5	1	25	·324	43	3,632
	Veneguera	12	5	1	9	·571	27	3,749
	Santa Lucia	10	7	1	19	·345	37	
	San Bartolome	26	3	2	27	·491	58	
								7,020
								8,809

The results were analysed for heterogeneity by χ^2 testing, pooling groups B and AB, and incorporating the four smallest samples (Artenara, Teror, Veneguera and Telde) with those from localities immediately adjacent to them (Tejeda, San Mateo, Mogan and Las Palmas respectively). Differences between the villages just failed to reach significance at the 5% level (χ^2 32.9, 22 degrees of freedom). The villages were then grouped (Table 6) according to the five regions used by Fuste (1959a). Again no significant differences appeared between the regions (χ^2 = 10.6, 8 degrees of freedom), although again it is the villages in the centre of the island that make the greatest contribution to χ^2 . This analysis suggests that for the ABO blood groups at least, the population of the island may be regarded as fairly homogeneous. The gene frequencies for the whole are p .2350, q .0702, r .6947.

However, a number of studies (e.g. Roberts, J. A. F., 1953) have shown the usefulness of the ratio $\frac{A}{O+A}$ for detecting local variation in gene frequency at the ABO locus in populations such as these, with a consistently low frequency of B and AB. The value of $\frac{A}{O+A}$ is that most of the variance in western Europe is concentrated on this ratio: B and AB are rare and vary little in frequency. Hence, if one eliminates these, one retains most of the variance but reduces the degrees of freedom and so shows up variations concealed by dilution with the constant B and AB. Rather different results emerge from an analysis of this ratio in the Canary

Island data. Comparison of all 16 village samples demonstrated a highly significant heterogeneity ($\chi^2 = 39.6$, 15 degrees of freedom, $p < .001$). First, this heterogeneity is partly due to differences between the five regions. When adjacent pairs of regions are compared, the central region is shown to be significantly different from the north ($\chi^2 = 5.61$, 1 degree of freedom, $p < .02$), and also from the west ($\chi^2 = 7.51$, 1 degree of freedom, $p < .01$). Differences between other pairs are not significant. Secondly, the total heterogeneity is partly due to differences between villages within the northern region ($\chi^2 = 24.8$, 8 degrees of freedom, $p < .01$), particularly San Mateo where there is an appreciable excess of A, and Guia, Teror and Las Palmas, where there is an excess of O; there are no differences between villages in the other regions, but of course very few were covered.

TABLE 6. Results by regions.

	A	B	AB	O	No. of subjects
North	270	69	19	332	690
Centre	23	8	5	54	90
South-west	24	10	2	34	70
South-east	36	10	3	46	95
West	27	5	3	21	56
Total	380	102	32	487	1,001

Gene frequencies

p	..	..	..	..	..	.2350
q	..	..	..	..	..	.0702
r	..	..	..	..	..	.6947

*The affinities of the Canary Islanders*1. *Earlier views*

Evidence of the affinities of the Guanches is of two main types, cultural and somatological. Some early writers (Glas 1764; Bertholot 1841; 1845) were impressed by the strong Berber affinities of the language, others (Bute 1891; Markham 1907) by its Aryan analogies. Abercromby's (1917) analysis indicated that Berber and, less markedly, Arabic words were present at appreciable frequencies, that the majority of words were definitely non-Berber, and that there were in the language sounds not proper to any existing Berber dialect. Subsequent work has confirmed the linguistic links with north Africa (Wolfel 1955). Wiener pointed out some link with west African Mande languages (Hooton 1925: 19). Hooton's (1925) analysis of culture traits suggested to him, if to nobody else, successive settlement by a pastoral, stone-chipping folk from Africa south of Morocco; a pottery-making, barley-cultivating people who came from Libya and Tunisia via the Atlas region and Morocco; a war-like aristocracy from the Atlas ranges of Morocco and Algeria; a wheat-cultivating, perhaps stone-polishing group with elaborate ceramic forms decorated in colour and using pottery stamps, coming from the central Mediterranean, again via north Africa; and finally casual Arabs, Berbers, and groups of early navigators! But certainly in material culture, relationship to the Mediterranean Neolithic, to north Africa and to western Europe is beyond doubt

(Marcy 1938; Diego Cuscoy 1954; Martinez Santa-Olalla 1947; Wolfel 1950). In brief, then, cultural evidence suggests influences from a variety of sources.

Biological evidence is chiefly limited to typological anthropometric and descriptive data. In the latter part of the last century, following Quatrefages & Hamy (1882), Verneau (1887) remarked on a certain resemblance between some Guanche remains and those from the palaeolithic Cromagnon people (tall stature, dolichocephalic crania, short broad faces, low orbits and narrow noses), and in this he was supported by Meyer (1896), von Luschan (1896), Shruballsall (1896), von Behr (1908), and Kalkhof (1914); it seemed that the Guanches might have been a relic of the Cromagnon population. Sergi was of the opinion that many of the Guanche crania were similar to those found in south European and north African populations, and felt that the ancient Canary population was derived from north Africa; this view was maintained by Arambourg *et al.* (1934), Vallois (1951), Briggs (1955), and Balout (1955). Falkenburger (1939) thought that some crania looked negroid, though neither Fuste (1959*b*) nor Schwidetsky (1956; 1963) could find any appreciable negro influence. Of greater reliability than the early typographical studies are the metrical. Lajard (1892) indicated that in 4 out of 8 cranial indices the means of the modern Canary population were closer to Cromagnon measurements than are the means of the Guanches. The Cromagnon hypothesis was disposed of by Hooton's (1925) definitive metrical analysis of Guanche crania. He showed, from a large number of cranial measurements and indices, that the greatest similarity undoubtedly lay with the early historic populations of north-west Europe rather than with the western Mediterranean populations; within the former there were appreciable differences of the Guanche series from the ancient germanic groups (Franks, Burgundians and Alamanni) but there was a surprising resemblance of the Guanches to seventeenth century Londoners: 'there is very little more difference between the Guanches and the two series [Moorfields and Whitechapel] of 17th century Londoners . . . than between the two groups of approximately contemporaneous inhabitants of London' (Hooton 1925: 189). Moreover, in most of these measurements and indices he showed that the Tenerife crania were *less* variable than the London series, thereby going far to discredit the hypothesis of heterogeneity that the typologists had claimed. In the cranial data, also, he demonstrated differences both from the modern Canary Islanders and, very clearly, from the Cromagnon series. In stature he showed that among ancient populations the male Guanches were most similar to Romano-British, Franks and Romano-Gauls. Hooton did not put all these findings into words, though they are quite clear from his tables. He, after the fashion of the time, went on to attempt a typological analysis and, distracted perhaps by this and by the cultural evidence, failed to draw the obvious conclusion that the affinities of the Guanches lay primarily with north-west Europe. The most recent metrical study of new cranial material, that by Schwidetsky (1963), suggests that the Guanches were somewhat similar to, but smaller than, a sample of a north African mesolithic population, but unfortunately no comparisons were made with other groups.

The existing evidence from characters with a strong genetic basis is meagre. The blood group data of Guasch *et al.* (1952) on a sample of the present population are what would be expected for a European population with some African admixture, and in particular a cDe frequency higher and cde lower than is usual in

European groups. The ABO blood groups in the soft tissue remains of 370 individuals studied by Schwarzfischer (quoted in Schwidetsky 1963) showed a very high O frequency (249 out of the 272 subjects in which it was possible to obtain a satisfactory determination) which, if it is not due to technical or sampling difficulties, suggests affinity with the high O-frequency peoples of the periphery of Europe, with very little influence from west Africa. Fuste & Pons (1961) studied in 267 inhabitants of rural villages in north, central and south Gran Canaria, those dermatoglyphic characters which make the clearest distinction between European and negroid populations; in 4 of the 5 characters examined the Gran Canaria frequencies fell distinctly in the European cluster and away from the negro frequencies, and in the remaining character the island frequency also lay clearly among the European values, but in the part of the range which overlaps the African values. These results again suggest that negro influence in Gran Canaria is slight, and are supported by recent analysis of haptoglobin types (Fuste 1965).

2. *The present blood group evidence*

The present blood group evidence further clarifies the matter, for comparison is possible with gene frequencies of populations in those areas from which some influence has been postulated. The A_1A_2BO results, showing a high frequency of O and low A and B, are similar to those for a number of peripheral populations in western Europe, such as the Scots, the Irish and the Icelanders. The present inhabitants of Spain and Portugal, on the other hand (apart from the Basques), have a considerably higher A frequency. The B gene frequency is somewhat high in the specimens tested in London but this is probably due to a slight sampling error, since that found for the specimens tested on the island is quite typical of western Europe. The moderately high A_2 frequency is compatible with this statement, but would not of itself eliminate the possibility of a substantial negroid component. The A_1A_2BO results would also, taken by themselves, be consistent with a close relationship to the Berbers.

The MNS results show an M gene frequency near 56 per cent., which is a typical European value. The high frequency of the MS complex is typically European. Berbers tend to have an M frequency below 50 per cent.: sometimes considerably below. West African Negroes tend to have less M and considerably less MS than this population.

The Rh results are essentially those of a European population. This is shown especially by the relatively high frequency of cde, though this is somewhat below the values (about 40 per cent.) found in most of Europe north of the Mediterranean area. There is some doubt as to the range of variation of cde frequency which a full survey of Berbers would show. Negroes certainly have a much lower frequency. The most important of the other frequencies are those of cDe and cDe^s. The total of these, about 11 per cent., is about one fifth of that to be found in most west African negro peoples, and considerably above that observed in north-western Europe; it suggests a detectable negroid component in these Canary Islanders. So, too, do the values found for e^s, cDe^s and V considered alone.

The K result is typically European. The relatively low frequency of P_1 is essentially European, not negro, but the low value found for Fy^a does suggest negro affinities. However, the low frequencies found for Fy^a and for P_1 may

possibly be an artefact due to the age of the specimens when tested, which would tend to give rise to false negative observations for the antigens concerned.

Taken together, the results suggest a population essentially European in the frequencies of the blood group genes and gene complexes, though with some African influence. Within Europe affinities with the north-west are on the whole most suggestive. Such an interpretation, of course, implies that the gene frequencies are unmodified by any process except intermixture. It is possible, however, as suggested by Mourant (1954), that gene frequencies for the ABO system may be more labile than for the other systems. If appreciable change in ABO frequencies took place after the population became isolated, then the MNS and Rh results, taken alone, would fit rather a central to east Mediterranean population.

This simple comparison of the blood groups, considered alone and individually, does not suffice to fix at all precisely the main place or places of origin in Europe of the Canary Islanders, though it does indicate the preponderance of the European contribution to their ancestry and the presence of a detectable African contribution. If fuller information were available on the frequency of other blood group genes in Europe and on the frequency of e^s (and of cDe^s) in west Africans, it would be possible to be more precise.

3. *Estimates of genetic contributions of parental populations*

It is possible, however, to improve this estimate of the relative European and African contributions to the gene pool of the present Canary Islanders by simultaneous consideration of all the relevant blood group gene frequencies. This can be done by a quantitative method (Roberts & Hiorns 1962) applicable when the gene frequencies in ancestral populations and in the hybrids deriving from them are known. Suppose that the present Canary population results from intermixture of four ancestral populations, as the discussion above suggests, from north-west Europe, Iberia, north Africa and west Africa. Suppose further that these ancestral populations were similar in gene frequency to the present-day English, Spanish, Berber and west African negro populations respectively, for which the gene frequencies set out in Table 7 may be taken as representative. Those for the English are as given by Race & Sanger (1964); for the Spanish Rh and ABO the several samples quoted in Mourant (1954) are pooled, and the MNS data are from Agosti Romero *et al.* (1950) and the K from Elosegui & Hors (1951); for the Berber the frequencies observed in the remote Ait Haddidu (Johnson *et al.* 1963) are regarded as more representative of the ancestral contributor than those in the less isolated north African populations; for the west African are used the pooled frequencies employed by Roberts & Hiorns (1962). The Fy^a and P_I frequencies have not been included in this analysis. On these assumptions, in the present Canary gene pool, the north-west European component contributes 75.1%, the Iberian component 0.3%, the north African contribution is 18.3% and the west African contribution is 6.3%. The frequencies expected in the Canary Islanders on this basis are shown in Table 7, where they are seen to agree closely with those observed.

This result is surprising in the slowness of the Spanish contribution it indicates. It suggests that the original Spanish conquerors, though dominant socially and culturally, may have contributed very little biologically. One wonders whether most of the Spaniards who settled and intermarried, if indeed there were more than

TABLE 7. Gene frequencies used in the calculation of admixture in Canary Islanders.

	R^1	R^2	R^0	r	M_s	N_s	p	r	K
England	·421	·141	·026	·389	·283	·390	·279	·660	·046
Spain	·472	·110	·040	·351	·309	·389	·315	·631	·053
Berber	·420	·080	·234	·217	·188	·527	·065	·891	·038
W. Africa	·069	·086	·551	·211	·383	·493	·150	·690	·009
Canary Is. (observed)	·415	·107	·111	·334	·275	·392	·229	·683	·042
Canary Is. (expected)	·399	·126	·097	·346	·272	·422	·232	·704	·042

a small minority of these, subsequently returned to Spain taking their hybrid offspring with them. This is perhaps supported by the fact that by the late seventeenth century the terms 'Guanche' and 'Canario' were only applied to bonded or enslaved landworkers and nobody wished to be known as belonging to these groups (Wolfel 1930: 301). This situation is hardly likely to have been tolerated had there been a strong Spanish upper caste. The result of course may be an artefact: discrimination between Iberian and north-west European contributions is weakened by the general similarity of their gene frequencies; the results are too heavily biased by the Rh concentration, and in fact the 9 'genes' used in the calculations refer to only 4 clearly independent chromosomal positions. The underlying assumptions may not be valid, particularly those stating that the sole process modifying gene frequency is intermixture, that the gene frequencies used in the calculations were the ancestral frequencies, or that there were 4 ancestral contributing populations as specified. Again, one could have assumed that there was no contribution from north-west Europe, with hybridisation thus between only 3 populations, Iberian, north African and west African, in which case their respective contributions to the present Canary Islanders would have been 71·9%, 22·1% and 6·0%; but this is shown to be unjustified by the 4-population results. As regards the extent of the contribution of north-west Europeans, there has, of course, been no massive immigration by these since the Spanish conquest, except for the modern tourist influx! Hence this component must have been present in the pre-Spanish gene pool and its strength supports and is supported by the results of Hooton's (1925) metrical analysis of Guanche remains. The size of the contributions from north Africa and west Africa is not unexpected; the latter is compatible with Fuste's (1959*a*; *b*; 1965) doubt as to any major negroid influence.

Local differences

The existence of some local differences among the pre-conquest inhabitants of the Canaries seems well established. Besides the inter-insular cultural differences tabulated by Hooton it seems that there may have been some more local variation within islands, for Nunez de la Pina (Verneau 1879), writing at the time of the conquest, noted that the language differed between districts of the larger islands. Biological differences between islands are indicated by several typological studies; those (e.g. Falkenburger 1939) based on measurements by a single observer, with types representing arbitrary divisions in continuous distribution curves, indicate some shift in the position of the distributions; at a more acceptable level, Hooton

showed statistically significant differences in a number of cranial measurements between the islands of Gomera, Tenerife and Gran Canaria; while Schwidetzky's (1963) metric and typological analysis demonstrated significant differences between islands and between regions within the larger islands. For the present-day population Fischer (1930) was unable to find any difference in mean stature between the inhabitants of Gran Canaria, Tenerife and Palma, whereas Sanchez & Schwidetzky (1958) indicated differences in the frequency of light eyes between Lanzarote on the one hand, and Fuerteventura and Gran Canaria on the other.

Of the intensive studies within any one island, Sanchez & Schwidetzky (1958) analysed hair and eye colour in 7,578 children at schools in Gran Canaria. The data were reported by schoolteachers using verbal description and so are not as reliable as could perhaps be desired. However, they showed significant differences between the different parts of the island, with the lowest frequency of light hair and eyes in the west and the highest in the north. They also showed appreciable differences within each region, and particularly between children from the 'urban' part of each locality and those from the more outlying area. A wider investigation was that of Fuste (1959a) who examined 355 adult males from Gran Canaria which he divided into five regions; he was able to show highly significant differences in eye colour, stature and cephalic index, the north being characterised by the highest frequency of light eyes, the west by its greatest stature, the south-west by its smallest stature, greatest cephalic index and greatest frequency of dark eye colour, and the centre by the lowest frequency of light eyes and the lowest cephalic index; there were no significant differences in skin colour, but the north again had the highest frequency of fair skin. He discussed briefly the possibility that these differences represented the outcome of drift and of selection, but he himself felt that these differences more probably represented the survival of different 'racial elements' in the different regions.

The present ABO data, though they do not fully support these differences, do not altogether disagree with them. Admittedly, the ABO coverage of the sparsely populated centre, west and south-west, is not as extensive as could be hoped, so that the most that can be said is that, if there are any regional differences, then it seems likely to be the central region (incidentally, the least accessible) that is primarily responsible. However, the ABO data do bring to light a point that is not shown by Fuste's analysis, though it is suggested in that of Sanchez & Schwidetzky and may be partly responsible for the regional differences, namely, that there may be appreciable variation from locality to locality within the region. This would perhaps be expected in a situation where there is little mobility of population, where small communities are highly endogamous, and where isolate size is small.

To determine whether these conditions hold for the population of Gran Canaria, where communications at least until recently were not easy and where the agricultural communities are closely linked to locality, further information of a demographic nature was collected. For a number of marriages in each sample area, information was obtained on the number of cases in which both spouses were born in the village of residence, in which one was, and in which neither was. These data, grouped to improve sample size, are set out in Table 8, together with the admixture rate in the generation investigated (i.e. the proportion of genes from some other

village entering the locality). These rates, though of course not as high as in other highly mobile societies such as Britain or the United States, appear to be quite high, though it is not clear from the data how much gene flow emanates from immediately adjacent localities; they seem to preclude appreciable drifting of local gene frequencies, if the village population is indeed the breeding unit.

TABLE 8. Numbers of local marriages.

Area	Total no. of marriages	Present generation				Admixture rate
		Male indigenous female indigenous	Male not indigenous female indigenous	Male indigenous female not indigenous	Male not indigenous female not indigenous	
Agaete	37	31	2	2	2	·108
Galdar	42	31	5	3	3	·167
Guia etc.	21	7	—	1	13	·643
San Nicolas	8	5	—	3	—	·188
Artenara	32	20	8	—	4	·25
Tejeda						
Arucas etc.	78	35	14	15	14	·365
Mogan	19	8	1	8	2	·342
Santa Lucia						
San Bartolome	27	22	2	2	1	·111
San Mateo	35	14	6	10	5	·371
Teror						

The latter assumption may be examined by referring to the frequency of first-cousin marriages, given in Table 9 by locality for the present generation and the previous one. (All four types of first cousin marriages are included in the tables.) Though again the small sample size for the present generation suggests caution,

TABLE 9. Canary Islands. Numbers of first cousin marriages.

Area	Total no. of marriages	Present generation		Total no. of marriages	Past generation	
		No. of cousin marriages	Cousin marriages as % of total		No. of cousin marriages	Cousin marriages as % of total
Agaete	40	3	7·5	104	5	4·8
Galdar	43	4	9·4	108	2	1·9
Guia, etc.	21	3	14·3	49	4	8·1
San Nicolas	8	2	25·0	56	13	23·2
Artenara	37	9	24·3	90	9	10·0
Tejeda						
Arucas, etc.	118	11	9·3	22	16	7·2
Las Palmas	29	2	7·0	69	2	2·9
Telde	31	8	25·8	70	9	12·8
Mogan						
Santa Lucia	30	5	16·6	95	16	16·8
San Bartolome						
San Mateo	42	3	7·1	136	6	4·5
Teror						
Total	399	50	12·5	998	82	8·2
both generations	1397	132	9·44			

such marriages are strikingly frequent, particularly in the areas other than the north. Now, a frequency of 24%, such as is approximated by San Nicolas (both generations) and the central and south-western villages in the present generation, would mean an isolate size of about 50 (applying the simple Dahlberg model and not its more sophisticated successors proposed by Barrai *et al.* (1962) and Hajnal (1963)) in the case of a surviving family size of three; the frequency for the whole island indicates isolate sizes of about 125. In view of the weakness of the Dahlberg model, weight should be attached not so much to the actual arithmetical values, as to the broad result which the observations so clearly demonstrate: namely that the size of the breeding population is much less than the demographic village size, particularly in the more remote regions. In the latter it may be so low that the observed admixture rate is not in fact sufficient to prevent appreciable drift. The present findings cannot, of course, exclude the possibility that the observed local variation represents the survival of heterogeneity within the early population of the island. But they do show that drift, as remarked in Weninger's (1964) discussion of the inhabitants of Hierro island, is at least a possible cause for part of it.

Summary

The frequencies of ABO, MNS, Rhesus, P, Kell, and Duffy blood groups in random samples of the inhabitants of Gran Canaria are presented, and employed in a discussion of their genetic affinities with those other populations which earlier cultural and biological studies suggest may have contributed to the present gene pool of the Canary Islanders. The respective contributions are calculated, and it appears that the preponderant genetic contribution comes from north-west Europe. Local genetic differences are indicated within Gran Canaria, and data on marriage patterns and the frequency of first cousin marriages show that drift cannot be excluded as a possible contributory cause of these.

NOTE

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