The Physical Anthropology of the Vikings

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THE VIKING EXPEDITIONS constitute the last of those migrations of peoples within Europe which reached any considerable magnitude and which might be expected to have had a significant effect on the present racial composition of many European countries. The Vikings, furthermore, settled in Iceland, a country until then uninhabited. Because it is of some importance for the study of anthropology in these countries to know as much as possible about the physical characters of the Vikings, I have tried to gather all the available anthropological information relating to them and have laid particular stress on obtaining measurements of, or measuring myself, skulls associated with Viking grave-finds. These data, together with the measurements of some related series of skulls, I have assembled in Table I.

The measurements of the Norwegian Iron Age series are taken from Schreiner (1946). They are based on ninety-two skulls, of which twenty-four date from the Migration Period, nine from the Merovingian Era, and fifty-nine from the Viking Period. Thus only two-thirds of these skulls date from the Viking Period, but as they do not differ appreciably from the rest I have not thought it necessary to give separate means for them. It may be stated, however, that the cranial index of thirty-six Viking Period skulls is 73·5 and that of nineteen Migration Period and Merovingian Era skulls 72·9. Nearly all the Danish Iron Age skulls belong to the Migration Period, and the measurements of those in Table I are also taken from Schreiner (1946). The Danish Viking Age skulls, which number twenty-four, were measured by the late K. Fischer-Möller, and I have calculated their means from his unpublished individual measurements. I have, moreover, remeasured eleven of them with substantially the same results as Fischer-Möller's, although we disagree about the sex of one skull, Rantzausminde V, which I believe to be that of a male. The measurements of the Swedish Iron Age skulls are again those of Schreiner (1946), but I have calculated the means for the Swedish skulls of the 10th to the 13th century from Backmann's (1911) measurements of eleven skulls from Visby and Hjortsjö & Krakau's (1944) measurements of eight skulls from Lund. The Icelandic skulls I have measured myself. Some of their measurements have already been published (Steffensen 1943), and subsequently several more have been added to the Viking Age and 11th- and 12th-century series. The Viking Age series has been enlarged by new finds and the 11th- and 12th-century series by skulls whose reconstruction had not been completed when the earlier measurements were published. The measurements of Viking skulls found in the British Isles are gathered from various sources. Four were measured by Turner (1915), two of them coming from Sutherland and the Outer Hebrides (Harris), respectively, and two from the Orkneys. For one of the last, however, I have used only the facial measurements, as those of the brain-case are unreliable. Two skulls of 12th-century Orcadian saints, Earl Magnus and Earl Rögnvald, were measured by Reid (1926), and two Irish skulls by myself. One of these comes from Island Bridge, Dublin, but is so poorly reconstructed

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TABLE I. *Mean Measurements of Male and Fem*

Character†	♂ Norwegian Iron Age	Danish Iron Age	Danish Viking Age	Swedish Iron Age	Swedish 10th–13th Century	Icelanc Viking Age
Glabello-occipital length, L = M.1	190·8 (55)	190·8 (41)	188·3 (12)	188·5 (15)	189·8 (13)	186·2 (18)
Maximum horizontal breadth, B = M.8	139·6 (55)	137·8 (41)	140·0 (12)	140·4 (15)	141·0 (13)	141·8 (14)
Minimum frontal breadth, B' = M.9	96·7 (50)	95·8 (36)	98·2 (12)	98·3 (15)	96·4 (13)	97·7 (19)
Basi-bregmatic height, H' = M.17 ‡	134·6 (49)	133·3 (27)	133·7 (9)	[136·9 (15)]	131·8 (12)	130·5 (14)
Auriculo-bregmatic height, βOH=M.20 ‡	115·2 (53)	—	111·6 (11)	[115·8 (9)]	114·0 (6)	111·3 (13)
Facial height, GH = M.47 §	117·8 (28)	116·3 (19)	113·0 (6)	118·0 (7)	119·0 (5)	120·7 (9)
Upper facial height, $G'H$ = M.48	71·0 (32)	69·5 (28)	68·3 (8)	69·5 (11)	69·8 (13)	72·6 (12)
Bizygomatic breadth, J = M.45	135·9 (27)	127·3 (28)	131·7 (9)	132·2 (12)	130·8 (13)	133·8 (8)
Bimaxillary breadth, GB = M.46‖	94·7 (33)	95·6 (29)	94·9 (8)	94·1 (11)	95·2 (6)	95·3 (13)
Nasal height, NH' = M.55	51·1 (35)	51·3 (28)	49·6 (8)	51·2 (10)	52·8 (13)	51·5 (12)
Nasal breadth, NB = M.54	24·1 (30)	24·1 (27)	22·8 (8)	24·1 (10)	23·8 (13)	23·9 (10)
Orbital breadth, O_1(L) = M.51 ¶	42·8 (36)	40·4 (29)	39·8 (8)	39·3 (12)	42·0 (6)	41·9 (13)
Orbital breadth, O_1'(L) = M.51*a* ¶	40·4 (30)	—	37·9 (6)	—	39·3 (7)	40·5 (13)
Orbital height, O_2(L) = M.52	33·8 (38)	33·0 (29)	31·0 (8)	32·2 (12)	34·1 (13)	34·1 (12)
$(L+B+H')/3$	{155·0 (49)}	{154·0 (27)}	152·9 (9)	{[155·3 (15)]}	154·3 (12)	153·0 (12)
$(G'H+J)/2$	{103·5 (27)}	{98·4 (28)}	99·6 (8)	{100·9 (11)}	100·3 (13)	102·9 (8)
100 B/L	73·5 (55)	72·3 (41)	74·4 (12)	74·6 (15)	74·3 (13)	76·1 (14)
100 B'/B	69·2 (50)	69·0 (35)	70·2 (12)	70·0 (15)	68·4 (13)	70·1 (13)
100 H'/L	70·9 (49)	70·5 (27)	71·6 (9)	{[72·6 (15)]}	69·7 (12)	70·4 (14)
100 H'/B	96·9 (49)	98·2 (27)	96·9 (9)	{[97·5 (15)]}	93·1 (12)	91·8 (12)
100 J/B	97·6 (25)	92·7 (27)	94·3 (8)	94·5 (12)	92·8 (13)	94·1 (6)
100 B'/J	70·8 (25)	74·9 (28)	75·0 (8)	75·2 (12)	73·7 (13)	75·3 (6)
100 GH/J	87·1 (18)	91·5 (18)	87·9 (6)	88·9 (7)	92·5 (5)	89·7 (7)
100 $G'H/J$	52·8 (23)	55·4 (22)	52·7 (8)	52·5 (11)	53·4 (13)	53·9 (8)
100 $G'H/GB$	75·7 (28)	{72·7 (28)}	72·1 (8)	{73·9 (11)}	74·4 (6)	75·6 (9)
100 NB/NH'	96·8 (30)	46·9 (26)	45·9 (8)	47·1 (10)	45·2 (13)	46·5 (9)
100 O_2/O_1(L)	79·2 (35)	81·2 (29)	78·1 (8)	82·0 (12)	79·8 (6)	31·9 (12)
100 O_2/O_1'(L)	83·6 (27)	—	81·6 (6)	—	88·1 (7)	84·9 (12)
Pro. $P\angle$	84·7°(32)	—	81·5° (4)	84·7° (6)	84·8°(13)	83·7°(10)

*In the columns of figures parentheses (round brackets) denote sample sizes, crotchets (square bra
their component dimensions.

†The italicized symbols are those customary in craniometric papers in *Biometrika,* and most of
(Kollman, Ranke & Virchow 1883, p. 6). The equivalent measurements in the scheme of Rudolf M

‡Means of the Swedish Iron Age series were compiled by Schreiner (1946) from the individual m
the basi-apical, H = M.18, and the auriculo-apical, OH = M.21. The unpublished equations H -
Dr J. C. Trevor from weighted mean and individual differences between these characters for series c
London (Morant 1931), Hythe, Kent (Stoessiger & Morant 1932), and Norwegian Iron Age (Schreine
amounts are rather less than the mean difference $H - H'$ = 1·0 mm. for the male Farringdon Street

§βOH, GH, and 100 GH/J are for skulls from Lund only.

‖GB and 100 $G'H/GB$ are for skulls from Lund only.

¶O_1(L) and 100 O_2/O_1(L) are for skulls from Lund only, and O_1'(L) and 100 O_2/O_1'(L) are for s

*…nd Female Viking and Related Series of Skulls**

			♀						
Icelandic		British Isles	Norwegian	Danish		Swedish		Icelandic	
…king Age	11th–12th Century	Vikings (pooled)	Iron Age	Iron Age	Viking Age	Iron Age	10th–13th Century	Viking Age	11th–12th Century
·2 (18)	188·9 (20)	187·8 (6)	179·5 (36)	183·4 (36)	181·8 (12)	180·3 (14)	179·0 (6)	180·7 (18)	179·0 (17)
·8 (14)	140·9 (20)	144·4 (6)	134·4 (30)	133·8 (36)	135·6 (12)	131·9 (14)	130·8 (6)	136·7 (15)	135·2 (15)
·7 (19)	94·4 (21)	99·1 (4)	93·3 (29)	93·6 (29)	94·6 (11)	93·1 (14)	93·0 (6)	92·5 (17)	93·0 (17)
·5 (14)	131·2 (19)	127·7 (6)	126·4 (22)	131·4 (16)	128·0 (12)	[130·6 (13)]	123·2 (6)	125·4 (17)	124·9 (16)
·3 (13)	111·3 (17)	—	109·3 (29)	—	108·4 (11)	[110·9 (5)]	110·0 (2)	106·9 (13)	108·8 (15)
·7 (9)	115·7 (15)	—	109·5 (17)	112·9 (18)	105·3 (3)	117·0 (3)	112·0 (2)	111·6 (8)	111·4 (12)
·6 (12)	71·6 (15)	73·6 (4)	66·2 (17)	66·7 (22)	65·3 (8)	65·2 (10)	64·8 (6)	67·1 (12)	69·3 (13)
·8 (8)	133·7 (18)	135·0 (2)	124·4 (11)	120·7 (20)	122·9 (8)	124·6 (10)	121·0 (6)	128·1 (9)	125·4 (12)
·3 (13)	92·0 (19)	95·5 (2)	88·7 (15)	91·7 (22)	91·2 (5)	89·9 (10)	88·0 (1)	88·4 (9)	87·9 (13)
·5 (12)	51·9 (19)	53·3 (3)	48·2 (18)	49·5 (21)	47·4 (8)	48·0 (10)	48·0 (1)	49·2 (12)	50·0 (13)
·9 (10)	23·6 (19)	23·6 (3)	22·6 (16)	22·6 (20)	23·1 (8)	23·7 (10)	22·7 (6)	23·7 (8)	23·1 (11)
·9 (13)	42·2 (16)	42·5 (2)	40·8 (19)	40·0 (22)	39·4 (8)	39·2 (11)	39·5 (2)	40·3 (11)	41·1 (13)
·5 (13)	40·3 (16)	40·1 (4)	38·4 (15)	—	38·9 (4)	—	37·0 (4)	38·5 (11)	39·3 (11)
·1 (12)	34·5 (16)	33·8 (5)	33·4 (20)	33·8 (22)	32·5 (8)	32·6 (11)	32·2 (6)	32·9 (11)	34·5 (11)
·0 (12)	153·8 (18)	153·3 (6)	{146·8 (22)}	{149·5 (16)}	148·5 (12)	{[147·6 (13)]}	144·3 (6)	147·3 (12)	145·6 (13)
9 (8)	103·0 (14)	103·8 (2)	{95·3 (11)}	{93·7 (20)}	94·1 (8)	{94·9 (10)}	92·9 (6)	97·7 (8)	97·4 (10)
·1 (14)	74·6 (20)	76·9 (6)	74·9 (30)	72·9 (36)	74·6 (12)	73·2 (14)	73·1 (6)	75·6 (14)	75·6 (14)
·1 (13)	67·0 (19)	66·7 (3)	69·5 (27)	70·1 (29)	69·9 (11)	70·6 (14)	71·2 (6)	67·9 (11)	69·1 (14)
·4 (14)	69·2 (18)	68·0 (6)	70·9 (21)	72·1 (16)	70·5 (12)	{[72·4 (13)]}	69·4 (6)	69·0 (15)	69·6 (15)
8 (12)	92·6 (18)	88·5 (6)	94·3 (20)	99·2 (16)	94·7 (12)	{[99·0 (13)]}	94·2 (6)	91·2 (13)	92·5 (14)
·1 (6)	94·3 (16)	95·5 (2)	93·3 (11)	90·7 (20)	89·9 (7)	95·4 (10)	92·5 (6)	92·7 (7)	92·1 (10)
3 (6)	70·8 (17)	72·9 (2)	75·0 (11)	77·6 (20)	77·1 (8)	74·5 (9)	76·9 (6)	73·4 (7)	75·1 (11)
7 (7)	86·8 (14)	—	88·0 (10)	92·9 (17)	88·4 (3)	89·3 (2)	92·2 (2)	87·9 (7)	90·0 (10)
9 (8)	53·8 (14)	53·8 (2)	53·1 (10)	55·4 (18)	53·2 (8)	51·7 (9)	53·6 (6)	52·7 (8)	55·2 (11)
6 (9)	78·3 (15)	75·9 (2)	74·3 (13)	{72·7 (22)}	72·8 (5)	{72·4 (10)}	78·4 (1)	77·6 (8)	78·5 (12)
5 (9)	45·0 (14)	44·1 (3)	47·2 (16)	45·9 (22)	48·8 (8)	48·6 (10)	47·4 (6)	47·9 (8)	46·6 (11)
9 (12)	81·8 (16)	83·5 (2)	81·2 (19)	84·4 (22)	82·7 (8)	83·6 (11)	84·7 (2)	81·6 (11)	83·9 (9)
9 (12)	85·7 (16)	81·6 (4)	87·9 (13)	—	84·9 (4)	—	85·3 (4)	85·5 (11)	87·8 (11)
7°(10)	85·3°(13)	—	84·5°(11)	—	84·3° (8)	83·5° (4)	80·8° (6)	83·9° (9)	84·4°(10)

…quare brackets) reconstructed values, and braces (curly brackets) indices calculated from the means of

… most of them originally appeared in the published version of the 1882 *Frankfurter Verständigung*
…Rudolf Martin (1928) are denoted by the letter M. followed by that author's reference number.
…ividual measurements of Retzius (1899) and of Fürst (1905), both of whom took as cranial heights
…ions $H - H'$ or $OH - \beta OH = 0{\cdot}6$ mm. ♂ (*c.* 150–300) and 0·7 mm. ♀ (40–165), determined by
…r series of western European skulls, viz. Farringdon Street, London (Hooke 1926), Spitalfields,
…(Schreiner 1946), have been used to reconstruct H' and βOH for the Swedish Iron Age crania. These
…don Street and two series of Slovenian and Etruscan skulls found by Morant (1928, p. 362).

…are for skulls from Visby only.

that only two measurements, the minimum frontal breadth, *B′*, and the upper facial height, *G′H*, are usable. The second comes from Larne, Co. Antrim, and had previously been measured by Martin (1935), together with five others which he also considered to be the skulls of Norsemen. But as none of the five is associated with any Viking grave-goods their origin must be regarded as uncertain, and I have not included them in my British Isles series.

A glance at the means in Table I shows that the Iron Age inhabitants of Scandinavia and Denmark were dolichocranial. This applies to all the series and to both sexes. These people were also on the whole orthocranial, the only exception being the Swedish skulls from the 10th to the 13th centuries which lie between the limits of orthocrany and chamaecrany. The breadth-height index, 100 H'/B, however, is less consistent. The skulls from the early Iron Age – the Danish Iron Age series – and those the majority of which date from the same time – the Swedish Iron Age series – are acrocranial or nearly so, but the series of which most or all of the skulls belong to the Viking Age are metriocranial. This appears with particular clearness in the Danish and Swedish skulls of both sexes, but it also applies to the Norwegian male series, for if we calculate the respective mean breadth-height indices for the early Iron Age and the Viking Age skulls of that series we get 98·5 (16) for the first and 96·1 (33) for the second. On the other hand, both the Norwegian female means are metriocranial, having breadth-height indices of 93·9 (10) for the early Iron Age and 94·6 (10) for the Viking Age. Fürst (1935) considered the combination of dolichocrany, orthocrany, and acrocrany to typify the Viking skull, but this is more characteristic of the early Iron Age skulls of Scandinavia and Denmark than of the Viking skull proper, which seems to correspond more to a dolicho-ortho-metriocranial type. The general decrease in height, which is so noticeable when Norwegian Iron Age are compared with medieval (Schreiner 1939) skulls, seems to have begun in the Viking Period. During the Iron Age, however, the skull size appears to have been much the same in all three northern countries. Here it may be objected that the cranial module, $(L+B+H')/3$, of the Danish male skulls is somewhat smaller than that of the Norwegian, but against this argument it can be pointed out that the Danish female skulls have a larger module than the rest. The facial dimensions of the Scandinavian and the Danish skulls are rather more variable than those of the brain-case, although such a fact could be partly due to the small number of measurements on which some of the means are based. The Norwegian skulls have a considerably larger face than the Danish and Swedish skulls, but as both the Norwegian bizygomatic breadth, *J*, and upper facial height, *G′H*, are greater than the Danish and Swedish, the values of the upper facial index, 100 $G'H/J$, are very similar for all three peoples. The only exception which does not seem to be merely accidental is the upper facial index of the Danish Iron Age skulls, which, because of their small bizygomatic breadth, is considerably higher than that of the other series. This feature is not found in the Danish Viking Age skulls. As far as we can tell from the Scandinavian and Danish cranial material of the Viking Period, then, the Vikings of all three countries showed a close correspondence in type and belonged to the same race.

The Icelandic male skulls of the Viking Period are meso-ortho-tapeinocranial and the female skulls meso-chamae-tapeinocranial. They thus differ materially from the Scandinavian and Danish skulls of the same period. A comparison of the Icelandic Viking Age and the Norwegian Iron Age skulls shows marked differences in glabello-occipital length, *L*, basi-bregmatic, *H′*, and auriculo-bregmatic, βOH, height, cranial index, and breadth-height index in the case of the males. The Icelandic and Norwegian skulls do not differ to any great degree in their facial characters, but a high value of the upper facial module, $(G'H+J)/2$, is characteristic of both in contrast to the Danish and Swedish skulls. The Icelandic skulls of 11th- and 12th-century date resemble the Norwegian Iron Age series more than the Icelandic Viking Age skulls do, although in the main

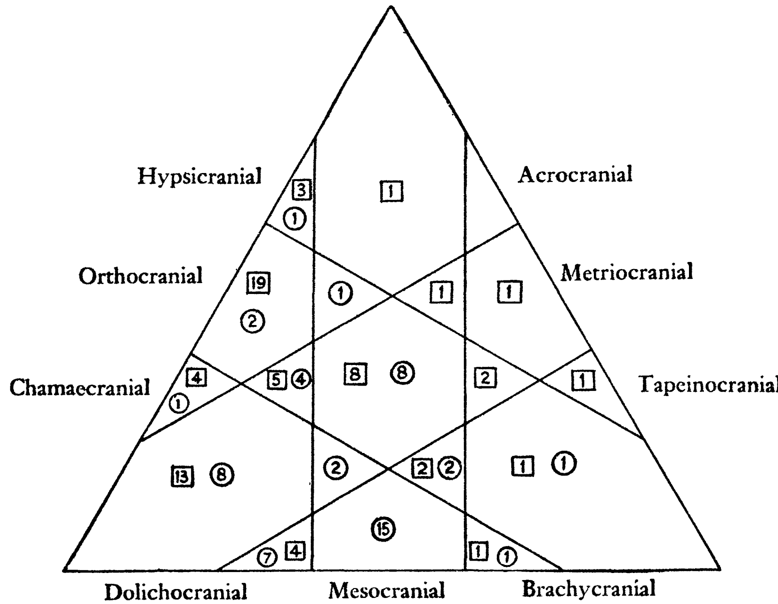

FIGURE 1. Tres Indices diagram (♂ and ♀ values combined) of 66 Norwegian Iron Age skulls □ and 53 Icelandic Viking Age and 11th–12th-century skulls ○.

the differences are of the same order. Between all the Icelandic skulls, male and female, of both periods, and the Iron Age Norwegians the clearest distinction is brought out by combining the three principal indices of the brain-case, the 'Tres Indices' of Fürst (1935), as has been done in Fig. 1. Of the Norwegian Iron Age skulls, nineteen out of sixty-six, or 29% – the largest percentage for any single series – are dolicho-ortho-acrocranial, whereas, of the Icelandic skulls, only two out of fifty-three, or 4%, belong to this group. By far the most common combination in the Icelandic skulls is meso-chamae-tapeinocrany, which occurs in 28% of them but not in any Norwegian skulls. If we look at the mesocranial and brachycranial groups separately, we see that a third of the Norwegian skulls in them occur in combinations which are not found among the Icelandic skulls, and that two-thirds of the Icelandic skulls occur in combinations not found among the Norwegian skulls. Such a result does not support another possible view that the Icelandic Vikings were originally selected from a group of the Norwegian Vikings which had relatively broad heads.

This comparison between the Norwegian and the Icelandic Vikings shows clearly that we are dealing with two distinct groups, to which I shall refer as the Eastern and the Western Vikings, respectively. The home of the Eastern Vikings is Scandinavia and Denmark, and they seem to represent in almost pure form the early Iron Age stock of these countries, which many authorities describe as the 'Nordic race'. The Icelandic Vikings, however, are of the Western group, to which, as the means in Table I suggest, the Viking skulls found in the British Isles also belong. The last fact becomes even more evident when the skulls are classified on the basis of 'Tres Indices', since, of the half-dozen for which these are determinable, one is dolicho-ortho-metriocranial and the remaining five are meso-chamae-tapeinocranial. The conclusion that the Norwegian and the Icelandic Vikings represent two different stocks is very surprising when we consider it in the light of historical records. According to the *Landnámabók* or *Book of Settlement*, the present form of which dates from the 13th century, 84% of those who settled in Iceland came from Norway, about 3% from Sweden, and rather less than 13% from the British Isles (Hannesson 1925). Since the *Landnámabók* includes at most 5% of all the settlers, these

TABLE II. *Constants of Male and Female Icelandic Skulls*

Absolute Measurements					
Character†	Means and Standard Errors		Standard Deviations		Ch
	♂	♀	♂	♀	
Glabello-occipital length, *L* = M.1	186·7 ± 0·73 (58)	179·2 ± 0·77 (49)	5·55	5·39	(*L*+*B*
Maximum horizontal breadth, *B* = M.8	141·8 ± 0·68 (52)	136·1 ± 0·86 (44)	4·87	5·72	(*GH*+
Minimum frontal breadth, *B′* = M.9	95·8 ± 0·66 (44)	93·2 ± 0·62 (44)	4·41	4·12	(*G′H*+
Maximum bimastoid breadth, *M′* = M.13(1)	127·2 ± 0·91 (38)	121·4 ± 0·90 (39)	5·64	5·61	100 *B*
Basi-bregmatic height, *H′* = M.17	131·2 ± 0·67 (51)	125·5 ± 0·59 (49)	4·77	4·10	100 *B′*
Auriculo-bregmatic height, *βOH* = M.20	111·3 ± 0·56 (45)	108·2 ± 0·69 (44)	3·77	4·56	100 *H*
Frontal chord, S_1' = M.29	111·1 ± 0·68 (48)	107·7 ± 0·72 (46)	4·72	4·90	100 *H′*
Parietal chord, S_2' = M.30	114·5 ± 0·67 (47)	108·5 ± 0·73 (48)	4·61	5·09	100 2*H*
Occipital chord, S_3' = M.31	95·7 ± 0·79 (47)	94·2 ± 0·72 (44)	5·39	4·78	100 S_1'
Frontal arc, S_1 = M.26	126·6 ± 0·80 (52)	122·7 ± 0·92 (46)	5·75	6·26	100 S_2'
Parietal arc, S_2 = M.27	126·8 ± 0·83 (50)	119·2 ± 0·92 (49)	5·84	6·71	100 S_3
Occipital arc, S_3 = M.28	119·5 ± 0·90 (50)	115·7 ± 1·06 (45)	6·34	7·10	*Oc. I.*
Sagittal arc, *S* = M.25	373·4 ± 1·83 (44)	358·1 ± 1·95 (43)	12·52	12·78	100 S_1
Transverse bregmatic arc, *βQ′* = M.24	307·1 ± 1·17 (33)	297·8 ± 2·22 (33)	6·74	12·76	100 S_2
Glabello-horizontal perimeter, Gla. *U* = M.23	525·8 ± 2·06 (33)	507·4 ± 2·74 (34)	11·81	15·98	100 S_3
Chord, endobasion–opisthion, *FL′* = M.7	36·7 ± 0·40 (45)	35·8 ± 0·34 (41)	2·71	2·20	100 *FL*
Foraminal breadth, *FB* = M.16	31·6 ± 0·26 (46)	30·0 ± 0·38 (40)	1·74	2·41	100 *G*
Basi-nasal length, *LB* = M.5	100·0 ± 0·79 (37)	96·6 ± 0·65 (41)	4·83	4·16	100 *J*/
Chord, endobasion–prosthion, *GL′* = M.40	95·5 ± 0·78 (29)	92·0 ± 0·87 (30)	4·20	4·76	100 *B′*
Facial height, *GH* = M.47	122·4 ± 1·83 (23)	112·3 ± 1·72 (23)	8·78	8·26	100 *G*
Upper facial height, *G′H* = M.48	73·4 ± 0·88 (30)	67·5 ± 0·83 (31)	4·84	4·61	100 *G′*
Bizygomatic breadth, *J* = M.45	135·0 ± 1·28 (22)	127·6 ± 0·75 (23)	6·00	3·58	100 *N*
Nasal height, *NH′* = M.55	52·7 ± 0·58 (32)	49·5 ± 0·52 (31)	3·26	2·92	100 *O*
Nasal breadth, *NB* = M.54	23·7 ± 0·29 (32)	23·3 ± 0·38 (26)	1·62	1·92	100 *P*
Orbital breadth, O_1(L) = M.51	42·9 ± 0·33 (29)	42·0 ± 0·40 (26)	1·76	2·05	Pro.
Orbital height, O_2(L) = M.52	35·5 ± 0·34 (29)	34·4 ± 0·43 (25)	1·83	2·15	Alv.
Palato-maxillary length, *PL′* = M.60	53·0 ± 0·44 (36)	51·4 ± 0·54 (27)	2·66	2·82	*N*∠
Palato-maxillary breadth, *PB* = M.61	62·1 ± 0·52 (39)	60·7 ± 0·58 (26)	3·24	2·95	*A*∠
Bicondylar breadth, W_1 = M.65	122·2 ± 1·26 (27)	116·2 ± 1·23 (26)	6·56	6·25	*B*∠

*The standard deviations are *sample* values and not estimates of the *population s*'s.

†[The following biometric symbols, currently used in the Duckworth Laboratory at Cambridge, are innovations: *M*
and is greater than *M* = M.13 taken between von Török's mastoidalia; *FL′* = M.7, which is less than the foramin
which is greater than the basi-alveolar length *GL* taken from the basion to the alveolare (alveolar point) and not e
greater than *PL* (or Palato-max. *L*) taken from Wilder's 'alveolon' to the alveolare instead of the prosthion. The pa
into craniometry under slightly different names by Flower (1881, p. 161), the conventional divisions of the resultant ind
ever, it has been assumed by various American and Continental anthropologists that both Turner and Flower used
Flower's contradictory definitions of the alveolare has been fully discussed by Karl Pearson (1925), but the regrettab
the prosthion with the alveolare – and, it might be added, the endobasion with the basion – persists. The barbarism
of *PL* and *PL′*, was used fifteen years earlier by Fürst (1905, p. 377) for the alveolare! On the subject of palatal measu
tration of the position of the endomolaria in Fig. 25 of Wilder (1920, p. 44). – ED.]

‡The modules and most of the indices are self-explanatory. The Pearsonian occipital index, *Oc.I.*, is defined to b
table computed by Tildesley (1921, p. 261–2). Pro.*P*∠ = M.72 is the profile angle between the standard horizontal (F
the profile angle between the same plane and the upper facial height. *N*∠, *A*∠, and *B*∠ are the biometric
GL (*not GL′*), *LB*, and *G′H*.

s of Male and Female Icelandic Skulls of the Period 900–1550*

			Modules, Indices, and Angles				
rrors	Standard Deviations		Character‡	Means and Standard Errors		Standard Deviations	
♀	♂	♀		♂	♀	♂	♀
0·77 (49)	5·55	5·39	$(L+B+H')/3$	153·3 ± 0·59 (32)	147·4 ± 0·72 (33)	3·36	4·12
0·86 (44)	4·87	5·72	$(GH+J)/2$	129·3 ± 1·78 (16)	119·5 ± 1·13 (18)	7·13	4·78
0·62 (44)	4·41	4·12	$(G'H+J)/2$	104·3 ± 1·10 (18)	97·2 ± 0·61 (21)	4·65	2·80
0·90 (39)	5·64	5·61	100 B/L	76·0 ± 0·53 (51)	76·1 ± 0·38 (41)	3·44	2·45
0·59 (49)	4·77	4·10	100 B'/B	68·0 ± 0·52 (33)	68·4 ± 0·51 (35)	2·98	2·99
0·69 (44)	3·77	4·56	100 H'/L	70·1 ± 0·50 (36)	70·0 ± 0·41 (37)	2·98	2·52
0·72 (46)	4·72	4·90	100 H'/B	91·9 ± 0·82 (33)	91·6 ± 0·67 (35)	4·73	3·95
0·73 (48)	4·61	5·09	100 $2H'/(L+B)$	79·5 ± 0·62 (32)	79·4 ± 0·48 (33)	3·53	2·74
0·72 (44)	5·39	4·78	100 S_1'/S_1	87·7 ± 0·25 (48)	87·9 ± 0·25 (45)	1·72	1·68
0·92 (46)	5·75	6·26	100 S_2'/S_2	90·3 ± 0·21 (47)	90·9 ± 0·16 (48)	1·44	1·11
0·92 (49)	5·84	6·71	100 S_3'/S_3	80·2 ± 0·46 (47)	81·3 ± 0·36 (44)	3·10	2·37
1·06 (45)	6·34	7·10	*Oc. I.*	57·6 ± 0·34 (47)	58·4 ± 0·31 (44)	2·31	2·03
1·95 (43)	12·52	12·78	100 S_1/S	34·0 ± 0·18 (44)	34·4 ± 0·19 (42)	1·20	1·26
2·22 (33)	6·74	12·76	100 S_2/S	34·1 ± 0·19 (44)	33·3 ± 0·23 (42)	1·27	1·51
2·74 (34)	11·81	15·98	100 S_3/S	31·9 ± 0·18 (44)	32·4 ± 0·27 (41)	1·19	1·71
0·34 (41)	2·71	2·20	100 FB/FL'	86·3 ± 0·86 (45)	83·9 ± 0·91 (40)	5·80	5·78
0·38 (40)	1·74	2·41	100 GL'/LB	95·3 ± 0·67 (27)	95·2 ± 0·72 (30)	3·50	3·93
0·65 (41)	4·83	4·16	100 J/B	93·9 ± 0·76 (19)	92·4 ± 0·72 (22)	3·31	3·39
0·87 (30)	4·20	4·76	100 B'/J	71·9 ± 0·84 (19)	74·4 ± 0·68 (22)	3·67	3·21
1·72 (23)	8·78	8·26	100 GH/J	90·8 ± 1·41 (16)	88·3 ± 1·61 (18)	5·65	6.81
0·83 (31)	4·84	4·61	100 $G'H/J$	54·7 ± 0·68 (18)	52·9 ± 0·84 (21)	2·89	3·86
0·75 (23)	6·00	3·58	100 NB/NH'	45·2 ± 0·70 (29)	47·3 ± 0·86 (25)	3·76	4·32
0·52 (31)	3·26	2·92	100 O_2/O_1(L)	82·7 ± 0·88 (29)	81·9 ± 0·99 (27)	4·74	5·14
0·38 (26)	1·62	1·92	100 PB/PL'	118·2 ± 1·27 (33)	118·4 ± 1·52 (25)	7·27	7·62
0·40 (26)	1·76	2·05	Pro. $P\angle$	84·2° ± 0·46 (37)	83·3° ± 0·63 (28)	2·81°	3·35°
0·43 (25)	1·83	2·15	Alv. $P\angle$	86·1° ± 0·47 (38)	86·1° ± 0·69 (33)	2·87°	3·98°
0·54 (27)	2·66	2·82	$N\angle$	62·8° ± 0·47 (38)	63·6° ± 0·72 (33)	2·88°	4·12°
0·58 (26)	3·24	2·95	$A\angle$	73·0° ± 0·61 (38)	73·8° ± 0·57 (33)	3·76°	3·27°
1·23 (26)	6·56	6·25	$B\angle$	44·2° ± 0·53 (38)	42·6° ± 0·55 (33)	3·26°	3·18°

population s's.

Laboratory at Cambridge, are innovations: M' = M.13(1), which is the *grösste Zitzenbreite* of von Török 1890, p. 171) ; FL' = M.7, which is less than the foraminal length FL (or *fml*) taken from the basion to the opisthion; GL' = M.40, n to the alveolare (alveolar point) and not equivalent to it, as stated by Stewart (1942, p. 17); PL' = M.60, which is ie alveolare instead of the prosthion. The palato-maxillary length and breadth (PB or Palato-max. B) were introduced the conventional divisions of the resultant index being due to Turner (1884, p. 7), who measured to the alveolare. How-ɔologists that both Turner and Flower used the prosthion as their anterior terminal. The confusion engendered by ed by Karl Pearson (1925), but the regrettable practice, apparently started by von Török (1890, p. 151), of equating ion with the basion – persists. The barbarism 'alveolon', which Wilder (1920, p. 42) proposed for the posterior terminal he alveolare! On the subject of palatal measurements, a caveat should be entered against following the erroneous illus- 44). – ED.]

rsonian occipital index, *Oc.I.*, is defined to be 100 $S_3/S_3' \sqrt{\{S_3/24(S_3 - S_3')\}}$, and its values have been found from the ofile angle between the standard horizontal (Frankfurt or ear–eye) plane and the chord, nasion–prosthion; and Alv.$P\angle$ ht. $N\angle$, $A\angle$, and $B\angle$ are the biometric nasal, alveolar, and basal angles, i.e. those subtended respectively by figures must be accepted with caution. On the other hand, it is principally members of the ruling class who are mentioned in it, and as both the Norwegian and the Icelandic Viking bones are certainly in the main those of chieftains the percentages quoted have a greater significance for the comparison of the available Viking skulls than for the actual national composition of the settlers as a whole. At the same time, I believe there is little doubt that the Icelandic Viking skulls give a very nearly correct picture of the Icelanders of the Viking Period, for about ninety medieval and later Icelandic skulls yield the same means as those of the Vikings and, furthermore, the cephalic index of the present-day Icelanders, 78·1, after the deduction of the usual two units, corresponds exactly to the cranial index of the Vikings, 76·1, both figures being for males. The head shape of the Icelanders, then, seems to have remained unchanged since the Viking period.

The remarkable unity of the Scandinavian and Danish skulls might suggest that they give a true representation of the Vikings of these countries in general. Yet several things indicate that this is not so. By far the greatest part of the Norwegian skulls come from northern Norway and only two of them from western Norway, that portion of the country which furnished about half the Norwegian settlers of Iceland. The most obvious inference, therefore, would be that the Vikings of western Norway belonged to the same type as the Icelandic Vikings and that it was primarily the Vikings of northern Norway who belonged to the Eastern Viking group. I doubt, however, whether the Norwegian Iron Age skulls give a correct picture of the inhabitants of northern Norway at that time. In the first place, the medieval skulls from St Olav's churchyard in Tronheim (Schreiner 1939) have an entirely different shape from the Iron Age skulls. Most of the Tronheim skulls date from about 1300 to 1500, and as they number over two hundred they should give a tolerably accurate portrayal of the inhabitants of Tronheim during the two centuries in question. But the history of Norway tells of no immigration in the course of the period 1000–1300 that could explain the change in head shape of the population. In the second place, about 20% of the Norwegian Vikings who settled in Iceland came from northern Norway, so it must be considered unlikely that the Western type of Vikings did not occur there as well. Now, the Icelandic Viking skulls and the Tronheim medieval skulls are similar in form, although the first are somewhat larger than the second. I thus think that it is reasonable to conclude that the Western Viking type was also common in northern Norway during the Iron Age and, later, probably throughout the country, as far as we can tell from the medieval skulls investigated by Schreiner.

We have here a problem that still waits to be solved. Why do nearly all the Iron Age skulls belong to the Eastern Viking type when the Western type predominates in the oldest Christian graveyards? It could, of course, be said that the Iron Age people were invaders who formed a ruling class with its own conspicuously separate culture, but this would not remove the difficulty concerning the Western Vikings in Norway. Icelandic grave-finds represent in all their essentials the same culture as do those in Norway, and, moreover, the Icelandic Vikings were descended from the Norwegian ruling class. One conclusion might perhaps justifiably be drawn from this study of Viking skulls, namely that King Harold Fairhair's struggle for power in Norway was more than a contest between individual chieftains for supremacy in that country, it was also a struggle between two different groups of people, the Eastern and the Western Vikings. The last were defeated and many of them went into exile. Such a supposition could to a certain extent explain why the remains of so few Vikings of the Western type have been found in Norway. As to the origin of the Western Vikings, two possibilities exist. They may be the old inhabitants of Scandinavia, probably more or less mixed with later Iron Age invaders. Or they may be the result of admixture between the Eastern Vikings and the inhabitants of the British Isles. I consider the alternative possibility the more feasible, in the first place because of the similarity in shape between the Western Viking skulls on the one hand and the British Iron Age skulls as represented by Morant's (1926) combined English and Scottish series and the Early Christian Irish skulls from Gallen Priory, Co. Offaly, in central Eire (Howells 1941) on the other; in the second place because most of the Viking skulls found in the British Isles belong to the Western group; and, finally, because so few skulls of the Western Viking type occur in the Norwegian Iron Age series.

Plausible as both these conjectures are, further investigation of new skeletal finds, especially of the Iron Age, is needed before we can reach a final opinion about them. A preliminary analysis, which may cast some light on the problem, can nevertheless be undertaken at the present stage of our knowledge. This involves comparisons between a combined Icelandic series, large enough for statistical treatment and based on those skulls of a date earlier than the middle of the 16th century which were at my disposal in 1946, and the Gallen Priory series, concerning which Howells (1937, p. 22) remarks: 'there is no historical reason for not equating it with the Irish Iron Age'. I have not included Morant's English and Scottish Iron Age skulls because no constants of variation were furnished for them and because in a later joint publication by him his Iron Age and Romano-British material is described, perhaps over-modestly, as 'very inadequate' (Goodman & Morant 1940, p. 310). The means and standard deviations of both male and female Icelandic skulls are given in Table II, and it will be seen that the sexual differences between the principal dimensions of the brain-case, *L, B, H'*, and *βOH*, are of the same order as those usual for samples drawn from homogeneous populations. The sexing, therefore, is unlikely to be in serious error. Although the skulls are derived from many scattered localities in Iceland and cover a long period of the country's history, from 900 to 1550, their variability, as measured by the standard deviation appears to be quite low. The legitimate use of the standard deviation or of some constant derived from it, such as its square the variance, for the purpose in view depends on whether the distributions of anthropometric characters in the population sampled are approximately normal in form. Within the past twenty years this problem has been investigated from various aspects, for example, in the case of a set of fifty special measurements on single cranial bones of a series of some eight hundred male Egyptian skulls from Giza (Elderton & Woo 1932), in that of anthropological measurements in general (Morant 1939, pp. 81–97), in that of twelve characters measured on a number of homogeneous series of living Indians, ranging in size from about fifty to two hundred (Malahanobis, Majumdar & Rao 1949, pp. 124–31, and in that of from two to six characters measured on eight series of interracial hybrids, each composed of more than seventy-five individuals, from different parts of the world (Trevor 1953, pp. 42–3). In brief, the results of these studies show that statistical methods dependent upon assumptions of normality may be used with confidence in routine anthropometric work.[1] To compare the

[1]It is perhaps necessary to stress the word 'routine' since the situation can apparently be otherwise for certain measurements of single bones: 'We are accordingly forced to the important conclusion that the distributions of characters measured on the individual bones of the skull are not of normal type, but rather that the skewness and kurtosis of such distributions are peculiar to the individual measurement' (Elderton & Woo 1932, p. 53). Apropos of such a finding, however, another authority remarks: 'This is a point of considerable theoretical interest though all the departures from normality were in fact slight. The conclusion that the population distributions almost invariably bear a close similarity to the form of the normal curve in the case of all kinds of measurements appears to be sufficiently exact for almost all practical purposes' (Morant 1939, p. 89). Finally: 'Although there exists some evidence of departures from normality in symmetry, kurtosis and linearity of regressions . . . it must be emphasized that the deviations from normality are almost always small in actual magnitude. It is justifiable, therefore, for practical purposes, to use tests and measures based on the normal theory' (Malalanobis, Majumdar & Rao 1949, p. 138); and 'It is shown . . . that the best data available suggest that such distributions are almost invariably described in an adequate way by the symmetrical and unimodal normal curve (any clear departures from this form being quite exceptional). . . .' (Trevor 1953, p.33).

TABLE III. *Differences between Variabilities of Male Irish, Icelandic, and Norwegian S*

Character	Mean Variance	Reciprocal of Mean Variance	Sample Variance, s^2, Number o			
			Irish			
			s^2	v	u	s^2
Glabello-occipital length, L = M.1	37·09 [26]	0·0270	36·60	116	0·99	30·80
Maximum horizontal breadth, B = M.8	25·30 [26]	0·0395	24·40	112	0·96	23·72
Minimum frontal breadth, B' = M.9	18·66 [24]	0·0536	19·36	119	1·04	19·45
Basi-bregmatic height, H' = M.17	26·21 [20]	0·0382	25·60	102	0·98	22·75
Auriculo-bregmatic height, βOH = M.20†	17·98 [15]	0·0556	16·16	65	0·90	14·21
Sagittal arc, S = M.25	161·54 [24]	0·0062	160·02	105	0·99	156·75
Transverse bregmatic arc, $\beta Q'$ = M.24	100·40 [12]	0·0100	85·38	103	0·85	45·43
Glabello-horizontal perimeter, Gla.U=M.23‡	199·94 [24]	0·0050	200·51	107	1·00	139·48
Basi-nasal length, LB = M.5	17·81 [22]	0·0561	19·62	90	1·10	23·33
Chord, endobasion–prosthion, GL'=M.40§	23·81 [19]	0·0420	30·47	54	1·28	17·64
Upper facial height, $G'H$ = M.48	18·32 [23]	0·0546	16·40	70	0·90	23·43
Bizygomatic breadth, J = M.45	26·01 [22]	0·0384	21·81	57	0·84	36·00
Nasal height, NH' = M.55‖	9·18 [16]	0·1089	11·97	77	1·30	10·63
Nasal breadth, NB = M.54	3·28 [25]	0·3049	3·10	76	0·95	2·62
Orbital breadth, O_1(L) = M.51 ¶	3·31 [10]	0·3021	3·35	65	1·01	3·10
Orbital height, O_2(L) = M.52 ¶	4·04 [12]	0·2475	4·62	69	1·14	3·35
Palato-maxillary length, PL' = M.60	8·58 [8]	0·1166	6·20	68	0·72	7·08
Palato-maxillary breadth, PB = M.61	10·18 [7]	0·0982	9·30	49	0·91	10·50
100 B/L	10·37 [23]	0·0964	9·67	110	0·93	11·83
100 H'/L	9·30 [19]	0·1075	9·00	101	0·97	8·88
100 H'/B	21·25 [7]	0·0471	23·33	99	1·10	22·37
100 $G'H/J$	10·89 [8]	0·0918	12·46	91	1·14	8·35
100 NB/NH'	20·16 [15]	0·0496	16·56	68	0·82	14·14
100 PB/PL'	43·69 [7]	0·0229	32·95	48	0·75	52·85

* The number of series on which each mean variance is based is shown in crotchets (square brackets). Values of the v ability level.

† In place of βOH the value of the mean variance is for the auriculo-apical height, OH=M. 21, i.e. from the biporial sample variance is for the maximum auricular height, Max. OH, i.e. from the biporial axis to the vertex (see Howells 1

‡In place of Gla. U the value of the mean variance and of the Irish sample variance are for the ophryo-horizontal p supraglabellare rather than through the ophryon.

§In place of GL' the values of the mean variance are for the basi-alveolar length, GL<M.40. In a personal communica character measured on his Norwegian Iron Age skulls was as stated in this table, i.e. GL' and not GL (cf. the individual I and II of Schreiner 1927 and 1946, respectively).

‖ In place of NH' and 100 NB/NH' the values of the Irish sample variance are for those based on the mean of the Fra narialia instead of the nasopinale (see Howells 1941, p. 141).

¶ In place of O_1(L) and O_2(L) the values of the mean variances are for the right orbital breadth from the dacryon, O_1'(R and in place of O_1(L) the value of the Irish sample variance is for the left orbital breadth from the dacryon O_1'(L) = M.51

ities of Male Irish, Icelandic, and Norwegian Skulls Expressed as Variance Ratios*

Sample Variance, s^2, Number of Degrees of Freedom, v, and Variance Ratio, u								
Irish			Icelandic			Norwegian		
s^2	v	u	s^2	v	u	s^2	v	u
36·60	116	0·99	30·80	57	0·83	59·13	54	*1·60*
24·40	112	0·96	23·72	51	0·94	27·56	54	1·09
19·36	119	1·04	19·45	43	1·04	26·63	49	1·43
25·60	102	0·98	22·75	50	0·87	26·52	48	1·01
16·16	65	0·90	14·21	44	0·79	11·56	52	*0·64*
160·02	105	0·99	156·75	43	0·97	246·80	50	1·53
85·38	103	0·85	45·43	32	*0·45*	90·82	48	0·91
200·51	107	1·00	139·48	32	0·70	245·86	49	1·23
19·62	90	1·10	23·33	36	1·31	18·15	46	1·02
30·47	54	1·28	17·64	28	0·74	24·80	31	1·04
16·40	70	0·90	23·43	29	1·28	22·18	31	1·21
21·81	57	0·84	36·00	21	1·38	39·94	26	1·53
11·97	77	1·30	10·63	31	1·16	11·02	34	1·20
3·10	76	0·95	2·62	31	0·77	3·72	29	1·13
3·35	65	1·01	3·10	28	0·94	2·37	35	0·72
4·62	69	1·14	3·35	28	0·83	6·45	37	*1·60*
6·20	68	0·72	7·08	35	0·83	13·84	29	1·61
9·30	49	0·91	10·50	38	1·03	6·76	31	0·66
9·67	110	0·93	11·83	50	1·14	14·59	54	1·41
9·00	101	0·97	8·88	35	0·95	9·86	48	1·06
23·33	99	1·10	22·37	32	1·05	29·48	48	1·39
12·46	91	1·14	8·35	17	0·77	15·92	22	1·46
16·56	68	0·82	14·14	31	0·75	14·44	29	0·72
32·95	48	0·75	52·85	32	1·21	54·17	27	1·24

s shown in crotchets (square brackets). Values of the variance ratio, u, in *italics* are statistically significant at the 5% prob-

culo-apical height, OH = M. 21, i.e. from the biporial axis to the point vertically above it; and the value of the Irish
.e. from the biporial axis to the vertex (see Howells 1941, p. 137*n*.).

: Irish sample variance are for the ophryo-horizontal perimeter, U = M.23*a*, which is now commonly taken through the

-alveolar length, GL < M.40. In a personal communication (December 1946) Professor Schreiner kindly confirmed that the
in this table, i.e. GL' and not GL (cf. the individual measurements for the same skulls in Table 149 and in Appendices

le variance are for those based on the mean of the Frankfurt nasal heights, NH(L) and NH(R), i.e. from the nasion to the

re for the right orbital breadth from the dacryon, O_1'(R) = M.51*a*, and the right orbital height, O_2(R) = M.52, respectively;
ie left orbital breadth from the dacryon O_1'(L) = M.51*a*.

variability of series of living subjects, Howells (1936) suggested that the standard deviation of each for a particular character should be divided by the unweighted mean of several standard deviations for the same character which he had computed from the literature, the quotient being expressed as a percentage and provisionally termed the 'sigma ratio'. In his account of the Gallen Priory skeletons he has since provided a further set of unweighted mean standard deviations for series of skulls, for the most part European and largely taken from craniological papers in *Biometrika* (Howells 1941, p. 145). A more exact test of differences between constants of variation than that proposed by Howells is Sir Ronald Fisher's variance ratio, two forms of which have now been applied to anthropological data (Trevor 1947, 1949), although in neither instance was the variability of the samples specifically considered in relation to a mean variance. Table III gives respectively the male mean variances (found by squaring Howells's mean standard deviations), their reciprocals,[1] and the male sample variances of the Gallen Priory Irish, the combined Icelandic, and the Iron Age Norwegian series, in each case together with the number of degrees of freedom, and the variance ratio u (Wishart 1947), for twenty-four corresponding or analogous characters.[2]

In the present case it is assumed that the mean variances are parametric or those of the population, thus implying that the number of degrees of freedom on which they are based is infinite. The significance or otherwise of the difference between a sample variance and the mean variance may be ascertained by entering a variance ratio table with the appropriate degrees of freedom and finding whether or not the observed value of u is greater than that at the conventional 5% probability level. Since the hypothesis of the equality of variances is being examined, the 'two-tailed' test should be applied, the critical value for u corresponding to $P = 0{\cdot}025$ in the usual tables, e.g. Table 7(*a*) of Lindley & Miller (1953, p. 9). It is evident from Table III that, compared with the values of the mean variances, the Irish and the Icelandic series are quite homogeneous, the Icelandic transverse bregmatic arc, $\beta Q'$, being significantly less than the mean variance for the corresponding character. For the glabello-occipital length, L, sagittal arc, S, and orbital height, O_2(L), however, the Norwegian variance is significantly greater than the mean variance, although significantly less for the auriculo-bregmatic height, βOH. This suggests a certain amount of heterogeneity for the Norwegian Iron Age series, a conclusion, incidentally, supporting Schreiner's own views. He points out that skull No. 74, which has the highest cranial index of the male ($100\ B/L = 86{\cdot}4$), is probably that of a Lappic-Norwegian hybrid, and that skull No. 90, also male, has a very exceptional form for an Iron Age Norwegian ($100\ B/L = 82{\cdot}5$; $H' = 118$) and is most logically interpreted as a variant of the Borreby type (Schreiner 1946, pp. 150–5). If these two skulls were excluded, it is unlikely that the Norwegian Iron Age variability for L and S would be appreciably greater than that of the mean variance.

In Table IV the differences between the means of the Irish, Icelandic, and Norwegian male skulls are compared in terms of their standard errors for twenty-five characters. Howells gives the probable errors of the means of his series, which, for convenience' sake, are reproduced in a footnote to Table IV, together with the standard errors that have now been computed for them. The standard errors of the means of the Norwegian skulls are given in Schreiner's Table XXII, but, by a slip, the relevant columns of this are headed 'P.E.' As is customary, when the difference between two corresponding means exceeds twice the standard error of that difference, the value

[1]Where a calculating machine is available, it is simpler in practice to multiply the sample variance by the reciprocal of the mean variance than to divide the sample variance by the mean variance.

[2]Theoretically, it would have been preferable to calculate the variances, not from sample but from estimated population standard deviations, and also to estimate the mean standard deviations before squaring them. Since, however, most of the sample standard deviations are based on thirty or more, and all those used to determine the mean standard deviations on at least forty, measurements, the less refined procedure adopted in this paper is probably adequate.

of the resultant 'critical ratio' is taken to be statistically significant. The comparison shows that thirteen of the differences between the Icelandic series and the Irish and eleven of those between the Icelandic series and the Norwegian are significant. For all absolute measurements of the brain-case the Irish skulls are significantly larger than the Icelandic, but these differences are not reflected in any of the indices of which such characters are components. The Norwegian brain-case is significantly larger than the Icelandic in glabello-occipital length, L, basi-bregmatic height, H', and transverse bregmatic arc, βOH, but the maximum horizontal breadth, B, is significantly smaller. The differences between these two series in the glabello-occipital and basi-nasal, LB, lengths, which are significant, and in the sagittal arc, S, which is not, indicate that the Icelandic occiput is much more protruding than the Norwegian. In other words, the Norwegian skulls are far longer and higher in proportion to their breadth than are the Icelandic, the critical ratios of both the indices 100 B/L and 100 H'/B being significant. The entire difference in glabello-occipital length between these two series, then, is confined to the portion of the skull in front of the basion. In the maximum and minimum calvarial breadths, B and B', the Irish mean is significantly larger, and in the basi-nasal length, LB, it is significantly smaller, than the Norwegian, the significance of the differences being repeated in all the indices of which either B or B' is a component as well as in the prosthionic profile angle, Pro. $P\angle$. Owing to the small number of characters on which some of the means are based, the facial characters of all three series are less satisfactorily discriminated by the critical ratio than those of the brain-case. The great Norwegian facial length, GL', is clearly distinguished from both the Icelandic and the Irish values, between which there is no significant difference. As expressed in measurements of the total height, GH, the Icelandic face is higher than either the Irish or the Norwegian, but in relation to the bizygomatic breadth, J, it is more like the second than the first, from which it differs with marked significance in the facial index, 100 GH/J. The Icelandic orbital height, O_2(L), is also larger than both the Irish and the Norwegian values. Finally, the Icelandic palato-maxillary length, PL', and index, 100 PB/PL', are respectively less and greater than they are in the other two series but only to a significant degree in the case of the Irish. The Irish palato-maxillary index, however, is significantly smaller than the Norwegian.

Because the Icelanders, unlike most other peoples, have remained isolated without any material admixture from abroad, we may assume that the genetical composition of the settlers of the country was the same as that of its present-day inhabitants, provided, of course, that no selective forces have been operative. It is interesting, therefore, to compare the four classical Landsteiner blood groups in terms of gene frequencies (here expressed as percentages) for the populations of Iceland, the British Isles, Denmark, and Scandinavia, and this has been done in Table V.[1] It is apparent from the table that the frequency of the O group gene, r, is highest in Iceland and becomes progressively lower in Eire, Northern Ireland, Scotland, northern England, southern England, Denmark, northern Norway, southern Norway, and Sweden in that order. The reverse is true of the A gene, p, which is the most common in Scandinavia and Denmark and the rarest in Eire and Iceland. Almost a quarter of a century ago it was pointed out that in their ABO frequencies the Icelanders were closer to the English and the Scots than to contemporary Norwegians (Dungal 1929). Later, when further data from Britain and the results of serological investigations in Ireland were available, it became evident that the ABO frequencies of the

[1]The figures for southern England are weighted pooled values, and, as a precaution, the gene frequencies have been calculated after omitting AB (Fisher & Taylor, 1940), in accordance with Sir Ronald Fisher's method (Dobson & Ikin 1946). The provenance of most of Fisher & Taylor's material is the more easterly, or supposed 'Saxon', part of southern England. Since it is in substantial agreement, as regards ABO gene frequencies, with that of Fraser Roberts for the six south-western counties, Glos., Wilts., Dorset, Somerset, Devon, and Cornwall (Roberts 1948, p. 111), the two bodies of data have been combined to represent southern England as a whole.

TABLE IV. *Differences between Mean Measurements of Male Irish, Icelandic, and Norwegian Skulls expressed as Critical Ratios**

Character	Irish – Icelandic		Norwegian – Icelandic		Irish – Norwegian	
	Difference & Standard Error	Critical Ratio	Difference & Standard Error	Critical Ratio	Difference & Standard Error	Critical Ratio
Glabello-occipital length, *L* = M.1	3·7 ± 0·92	*4·0*	4·1 ± 1·27	*2·2*	−0·4 ± 1·18	0·3
Maximum horizontal breadth, *B* = M.8	3·5 ± 0·82	*4·3*	−2·2 ± 0·98	*3·2*	5·7 ± 0·85	*6·7*
Minimum frontal breadth, *B′* = M.9	2·7 ± 0·64	*4·2*	0·9 ± 0·98	0·9	1·8 ± 0·83	2·2
Basi-bregmatic height, *H′* = M.17	3·5 ± 0·81	*4·3*	3·4 ± 0·99	*3·4*	0·1 ± 0·89	0·1
Sagittal arc, *S* = M.25	9·1 ± 2·21	*4·1*	5·5 ± 2·86	1·9	3·6 ± 2·52	1·4
Transverse bregmatic arc, *βQ′* = M.24	6·0 ± 1·45	*4·1*	7·1 ± 1·79	*4·0*	−1·1 ± 1·30	0·8
Basi-nasal length, *LB* = M.5	2·7 ± 0·91	*3·0*	4·4 ± 1·00	*4·4*	−1·7 ± 0·77	2·2
Chord, endobasion–prosthion, *GL′* = M.40	1·3 ± 1·08	1·2	4·6 ± 0·99	*4·6*	−3·3 ± 1·11	*3·0*
Facial height, *GH* = M.47	−4·6 ± 2·11	2·2	−4·6 ± 2·23	*2·1*	0·0 ± 1·64	0·0
Upper facial height, *G′H* = M.48	−1·4 ± 1·04	1·4	−2·4 ± 1·21	2·0	1·0 ± 0·96	1·0
Bizygomatic breadth, *J* = M.45	0·6 ± 1·47	0·4	0·9 ± 1·77	0·5	−0·3 ± 1·36	0·2
Nasal breadth, *NB* = M.54	0·5 ± 0·36	1·4	0·4 ± 0·45	0·9	0·1 ± 0·40	0·2
Orbital height O_1(L) = M.52	−2·4 ± 0·42	*5·7*	−1·7 ± 0·53	*3·1*	−0·7 ± 0·49	1·4
Palato-maxillary length, *PL′* = M.60	1·7 ± 0·52	*3·3*	0·3 ± 0·81	0·4	1·4 ± 0·74	1·9
Palato-maxillary breadth, *PB* = M.61	0·5 ± 0·69	0·7	0·4 ± 0·69	0·6	0·1 ± 0·81	0·1
100 *B*/*L*	0·4 ± 0·61	0·6	−2·7 ± 0·74	*3·6*	3·1 ± 0·59	*5·3*
100 *B′*/*B*	0·0 ± 0·60	0·0	1·2 ± 0·73	1·6	−1·2 ± 0·55	2·2
100 *H′*/*L*	0·8 ± 0·58	1·4	0·8 ± 0·69	1·2	0·0 ± 0·54	0·0
100 *H′*/*B*	0·7 ± 0·95	0·7	5·0 ± 1·13	*4·4*	−4·3 ± 0·92	*4·6*
100 *J*/*B*	−0·4 ± 0·90	0·4	3·7 ± 1·08	*3·4*	−4·1 ± 0·89	*4·6*
100 *B′*/*J*	0·8 ± 0·98	0·8	−1·1 ± 1·07	1·0	1·9 ± 0·82	*2·3*
100 *GH*/*J*	−5·3 ± 1·77	*3·0*	−3·7 ± 2·10	1·8	−1·6 ± 1·89	0·8
100 *G′H*/*J*	−2·7 ± 0·87	*3·1*	−1·9 ± 1·08	1·8	−0·8 ± 1·00	0·8
100 *PB*/*PL′*	−4·3 ± 1·51	*2·8*	−0·7 ± 1·88	0·4	−3·6 ± 1·61	2·2
Pro. *P*∠	−1·1° ± 0·69	1·6	0·5° ± 0·69	0·7	−1·6° ± 0·46	*3·5*

*Values of the critical ratio in *italics* are statistically significant. Together with those for the ophryo-horizontal perimeter, the mean Frankfurt nasal height, the left orbital breadth from the dacryon, and the nasal and orbital indices (characters which are omitted from the comparison in this table), the male means, standard errors, and sample sizes of Howells's Early Christian Irish skulls from Gallen Priory are: *L* 190·4 ± 0·56 (117); *B* 145·3 ± 0·46 (113); *B′* 98·5 ± 0·40 (120); *H′* 134·7 ± 0·50 (103); *S* 382·5 ± 1·23 (106); *βQ′* 313·1 ± 0·91 (104); *U* 535·1 ± 1·36 (108); *LB* 102·7 ± 0·46 (91); *GL′* 96·8 ± 0·74 (55); *GH* 117·8 ± 1·03 (59); *G′H* 72·0 ± 0·48 (71); *J* 135·6 ± 0·61 (58); [*NH*(L) + *NH*(R)]/2 51·4 ± 0·44 (78); *NB* 24·2 ± 0·20 (77); O_1'(L) 39·9 ± 0·28 (66), O_2(L) 33·1 ± 0·26 (70); *PL′* 54·7 ± 0·30 (69); *PB* 62·6 ± 0·43 (50); 100 *B*/*L* 76·4 ± 0·30 (111); 100 *B′*/*B* 68·0 ± 0·30 (111); 100 *H′*/*L* 70·9 ± 0·30 (102); 100 *H′*/*B* 92·6 ± 0·48 (100); 100 *J*/*B* 93·5 ± 0·47 (58); 100 *B′*/*J* 72·7 ± 0·50 (54); 100 *GH*/*J* 85·5 ± 1·07 (40); 100 *G′H*/*J* 52·0 ± 0·54 (42); 100 *NB*/{[*NH*(L) + *NH*(R)]/2} 47·5 ± 0·59 (69); 100 O_2/O_1'(L) 82·9 ± 0·89 (62); 100 *PB*/*PL′* 113·9 ± 0·82 (49); and Pro.*P*∠ 83·1° ± 0·38 (55).

Icelanders resembled those of the Irish and the Scots (Boyd & Boyd 1937; Sachs 1940; Fisher & Taylor 1940; Hart 1944; Hooper 1947). Fisher & Taylor (1940) accounted for the distribution of the *O* and *A* genes in the following manner:

> The stock from which the Icelanders sprang would seem to have just the blood-group constitution needed to harmonize with the gradient found in Great Britain, but in recognizing this stock as genuinely Scandinavian, we must distinguish it sharply from the modern Scandinavian peoples, which have evidently changed greatly by infiltration from central or eastern Europe, since the Viking period. The Scottish and N. English blood-groups show, certainly not modern Scandinavian, but it may well be a proto-Scandinavian, influence.

If such a conjecture were correct, it would mean that the Irish and the Scots had a far greater amount of proto-Scandinavian blood than the Scandinavians themselves, and this, it seems to me, is not easy to imagine. There are other considerations, too, which speak against the Fisher-Taylor theory. In western Iceland, where most of the immigrants from the British Isles settled, the *O* group is the most common, and in Dublin, which was by far the largest Viking settlement in Ireland, the *O* group is below the average for the Irish as a whole.

According to the most recent investigator of blood-group distribution in Eire, 'The original inhabitants of the country probably had a greater proportion of Group O, as this group is found more commonly in the older native districts' (Hooper 1947, p. 478). It appears, then, that we might have here a Celtic characteristic, a view which could be supported by pointing out the similarity between the Icelanders and the Irish in head shape and the peculiar combination of dark hair and blue eyes that is so often seen among these two peoples.[1] If we incline to the opinion that the Iron Age population of Great Britain and Ireland was Celtic in race, it would strengthen the theory that the high frequency of the *O* gene is a Celtic trait, for, as I have already indicated, there is considerable resemblance between the British Iron Age skulls and the skulls of the Western Vikings. Although the work of Donegani *et al.* (1950) did not demonstrate that the very high frequency of the *Rh*-negative (*D*-negative) group and the low *B* frequency found among the Basques were repeated in Iceland, it is noteworthy that, according to Morant (1939, pp. 73–4), Basque skulls resemble those of the British Iron Age. Since the Basques have an *r* frequency very similar to that of the Irish and the Icelanders,[2] it seems that the occurrence of the *O* gene in Europe is associated with populations characterized by a rather low mesocranial skull. On the other hand, I hesitate to look upon this as an original Celtic trait, for to do so would amount

[1][In a preliminary account of the anthropometric side of the Harvard anthropological survey of Ireland, the interpretation of which, it is stressed, must be tentative until the material has been studied as a whole, the suggestion is made that Gaelic languages were introduced into the country by 'tall, long-headed near-blonds' and it is stated that the central east coast, 'perhaps the area settled by the Megalithic people who sailed up the Irish Channel', is the 'shortest and most dolichocephalic region with highest concentration of light eyes (especially blue eyes), but very dark hair' (Hooton 1940, pp. 246, 248). However, the author of an earlier survey of the regional distribution of hair and eye colour for a sample of over half a million Scottish schoolchildren felt it possible to infer from this that the correlation between blue eyes and dark hair was particularly marked in the Gaelic-speaking areas of Scotland, as well as among the large Irish community in Glasgow, and he added: 'The association of dark hair, jet black hair, blue eyes and light eyes with the Scoto-Keltic and Irish populations is a striking feature in these results. The results but confirm the common origin of the two peoples – their association as determined by language, by history and by tradition' (Tocher 1908, pp. 184, 190, 217). In view of the Norse settlement on Man in early medieval times, a finding of great interest is that, of 566 Manxmen with dark brown hair, 30% had unpigmented eyes, and in about 15% of the total sample of 1200 dark hair and light eyes were combined (Davies & Fleure 1936, p. 135). It is much to be hoped that the individual records, metrical and otherwise, of this valuable study will some day be published in full. Although on the basis of only a small sample of 48 adults, the further inference can be made that there is a sensible correlation between dark hair and light eyes in the data for the largely inbred inhabitants of the Isle of Benbecula, Outer Hebrides, collected by Searight, Bathurst & Noone (1946, p. 29). – ED.]

[2]Two recent figures are 71·7 for a sample of 383 (Chalmers, Ikin & Mourant 1949, p. 532), and 74·9 for a sample of 189, some fifty of whom were Spanish Basques (Kherumian 1951, p. 107).

TABLE V. ABO *Blood-Group Phenotypic Frequencies (expressed as Percentages) for Iceland, the British Isles, Denmark, and Scandinavia*

County or Region and Source of Data	Size of Sample	Phenotypic Frequencies				Gene Frequencies		
		O	*A*	*B*	*AB*	*p*	*q*	*r*
Iceland (Dongani *et al.* 1950, including Jónsson 1922)	1,883	55·8	31·3	10·5	2·5	18·6	6·7	74·7
Eire (Hooper 1947)	12,869	53·8	32·1	11·5	2·6	19·3	7·5	73·3
Northern Ireland (Hart 1944)	13,554	52·2	34·9	10·1	2·8	21·0	6·7	72·3
Scotland (Fisher & Taylor 1940)	10,969	52·0	34·2	10·4	3·3	20·8	7·0	72·2
England, N. of Humber (Fisher & Taylor 1940)	8,716	48·6	40·3	8·5	2·5	24·5	5·9	69·6
Southern England* (Fisher & Taylor 1940 + Roberts 1948)	227,351	44·8	43·6	8·4	3·1	27·1	6·0	66·9
Denmark (Streng 1935 – pooled values)	16,037	42·0	43·5	10·4	4·2	27·7	7·5	64·8
Northern Norway† (Hartmann, Hadland & Bjerkelund 1941)	1,960	40·9	44·6	10·2	4·3	28·5	7·5	63·9
Southern Norway‡ (Hartmann & Lundevall 1944)	33,580	38·7	49·3	8·1	3·9	31·6	6·2	62·2
Sweden (Nordlander 1940)	12,094	38·2	47·4	9·8	4·6	30·7	7·5	61·8

* The pooled values for southern England are given here for the first time.
† Nordland, Troms, and Finnmark.
‡ Østland, Sørland, Vestland, and Trøndelag.

to saying that the Icelanders had more Celtic blood than the Irish and the Scots, and the history of the three nations does not warrant such a conclusion. The most natural conclusion appears in my view to be that these peoples inherited the prevalence of the *O* gene through a pre-Iron Age population which had been isolated on the outskirts of Europe. The relative smallness of the *O* group in Scandinavia today is perhaps most easily explained by assuming that the Iron Age peoples brought a large number of *A* genes there and that many *A* genes were also carried to Britain by the same race through the invasions of the Anglo-Saxons, the Danes, and the Normans. If the present difference in hair colour between the Scandinavians and the Icelanders is considered, as well as the descriptions of Germanic peoples found in ancient literary sources, it seems most likely that the Eastern Vikings had light-coloured hair and eyes. The personal descriptions in the Icelandic Sagas, however, show that the hair colour of the Icelanders of the period was far darker (Kvaran 1934).

The present study of the Vikings leads to the conclusion that, in regard to anthropological characteristics, they represented two separate groups, an Eastern one and a Western one. The Eastern group varied from dolicho-ortho-acrocrany to dolicho-ortho-metriocrany, was mesene, and probably had light hair and eyes and a large number of *A* genes. The Western group varied from meso-ortho-tapeinocrany to meso-chamae-tapeinocrany, was also mesene, and had the same pigmentation and blood-group distribution as the present-day Icelanders, viz. relatively dark hair combined with blue eyes, and a considerable proportion of *O* genes.

REFERENCES

BACKMANN, GASTON 1911. Bidrag till kännedomen om de medeltida Svenskarnas Antropologi. I. Kranier och skelett från S:t Clemens kyrkoruin i Visby. *K. svenska VetenskAkad. Handl.* **47** (7). 180 pp.

BOYD, W. C. & L. G. 1937. Frequency of Blood Groups and Other Hereditary Factors in Europe and Egypt. *Amer. J. Phys. Anthrop.* **23**, pp. 49–70.

BRYN, HALFDAN & SCHREINER, K. E. 1929. *Die Somatologie der Norweger.* Skr. norske. VidenskAkad., I, Mat.-Naturv. Kl., No. 1. 608 pp.

CHALMERS, J. N. MARSHALL, IKIN, ELIZABETH W. & MOURANT, A. E. 1949. The ABO, MN and Rh Blood Groups of the Basque People. *Amer. J. Phys. Anthrop,* N.S., **7**, pp. 529–44.

DAVIES, ELWYN & FLEURE, H. J. 1936. A Report on an Anthropometric Survey of the Isle of Man. J. R. ANTHROP. INST. **66**, pp. 129–87.

DOBSON, AILEEN M. & IKIN, ELIZABETH W. 1946. The ABO Blood Groups in the United Kingdom; Frequencies based on a very Large Sample. *J. Path. Bact.* **58**, pp. 221–7.

DONEGANI, JOYCE A., DUNGAL, N., IKIN, ELIZABETH W. & MOURANT, A. E. 1950. The Blood Groups of the Icelanders. *Ann. Eugen., Lond.,* **15**, pp. 147–52.

DUNGAL, N. 1929. Um blodflokka. *Vaka,* **3**, pp. 195–210.

ELDERTON, M. E. & WOO, T. L. 1932. On the Normality or Want of Normality in the Frequency Distributions of Cranial Measurements. *Biometrika,* **24**, pp. 45–54.

FISHER, R. A. & TAYLOR, G. L. 1940. Scandinavian Influence in Scottish Ethnology. *Nature, Lond.,* **145**, p. 590.

FLOWER, WILLIAM HENRY 1881. On the Cranial Characters of the Natives of the Fiji Islands. J. ANTHROP. INST. **10**, pp. 153–74.

FÜRST, CARL M. 1905. Skelettfynd i jämtlandska gratva från den ynge jånaldern. *Ymer,* **25**, pp. 372–401.

FÜRST, CARL M. 1935 (1934). Ueber die Schädelform der Nordländer und ihre Veränderungen während prähistorischer Zeit und dem Mittelalter beurteilt nach den drei Dimensionen des Schädels in ihren Verhältnissen zueinander (Tres Indices, TrI). *Acta Univ. lund.,* N.F. Afd.2, **31**(1). 19 pp.

GOODMAN, C. N. & MORANT, G. M. 1940. The Human Remains of the Iron Age and Other Periods from Maiden Castle, Dorset. *Biometrika,* **31**, pp. 295–312.

HANNESSSON, GUDMUNDUR 1925. *Körpermasze und Korperproportionen der Isländer.* 254 pp. Reykjavík, Aarbok Háskola Islands (pr.).

HART, E. W. 1944. An Analysis of the Blood-Group Composition of a Population in Northern Ireland. *Ann. Eugen., Lond.* **12**, pp. 89–101.

HARTMANN, OTTO, HADLAND, KAARE & BJERKELUND, CHR. JUEL 1941. Blood Group Distribution in Norway. *Avh norske VidenskAkad.,* I. Mat.-Naturv. Kl., No. 5. 41 pp.

HARTMANN, OTTO & LUNDEVALL, JON UTHEIM 1944. Blood Group Distribution in Norway; with Special Regard to the MN and OA_1A_2B System. *Avh. norske VidenskAkad.,* I, Mat.-Naturv. Kl., No. 2. 68 pp.

HJORTSJÖ, CARL-HERMANN & KRAKAU, TORSTEN 1944. Antropologiska data beträffande befolkningen i Lund under 1000– 1100– och 1200 talen. *Acta. Univ. lund.,* N.F. Afd.2, **40**(4). 43 pp.

HOOKE, BEATRIX G. E. 1926. A Third Study of the English Skull with Special Reference to the Farringdon Street Crania. *Biometrika,* **18**, pp. 1–55.

HOOPER, IVOR 1947. Blood Group Distributions in Ireland. *Irish J. Med. Sci.,* 6th Ser., No. 259, pp. 471–9.

HOOTON, EARNEST A. 1940. Stature, Head Form and Pigmentation of Adult Male Irish. *Amer. J. Phys. Anthrop.* **26**, pp. 229–49.

HOWELLS, W. W. 1936. Some Uses of the Standard Deviation in Anthropometry. *Hum. Biol.* **8**, pp. 592–600.

HOWELLS, W. W. 1937. The Iron Age Population of Great Britain. *Amer. J. Phys. Anthrop.* **23**, pp. 19–29.

HOWELLS, W. W. 1941. The Early Christian Irish: The Skeletons at Gallen Priory. *Proc. R. Irish Acad.,* Sect. C, **46**, pp. 103–219.

JÓNSSON, S. 1922. Isoagglutinin í blódi Islendenga. *Læknabladid,* **8**, pp. 81–2.

KHERUMIAN, R. 1951. *Génétique et anthropologie des groupes sanguins.* 128 pp. Paris, Vigot.

KOLLMANN, J., RANKE, J. & VIRCHOW, R. eds. 1883 (1884). Verständigung über ein gemeinsames craniometrisches Verfahren. *CorrespBl. dtsch. Ges. Anthrop.* **14** (in *Arch. Anthrop., Braunschw.,* **15**), pp. 1–8.

KVARAN, E. S. 1934. Um Mannfrædilegt gildi fornílenskra mannlysinga. *Skírnir,* **108**, pp. 83–101.

LINDLEY, D. V. & MILLER, J. C. P. 1953. *Cambridge Elementary Statistical Tables.* 35 pp. Cambridge, University Press.

MAHALANOBIS, P. C., MAJUMDAR, D. N. & RAO, C. R. 1949. Anthropometric Survey of the United Provinces, 1941. A Statistical Study. *Sankhya,* **9**, pp. 89–324.

MARTIN, CECIL P. 1935. *Prehistoric Man in Ireland.* 184 pp. London, Macmillan.

MARTIN, RUDOLF 1928. *Lehrbuch der Anthropologie in systematischer Darstellung,* 2nd ed., 3 vols., II. Jena, Fischer.

MORANT, G. M. 1926. A First Study of the Craniology of England and Scotland from Neolithic to Early Historic Times, with Special Reference to the Anglo-Saxon Skulls in London Museums. *Biometrika,* **18**, pp. 56–98.

MORANT, G. M. 1928. A Preliminary Classification of European Races based on Cranial Measurements. *Biometrika,* **20B**, pp. 301–75.

MORANT, G. M. 1929. A Contribution to Basque Craniometry. *Biometrika,* **21**, pp. 67–84.

MORANT, G. M. 1931. A Study of the Recently Excavated Spitalfields Crania. *Biometrika,* **23**, pp. 191–248.

MORANT, G. M. 1939. The Use of Statistical Methods in the Investigation of Problems of Classification in Anthropology. Part I. The General Nature of the Material and the Form of Intraracial Distributions of Metrical Characters. *Biometrika,* **31**, pp. 72–98.

NORDLANDER, O. 1940. *Apud* Transactions of the Association of Swedish Surgeons. *Nordisk Medisin,* **8**, pp. 2683–2741. Cited by Hartmann *et al.* 1941, p. 35.

PEARSON, KARL 1925. The Definition of the Alveolar Point. *Biometrika,* **17**, pp. 53–6.

REID, R. W. 1926. The Remains of Saint Magnus and Saint Rögnvald, entombed in Saint Magnus Cathedral, Kirkwall, Orkney. *Biometrika,* **18**, pp. 118–50.

RETZIUS, GUSTAV 1899. *Crania Suecica antiqua.* (German ed. 1900.) 182 pp. Stockholm, Aftonbladets Druckerei (pr.).

ROBERTS, J. A. FRASER 1948. The Frequencies of the *ABO* Blood-Groups in South-Western England. *Ann. Eugen., Lond.,* **14**, pp. 109–116.

SACHS, HANS 1940. Some Aspects of the Problem of Blood Grouping and the Distribution of Blood Groups in the Irish Population. *Irish J. Med. Sci.,* 6th Ser., No. 172, pp. 145–58, 178.

SCHREINER, K. E. 1927. Menneskeknoklene fra Osebergskibet og andre Norske jernalderfund. In *Osebergfundet,* V, A. W. Brøgger & Haakon Schetelig eds., pp. 81–279, tables (22 pp.) & English summary (pp. 285–306). Oslo, Universetetets Oldsaksamling.

SCHREINER, K. E. 1939. *Crania Norwegica,* I. Skr. Inst. sammenl. KulturForskn., Ser. B, **36** (1). 201 pp. Oslo, Aschehoug.

SCHREINER, K. E. 1946. *Crania Norwegica,* II. Skr. Inst. sammenl. KulturForskn., Ser. B, **36** (2). 187 pp. Oslo, Aschehoug.

SEARIGHT, H. FF., BATHURST, C. M. A. & NOONE, R. O. 1944 (1947). A Contribution to the Anthropology of the Outer Hebrides. J. R. ANTHROP. INST. **74**, pp. 25–32.

STEFFENSEN, JÓN 1943. Knoglerne fra Skeljastadir i Ijórsárdalur. In *Forntida Gådar i Island,* Mårten Stenberger ed., pp. 227–60. København, Munksgaard.

STEWART, T. D. 1942. Equivalent Definitions of Cranial Measurements. *Anthrop. Briefs, N.Y.,* No. 1, pp. 16–17.

STOESSIGER, BRENDA N. & MORANT, G. M. 1932. A Study of the Crania in the Vaulted Ambulatory of Saint Leonard's Church, Hythe. *Biometrika,* **24**, pp. 135–202.

STRENG, OSVALD 1935. Die Blutgruppenforschung in der Anthropologie. *Acta. Soc. med. fenn. duodecim.,* Ser. A, **17** (8). 318 pp. Cited by Wiener 1943, p. 299.

TILDESLEY, M. L. 1921. A First Study of the Burmese Skull. *Biometrika,* **13**, pp. 176–262.

TOCHER, J. F. 1908. Pigmentation Survey of School Children in Scotland. *Biometrika,* **6**, pp. 129–235 & Supplementary appendix (67 pp.).

TÖRÖK, AUREL VON 1890. *Grundzüge einer systematischen Kraniometrie.* 631 pp. Stuttgart, Enke.

TREVOR, J. C. 1947 (1950). The Physical Characters of the Sandawe. J. R. ANTHROP. INST. **77**, pp. 61–78.

TREVOR, J. C. 1949. The Metrical Features of Ashanti and other African Negro Crania. In *Homenaje à don Luis de Hoyos Sainz,* I, José Rogiero Sanchez *et al.* eds., pp. 317–32. Madrid, Graficas Valera (pr.).

TREVOR, J. C. 1953. *Race Crossing in Man: The Analysis of Metrical Characters.* Eugen. Lab. Mem., No. 36. 45 pp. Cambridge, University Press.

TURNER, Sir WILLIAM 1884. Report on the Human Crania and other bones of the Skeletons collected during the Voyage of H.M.S. Challenger, in the Years 1873–1876. Part I. The Crania. *Challenger Rep. Zool.* **10** (29). 130 pp. London & Edinburgh, H.M. Stationery Office.

TURNER, Sir WILLIAM 1915. A Contribution to the Craniology of the People of Scotland. Part II. Prehistoric, Descriptive and Ethnographical. *Trans. Roy. Soc. Edinb.* **51**, pp 171–255.

WIENER, ALEXANDER S. 1943. *Blood Groups and Transfusion,* 3rd ed. 438 pp. Springfield, Ill., Thomas.

WILDER, HARRIS H. 1920. *A Laboratory Manual of Anthropometry.* 193 pp. Philadelphia, Blakiston.

WISHART, JOHN 1947. The Variance Ratio Test in Statistics. *J. Inst. Actu. Stud. Soc.* **36**, pp. 172–84.