

Es wird von der grössten Bedeutung sein die Stoffwechselprozesse in Organisatoren und den auf ihre Wirkung reagierenden Reaktionssystemen genau zu untersuchen.

Erst auf diese Weise können wir hoffen in der Induktionsfrage der Lösung näher zu kommen.

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Anthropology. — *Bloodgroup Investigation in the "Hoeksche Waard"*. By FLORIS HERS, M. A. VAN HERWERDEN and TH. J. BOELE—NIJLAND. (Communicated by Prof. J. BOEKE.)

(Communicated at the meeting of September 30, 1933).

In the Proceedings Vol. 33, N^o. 6, 1930 and Vol. 35, N^o. 5, 1932 the first results have been published of the bloodgroup investigation in Holland instigated by the Anthropological Commission of the Royal Academy of Sciences. In the first-mentioned paper relating to 3085 students the technique has been described in detail. It will be sufficient to repeat that all agglutination tests have been performed in duplicate by the same trained investigators. The data were copied on individual cards for each person tested.

The paper published in 1932 contains the results of an investigation in the "Over Veluwe" a part of the province of Gelderland. This time we are able to consider another rural part of the Netherlands, namely the "Hoeksche Waard" one of the islands belonging to the southern part of the province of Zuid-Holland. The first-mentioned author, physician in the small town of Puttershoek collected the bulk of the material and furnished the anthropological data. Both the other authors are responsible for the

agglutination tests and for the selecting of the material, the computations etc.

As to the development of the Hoeksche Waard it may be stated that the different islands forming the southern part of the province of Zuid-Holland are deposits of the delta of the river Maas. To the formation of the Hoeksche Waard however the estuary of the Schelde river has also contributed. In former times a large estuary, called the Striene, joining the Maas and Schelde, separated what later became the Hoeksche Waard into two parts. Before the polders Zuid-Hollandsche and Tijsseler Waard were inundated (the so called St. Elisabethflood of the year 1421) the entire territory consisted of a number of small islands. From the detailed investigation of J. C. RAMAER in the Proceedings of the Academy of Sciences¹⁾ it may be concluded that in mediaeval times the habited world in that territory terminated in a levee stretching from Dordrecht to Puttershoek, continuing in a levee in the Maas river (actually the town of Maasdam) and from there to Strijen and Geertruidenberg. On the westside of this levee the situation was as it is nowadays in the Biesbosch, namely muddy water courses and marshes, a country only visited in those times by a wandering, hunting, fishing population. Only the Anthoniepolder and a small polder called the Wale existed before the inundation, the former one since 1355. It was only a long time after the St. Elisabethflood and after the above-mentioned Striene was silted up, that the entire Hoeksche Waard has been consolidated into one island. It seems that the eastern and the western part of the Hoeksche Waard each of them retained their own population and that even today marriages between the inhabitants of different places are infrequent. The people living in Puttershoek, Maasdam, Strijen and 's Gravendeel have to be considered as the descendants of the survivors of the population of the above-mentioned old Zuid-Hollandsche Waard (mentioned for the first time in the year 1200), which was completely inundated in 1421. Except for a number of later immigrants, the population of these places must be considered as descending from the inhabitants of the boroughs swallowed up by the flood.

In treating the anthropological material we had reasons to divide it into several parts, these parts being considered together as well as separately. To begin with we will take the results obtained in the Hoeksche Waard as a whole. It has to be taken into account that the material at our disposal has been dependent on many factors²⁾ and that there has been no lack of interest on our side, if we have not succeeded in getting a sufficient number of tests in places which it would have been very desirable to include in the investigation. As to the division made, we have taken the small town of Puttershoek separately, partly because the first author in his position as a

¹⁾ J. C. RAMAER. *Graphische geschiedenis van Holland bezuiden de Lek en de Nieuwe Maas*. Verh. K. Acad. v. Wetenschappen, 1899, II, No. 3.

²⁾ Psychological factors playing a considerable role. It is very difficult to obtain a few drops of blood for scientific investigations from our Dutch peasants. It is also extremely difficult to obtain the collaboration of our Dutch colleagues.

physician in this place had the best opportunity of obtaining material there, but principally because the percentage of bloodgroup *B* in that town shows a considerable difference from that in the surrounding districts and the same holds true for another anthropological trait, the colour of the hair. Only in the few last years has the population of Puttershoek begun to show a certain mobility (emigration to Rotterdam, immigration from the province Noord-Brabant to the sugar factories, immigration from the province of Zeeland to replace the labourers emigrating to Rotterdam). From the election lists of Puttershoek it can be seen that many natives of Puttershoek bear the same family name (often without acknowledging any relationship). Out of 617 electors not less than 99 identical names have been counted. Identical names are also frequently found amongst the 526 persons collected at random in Puttershoek for the bloodgroup investigation. Only 162 different names have been counted. Even if we consider the whole material collected by the first author in the Hoeksche Waard, the names are reduced to a relatively small number. This material amounts to 1282 persons but the number of family names does not exceed 295. A number of these names already occur in the oldest churchregisters. Puttershoek from olden times is a place where intermarriage has been of frequent occurrence. This explains to a great extent (as will be stated further on) why a population, descending as a whole from a relative small group of people surviving an inundation, shows in its different branches such a difference in bloodgroup relations and (as the first author stated during his investigation) also in general habitus and frequency of diseases.

The eastern part of the Hoeksche Waard (except Puttershoek) has been considered separately. The districts investigated there ('s Gravendeel, Maasdam, Strijen, Strijen Sas) were drained at a later period, namely in the latter half of the 16th century. The town of Oud-Beyerland situated in the western part of the Hoeksche Waard has been taken separately, this small town being inhabited for the greater part by immigrants from the Zuid-Holland towns of Vlaardingén and Schiedam (according to Mr. TRESLING, who has made an exhaustive study of this town). The material in this place has been collected by Dr. A. A. DE KONING as a medical student. A number of places in the middle part of the Hoeksche Waard have been taken together excepted Numansdorp, which has its own history, being situated in the sands which silted up the old Striene. We did not succeed in completing the material collected in that place by Dr. C. FLOHIL.

The material can be classified in another way, namely by taking the boroughs poldered before the 16th century and those after that time. The results of the different divisions made will be found in the text.

As to the neighbouring islands of Putten and Voorne situated in the west of the Hoeksche Waard, after due selection of the material collected there by some medical students, only 252 tests could be considered.

The distribution as to the bloodgroups is as follows :

I. Material collected by the first author :

Number	O	A	B	AB
1282	569	590	97	26
	44.4%	46.0%	7.6%	2.0%
	± 1.39	± 1.39	± 0.74	± 0.39

II. To this number have been added the bloodgroups of 309 persons in the towns of Oud-Beyerland and Numansdorp also situated in the Hoeksche Waard (collected resp. by Dr. DE KONING and Dr. FLOHIL).

Number	O	A	B	AB
1591	723	704	124	40
	45.4%	44.3%	7.8%	2.5%
	± 1.25	± 1.25	± 0.67	± 0.40

In cases where 2 or more sisters or brothers have been tested only the two eldest of these have been taken, the other ones being eliminated from the material.

$$\text{The blood-index after HIRSZFELD} = \frac{A + AB}{B + AB} = 4.5.$$

Computed after BERNSTEIN :

$$p = 27 \quad q = 5.5 \quad r = 67.5 \quad p + q + r = 100$$

For the students (published in the year 1930) we got :

$$p = 25.6 \quad q = 6.8 \quad r = 67.6 \quad p + q + r = 100$$

For the investigation in the Over Veluwe we got :

$$p = 25.8 \quad q = 5 \quad r = 68.8 \quad p + q + r = 99.6$$

Dividing the Hoeksche Waard in different parts we get :

III. Puttershoek :

Number	O	A	B	AB
526	234	257	25	10
	44.5%	48.8%	4.8%	1.9%
	± 2.17	± 2.18	± 0.93	± 0.59

IV. Computing the Hoeksche Waard without Puttershoek :

Number	O	A	B	AB
1065	489	447	99	30
	45.9%	42.0%	9.3%	2.8%
	± 1.53	± 1.51	± 0.89	± 0.51

V. The eastern parts of the Hoeksche Waard without Puttershoek

(namely the towns of Maasdam, Schenkeldijk, Mookhoek, 's Gravendeel, Strijen, Sas van Strijen) :

Number	O	A	B	AB
664	286	301	62	15
	43.1 %	45.3 %	9.3 %	2.3 %
	± 1.92	± 1.93	± 1.13	± 0.58

VI. Taking the town of Oud-Beyerland, situated in the western part of the Hoeksche Waard :

Number	O	A	B	AB
217	107	88	15	7
	49.3 %	40.6 %	6.9 %	3.2 %
	± 3.39	± 3.34	± 1.72	± 1.20

VII. The total Hoeksche Waard without Puttershoek and Oud-Beyerland :

Number	O	A	B	AB
848	382	359	84	23
	45.0 %	42.3 %	9.9 %	2.7 %
	± 1.71	± 1.30	± 1.02	± 0.56

VIII. Making a separation between the lands poldered before and after the 16th Century :

1. The places Puttershoek, St. Anthoniepolder, Maasdam, Cillaarshoek:

Number	O	A	B	AB
723	315	349	46	13
	43.6 %	48.3 %	6.3 %	1.8 %
	± 1.85	± 1.86	± 0.90	± 0.49

2. The towns of 's Gravendeel, Schenkeldijk, Mookhoek, Strijen, Sas van Strijen, Numansdorp, Oud-Beyerland :

Number	O	A	B	AB
868	408	355	78	27
	47.0 %	40.9 %	9.0 %	3.1 %
	± 1.70	± 1.67	± 0.97	± 0.59

Considering these percentages (Fig. 1), it can be stated that Puttershoek with its extremely low percentage of bloodgroup *B* is situated in the middle of a territory where this percentage is much higher, reaching a percentage which is very high if compared with the mean one in Holland and resembling the percentage we obtained in the islands of the province of Zeeland¹⁾. For comparison the columns relating to the 4 bloodgroups of

¹⁾ To be published in a future paper.

the investigation of the "Over Veluwe" mentioned before and those relating

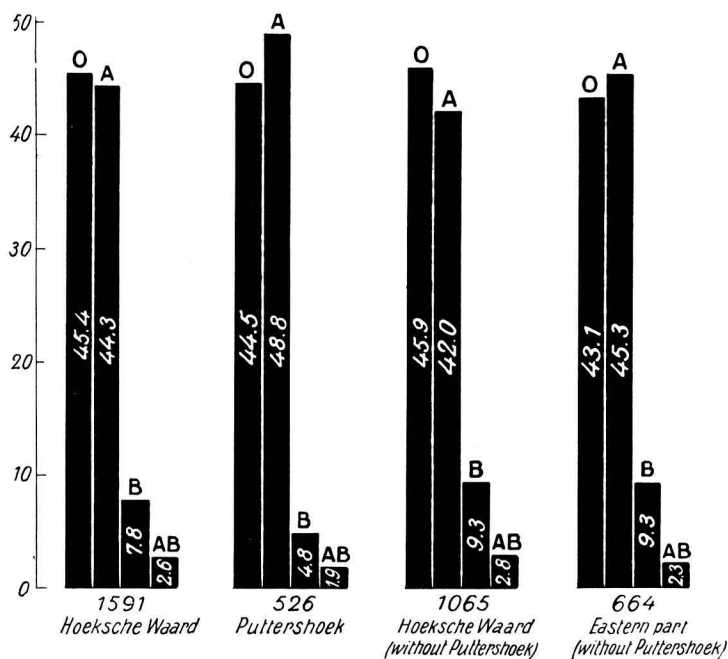


Fig. 1.

to N^o. IV of the present investigation have been placed side by side (fig. 2).

If we consider the family names and family relations of those belonging to group *B* and *AB* in Puttershoek it appears that there exist two families who are greatly responsible for the agglutinogenes *B*. Eliminating the persons belonging to bloodgroup *B* or *AB* in these two families there only remain 15 instead of 25 persons belonging to *B* which momentarily can't be traced back to these relationships. This does not mean however that they have not any connections with these families, whose pedigrees could not be traced back any further than the beginning of the 19th century.

So we have to conclude that probably after the St. Elisabethflood in 1421 the settlement of population in this borough has been very poor as to the *B* factor in contrast to the people settling in the surrounding districts.

This low percentage of bloodgroup *B* at Puttershoek is also reflected in the material collected together in the places poldered before the 16th century (VIII 1) when compared with the material from later poldered regions (VIII 2), the larger part of this material having been collected at Puttershoek (526 from the 723 cases mentioned sub VIII 1).

In order to see if any correlation exists in the material collected in the Hoeksche Waard between the bloodgroup and other anthropological traits.

the distribution of the bloodgroups has been compared with the distribution of the colour of the hair and the colour of the eye. The number of head-indices of grown-up people investigated is too small to be taken into account for these correlation studies.

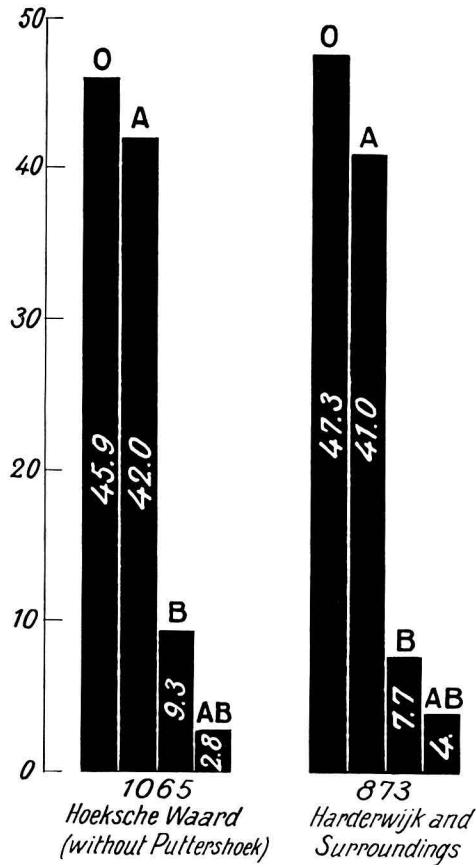


Fig. 2.

The Colour of the Eye.

Among 1267 persons examined in respect to eye colour by the first author 773 or 61.0 percents had light coloured eyes (blue, bluegrey or grey), 494 or 39.0 percent had dark coloured eyes (greybrown, brown or blue (or bluegrey) with brown pigment spots or heterochromic eyes).

Taking all the persons together examined for eye colour in the Hoeksche Waard (1560 persons) these numbers amount to respectively 980 or 62.8 percent ± 1.22 and 580 or 37.2 percent ± 1.22 . Table 1 gives the distribution of the different eye colours over the 4 bloodgroups.

It is sufficiently clear from this table that in this material no correlation exists between bloodgroup and eye colour. The same holds true if we consider the material in Puttershoek separately (table 2).

For the districts of the eastern part of the Hoeksche Waard with the exception of Puttershoek (the towns of Maasdam, 's Gravendeel, Schenkeldijk, Mookhoek, Strijen and Sas van Strijen) 403 or 67.6 percent had light coloured eyes, 193 or 32.4 percent dark coloured eyes.

Taking all the persons examined in respect to eye colour in the Hoeksche Waard together excepting those in Puttershoek (1051 persons) 697 or 66.3 percent had light coloured eyes, 354 or 33.7 percent had dark coloured eyes.

The Colour of the Hair.

Among 1259 persons examined by the first author in respect to hair colour, 39 or 3.1 percent ± 0.49 were red haired, 633 or 50.3 percent ± 1.41 fair, 587 or 46.6 percent ± 1.41 darkblond or black. Taking all the persons together examined for hair colour in the Hoeksche Waard (1556 persons), 42 or 2.7 percent ± 0.41 were red, 741 or 47.6 percent ± 1.27 fair, 773 or 49.7 percent ± 1.27 were darkblond or black haired (table 3).

TABLE 3. Bloodgroup and Hair Colour in the Hoeksche Waard.

Blood-group	Number	Red hair	Fair hair	Darkblond or black hair
O	708 45.5% ± 1.26	9 = 1.3% ± 0.65 21.4% 6.32	349 = 49.3% ± 1.88 47.1% ± 1.83	350 = 49.4% ± 1.88 45.3% ± 1.79
A	692 44.5% ± 1.26	29 = 4.2% ± 0.76 69.0% ± 7.04	316 = 45.7% ± 1.89 42.6% ± 1.82	347 = 50.1% ± 1.90 44.9% ± 1.79
B	119 7.6% ± 0.67	3 = 2.5% ± 1.43 7.1% ± 3.96	66 = 55.5% ± 4.55 8.9% ± 1.05	50 = 42.0% ± 4.53 6.5% ± 0.89
AB	37 2.4% ± 0.39	1 = 2.7% ± 2.66 2.4% ± 2.36	10 = 27.0% ± 7.30 1.4% ± 0.43	26 = 70.3% ± 7.52 3.3% ± 0.64
Totals	1556	42 = 2.7% ± 0.41	741 = 47.6% ± 1.27	773 = 49.7% ± 1.27

The correlation O \rightarrow B and fair hair \rightarrow darkblond or black hair = 0.049 \pm 0.035

" " A \rightarrow B " " " " \rightarrow " " " " = 0.066 \pm 0.023

For the district of Puttershoek of 502 persons examined in respect to hair colour (table 4) 15 or 3.0 percent ± 0.76 were red haired, 160 or 31.9 percent ± 2.08 fair, 327 or 65.1 percent ± 2.13 had darkblond or black hair.

TABLE 4. Bloodgroup and Hair Colour at Puttershoek.

Blood-group	Number	Red Hair	Fair Hair	Darkblond or black hair
O	221 44.5% ± 2.22	4 = 1.7% ± 0.87 26.6% ± 3.61	81 = 35.4% ± 3.22 50.6% ± 3.96	136 = 62.9% ± 3.24 41.6% ± 2.73
A	249 48.8% ± 2.23	9 = 3.5% ± 1.17 60.0% ± 12.7	68 = 26.8% ± 2.81 42.5% ± 3.92	172 = 69.0% ± 2.93 52.6% ± 2.76
B	23 4.8% ± 0.96	2 = 8.7% ± 5.88 13.4% ± 8.8	10 = 43.5% ± 10.4 6.3% ± 1.92	11 = 47.8% ± 10.4 3.4% ± 1.00
AB	9 1.9% ± 0.61	0	1 = 11.1% ± 10.5 0.6% ± 0.61	8 = 88.8% ± 10.5 2.4% ± 0.85
Totals	502	15 = 3.0% ± 0.76	160 = 31.9% ± 2.08	327 = 65.1% ± 2.13

The correlation $O \rightarrow B$ and fair hair \rightarrow darkblond or black hair = 0.060 ± 0.065
 " " $A \rightarrow B$ " " " \rightarrow " " " " = 0.11 ± 0.061

For the districts of the eastern part of the Hoeksche Waard excepting Puttershoek ('s Gravendeel, Maasdam, Schenkeldijk, Mookhoek, Strijen, Sas van Strijen) from the 596 persons tested for hair colour 18 or 3.0 percent ± 0.70 were red haired, 373 or 62.6 percent ± 1.98 were fair, 205 or 34.4 percent ± 1.95 darkblond or black.

Taking all the persons examined for hair colour in the Hoeksche Waard together excepting Puttershoek (1054 persons) 28 or 2.7 percent ± 0.50 were red haired, 580 or 55.0 percent ± 1.53 fair and 446 or 42.3 percent ± 1.52 darkblond or black.

The Cephalic Index.

Among 496 grown up people tested by the first author as to the index cephalicus 37 or 7.5 percent ± 1.18 were dolichocephalic, 281 or 56.6 percent ± 2.21 mesocephalic and 178 or 35.9 percent ± 2.16 brachycephalic.

From the percentages mentioned it can be stated that on the whole the light eye colour predominates in the different parts of the Hoeksche Waard, especially in the south eastern part (67.6 percent). There is a slight augmentation of dark coloured eyes in Puttershoek (44.4 percent against 32.4 percent in the surrounding districts). As to the colour of the hair a remarkable difference exists between Puttershoek and the other parts of the Hoeksche Waard investigated. No less than 65.1 percent proved to have dark hair against 34.4 percent in the rest of the eastern part and against 42.3 percent of all the persons examined as to hair colour in the Hoeksche Waard except Puttershoek.

However in comparing these percentages of hair colour it should be borne in mind, that in contrast to Puttershoek, in the small towns outside that community, chiefly schoolchildren were examined by the first author. Consequently an augmentation of the hair pigmentation with age has to be taken into consideration.

As to the red hair in the Hoeksche Waard a corresponding high percentage has been found in the above-mentioned investigation in the Over Veluwe (26 on 818 persons examined = 3.2 procent). As to the 3085 students examined a percentage of 2.0 procent red haired have been found.

For each bloodgroup a separation has been made between persons having fair or red hair and light (blue, bluegrey or grey) eyes and those having darkblond or black hair and dark coloured (greybrown or brown) eyes. In table 5 we consider the material of 1282 persons investigated by the first author.

It appears from this table that the first combination is much more frequent in group *O*, *A* and *B* than the second combination. Considering the whole group of 1282 persons, the combination fair or red hair with light coloured eyes is nearly 3 times as frequent as the combination darkblond or black hair with dark coloured eyes.

If however we take Puttershoek separately we find on the contrary that

TABLE 5.

Bloodgroup	Total number investigated	Fair (or red) hair light eyes	Dark hair, dark eyes
<i>O</i>	569	224	111
<i>A</i>	590	141	34
<i>B</i>	97	40	16
<i>AB</i>	26	7	6
	<u>1282</u>	<u>412</u>	<u>167</u>

the combination darkblond or black hair with dark coloured eyes in this material exceeds the combination fair (red) hair with light eyes, as can be seen from the following table :

TABLE 6.

Bloodgroup	Total number investigated	Fair (or red) hair light eyes	Dark hair, dark eyes
<i>O</i>	234	64	60
<i>A</i>	257	50	74
<i>B</i>	25	8	2
<i>AB</i>	10	0	4
	<u>526</u>	<u>112</u>	<u>140</u>

Taking the material collected by the first author with the exception of Puttershoek we get :

TABLE 7.

Bloodgroup	Total number investigated	Fair (or red) hair light eyes	Dark hair, dark eyes
O	489	160	51
A	447	141	34
B	99	32	14
AB	30	7	2
	1065	340	101

For each bloodgroup the combination fair (red) hair with light eyes is here considerably more frequent than the combination darkblond (black) hair with dark eyes. Considering the total numbers the first combination proves to be nearly $3\frac{1}{2}$ times as frequent as the second combination.

These latter tables confirm the fact already stated, that the pigmentation in Puttershoek has been found higher than in the surrounding districts.

In this same paper may be mentioned the selected data (252 cases) collected with the collaboration of some medical students in the districts of Brielle, Oost-Voorne and Hekelingen (Islands of Voorne and Putten).

Number	O	A	B	AB
252	105	119	24	14
	41.6 %	43.4 %	9.5 %	5.5 %
	± 3.11	± 3.2	± 1.85	± 1.44

Of 248 of these persons examined in respect to eye colour 132 proved to have blue, bluegrey or grey eyes, 103 greybrown or brown eyes.

From 241 of these persons examined for hair colour 1 proved to have red hair, 120 fair and 120 darkblond or black hair. As to the bloodgroup distribution, in these western parts of the islands as compared with the Hoeksche Waard, no lowering of percentage B has been found. This last material collected in the western part is however too small to admit of any conclusion being made. But in a subsequent publication we shall be able to show the same phenomenon, when the western part of the province of Zeeland will be taken into consideration, in which the material dealt with is sufficiently large.

Conclusions.

This second investigation of the settled population in provincial districts leads to the same results as those obtained in the Over Veluwe and

confirms the results from the extensive material taken from Netherland students, namely an absence of significant correlation between bloodgroup and the other anthropological traits investigated. Taking into consideration the probable errors no correlation can be traced.

The percentage of bloodgroup *B* is rather high, if the material is considered without the borough of Puttershoek with its very low percentage of that group (the material investigated at Puttershoek covers more than $\frac{1}{3}$ part of the total number of cases). In subsequent publications it will be seen that the percentage of *B* obtained in these islands, with the exception of Puttershoek, is as high as that found in the islands of the province of Zeeland and that this forms a contrast with the lower mean percentage found in many localities of the Netherlands. As stated in our former paper local variations may be considerable even between localities separated by only a few miles, which phenomenon has to be contributed to centuries of intermarriage in our small communities. The findings at Puttershoek give an other good example of this phenomenon which is responsible for the local character of our small population groups, a phenomenon which as we have stated, is reflected in the local distribution of the bloodgroups, but which anthropologically, psychologically and socially, has a much wider meaning. We will reconsider this question when the total Dutch material available has been sufficiently selected, arranged and computed. It is not impossible that in a complete survey of the material some small indications may be gathered that, as to the general bloodgroup distribution in the Netherlands, differences exist which will prove to be of some anthropological significance. There is no reason however at all to expect that a nordic and an alpine race might be traced in our country by means of bloodgroup investigation. This has only be accepted by some other authors in the first enthousiasm about the discovery of these interesting hereditary traits in man. Interesting indeed, if we consider how closely they conform to the law of Mendel without being influenced phaenotypically by any conditions of life or other external conditions.
