THE MONTHLY BIRTH-RATE[1].

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(With 5 Charts.)

I. Introduction.

Since the birth-rate is persistently diminishing, interest in the laws by which nativity is governed is steadily increasing. This interest became still more intense when, on account of the war, a large number of human lives were destroyed, causing a decrease of population in many countries. Those who fell in this war happened to be men in the prime of life, a fact which manifested itself after the war in a decreased number of births, apart from the temporary increase of births in consequence of the return of the mobilised men to their native towns.

The scarcity of food in the Central countries previous to and also after 1918, and the economic depression in the whole of Europe as a result of the war, were the causes of a rapidly falling birth-rate and a small excess of births over deaths. It is no great wonder, therefore, that the birth question is a problem which has roused the greatest interest of biologists, economists, hygienists, politicians, sociologists and statisticians.

After the war the interest was great in Holland too. I may refer here to the congress of the Anti-Neomalthusians held at Arnhem in 1919, and to the discussions on the problem of population in 1922 in the general meeting of the Society of Political Economy and Statistics. At the same time, various articles appeared in newspapers and periodicals. And in the course of 1923 the Municipal Bureau of Statistics of Amsterdam published a study on the population of that town, which contains an important and extensive chapter on the question of birth-rate. In conclusion, Prof. Methorst published in the *Economist* a study of the excess of births of boys over that of girls in Holland.

Researches in Holland.

Prof. Bolk wrote an aricle in *Het Nederlandsch Tydschrift voor Geneeskunde*, 1902, pt. II. p. 1023, on the inheritance of tuberculosis. In it, Prof. Bolk describes a tuberculous family of which six members were born in the first half of the year, thirteen others in the second half. Of those six members five died; three of them certainly, one probably, from tuberculosis. Those who

[1] *Editorial Note.* Whilst going through the press, the author's proof having been passed, we learn that this paper has recently appeared in German in the *Archiv für Hygiene*, xcv. 363–381. If the author had informed us of his intentions we should have withheld the paper in the customary manner.

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were born in the first four months of the year were physically stronger than the others. Considered from a biological point of view, the characteristic thing about this family is an increased faculty of conception in a definite period of the year; the individuals conceived in that period were in part physically strong, in part they possessed enough power of resistance to conquer a tuberculous process; the same family, however, showed a decreased faculty of conception in a second longer period of the year; the persons conceived in this period were in part physically less strong, in part they had lacked the power to resist a tuberculous process. Prof. Bolk now puts two questions: (1) Do any periods of increased power of conception occur in the life of man, whether as a general or as a family phenomenon? (2) Is the individual's power of resistance, that is, the measure of his vital strength, determined by the time of the year in which he is conceived; does it make any difference to the individual's power of resistance, whether he be conceived in this or other period of the year?

This problem may be examined from different points of view: by the statistician, but also by the physician. The former will have to analyse the figures furnished, the second will rather fix his attention on special cases. Bolk now calculated the monthly birth-rate for Amsterdam, Waalwyk and Overschie, being three types of population, during a great number of years.

In all three municipalities he found a minimum birth-rate in June; a second slightly higher minimum in November. The spring maximum for Amsterdam appears to be in March, for Waalwyk in April, and for Overschie in February. The autumn maximum is in August for Amsterdam and Waalwyk, for Overschie in September. The difference between maxima and minima is smallest for Amsterdam. From this it appears, that the curve of births for all three municipalities is essentially alike. Through the influence of social factors they differ a little in form, but that may be neglected here.

In order to make a close examination of the influence of the biological factors, the monthly course of births of children other than first-born should be traced and for both sexes separately.

This is Prof. Bolk's view of the questions, which are of interest for the biologist and upon which the statistician perhaps may be able to throw some light.

Bolk's article has incited various other persons to write on this subject. Broeksmit, in the *Nederlandsch Tydschrift voor Geneeskunde* of 1903, traced the monthly birth-rate of Rotterdam during the years 1875–1900. He, too, found a March and August maximum and a June and November minimum. By comparing the birth-rates of legitimate and illegitimate children, he found that the March maximum is the result of the great number of weddings in May, for the maximum point of March is absent in the case of the illegitimate births.

The birth maximum in May, according to him, as regards the illegitimate children, is the result of the Rotterdam fair in August. In my opinion, the absolute figures are too small to attach a high value to Broeksmit's conclusions about the births of twins.

In a following article, published in 1905 in the same periodical, Broeksmit corrects some mistakes of the first article. He had omitted to take into consideration the difference in length of the month. After putting right this mistake, it appeared to him that the spring maximum was not in March but in February, and so it was for Amsterdam, Waalwyk, Overschie and Boskoop. The autumn maximum for all places seems in September. Broeksmit shows us, with the birth figures of the village of Pernis, that the influence of a definite trade among the population, in this case the fisherman's trade, may cause births maxima and minima in other months. In other words, they may be the result of purely social conditions. This naturally makes it very difficult to trace the influence of possible biological factors.

In the *Nederlandsch Tydschrift voor Geneeskunde* of 1904, pt. I. p. 1389, van Eyk published statistics about the birth-rate at Boskoop over a period of 30 years. Now, one error is inherent in these statistics, as in some of Bolk's and Broeksmit's, namely that the figures are too small to exclude chance circumstances. Van Eyk has elaborated 3600 births and 722 marriages, which means a monthly average of 300, and of 60. Such small figures are of no use from a statistical point of view. The conclusions, drawn from them, are subject to large errors of sampling.

In the *Nederlandsch Tydschrift voor Geneeskunde* of 1914, pt. II. no. 25, Kroon publishes a very interesting memoir on the monthly birth-rate. By leaving out the first-born children and consequently the influence of marriages contracted about a year before, he got a monthly table of the later-born in Holland in the years 1907–1912. Here, too, it appeared that the spring maximum point occurs in February, but it was not so high as in the case of the first-born. The curve of the later-born is more graduated, the differences between maxima and minima not being so large as in the case of the first-born.

The statistics of the births of Berlin, published by Kroon, from which the first- and second-born have been eliminated, show about the same course as that of the later-born in the Netherlands.

Influences on the Births.

If we consider what factors may influence the births in the various months we find:

1. *The marriages.* The marriage curve shows a high maximum point in May and two lower ones in August and November. Consequently, we may expect a high maximum point with respect to the first-born in February, March and April. Kroon has found that 40 per cent. of all the first-born are born in the 9th, 10th and 11th month after the wedding month. So the influence of marriage is obvious not only from the 9th month onwards, but the great number of conceptions keeps on for a long time and the optimum does not even seem to occur immediately after the wedding.

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2. *The seasons.* About this much has been written. Prof. Bolk accepts a mating-season in spring for primeval man and therefore in his opinion the question whether any phenomena are still to be discovered which point to this primitive form of sexual life is perfectly justified. Broeksmit, van Eyk and Kroon mention a rutting-season which is supposed to exist. Kroon, however, does not believe in this explanation.

Another influence of the season is the heat of the summer months. Kroon discovered that 9 months after the hot month of August 1911, the birth-rate decreased considerably. Whereas in 1910 and 1911 the birth-rate in Berlin in the month of May amounted to 8·28 and 8·50 respectively per 100 of the population, it was only 7·84 in May 1912 and in May 1913 again 8·73. In this country the birth-rate in May 1911 was 29·6 per 1000 of the population, in May 1912, 27·4, and in May 1913, 29·6; it was also lower after the hot month of August 1911. A similar phenomenon was stated to occur in Germany, Belgium and France, which is consistent with the view that too great heat causes the number of conceptions to diminish.

3. *Festivities.* A comparatively great influence has been ascribed to fairs, Christmas and other festivals, especially as regards the illegitimate children. This is at the least very much exaggerated, if not incorrect. In 1894 an extensive report was published in Rotterdam about the abolition of the fair. In it, among other things, the influence of the fair on the illegitimate births has been examined. The Rotterdam fair is held in August and so one would expect a maximum point of birth in May with respect to illegitimate children, which is not the case; the maximum point occurs in April. Moreover, it appeared that, when in 1883 the fair was not held for some reason or other, the number of illegitimate births in May 1884 was not less than in other years.

4. *Religious customs.* The Roman Catholic season of Lent is said to cause a decreased number of conceptions. This has never been proved, and is at the least very improbable. Indeed, there are authors who declare that, on the contrary, the eating of fish and vegetables raises the sexual passion.

5. *Social conditions.* The influence of these cannot be denied. In harvest-time, when the women assist in the work, the number of conceptions is smaller. Weressajew declares that the Russian farmers' wives do not menstruate in summer, in consequence of their heavy toil.

Now the various factors may cooperate, but they may also counter-influence each other. For instance, in May many marriages are contracted, and at the same time the general external conditions of spring may stimulate the sexual passion. Both factors, therefore, cooperate towards increasing the number of conceptions. In November, on the contrary, the approaching winter will have an unfavourable influence in spite of many marriages being contracted at that time. The result in this case will be that the maximum point of births as a consequence of the greater number of marriages will be considerably lower owing to the opposing influence of the approaching winter.

Own Research in Holland.

I have tried to collect new data concerning the monthly birth-rate. In the first place I traced the birth-rate in Holland during the period 1907 to 1914 inclusive. My statistics cover 265,909 first-born children and 1,076,744 later-born. These births were classified according to months, calculating 30 days in a month and putting the monthly average equal to 100. In this way the following table was obtained (Chart 1):

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
First-born	94·3	114·7	117·6	108·7	105·4	99·8	99·4	99·5	98·5	88·4	87·5	86·2
Later-born	103·3	106·8	102·8	100·5	99·5	95·9	96·1	99·5	102·2	99·5	95·8	98·1

It must be added that in this table only the infants born alive are recorded. The numbers are big enough for reliable conclusions to be derived from them (see Appendix).

This table shows that the first-born have a high maximum point in February, March and April, with the highest point in March. Then the curve rapidly falls to June, descending very slowly until September, and after that very fast.

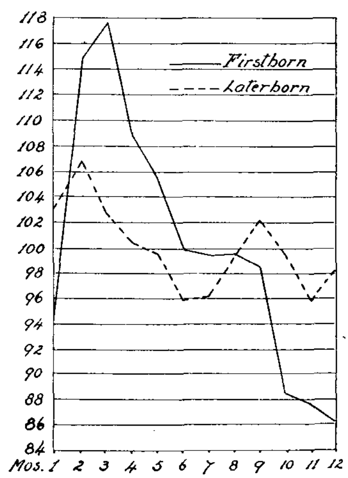

Chart 1. Monthly birth-rate in Holland during period 1907 to 1914; monthly average = 100.

There is thus one maximum point. The curve of those born afterwards shows one maximum point in February, but this one is much lower than in the case of the first-born. A second maximum point we find in September. The March point in the case of the first-born may partly be explained from the great number of weddings contracted in May.

As has been mentioned before, Kroon indicated that the greatest number of conceptions of couples marrying in May does not take place in this month, but a little later on; this is why the maximum does not reach its highest point in February, but in March. The maximum point of February of the later-born is the result of the approach of summer. The difference between the maximum point of March of the first-born and the maximum point of February of the later-born may be considered the exclusive result of the greater number of weddings contracted in May. Whether the maximum point of February of the later-born is due to the exhilarating influence of the approaching summer, or to the influence of a rutting-season, a phylogenetic survival of a male periodicity is difficult to ascertain. Most probably both influences are active here.

The cause of the September maximum cannot be satisfactorily explained. We may make all kinds of speculations about special factors, town influences, etc., but they are mere speculations.

The following table shows the birth-rate per 1000 of the population in the period 1910–1919:

Average of births per 1000 *of the population in the period* 1910–1919.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Amsterdam	22·25	23·81	23·30	22·15	22·01	21·78	22·01	22·25	22·15	21·66	21·91	22·36
Rotterdam	27·31	28·34	27·89	26·29	26·25	26·04	26·25	25·89	26·29	25·78	25·92	26·01
The Hague	23·30	24·20	23·19	21·78	22·25	22·03	21·66	22·48	23·85	22·83	21·54	22·60
Cities over 100,000 population	24·48	25·75	25·19	23·85	23·89	23·61	23·66	23·89	24·22	23·66	23·49	24·01
Munic. of 20,000–100,000 population	26·01	27·30	26·95	26·40	25·54	25·07	25·54	25·19	26·04	25·19	25·56	25·42
Netherlands	27·19	28·86	28·60	27·63	26·60	25·02	26·01	26·48	27·26	26·60	26·17	26·25

These figures prove how this September maximum point may vary. They are compiled by my teacher, Prof. Saltet, and were published last year by the city of Amsterdam in the book mentioned above.

Here we see the birth-rate in the three great cities of Amsterdam, The Hague and Rotterdam. All three show the spring maximum point. Amsterdam has a low August-September maximum, Rotterdam only a small September maximum, whereas The Hague has a very high September maximum point. What is the reason of these differences in the three great cities? In the same table the birth-rate of the great cities of the average municipalities and of the Kingdom are given. Everywhere the February maximum point appears and the autumn maximum point appears; the latter regularly growing higher in the same order of succession. One might be inclined to say that the autumn maximum is an essential characteristic of the country population, but that does not tally with the results found at The Hague, which also shows the high September maximum. Have we got to look for another explanation for this city? It will be better to say that, for the time being, we are still groping in the dark.

The monthly birth-rate of Amsterdam in the period 1910–1919 is given in the following table:

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
First-born	96·8	95·9	109·4	99·1	103·2	100·1	103·8	108·5	99·1	96·9	93·2	99·0
Later-born	104·1	99·5	105·4	97·3	99·1	94·0	98·8	100·1	97·3	100·4	99·1	104·9

We may notice a very high maximum in March for the first-born, after that smaller maxima in May and July–August. For the later-born, we find a maximum in March, not so high as in the case of the first-born, and, further, a minimum in June; and a few small maxima in May, August and October, with a higher one in December–January. So this curve runs very irregularly. As a matter of fact, we can see one distinct maximum in spring and a minimum in summer. The curve for the first-born again has a very low minimum in November. The existence of the various small maxima and minima in these curves is very probably caused by the low absolute figures, which amount to about 3500 for the first-born, for the later-born 8300 a month. One might be inclined to say that these are big figures indeed, but this is not quite correct. The elaboration of birth statistics, which depend in such a large measure on many known and unknown factors, requires very large figures. It will have been noticed already in the first table, which indicated the birth-rate in Holland and was based on about 25,000 first-born and 90,000 later-born per month, that those small maxima had disappeared. It is only averages based on large figures that are of value.

Legitimate and Illegitimate Births.

I propose to study this spring maximum from another point of view. I have traced the monthly birth-rate for legitimate and illegitimate children in Rotterdam. For the legitimate children I was able to collect the figures for the years 1885–1923, for the illegitimate ones for 1868–1923. In this way I had about 35,000 births for the legitimate births per month, for the illegitimate births 2000. This last figure is too low, but it will suffice for establishing a spring maximum. I then calculated the following table (Chart 2):

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Legitimate	104·9	108·2	102·9	99·9	100·2	99·0	97·2	97·8	97·9	95·6	97·0	99·4
Illegitimate	109·8	110·7	98·7	101·2	101·5	97·9	102·3	90·0	97·6	94·5	99·5	96·3

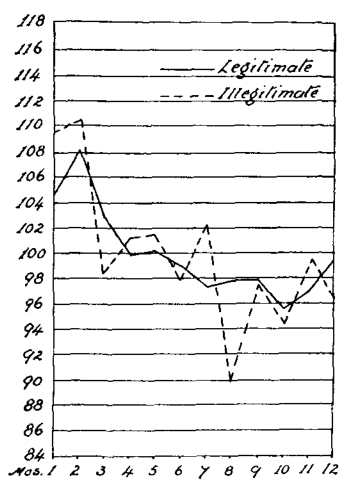

Chart 2. Monthly birth-rate for legitimate and illegitimate children in Rotterdam; monthly average = 100.

The curve for the legitimate births runs fairly regularly with a maximum in February. For the illegitimate children the curve runs very capriciously, which very probably is the result of the small figures; so I shall not enter into

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details. I only want to point out, and this is important here, that there is a distinct January–February maximum, which is beyond the ordinary limits of simple sampling.

This maximum point is higher than for the legitimate children. Now it is remarkable that Broeksmit did not find a spring maximum point for the illegitimate births in Rotterdam in the years 1875–1900. So it is clearly demonstrated what faulty conclusions we may arrive at by using too small absolute figures. Broeksmit had concluded from them that the spring maximum must be the result of the many weddings in May, without making any distinction between first- and later-born children. To me that January–February maximum of the illegitimate births is sufficiently explained by the opportunities which are offered to the young people in April and May to spend the evenings together in the country on the quiet roads near the town, with all the temptations connected with these excursions. Perhaps the influence of a survival of the rutting-period is to be taken into consideration.

In this connection I refer to the statistics of Prussia covering the years 1886–1895, where the curve for the legitimate births has a maximum point in February and a higher one in September.

Birth-rate in Prussia; monthly average = 100.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Legitimate	103·7	104·2	102·7	99·3	96·2	93·9	95·5	99·3	104·9	99·6	100·0	100·7
Illegitimate	116·6	116·7	111·6	105·3	102·7	97·7	90·0	86·4	96·4	85·0	92·6	104·0

The curve of illegitimate births again shows a high February maximum like Rotterdam. What is the reason of the September maximum of the legitimate births? I cannot tell, as a closer study of the Prussian material would be required.

II. Wolda's Theory.

In the Dutch periodical *Genetica*, 1923, pts. 5–6, Wolda has published an article on "Acclimatisierung und Deklimatisierung." In this important essay Wolda arrives at the conclusion that the periodicity of births among men as among birds is entirely dependent on biological and climatological influences, social influences excluded. For this purpose, he traced the available figures of the births in the city of Amsterdam during the years 1908–1923 (179,000 births), and found the same results as he had obtained in long years of study among some kinds of singing-birds.

Objections to Wolda's Theory.

There are some objections to Wolda's theory as regards the periodicity of births among men.

1. The number of births, from which he draws his conclusions, is too small for chance circumstances to be excluded. For instance, he has 886 births from fathers under twenty, 4282 births from mothers under twenty and 1092 births from mothers of 45–49 years of age, distributed over the 12 months of

the year, and ventures to draw far-reaching conclusions from these small numbers.

2. He talks about a maximum point in the curve, when the line descends a little more rapidly, be it ever so little. Now, from a statistical point of view, one must not call such a small crest a maximum point, not even a relative maximum point. At the utmost one may say that the line descends more quickly.

3. The influence of social factors is entirely put aside; so, for instance, the fall in the birth-rate in April-June 1919, and the great rise after that is entirely ascribed to the epidemic of influenza of 1918, which is introduced as a "provisorische Deklimatisierung." In my opinion he here forgot the most important factor, the demobilisation of 1918.

4. Wolda assumes two maximum points in the curve, indicating the number of changes of residence; in reality there are four.

5. Wolda holds that 9 months after each wedding a child is born. Kroon, however, has shown that the maximum number of births does not occur before 11 months after the wedding, apart from the fact that with 45 per cent. of the marriages the birth of the first child occurs within 9 months.

6. The comparative regularity in the periodicity of births from parents of 20–44 years of age in Amsterdam need not be the consequence of endogenous causes, as Wolda thinks, but may be the consequence of the use of large numbers through which random variations are more or less eliminated, whereas the irregularities, which present themselves above and under this period of age, may arise from too small absolute figures.

The above are the principal objections from a medical-statistical point of view to Wolda's theory of trying to find among men, especially in the birth-rate at Amsterdam, what he has found among birds.

Own Researches.

A closer study of the birth-rate in Holland opened a few new points of view to me, which have confirmed my opinion, that the periodicity of births depends on exogenous as well as endogenous causes.

The material which I used for my study covers the births in Holland during the years 1907 to 1923 inclusive, being in total:

Legitimate first-born among the live-born registered (1907–1923)	626,503
,, later-born ,, ,, ,, ,, ,, ,,	2,276,729
Illegitimate first-born ,, ,, ,, ,, (1916–1923)	22,689
,, later-born ,, ,, ,, ,, ,, ,,	7,164

When we divide 1000 male and 1000 female births in Holland of each group of the period 1907–1923 according to the twelve months, a month being reckoned 31 days, then we find:

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Legitimate first-born Boys	78·9	95·0	95·8	89·8	87·1	83·4	82·5	82·4	82·2	74·9	73·9	74·1
Legitimate first-born Girls	78·7	94·4	96·7	89·9	86·9	83·4	82·3	81·7	82·5	74·5	74·6	74·4
Legitimate later-born Boys	85·8	89·1	85·8	84·3	82·6	80·2	80·3	82·3	84·8	81·9	80·9	82·0
Legitimate later-born Girls	86·1	88·7	86·1	84·9	82·8	79·9	80·4	82·4	84·4	81·4	80·5	82·0
Legitimate first-born	78·8	94·7	96·1	89·8	87·0	83·4	82·4	82·1	82·4	74·7	74·3	74·3
Legitimate later-born	85·9	88·9	86·0	84·6	82·7	80·1	80·3	82·3	84·6	81·9	80·7	82·0

This table shows that in both groups the difference between the periodicity of the births of boys and girls is not large. The lines almost cover each other. Among the first-born (Chart 3) we find a high maximum in February to March, then a strong descent till June, after which the line runs rather horizontally till September. After descending again rapidly till October, it continues horizontally to the end. Among the later-born (Chart 3) we find two maxima, one in February and one in September. The February maximum of the latter is not by far so high as in the case of the first-born.

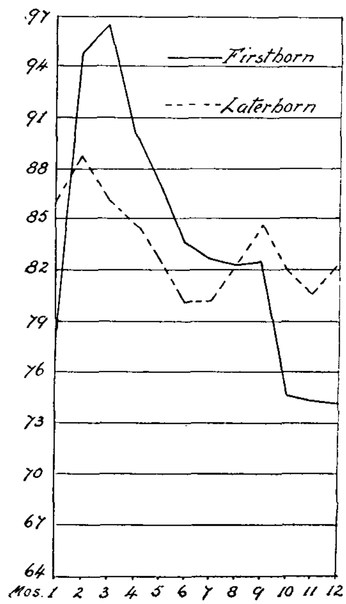

Chart 3. Division of 1000 male and 1000 female births in Holland (legitimate first-born and legitimate later-born) during the period 1907–1923 according to months.

It is possible to divide the marriages in Holland of the years 1920 up to 1923 inclusive according to the months. In total, 251,615 marriages were contracted in that time. A yearly total of 1000 gives the following numbers in the calendar month:

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
61·8	70·5	57·0	99·5	145·6	94·9	74·2	88·6	82·7	77·8	88·7	58·7

We notice here a very high maximum in May and lower ones in August, November and February. Those in August and November are equally high, the one in February the lowest. The May maximum will result in a high maximum in the birth curve of the first-born by the cooperation of various influences (see pp. 276 and 277). As a consequence of the February and November maximum the descent of the birth curve will come to a standstill in the months October–December and July–September. The result of the August maximum is not very conspicuous in the curve of the first-born. There is not such a strong descent in May, it is true; in the period April–May this birth-rate has a fall of

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2·8 and in May–June 3·6. The less rapid descent in May may be attributed to the August maximum of the marriages. So we see that the course of the curve of the first-born is to some extent dependent on the marriage curve. However, this does not mean that it depends exclusively on the latter. As has been pointed out before, endogenous influences also play a part in the case of the first-born, though they are still more evident among the later-born. The explanation of this curve with two maxima I have given before.

Births in Towns and Country.

I thought also that it might be important to trace whether the various influences are equally active in the towns and in the country. For this purpose I classed the births in Holland in five groups:

I. Municipalities above 100,000 inhabitants.
II. Municipalities of 50,001–100,000 inhabitants.
III. Municipalities of 20,001–50,000 inhabitants.
IV. Municipalities of 5,001–20,000 inhabitants.
V. Municipalities of 5,000 and less inhabitants.

In the following I shall indicate these groups by Roman figures for the sake of shortness. The division of the births in these groups according to the months was as follows:

			Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Legitimate first-born	I	Boys	79·3	86·8	86·6	84·0	88·0	87·2	86·4	85·5	84·7	78·0	75·7	77·8
		Girls	78·3	85·9	87·6	84·2	87·3	86·3	84·3	84·3	83·9	79·2	78·9	79·8
	II	Boys	75·6	87·4	91·2	90·8	91·7	85·4	83·3	84·0	81·9	74·6	78·8	75·3
		Girls	78·9	86·9	91·8	87·9	86·3	88·8	89·2	82·2	84·3	73·2	75·3	75·2
	III	Boys	79·9	87·1	87·9	86·2	87·5	86·4	85·9	83·3	86·2	77·0	76·8	75·1
		Girls	81·8	89·7	87·9	87·2	85·8	83·3	88·2	81·5	83·4	73·9	78·4	78·1
	IV	Boys	77·9	99·3	99·4	93·1	86·7	83·4	81·3	81·9	80·0	73·2	71·3	72·5
		Girls	76·7	97·8	101·7	93·0	88·4	81·7	80·1	81·5	81·3	73·6	72·3	71·9
	V	Boys	80·5	102·8	102·4	91·8	84·5	80·0	78·6	78·5	81·2	74·0	72·9	72·8
		Girls	79·9	100·6	104·9	92·8	84·5	79·9	78·8	78·9	81·9	72·6	73·1	72·1
Legitimate later-born	I	Boys	86·2	89·2	85·6	82·0	82·1	81·5	80·9	82·4	83·3	81·3	82·1	83·6
		Girls	87·6	90·0	85·5	83·2	82·2	79·1	81·6	81·5	83·8	81·0	82·0	82·5
	II	Boys	87·0	90·1	86·0	83·5	84·0	81·1	82·2	79·6	83·4	79·2	80·8	83·1
		Girls	88·2	89·4	86·8	84·0	81·9	80·7	82·2	80·6	83·0	81·2	79·4	83·6
	III	Boys	86·2	86·7	84·5	83·6	83·4	80·9	81·7	83·8	82·1	81·8	81·2	84·1
		Girls	84·7	89·5	85·6	85·8	84·1	81·1	80·1	81·5	82·8	81·0	81·4	82·4
	IV	Boys	86·2	88·5	85·9	85·0	82·1	79·3	80·2	82·2	85·5	81·9	81·4	81·8
		Girls	86·4	87·7	85·8	84·3	83·6	79·1	79·5	83·4	84·4	82·2	80·8	82·8
	V	Boys	84·2	88·2	86·5	83·6	82·5	85·8	79·4	82·0	84·4	82·5	80·3	80·6
		Girls	84·1	87·6	86·0	85·9	82·3	80·5	80·3	82·6	85·3	83·0	80·4	82·0

Legitimate First-born.

In examining first the group of the legitimate first-born among those registered as live-born, we clearly notice a large difference between I, II and III on one side and IV and V on the other. Among the former we do find a maximum in February–March, but this is not nearly as high as among the latter. We may express it in this way: Among the former, the curve is more flattened out than among the latter. I feel inclined to ascribe the irregular course of the curves II and III to the comparatively small absolute numbers. The division of the legitimate first-born into the five groups is as follows:

	I	II	III	IV	V
Boys	70,957	18,083	32,878	85,827	79,384
Girls	66,941	16,904	30,858	80,717	74,527

Group II, with the smallest number of births, has a curve running capriciously; the difference between the curves of boys and girls is largest here. Then follows III, which runs a little more regularly, it is true, but still shows a rather large difference between the two sexes. In the case of the other ones, the difference between boys' and girls' births is very small. Here the curves show a more regular line. The curve of I (the large towns) is the flattest; that of V has the largest differences.

If we put together I, II and III and also IV and V, in other words, if we class the legitimate first-born into two groups: municipalities over and under 20,000 inhabitants, then we find:

		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
I, II and III	Boys	78·9	87·0	86·6	85·6	88·6	86·7	85·8	84·7	84·7	77·2	76·5	76·7
	Girls	79·3	87·1	88·3	85·5	86·7	85·9	86·1	83·3	83·9	76·8	78·3	78·8
IV and V	Boys	79·1	101·8	100·9	92·5	85·7	81·6	80·0	80·3	80·5	73·6	72·1	72·7
	Girls	78·2	99·1	103·3	92·9	86·5	80·8	79·4	80·3	81·8	73·1	72·7	71·9
I, II and III		79·1	87·1	88·0	85·6	87·6	80·3	85·9	84·0	84·2	77·1	77·4	77·7
IV and V		78·7	100·0	102·1	92·7	86·1	81·2	79·7	80·3	81·1	73·4	72·4	72·3

From this we see that in both groups the difference between boys' and girls' births is small. However, now the difference between the two groups appears very clearly (Chart 4). Therefore in the two last lines of the above-

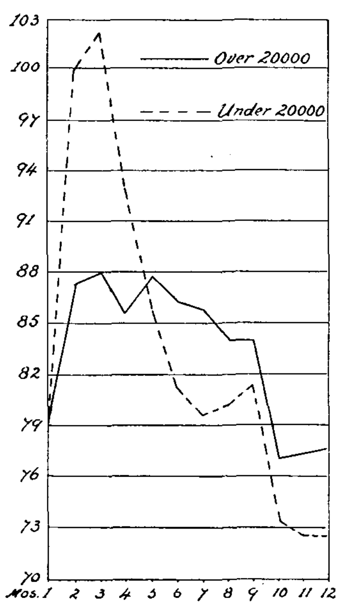

Chart 4. Division of 1000 legitimate first-born of each group of municipalities according to months.

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mentioned table we have joined the boys and girls in order to accentuate the difference.

We may thus conclude:

The periodicity of births in municipalities of over 20,000 inhabitants differs from that in municipalities under 20,000 inhabitants in this way, that the latter shows a very high February–March maximum, whereas in the case of the former the spring maximum is low and the curve broadens from February to July with a depression in April. In the group under 20,000 inhabitants we find a September maximum, in the other groups there is a tendency towards forming a September maximum. In this connection I have traced a division of the marriages according to the months in the five different groups of communities, and I found for the period 1920 to 1923 inclusive:

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
I	63·1	75·9	71·8	74·2	99·5	96·1	82·1	103·0	93·0	80·9	89·3	71·2
II	65·1	77·6	52·5	84·7	116·5	96·9	80·0	103·4	85·8	82·8	95·5	59·2
III	60·4	74·4	58·7	93·2	117·0	90·9	82·6	96·7	88·8	80·4	92·7	64·2
IV	59·7	65·2	49·6	100·5	191·4	94·1	69·3	79·3	77·0	74·8	85·9	53·2
V	62·3	66·0	48·8	135·0	172·5	95·8	64·3	73·5	73·2	74·5	86·7	47·4
I, II and III ...	62·7	75·7	65·2	81·0	106·8	94·8	81·9	101·9	90·3	81·1	91·2	67·4
IV and V	60·9	65·6	49·2	116·9	182·7	94·9	66·9	76·5	75·2	74·4	86·3	50·5

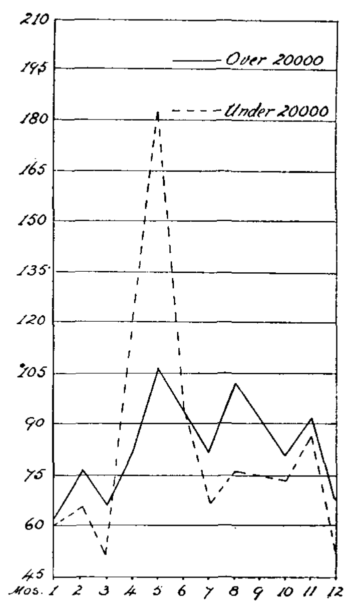

Chart 5. Division of 1000 marriages of each group of municipalities according to months.

From this we see also that the line of the periodicity of marriages in the groups I, II and III has been flattened, the greatest flattening occurring in V. In IV and V we find very high maxima in May. So that among the marriages Chart 5) we may distinguish the same two groups as among the births, with the same differences, viz. under 20,000 inhabitants a high May maximum and over

20,000 a lower one. Wolda mentions a quarterly periodicity with the maxima in May, August, November and February, which in this order of succession show a regular but distinct decline. This is true as regards the communities of over 20,000 inhabitants, but not as regards the other ones. If we now compare the marriage curve with the curve of the first-born for the two large groups we notice a moderate accordance in this sense, that the marriage curve and the birth curve, as regards communities of over 20,000 inhabitants, correspond in many respects, as did those for the other group of communities. Entire correspondence does not exist, and this is chiefly due to three reasons:

1. The marriages have been taken during the period 1920–1923, the births during 1909–1923. The absolute figures of the marriages are thus comparatively small and subject to chance variations.

2. The maximum of births generally does not occur exactly 9 months after the wedding, but about 11 months after it.

3. Besides the time of marriage many other influences are at work in determining the periodicity of the first-born.

Nevertheless, the high May maximum of the marriages in the small communities and the high maximum of births in February in the same group are striking. Our conclusion is that the form of the curve of the monthly birth-rate of the first-born infants registered as living largely depends on the curve of the marriages.

LEGITIMATE LATER-BORN.

When we now trace the periodicity of birth of the later-born infants, then we find the same type of curves for the five groups of communities. The difference between boys' and girls' births is not striking. The lines run almost parallel. There may be some exception here and there, as for instance the month of June in communities with 5000 and less inhabitants, where the boys show a maximum, the girls a minimum, but this is a very great exception.

Another point of interest is that we cannot divide the later-born into two groups as in the case of the first-born, for the 10 curves are all of them approximately alike. One curve may be a little flatter than the other, but the large differences we noticed before in the case of the first-born are absent here. This means that in the towns and in the country the same factors are at work, which influence the birth-rate of the later-born as regards the periodicity. What those factors are we do not know, and it does not matter for the present, but they are the same for the towns and for the country, and they comprise the endogenous causes. So if those endogenous causes are the same in the case of the later-born, why then should we not be permitted to assume that they are also the same in the case of the first-born? Endogenous causes are inborn qualities, which will influence the first-born, as well as the later-born. At least there is no reason to suppose that endogenous causes will not affect nulliparae and that multiparae will be influenced by them. So the difference in the spring maximum of the first-born of the two large groups of communities is only the consequence of an exogenous phenomenon, in this case the marriages. That there is such a large difference in the marriage curve for the two groups may again be attributed to social factors upon which we shall not enlarge any further.

Perhaps objections will be made against my talking of parallel curves, though rather considerable differences may be indicated. This is only partly true. We should not forget that it is impossible to explain each rise and fall in the curve. There are too many factors, endogenous and exogenous ones, which influence the birth-rate. We must follow the chief lines and neglect the small deviations. In doing so we see the point of difference and correspondence, which showed above and which I have tried to explain.

Conclusions.

1. In order to get trustworthy statistics about the monthly birth-rate it is necessary to work with very large figures at least above 20,000 births a month.

2. The periodicity of births in the case of the legitimate first-born, registered as living in Holland, is of two types: (*a*) for the communities of over 20,000 inhabitants; (*b*) for the communities of under 20,000 inhabitants.

3. The same differences occur in the periodicity of the marriages.

4. The periodicity of births of the illegitimate later-born infants, registered as living, is approximately equal for the five groups of communities in Holland.

5. The periodicity of births of the legitimate first-born infants, registered as living, depends for the most part on the periodicity of marriages.

6. The endogenous causes, which influence the periodicity of births, are the same both for the towns and for the country.

7. The differences in the periodicity of births of the legitimate first-born infants, registered as living, which appears in the two large groups of communities are caused by exogenous factors, in this case the periodicity of marriages in these two groups.

8. The spring maximum of births in the case of the first-born is partly to be explained from the many marriages contracted in May.

9. The spring maximum which also occurs in the case of the later-born may be perhaps wholly explained by the exhilarating influence of spring with regard to the later-born, partly so with regard to the first-born. Besides, there may be other influences, for instance, social causes, such as larger wages in summer.

10. The spring maximum in the case of the illegitimate births may be explained from exogenous and endogenous causes. The latter may act alike on legitimate and illegitimate births; the former include a greater opportunity for seclusion out-of-doors.

APPENDIX.

Absolute Figures of the Tables.

Births in Holland during the period 1907 to 1914.

First-born.

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
21,326	23,432	26,586	23,773	23,836	21,841	22,470	22,485	21,547	19,983	19,151	19,479

Later-born.

94,277	88,048	93,823	88,800	90,778	84,751	87,770	90,823	90,302	90,874	84,664	89,560

Legitimate and illegitimate births in Rotterdam for the years respectively 1885–1923 and 1868–1923 (calculated 30 days in a month).

Legitimate (1885–1923).

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
35,500	36,653	34,837	33,812	33,928	33,527	32,912	33,114	33,161	32,363	32,852	33,650

Illegitimate (1868–1923).

2,206	2,225	1,984	2,034	2,040	1,967	2,057	1,812	1,962	1,899	1,999	1,936

Births in Holland according to the sex in the period 1907–1923.

Legitimate first-born.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Boys	25,976	28,276	31,536	28,601	28,676	26,572	27,148	27,127	26,198	24,647	23,547	24,411
Girls	24,397	26,431	29,965	26,958	26,939	25,000	25,492	25,318	24,732	23,081	22,372	23,056

Legitimate later-born.

Boys	102,354	95,876	102,360	97,187	98,455	92,403	95,769	98,012	97,776	97,690	93,258	97,806
Girls	97,166	90,534	97,157	92,861	93,527	87,365	90,828	93,010	92,260	92,425	87,997	92,653

Marriages in Holland in the period 1920–1923.

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
15,575	16,014	14,356	24,234	36,684	23,098	18,666	22,285	20,138	19,566	21,689	14,859

Births in the five groups of municipalities (1909–1923).

Legitimate first-born.

		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
I	Boys	5,732	5,672	6,257	5,872	6,365	6,098	6,246	6,181	5,922	5,642	5,298	5,627
	Girls	5,355	5,306	5,987	5,567	5,967	5,707	5,760	5,769	5,556	5,409	5,225	5,463
II	Boys	1,394	1,455	1,683	1,621	1,691	1,522	1,537	1,549	1,461	1,375	1,407	1,388
	Girls	1,367	1,362	1,592	1,476	1,495	1,491	1,548	1,424	1,413	1,269	1,263	1,304
III	Boys	2,679	2,638	2,947	2,798	2,935	2,805	2,882	2,794	2,798	2,581	2,494	2,519
	Girls	2,574	2,554	2,771	2,657	2,702	2,539	2,778	2,567	2,540	2,327	2,390	2,459
IV	Boys	6,815	7,863	8,713	7,888	7,601	7,064	7,129	7,178	6,764	6,409	6,044	6,359
	Girls	6,317	7,283	8,381	7,411	7,285	6,507	6,595	6,720	6,481	6,059	5,762	5,916
V	Boys	6,521	7,515	8,304	7,201	6,842	6,277	6,363	6,355	6,366	6,004	5.753	5,893
	Girls	6,073	6,904	7,984	6,833	6,422	5,886	5,988	5,998	6,030	5,520	5,410	5,481

Legitimate later-born.

I	Boys	17,743	16,688	17,632	16,329	16,911	16,234	16,644	16,955	16,598	16,733	16,351	17,202
	Girls	17,132	15,919	16,736	15,773	16,081	14,988	15,969	15,952	15,858	15,861	15,514	16,149
II	Boys	4,848	4,539	4,797	4,506	4,677	4,373	4,576	4,435	4,499	4,409	4,360	4,629
	Girls	4,698	4,303	4,625	4,335	4,366	4,156	4,378	4,291	4,275	4,271	4,093	4,454
III	Boys	9,324	8,477	9,151	8,756	9,031	8,362	8,825	9,055	8,780	8,844	8,491	9,093
	Girls	8,728	8,331	8,814	8,555	8,661	8,077	8,226	8,394	8,252	8,329	8,105	8,487
IV	Boys	29,313	27,196	29,216	27,969	27,935	26,086	27,260	27,916	28,110	27,834	26,754	27,775
	Girls	27,593	25,282	27,381	26,040	26,689	24,423	25,360	26,607	26,012	26,212	24,929	26,411
V	Boys	28,069	26,531	28,826	26,968	27,489	25,728	26,470	27,311	27,193	27,474	25,884	26,841
	Girls	26,469	25,211	27,052	26,168	25,892	24,508	25,281	25,977	25,939	26,103	24,444	25,785

Marriages in the five groups of municipalities in the period 1920–1923.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
I	4,390	4,763	5,001	4,993	6,909	6,468	5,712	7,166	6,262	5,629	6,009	4,951
II	1,261	1,358	1,017	1,589	2,251	1,817	1,550	2,009	1,609	1,604	1,791	1,148
III	1,990	2,215	1,934	2,971	3,853	2,899	2,723	3,187	2,830	2,648	2,956	2,114
IV	4,063	4,011	3,374	6,622	13,035	6,198	4,715	5,396	5,071	5,091	5,661	3,623
V	3,842	3,677	3,010	8,059	10,636	5,716	3,966	4,531	4,366	4,594	5,272	2,923

(*MS. received for publication* 1. VII. 1925.—Ed.)