Statistics. — "*Relations between mortality of infants and high temperatures.*" By Dr. E. VAN EVERDINGEN. (Communicated by Prof. C. H. WIND.)

In the "Statistische mededeelingen uitgegeven door het bureau van statistiek der gemeente Amsterdam" the other day a treatise appeared as N° 19: "Kindersterfte in Nederland (in de jaren 1881—1905)" by Prof. Dr. R. H. SALTET and Mr. PH. FALKENBURG.[1]) The authors point to the fact of the existence of a distinct maximum in the mortality of children under one year of age in the summer-months, and try to find among others a relation between the amplitude of this maximum in different places and in different periods, and the monthly means of temperature at neighbouring places in the same periods. The result is rather negative; hence they write as follows:

"Also from the chronological comparison of the mortality of infants and temperatures, as given by us here for Zealand and the town of Groningen, we are only able to draw a negative conclusion. If in a single case we may speak of parallelism, in the majority of the cases no direct relation between temperatures and mortality of infants can be traced. In so saying we do not imply that we have proved the statement, that the mortality of infants should be independent of the condition of the air. On the contrary, the diagrams we gave furnish the most evident proofs of a relation between the condition of the air in the summer and the mortality of infants. But it is not the height of the temperature which regulates this mortality. As we remarked before, in our opinion the probability remains, that the temperature-fluctuations of the summer — diurn or interdiurn — are the causes which exert an obnoxious influence. The data concerning these fluctuations fail however and cannot in our opinion be replaced by data about temperature-frequencies, which the Meteorological Institute would be able to furnish. We cannot but with a single word refer here to the theory which connects the summer mortality of babies with the presence in this season of a larger number of insects, bearers of disease-germs. Positive facts enabling to further investigate this matter are lacking at present.

Hence there is reserved here a vast field of research for the zealous investigator of the future.

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1) A german translation of this treatise appeared under the title: "Statistische Mitteilungen des Statistischen Amtes der Stadt Amsterdam N°. 19. Kindersterblichkeit besonders in den Niederlanden, bearbeitet von Prof. Dr. R. H. SALTET and Dr. PH. FALKENBURG.

2. We think we can show that the writers have expressed themselves here in too definite terms, and that a distinctly positive result is obtained if another method of research is followed.

Already in furnishing the mean monthly temperatures for periods of 5 years, which the writers used for their research, the present writer expressed his doubt as to whether these data were fitted for the purpose aimed at. If the fluctuations of the mortality of infants were merely directly proportional to the fluctuations of the mean monthly temperature, the relation sought for ought indeed to appear also in this way. As soon however as these data are otherwise connected — e.g. the increased mortality occurs only after the temperature exceeding a certain limit — it is no longer allowed to use mean values without further inquiry.

The research of Prof. SALTET and Mr. FALKENBURG did indeed not, as we saw before, reveal any relation between mean monthly temperatures and mortality of infants. We will demonstrate this here clearly once more by giving for a single town, Groningen, the deviations from the mean for 25 years of the 5-annual means of the mortality of infants in the summer months May-September, and by their side, in italics, the same deviations for the temperature. The former are given in hundredths per diem, the latter in tenths of a degree Celsius.

GRONINGEN 1881—1905.

Period	May		June		July		Aug.		Sept.	
1881—1885	10	—5	12	— 9	32	1	0	— 8	—9	—4
1886—1890	9	3	17	1	24	—11	— 1	— 6	9	—2
1891—1895	3	5	—10	—10	—'8	— 1	—13	4	—2	4
1896—1900	—14	—5	— 5	15	—20	6	9	11	4	3
1901—1905	— 7	2	—17	4	—16	6	6	— 2	—4	—2

If high temperature-means for 5-year-periods were accompanied by high mortalities of infants, at least the signs of the two kinds of deviations ought to agree generally. We find however 12 concordances, 12 discrepancies and 1 undecided case; hence in this way no relation is apparent.

3. It might be supposed that this very unfavourable result is caused partly by adding up the numbers for five years. In this connection we might mention that Dr. OLLAND [1]) formerly traced a

[1]) A. G. OLLAND, Invloed van het weer op het sterftecijfer. Thesis, Utrecht. 1896.

difference in the general mortality by comparing very hot and very cold summermonths. The principal causes however are different.

We now take as an example the mean mortality of infants at Groningen over the whole period 1891—1905, expressed for every month in percentages of one twelfth of the year-mortality; then we find in round percentages (l.c. p. 74, Table XLIII B).

April	May	June	July	Aug.	Sept.	Oct.
103	93	100	110	133	103	83

We will compare these numbers with the mean monthly temperatures, and moreover with the number of days with excessively high temperatures, which occurred during a similar period. In this respect we think in the first place of the days with maximum temperatures above 25° C., for which the normals occur in the "Maandoverzicht der weersgesteldheid in Nederland" [1]).

We thus find for the total number during the period 1894—1906.

April	May	June	July	Aug.	Sept.	Oct.
2	20	64	100	51	22	1

whereas the mean monthly temperatures in the period 1891—1905 are

8.6	13.0	16.6	18.4	17.6	14.7	9.6

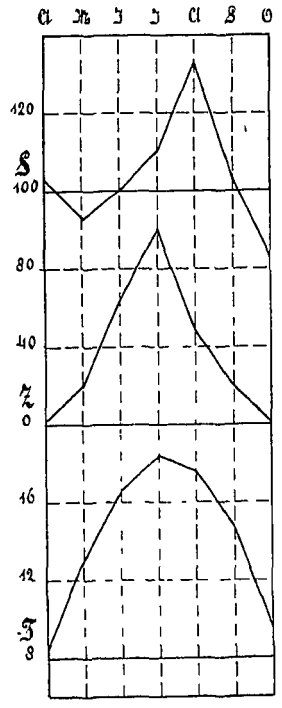

Fig. 1.

There is much more resemblance between the form of the maxima in the first two series of numbers than between those of the first and third series, as is clearly shown by fig. 1. (S mortality, Z number of days with max. temp. $> 25°$, T mean monthly temperature); but also for the second series the epoch of the maximum does not coincide with that of the first: it seems as if there is a retardation of the mortality as compared with the high temperatures.

In itself this does not look improbable. Though the writer enters here a field where he is scarcely entitled to a judgment, he thinks he may risk the supposition, that perhaps the high temperatures favour the development of diseases which only after a certain lapse of time cause death. If this be the case, then a better agreement between the fluctuations of temperature and mor-

[1]) (Monthly weather review in the Netherlands) Publ. N°. 94 Kon. Ned. Meteor. Inst.

tality must be obtained if the latter are compared with mean temperatures or numbers of days with high temperatures for a period which begins and ends a little earlier.

We have tested this conclusion by calculating the mean temperatures as well as the numbers of days with temperature above 25° — which, in accordance with a terminology used in meteorology, we will call henceforth "summer days" — once for the calendar months, once for periods from the 16th of one month till the 15th of the next month.

Both the choice of the "shift" of 15 days and that of the temperature-limit 25° are somewhat arbitrary. For a preliminary research like ours there is however no objection to this. From the table below it appears that at least for some parts of our country the shift has about the size which serves the purpose; by S are indicated the mean values of the mortality of infants for calendarmonths during the period mentioned in the first column, given in percentages of one twelfth of the yearly death-rate, as we will continue doing in the following pages; by T the mean numbers of summerdays in 5 years, for periods of one month shifted over 15 days.

Period	Place of observation	May-June	June-July	July-Aug.	Aug.-Sept.
1891—1905	S Groningen	100	110	133	103
	T Groningen	19	21	32	16
1881—1905	S Utrecht	102	130	133	97
	T Utrecht—de Bilt	18	25	22	15
1881—1905	S Zealand	72	101	159	159
	T Flushing	4	12	12	7

For Groningen and Utrecht the maxima now coincide wholly or almost so. For the province of Zealand, only partially well represented as to its climate by Flushing, a difference of a month in the epoch of the maximum remains.

4. We first give here the results of the investigation for Groningen, in which we compare successively with the deviation of the mortality in 5-year periods the deviations of:

a the common mean monthly temperatures,

b. the means for the periods May 16th—June 15th etc.;

c. the numbers of summerdays for calendarmonths;

d. the number of summerdays for the periods May 16th—June 15th etc.

GRONINGEN 1881—1905.

Period	June		July		Aug.		Sept	
	a. Mean temperatures for calendarmonths							
1891—1895	—3	*—13*	—5	*—5*	—28	*0*	—7	*2*
1896—1900	7	*12*	—6	*2*	10	*7*	5	*1*
1901—1905	—4	*1*	11	*2*	19	*—6*	2	*—4*
	b. Mean temperatures May 16th—June 15th etc							
1891—1895	—3	*—7*	—5	*0*	—28	*—7*	—7	*4*
1896—1900	7	*3*	—6	*—2*	10	*8*	5	*5*
1901—1905	—5	*3*	11	*2*	19	*—2*	2	*—8*
	c. Summerdays calendarmonths.							
1891—1895	—3	*—11*	—5	*—12*	—28	*1*	—7	*—2*
1896—1900	7	*14*	—6	*6*	10	*2*	5	*3*
1901—1905	—4	*—2*	11	*6*	19	*—3*	2	*—1*
	d. Summerdays May 16th—June 15th etc.							
1891—1895	—3	*—7*	—5	*—1*	—28	*—16*	—7	*5*
1896—1900	7	*8*	—6	*—2*	10	*9*	5	*2*
1901—1905	—4	*—2*	11	*3*	19	*7*	2	*—8*

First regarding only the signs, we find:

	concordances	discrepancies	Undecided
a	6	5	1
b	7	4	1
c	8	4	—
d	10	2	—

The differences between a and b, and between c and d give the effect of the substitution of number of summerdays for mean-temperatures, the differences between a and b, and between c and d the effect of a shift of 15 days. It appears that the improvement in the concordance of the signs is largest for the transition from b to d; in the transition from c to d in the first place the improvement also in the quantitative agreement of the deviations of mortality and number of summerdays is remarkable. Finally the agreement in case d may be called so satisfactory, that but little doubt remains whether the high temperatures must be considered as the cause of the increased mortality of infants.

Hence the negative result arrived at by Prof. SALTET and Mr. FALKENBURG was due partly to the use of mean temperatures instead of temperature frequencies, partly to their non considering a retardation of the mortality with respect to the cause of death.

We will now test the agreement in case d also for Utrecht and Zealand.

UTRECHT (de Bilt).

Period	June		July		Aug.		Sept	
1881—1885	16	— 7	17	10	—29	— 3	—13	— 4
1886—1890	15	— 4	—22	—11	—11	—14	— 2	1
1891—1895	—10	— 2	—10	— 7	— 6	—10	— 2	1
1896—1900	— 7	8	7	4	8	21	15	8
1901—1905	—21	5	7	6	46	8	3	— 6

ZEALAND (Flushing)

Period	June		July		Aug		Sept.	
1881—1885	— 3	1	11	9	21	3	—12	— 3
1886—1890	4	2	3	— 1	—30	— 3	7	0
1891—1895	9	0	4	— 1	—12	—10	— 8	1
1896—1900	—13	— 1	—11	— 5	21	7	38	7
1901—1905	4	0	— 7	0	1	1	—24	— 5

Hence so far as the signs are concerned we find:

	Concordance	Discrepancy	Undecided
Utrecht:	13	7	—
Zealand:	12	4	4

The number of concordances in these cases is large enough to show that the fluctuations in the number of summerdays play an important part in the matter of the mortality of infants, especially if we consider that at Utrecht as well as in Zealand most concordances occur in the months of large mortality of infants: July and August for Utrecht, August and September for Zealand. Doubtless there are besides them other important circumstances, not connected with temperature, the influence of which even in means for 5 years is not yet eliminated. This need not surprise us — it rather may be called remarkable that in the case of Groningen not *more* is shown of such circumstances. Whether a better agreement might be obtained by assuming a higher temperature limit for Utrecht, for Zealand a lower temperature limit and another value for the shift we have not tried so far.

The mean temperatures for the periods May 16th—June 15th etc. were not calculated for Utrecht—de Bilt and Flushing; a comparison of the methods *a*, *c* and *d* however favours the view, that no improvement would ensue. For, the result for Utrecht was:

	Concordance	Discrepancy	Undecided
a	13	7	—
c	13	6	1
d	13	7	—
for Flushing			
a	7	7	6
c	12	7	1
d	12	4	4

It would seem as if the result for Utrecht is practically the same in the three cases. If however also the quantitative agreement is considered, this appears to be wholly lacking in the case *c*, but to be much better in case *d* than in case *a*; hence the results obtained for Groningen are also here, though not so generally, valid.

5. A drawback of the use of means or sums for periods of 5

years is this, that the total number of data for comparison is rather small, and that there remains an uncertainty as to whether really the increased mortality, appearing from these means, occurred in the *same* years in which also the number of summerdays was largest. For this reason we have compiled from the "Ned Staatscourant" the numbers expressing the death-rate of children less than one year of age for the period 1881—1905, both for Utrecht and Groningen; we have expressed the monthly values in percentages of one twelfth of the yearly death-rate, and compared these data after the method of the preceding §§, by comparing the deviations from the means for the period 1881—1905 respectively 1891—1905, with the deviations of the number of summerdays between May 16th and June 15th etc.

The results are given in the following tables.

GRONINGEN 1891—1905.

Year	June		July		Aug.		Sept.	
1891	— 4	—4	— 32	—1	—47	—5	0	—2
92	35	2	—26	—5	— 9	—4	2	2
93	—26	—2	12	5	—22	—2	—37	4
94	—39	—2	2	—1	— 61	—1	— 7	—3
95	25	—2	11	0	4	—2	13	5
96	41	3	48	2	—15	2	—44	—3
97	— 2	4	—12	0	24	1	7	—3
98	— 7	—1	—67	—6	42	—2	— 2	5
99	— 3	—2	8	3	—33	5	— 8	2
1900	12	3	—11	—2	36	5	61	2
01	— 5	—3	10	3	2	13	—30	0
02	48	2	—21	1	—30	—5	— 9	—2
03	—11	0	—15	—3	1	—4	33	—1
04	—21	0	13	—4	134	5	18	—1
05	—38	—2	75	5	—21	0	6	—3

UTRECHT 1881– 1905.

Year	June		July		Aug.		Sept.	
1881	9	— 3	—14	2	—12	1	— 9	— 3
82	—17	— 3	3	— 3	—49	— 2	10	— 3
83	35	— 2	0	3	—61	— 3	— 9	— 1
84	25	— 4	35	7	7	6	—40	5
85	39	3	12	1	—41	— 3	—15	— 2
86	26	— 1	—35	— 3	—15	— 2	43	10
87	23	— 4	—17	— 1	— 9	0	—25	— 1
88	— 9	— 1	—21	— 1	—29	— 2	—27	— 3
89	27	4	16	— 1	— 8	— 4	10	— 2
90	21	— 4	—45	— 5	— 3	— 2	—15	— 2
91	—21	— 4	—28	— 3	—15	— 2	— 8	— 2
92	3	4	—22	— 4	—42	— 3	16	2
93	1	0	18	1	40	0	—21	2
94	—12	— 2	10	— 1	0	— 1	—17	— 3
95	— 4	— 2	— 6	— 2	—14	— 2	21	2
96	3	0	0	4	—13	1	8	— 3
97	17	6	19	4	0	6	— 6	— 2
98	3	2	—33	— 5	15	— 1	57	8
99	—46	— 1	27	2	14	8	13	3
1900	— 8	3	41	— 1	18	9	— 5	2
01	—17	0	20	1	21	9	—12	0
02	— 9	1	—40	1	—48	— 3	11	— 1
03	—25	3	—18	1	18	— 3	27	0
04	—45	— 1	35	— 2	174	7	6	— 2
05	— 8	0	44	5	36	0	—17	— 3

For comparison we give the same table, with the mean temperatures at Groningen for the periods May 16th—June 15th etc. (case *b* § 4). The deviations for these temperatures are given in tenths of degrees.

GRONINGEN 1891—1905 *(b)*.

Year	June		July		Aug.		Sept.	
1891	— 4	—23	—32	2	—47	— 9	—27	3
92	35	9	—26	—16	— 9	—17	4	10
93	—26	6	12	13	—22	— 4	—35	7
94	—39	—18	2	3	—61	— 1	— 5	—19
95	25	— 6	11	— 4	4	— 3	15	20
96	41	11	48	6	—15	1	—42	— 1
97	— 2	27	—12	2	24	12	9	— 8
98	— 7	— 9	—67	—22	42	— 5	0	25
99	— 3	—13	8	9	—33	14	— 6	5
1900	12	3	—11	— 4	36	15	63	3
1	— 5	— 4	10	2	2	21	—28	— 8
2	48	— 2	—21	2	—30	—29	— 7	— 6
3	—11	0	—15	—14	1	—15	35	—13
4	—21	8	23	— 4	134	13	20	— 4
5	—38	10	75	24	—21	1	8	— 8

It was to be expected that in these tables more cases would be found where the signs do not agree, or the magnitude of the deviation in one series of numbers is not proportional to that in the other series; indeed, all disturbing causes exert their full influence here. If however we leave out of consideration those cases where one of the deviations is zero, and those where the deviation of the number of summerdays is but one, or the deviation of the mean temperature not more than 0.°2 (Groningen *b*) then we obtain the following résumé:

Signs equal.				Signs opposite.		
Number of cases	Sums			Number of cases	Sums	
	T	*S*			*T*	*S*
31	114	927	Groningen	13	42	191
50	186	1275	Utrecht	19	54	308
31	38,4	836	Groningen (b)	17	14,9	366

Hence in the two first tables the number of concordances is much larger than that of the discrepancies, and, moreover, in the favourable cases the mean deviations of number of summerdays and mortality are greater, so that in our opinion no doubt remains concerning the relation between the two phenomena.

The résumé for the third table clearly shows that the parallelism with the deviations of the mean monthly temperatures is not so good as with the number of summerdays.

We may now try to find the factor, which can express this relation approximately. For this purpose we take the sum of all positive deviations of the number of summerdays, and compute the algebraic sum of the corresponding deviations of the mortality of infants. Likewise for the negative deviations of the summerdays. We thus find:

	Sum pos. dev. T	Sum S	Sum neg. dev. T	Sum S
Groningen	+ 81	+ 463	— 83	— 352
Utrecht (town)	+ 120	+ 502	— 120	— 465

Without giving all numbers in detail we may add here the result for the province of Utrecht, where 54 concordances occur against 17 discrepancies:

Utrecht (prov.)	+ 133	+ 543	— 118	— 433

The difference between sum S for positive and negative deviations of T, rather large for Groningen, is probably an indication of a non linear relation. If we overlook this and combine the two kinds of deviations, we find for the factor sought for Groningen about 5.0, for Utrecht (town) about 4.0, Utrecht (prov.) about 3.9.

6. What precedes still leaves open to doubt whether the high temperatures themselves cause the increased mortality, or, as Prof SALTET and Mr. FALKENBURG supposed, temperature-fluctuations connected with them. It might indeed be imagined that, as a rule, numerous high temperatures would be accompanied by numerous large temperature fluctuations. Though, from a meteorological point of view, this supposition did not look very probable, we have tested it likewise, for which purpose the annals of the Royal Netherlands Meteor. Institute are quite sufficient. For the same periods from the middle of one month to the middle of the next for which the summerdays had been counted, we computed for Groningen the sum of the differences of the maximum temperature from one day to another, for simplicity neglecting the tenths of degrees. The results were dealt with in the same way as before: hence the deviations of the

temperature fluctuation sums are expressed in entire degrees. The result follows here:

GRONINGEN 1891—1905.

Period	June		July		Aug.		Sept.	
1891—1895	— 3	*—19*	— 5	*22*	—28	*—16*	— 7	*20*
1896—1900	7	*31*	— 6	*9*	10	*45*	5	*— 1*
1900—1905	— 4	*—11*	11	*—31*	19	*—30*	2	*—18*

Among 12 cases there is concordance in 5, discrepancy in 7 cases, so that in this way no relation between the temperature-fluctuations from day to day and the fluctuations of the mortality of infants is shown Also the annual range of the mean amplitude of the temperature-fluctuations from day to day has another character than that of the frequency of high temperatures, the maximum of the temperature-fluctuations falls in June, not in August. Therefore we thought it useless to separately investigate the *large* or the diurn temperature-fluctuations.

7. In concluding our investigation we are well aware that it is far from complete and leaves room for various questions. If we succeeded in convincing the reader that one of the prominent causes of increased mortality of infants is an increase of the number of very hot days, we express a hope that others, may it be competent in medical matters, will feel inclined to trace the more direct relations, to explain the different character of the phenomenon in various parts of the country, perhaps with the aid of other temperature limits and other shifts. The data the Meteorological Institute is able to furnish for this purpose, also concerning other elements than temperature, will readily be put at the disposal of the future investigator.

The results obtained so far may be summed up as follows·

1st. The fluctuations of the mortality of infants bear hardly any relation to those of the mean monthly temperatures in the same months, neither with those of the mean amplitude of the temperature-fluctuations from day to day.

2nd. The number of days with maximum temperature above

25° C. ("summerdays") counted for periods from May 16th to June 15th, June 16th—July 15th etc shows fluctuations, which in a large majority of cases agree in sign with those of the mortality of infants in June, July etc.

3rd. If a simple proportionality is assumed between the deviation from the normal of the number of "summerdays" and that of the mortality in a period beginning and ending 15 days later, then for each summerday above or below the normal number the mortality of infants is increased or diminished at Groningen with 5, at Utrecht with 4% of the mean monthly death-rate.

Chemistry. — "*Action of potassium hypochlorite on cinnamide*", (2nd communication). By Dr. R. A. WEERMAN. (Communicated by Prof. S. HOOGEWERFF).

It has been stated in a previous communication [1]) that from cinnamide and potassium hypochlorite was obtained cinnamoylstyrylurea.

$$\begin{matrix} C_6H_5C^{II} = C^{H} - N^{II} \\ C_6H_5C^{II} = C^{II} - C^{O} - N^{H} \end{matrix} \Big\rangle CO.$$

This proved that in the action of potassium hypochlorite on cinnamide an intramolecular rearrangement of atoms takes place, and that it therefore becomes possible to arrive from a compound with the atomic grouping:

$$C_6H_5C = C - C - N$$

at one with the atomic grouping:

$$C_6H_5C = C - N - C.$$

A compound of this structure may be very readily obtained from cinnamide by treating this in methylalcoholic solution with an alkaline solution of potassium hypochlorite. In this way a yield of about 70 % of the urethane is obtained:

$$C_6H_5C^{II} = C^{II} - N^{II} - C^{O}{}_{OCH_3}$$

styrylaminoformic methyl ester.

B. p. 181°—182° at 14 mm. M. p. 122°—123° (corr.)

0,1674 gr. yielded 0,0914 gr. H_2O and 0,4141 gr. CO_2

0,1733 „ „ „ 12 cc. N_2 at 14° and 761 mm.

Found: 67,45 % C; 6,11 % H and 8,12 % N.

Calculated for $C_{10}H_{11}O_2N$: 67,76 % C; 6,27 % H and 7,91 % N.

[1]) Proc. 1906, 303.