THE COMPUTER IN SOCIAL HISTORY:* HISTORICAL DEMOGRAPHY IN WEST GERMANY

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Among historical disciplines, modern social history is one of the fields in which quantification is relatively often employed today. Since in Germany most professors must represent their fields "in teaching and research" at the same time, the social historian belongs almost automatically to that group of scientists whose profession compels them again and again to think about "Computers and the Humanities."

If one glances through the literature or asks around among colleagues who have themselves worked with computers, one quite often runs across a certain resignation. The labor involved in collecting and evaluating the data was often much greater than originally planned. The investment of time which turned out to be necessary for the technical implementation of the project was not, in thematic perspective, compensated by the quantity of novel results achieved. The uneasiness reported can be due to various causes: unsuitable source material, technical problems with the computer, but above all, imprecise formulation of the questions, which usually is connected to an insufficient theoretical reflection in the preliminary stages. Often one stands helpless amid a flood of rather irrelevant computer output. A mass of results can be put together in a meaningful whole only with difficulty and with renewed expenditure of time. The stolid efficiency of the computer becomes fateful for its user, who turns away and gives up.

It would be more sensible, however, to draw a balance and to consider again — more thoroughly and critically — when and in what circumstances the employment of computers is really worth while, where it makes sense and where it does not. The answer to this question, which must be based on experience, will in the end determine how the complex relationship of computers and the humanities will develop in the coming years, and whether the computer will remain the rather exclusive instrument of a few highly specialized and above all technically skilled scientists, or whether its employment will be taken into consideration at lower levels of research, even by graduate and undergraduate students, as a matter of course for the solution to this or that problem. In regard to this last point, which I think is the more important one, it seems to me essential to pass on one's experiences (including the negative ones) that is, to incorporate them into the curriculum, even when one has oneself given up. Only in this manner can a broad base of scientists be developed who know how to deal adequately with the computer as an instrument, who are in a position to judge competently which sources are suited to computer processing and which are not, who can calculate the amount of time that can sensibly be expended for the solution of problems with — and also without — the aid of the computer, and above all who know that wide-ranging theoretical preparation is the first step toward a goal-directed and promising application of the computer.

With this in mind, I would like to present the following points, which summarize five years of my own experience with the computer in teaching and research:

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*Prof. Imhof gave this lecture in April 1983 while a visiting professor at the University of Pretoria.

1 The initiation of students to computer work is achieved advantageously in groups of ten to twelve. Thus the first step of collecting, coding and feeding in the data and of reworking it into a machine-readable form can be distributed among a number of people, with the time and frustration required of each participant reduced to a fraction. The goal in each case, a common databank, makes it possible subsequently to work on more specific problems individually or in groups.

2. The computer must demonstrate its effectiveness and usefulness in a relatively short time within the framework of a particular outlined problem complex which is theoretically firm. This goal is most easily accomplished if one has the computer reorganize large amounts of data according to different perspectives or carry out simple calculations and present them in statistics and graphs.

3. Even the most simple stages of evaluation should either bring new information to light, which with another procedure could have been achieved only with a much greater expenditure of time and labor, or else reoganize and present the data so as to stimulate the historical imagination in a way which would not have been possible merely on the basis of the original source material.

4. More complex programs should contribute primarily to the solution of basically new questions rather than to the sophisticated paraphrasing of problem-solutions, which have in principle already been achieved.

5. Dependency on the computer is to be avoided. One should at all levels of research be able to carry out the essential steps of evaluation at least in part by hand.

In discussing these five points concretely, I shall concentrate on a subdivision of social history which in the past few years has been expanding rapidly throughout the world and has been developing quite dynamically: historical demography.

Establishing a Databank

With regard to a great number of contemporary research problems in the field of "human sciences," historical demography is today able to intervene in the current discussion on the basis of very substantial research results. This generalization applies to disciplines such as family history, history of *mentalité*, ethnohistory, historical anthropology or historical psychology, as well as to parts of human biology (e.g., inheritance, fertility) or medicine (e.g. epidemiology, bacteriology, hygiene, genetics, history of medicine) (Imhof, 1977a).

In my own classroom, goal was to acquaint the students with as many aspects as possible of this modern historical demography, as well as to stimulate them to independent reflection and study; in research, on the other hand, the goal was to achieve an independent investigative contribution which went beyond the current state of knowledge. A survey of the research literature soon showed that, on the basis of the great number of parish monographs, one knows a relatively great deal about the temporal-vertical development of many individual populations but relatively little about the geographic-horizontal aspects, for example, about the geographic spreading of epidemics or birth restriction and family planning, about geographic mobility, etc.

Furthermore it seemed remarkable, that most analyses concentrated on the late 17th and the 18th centuries, but that the 19th century was clearly underrepresented. As a consequence, we are still in the dark about precisely that period of time between the end of the 18th century and the establishment of statistics offices (mostly in the second half of the 19th century), during which in many places in Germany the demographic transition took place, i.e., the transition from a mode of population with high birth and death rates to a mode with low rates. Although it has long been known that this fundamental change was introduced by a decline in mortality, and that the decline, and thus the adaptation, of fertility through increased restriction of births gradually followed, nonetheless it is still undecided why and in exactly what manner the decline in mortality (which has continued up to the present), the increase in life expectancy and thus the process of superannuation, and the fundamental change in the spectrum of diseases and causes of death all began in this period of time. Where did the causes lie? Were they medical, biological, ecological, economic, demographic, or due to *mentalité*? Was it primarily a growing interest in the child, which encouraged responsibility and conscientiousness in mother and nurses and by means of improved nourishment and hygiene for infants and small children led to a drastic reduction of the enormous death rates among the youngest age groups? Or was this circumstance due rather to the influence of medicine and medicaments, above all to smallpox vaccination, which spread rapidly across the European continent at the beginning of the 19th century? Or, finally, was the demographic transition perhaps introduced by a decline in mortality among adults, which could, for example, have been based on greater administrative efficiency in securing the food supply in case of bad harvests or on increased opportunities for additional income through domestic industry (proto-industrialization)? The verification or falsification of these and other such theories, which have long been proposed and have recently again become the subject of lively discussion, was not possible except with such relevant data as detailed life-expectancy tables or mortality patterns, and knowledge of how many children survived past the reproductive phase of their parents. (Lee, 1977; Mattmüller, 1976; McKeown, 1976; Post, 1977; Razzell, 1977; for a comparison vide the French and Swedish data: Blayo, 1975; *Historisk statistik*, 1969, 11–119; Hofsten and Lundström, 1976, 40–59).

The final result of these considerations, with regard to the data bank which we wanted to establish, was that historical-demographic material had to be obtained not merely from one parish but from several neighbouring parishes, not merely for the 17th and 18th centuries, but also at least up to the second half of the 19th century. Our choice fell on the Schwalm, a region in northern Hesse in West Germany consisting of eight neighboring communities, which could all provide good source material. The data on birth, marriage, and death for around 30 000 persons as well as personal specifics (parents, spouse, children, cause of death, occupation, etc.) from parish registers kept in the respective communities, as far back as the 16th, 17th, 18th centuries, were collected by a team of twelve, who transferred the information to preprinted forms, coded them and fed them via teleprint into the computer (for a detailed methodological description, cf. Imhof, 1977b).

Reorganizing Source Material to Stimulate Teaching and Research

Whereas traditional population history works with aggregated data (of the statistical offices), historical demography bases itself on the entries in the parish registers for each of our forefathers. The processing of the sources is much more wearisome, but it brings with it considerable advantages. Above all, the individual human being can

again at any time be made the center of attention; one can investigate how this or that personal fate develops under varying circumstances. For larger groups, average values and statistical compilations easily become blurred and unsuitable to stimulate the historical imagination in a direct manner.

Thus the guiding theme for the reorganization of our data bank was to provide, on the basis of individual biographies, the best possible stimulus for the students' historical imagination. We hoped that in the examination of the well-thought-out computer printouts a number of questions would of themselves spring to mind, which the individual participants could afterwards follow up according to their interests and their available time, on very different levels and with or without the computer. In this reorganization, the computer showed itself to be a superb and convincing instrument. We had it arrange the 30 000 persons according to the simplest parent-child relations and print them out with a number of selected data and simple calculations. In this manner we obtained 7 000 reconstituted families (cf. Figure 1).

Each family printout consists of two parts. The graphic presentation above contains the personal record of each individual member of the family along a time axis, and the most important demographic data (birth, marriage, death). It is easy to make a temporal section and read off, year for year, the state and development of the family cycle. In the bottom part, the exact vital statistics of all members of the family are displayed on the one hand, and on the other hand their ages, as calculated by the computer, at marriage and death, the age of the mother at each birth, the intervals between the different births, and other relevant items are noted.

In Figure 1, the code-number 03495 suggests problems whose solutions would help us better to understand the behavior, actions and way of life of Hessian families in the past. The possibilities begin with the marriage of the parents, on March 26, 1680. Only a few dozen family data forms examined by hand, reveal that a day in March was quite unusual for a wedding. In agrarian societies of the European Ancien Régime, marriages usually took place after the completion of the harvest labors, that is, in autumn (note that children 4 and 5 married on November 6, 1714, and October 15, 1709). If we look closer, we see that the bride was, at the time of her marriage, already in the eighth or ninth month of pregnancy (birth of her first child on April 22, 1680). In order that the child come into world as legitimate, the marriage, scheduled in the middle of Lent (in the year 1680, from March 6 to April 20), would normally have run up against the Church's prohibition (Houdaille, 1978).

The eldest son's marriage, also outside the autumn months (January 14, 1710), is most likely connected with the death of his father in November of the previous year (November 8, 1709). The widowed mother (at the age of 53, no longer attractive for a second marriage) was left alone on the farm with two marriageable bachelors (26 and 24 years old). The only surviving daughter had got married in the neighboring village of Wasenberg (October 15, 1709), a few weeks before the death of her father. A young woman was needed on the farm. The eldest son waited for the end of Advent, which was also to be avoided, waited out the beginning of the new year and set a date for the middle of January.

This example can easily sharpen one's awareness of questions of the history of *mentalité*. How long was the Church able to exercise enough influence on its members to keep them from marrying during Lent and Advent? Or the other way around: when does "dechristianization" begin in the Schwalm region and in which social strata (here, occupational groups) does it occur first? Furthermore, can one ascertain in this Protestant district the same restraint in sexual matters during Lent and Advent as one would expect in Catholic areas? Concretely, were fewer than average children conceived in

FAMILY CODE-NUMBER	HUSBAND CODE-NUMBER	HUSBAND LINEAGE CODE-NUMBER	WIFE CODE-NUMBER	WIFE LINEAGE CODE-NUMBER	DATE OF MARRIAGE	PARISH	CHILDREN BORN	SURVIVING CHILDREN
03495	17234	0197	36893	0582	1680-03-26	WA	7	3

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YEAR  1650      1660      1670      1680      1690      1700      1710      1720      1730      1740      1750      1760      1770
      IIIIIIIII IIIIIIIII IIIIIIIII IIIIIIIII IIIIIIIII IIIIIIIII IIIIIIIII IIIIIIIII IIIIIIIII IIIIIIIII IIIIIIIII IIIIIIIII IIIIIIIII
HUSB     M------ ---------- ---------- R--------- ---------- ---------D
WIFE        F--- ---------- ---------- R--------- ---------- ---------- ---------- -D
CH 1                                    X
CH 2                                     FD
CH 3                                       M------ ---------- ---------- R--------- ---------- ---------- ---------- -D
CH 4                                          M---- ---------- ---------- ----R----- ---------- ---------- --D
CH 5                                             F- ---------- ---------R ---------D
CH 6                                                 F----D
CH 7                                                     MD
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FAMILY EVENT TABLE

	CODE-NUMBER	BIRTH-DATE	PARISH	AGE		DEATH-DATE	PARISH	AGE	CAUSE OF DEATH	OCCUPATION
HUSB	17234	1653-10-24	RA	26		1709-11-08	RA	56Y		PEASANT
WIFE	36893	1656-01-11	WA	24		1721-04-13	WA	65Y		
				MOTHERS AGE	INTERVAL					
CH 1	17235	1680-04-22	WA	24	0 MON	1680-04-29	WA	7D		
CH 2	17236	1681-03-27	WA	25	11 MON	1682-08-15	RA	1Y	TEETH	
CH 3	17237	1683-05-02	RA	27	25 MON	1751-11-28	RA	68Y		PEASANT
CH 4	17238	1685-11-29	RA	29	30 MON	1742-03-14	RA	56Y		TEAMSTER
CH 5	17239	1688-04-18	RA	32	28 MON	1719-07-12	WA	31Y	CHILDBED	
CH 6	17240	1691-10-25	RA	35	42 MON	1696-11-05	RA	5Y	SMALLPOX	
CH 7	17241	1695-11-29	RA	39	49 MON	1696-11-03	RA	11M	SMALLPOX	

DATE OF MARRIAGE	PARISH	LINEAGE CODE-NUMBER	FAMILY CODE-NUMBER	BIRTHS
1710-01-14	RA	0781	03511	6
1714-11-06	RA	0056	03512	0
1709-10-15	WA	0582	07493	3

LEGEND
M MALE
F FEMALE
R MARRIAGE
D DEATH
X BIRTH AND DEATH IN THE SAME YEAR
WA WASENBERG
RA RANSBACH
CH CHILD

FIGURE 1: Family reconstitution by computer

these periods? Are there temporal parallels to the development in marriages? In our example family printout only the conception of the last child falls in Lent (in the year 1695, February 16 to April 2). Likewise aimed in the direction of the history of *mentalité* is the question as to the day of the week of the marriage. Even though in our example we have data for only four marriages, it is surely no accident that they all fall on a Tuesday. When and why are such preferences developed? How long could a particular day of the week maintain itself in one parish? Which groups were the first to deviate, and when; which followed them at what intervals (Ohler, 1974–1977, 126–127; Lebrun, 1974)?

Relevant for social history and historical antrhopology is the question of geographic micromobility, above all mobility for the purpose of marriage and, in the same context, to establish and maintain a familially organized net of social security. As for the couple in our example, the man comes from the lineage code-number 0197 in Ransbach, his wife from the lineage code-number 0582 in the neighboring Wasenberg. The marriage took place on March 26, 1680 in the wife's parish, where the first two children were also born, on April 22, 1680, and on March 27, 1681. Since the second child died in Ransbach in August 1682 and the baptism of the next five children likewise took place there, the man must have returned with his family to the community of his birth between April 1681 and August 1682. It is also revealing that, in Wasenberg in 1709, the only daughter married into the same lineage code-number 0582 from which her mother came. Since the mother was also buried in Wasenberg in April 1721, she must in her old age have returned to her home community some time after the death of her husband (1709); both sons had married (1710, 1714) and her daughter died in childbirth in Wasenberg in July 1719 leaving behind three small children. (More detailed information on this question can be seen in the family printouts of the married children: families code-numbers 03511, 03512, 07493).

From this we can again infer a number of questions, at first questions on the collection of material: if we had been satisfied with a one-parish investigation, that is, had we examined the parish logs of only Ransbach or Wasenberg, we would have obtained a completely distorted picture of our family. The pastor's register in Wasenberg would have shown that the woman had been born there, that she married and brought into the world two children, one of which died at the age of seven days, and that she died there. We would have learned nothing about her husband and the five other children, unless we happened to be struck by the similarity between the maiden name of the mother and the family name of the daughter at her marriage and in this manner to discover the relevant family connection. On the other hand, in Ransbach we are shown a family with many children. There must have been at least six children, five baptized here and one buried here earlier. We would have learned nothing, however, about the mother, and would have known neither her age at marriage and at each birth nor how many children all told she brought into the world or at what age she died.

Thematic questions can be added on: how large were marriage circles? To what extent did they conform to geographic regions, administrative units, economic market areas, zones of unified behavioral patterns (e.g., religion)? Can marriage bonds be found more often than average between particular lineages, in which periods, over what distance, to what purpose? This final, central question, as well as many others, can only be touched on and partially answered on the basis of our material. For a more detailed and thorough answer we would need other kinds of sources: land registers, household lists, marriage contracts, testaments, court records, etc. (Macfarlane et al., 1977; Plakans, 1977).

Here at the latest arise the genuine historical demographic questions: How many children were born per marriage, and at what intervals? How many of them survived? Were particular goals or notions normative in this regard, e.g., three or four or five living children at the end of the parental reproductive phase? Does a difference in reproductive behavior ensue between the children chosen as heirs (above all the eldest sons) and the others? Did they marry earlier; did they have more children? Is there a direct relation between their ages at marriage and their fathers' ages, with their fathers' deaths? How large was the number of half and full orphans among non-adults? At what age did one become a grandfather or grandmother? or how many children over what period of time had at least one grandparent? Although the clarification of these and other standard questions of historical demography was the central concern of our overall evaluation of the sources, in the framework of this paper the point is not to present historical-demographic standard questions, but rather to clarify to what extent the computer by way of reorganizing databank material can provide a favorable starting position for the problematization and possible solution of questions from the broad surrounding area of the human sciences.

Our last example, taken from the bio-medical area, concerns the intergenetic intervals and the causes of death. The intervals between births differ strikingly, ranging from eleven months to more than four years. Which are biologically natural, which are intentionally lengthened intervals? This problem, especially birth control and family planning in historical time, has been much discussed in recent years (Gaunt et al., 1978; Sullerot, 1978). It is sufficient here to point out that predominantly biological mechanisms often play a decisive role (e.g., earlier renewed ability to conceive as a result of the premature end of lactic amenorrhea due to the death of the infant at a very early age; cf. in our example the small interval between the birth of child 1 — who died after seven days — and that of child 2); on the other hand, however, our ancestors were able to exercise a certain marital birth restriction when a strong enough motive existed (e.g., economic, ecological, religious, demographic). A large enough historical-demographic databank allows us to ascertain with greater precision the variations and changes in marital fertility, broken down temporally, geographically, and according to social strata.

The same holds for the causes of death caused by epidemics, although the identity of the diseases is often problematical. In only a few instances (such as smallpox) do the names used today designate the same disease entities as they designated two hundred years ago. The basic diseases, which were not understood, are not given; instead, symptoms are usually described, such as fever, dropsy, jaundice. Or babies died "of the teeth," that is, during their first and clearly perceivable, painful teething, which our knowledge today rejects in most cases as the real cause of death. On the other hand, some causes are unambiguous, as for instance childbirth or accident (Imhof and Larsen, 1977; Imhof, 1978).

In our family printout, another possible connection in regard to the male line is worth mentioning. Child 6 and Child 7 died of smallpox within a few days of each other at the beginning of November 1696. Since this infectious disease is very contagious but with recovery leaves behind a practically permanent immunity, we can assume that the other living children in the family 3, 4 and 5 either likewise took sick or else had already been immunized by an earlier smallpox epidemic. Now, smallpox (like spotted fever, leprosy, malaria, tuberculosis or — the best known — mumps) is one of those general infections which can be complicated by an orchitis, and inflammation of the testicles which frequently leads to a serious limitation (if not absolute loss) of fertility. It is therefore not improbable that the childlessness in the marriage of

the second son (child 4, family code-number 03512) is due to such an orchitis, which he had contracted in connection with a smallpox infection in his younger years.

These selected examples should have made it clear to what extent the computer can be employed with great benefit for all participants, even at this lowest level of the mere reorganization of extensive data material collected and rendered machine-readable in teamwork. The employment of the computer would have been worth while merely for the purpose of this reorganization, even if all of the problems touched on here had subsequently been pursued manually or even exclusively by qualitative methods. For the great majority of the student participants, the first contact with the computer in the humanities was effective and stimulating, that is, all in all positive.

The Solution of Complicated Research Problems

We did not, however, content ourselves with the printing out of the reorganized source material; rather we put the computer to work on a higher research level in order to pursue further some of the problems touched on above, especially for evaluations, which would have taken incomparably much more time with any other method. We can, for instance, take an example which is tied in with the above-mentioned question as to the beginning and the causes of the demographic transition in Germany. For this purpose we selected from the entire period investigated the especially relevant section from 1690 to 1869, which was then schematically divided into six time units of three decades each. Especially informative were the data in the following areas: development of life-expectancy and mortality patterns, distribution of age at marriage, number of children born, and number of surviving children per family. Tables 1, 2 and 3 contain the relevant computer calculations in a simplified and shortened form.

TABLE 1: Mortality pattern and life-expectancy of the male population in the Schwalm Region 1690—1869

Exact Age	1690—1719		1720—1749		1750—1779		1780—1809		1810—1839		1840—1869	
	M	L	M	L	M	L	M	L	M	L	M	L
0	1 000	31,5	1 000	32,1	1 000	31,0	1 000	31,7	1 000	35,8	1 000	34,2
1	729	42,2	763	41,1	760	39,8	803	38,5	803	43,5	778	43,0
5	592	47,8	589	48,9	588	47,1	602	47,0	662	48,7	632	48,7
10	554	46,1	539	48,2	542	45,9	551	46,2	625	46,5	581	47,8
15	540	42,2	524	44,6	516	43,2	536	42,5	610	42,6	558	44,7
20	518	38,9	511	40,6	501	39,4	517	39,0	587	39,2	532	41,8
25	500	35,2	492	37,1	478	36,1	491	35,9	556	36,3	504	39,0
30	486	31,1	485	32,6	459	32,5	480	31,6	536	32,6	486	35,4
35	467	27,3	467	28,8	451	28,1	462	27,8	519	28,6	461	32,2
40	440	23,9	445	25,1	434	24,1	444	23,8	493	25,0	444	28,4
45	404	20,8	418	21,6	402	20,9	424	19,9	457	21,8	417	25,1
50	372	17,5	396	17,7	376	17,2	388	16,6	419	18,6	398	21,2
55	328	14,5	352	14,7	338	14,0	332	14,0	378	15,4	367	17,9
60	294	11,0	316	11,1	281	11,4	273	11,6	327	12,6	335	14,4
65	234	8,4	246	8,7	218	9,1	220	8,9	272	9,7	286	11,5
70	150	7,0	181	6,1	156	7,0	160	6,6	205	7,2	236	8,6
75	109	5,0	90	5,0	91	5,6	90	5,0	137	4,8	166	6,2
80	43	3,4	39	3,8	47	4,1	42	3,5	65	3,0	98	4,2

M Mortality pattern (survivors at the age x out of a group of 1 000 live-born children)
L Life-expectancy (additional years expected at age x)

TABLE 2: Age distribution of mutual first-marriages (complete marriages only) in the Schwalm Region 1690—1869

Time Period	Age at marriage under 25 years				25—under 30 years				30—under 35 years				over 35 years				average		total complete first-marriages	
	m		f		m		f		m		f		m		f		m	f		
	abs.	in %	abs.	in %	abs.	in %	abs.	in %	abs.	in %	abs.	in %	abs.	in %	abs.	in %	years		abs.	in %
1690—1719	34	46,0	50	67,6	23	31,1	17	23,0	12	16,2	5	6,8	5	6,7	2	2,6	26,7	23,9	74	100,0
1720—1749	40	40,8	60	61,2	32	32,7	22	22,4	10	10,2	4	4,1	6	6,2	26,7	24,7	98	100,0		
1750—1779	47	40,9	75	65,2	37	32,2	26	22,6	24	20,9	10	8,7	7	6,0	4	3,5	27,1	24,0	115	100,0
1780—1809	53	33,5	104	65,8	65	41,1	39	24,7	25	15,8	13	8,2	15	9,6	2	1,3	27,2	23,7	158	100,0
1810—1839	52	23,6	116	52,5	107	48,4	79	35,7	48	21,7	22	10,0	14	6,3	4	1,8	28,1	25,0	221	100,0
1840—1869	40	14,3	114	40,9	152	54,5	119	42,7	68	24,4	36	12,9	19	6,8	10	3,5	28,7	26,2	279	100,0

TABLE 3: Number of children born and number of surviving children in complete marriages in the Schwalm Region 1690—1869

Time Period		*A What percent of parents had x children*										*B What percent of parents had at least x children*						*C What percent of parents had x children or less*				
				2		4	5	6			9	10—	1	2	3	4	5	1	2	3		
1690—1719	b	5,5	3,6	8,2	13,6	8,2	10,0	14,5	12,7	10,0	5,5	8,2	94,5	90,9	82,7	69,1	60,9	3,6	11,8	25,4	33,6	43,6
	s	9,1	10,0	17,3	16,4	12,7	14,5	8,2	6,4	2,7	1,8	0,9	90,9	80,9	63,6	47,2	34,5	10,0	27,3	43,7	56,4	70,9
1720—1749	b	6,8	4,7	7,4	12,2	8,1	11,5	10,8	16,2	10,1	4,7	7,5	93,2	88,5	81,1	68,9	60,8	4,7	12,1	24,3	32,4	43,9
	s	12,8	12,2	10,8	16,9	12,2	6,8	10,1	8,8	4,1	2,7	2,6	87,2	75,0	64,2	47,3	35,1	12,2	23,0	39,9	52,1	58,9
1750—1779	b	3,8	8,9	10,1	9,5	17,1	8,9	13,9	8,2	5,7	5,7	8,2	96,2	87,3	77,2	67,7	50,6	8,9	19,0	28,5	45,6	54,5
	s	15,2	18,4	20,3	13,3	8,2	8,9	4,4	5,1	1,9	3,2	1,1	84,8	66,4	46,1	32,8	24,6	18,4	38,7	52,0	60,2	69,1
1780—1809	b	3,4	5,9	9,8	10,7	10,2	15,1	10,2	10,7	6,8	7,4	96,6	90,7	80,9	71,1	60,4	5,9	15,7	25,5	36,2	46,4	
	s	13,2	15,6	20,0	13,2	8,8	8,3	7,3	6,3	3,4	2,4	1,5	86,8	71,2	51,2	38,0	29,2	15,6	35,6	48,8	57,6	65,9
1810—1839	b	4,7	6,3	9,0	11,4	12,2	11,4	14,5	12,9	7,1	3,5	7,0	95,3	89,0	80,0	68,6	56,4	6,3	15,3	26,7	38,9	50,3
	s	12,2	12,9	16,1	17,3	13,3	10,6	6,3	5,1	2,7	2,0	1,5	87,8	74,9	58,8	41,5	28,2	12,9	29,0	46,3	59,6	70,2
1840—1869	b	5,0	6,6	10,9	13,2	13,9	9,9	9,9	11,9	8,6	5,9	4,2	95,0	88,4	77,5	64,3	50,4	6,6	17,5	30,7	44,6	54,5
	s	9,6	17,2	16,8	14,5	12,2	11,2	7,9	5,0	3,3	1,7	0,6	90,4	73,2	56,4	41,9	29,7	17,2	34,0	48,5	60,7	71,9

b children born
s surviving children

It should be noted that Table 1 takes into consideration only the male population. (For methodological problems, especially on account of deficient source material cf. Wrigley, 1968; and Perrenoud, 1975). Table 2 is based on the age at marriage in mutual first-marriages. A marriage is considered complete when the fertility of the wife could be fully exploited, i.e., when both partners lived till the wife's 45th year. Table 3 shows the reproductive achievement of complete marriages. First the number of children born per marriage is determined; then the number of survivors is ascertained, i.e., the number of children actually present in the family at the end of the reproductive phase (again the wife's 45th year).

What follows from these three tables for our question complex? We shall summarize the major results in four points:

Prologue (period 1750—1779)

With a constant age at marriage for women (on the average 24,0 years; 1690—1719: 23,9; 1720—1749: 24,7 years) and with a small percentage of infertile marriages (3,8%), the number of small families increases drastically. Only in every second marriage (50,6%) are at least five children born. The number of families with seven births sinks from 16,2% in the previous period to 8,2%, of famiflies with eight births from 10,1% to 5,7%. Almost two-fifths of all couples (38,7%) have at the end of their reproductive phase two children or fewer to care for; more than half (52,0%) have three or fewer. At no other point in time had there been a greater percentage of families with one child (18,4%), two (20,3%), or three (13,3%), or couples without any children at all (15,2%); at no other time were inheritances thus divided among fewer survivors, or were fewer adults compelled to remain single, emigrate, or enter a subordinate occupation. Never before had parents been able better to accept each individual child, to nourish it better, to teach it the necessary skills, all of which could hardly have been without its positive effects on the children's future chances in a very comprehensive sense — biologically, psychologically, economically, socially.

2. *Developmental Phase 1 (period 1780—1809)*

Possibly in a causal relationship with the just-mentioned circumstances, infant and child mortality begins to sink. For the first time more than four-fifths of all live-born children (803 out of 1 000) survive their first year, and more than three-fifths (602 out of 1 000) survive the first five years. The decline in mortality among these younger age groups (since it is not again reversed) is decisive for later developments. Although the trend is clearly strengthened in the following period, there is a certain breach in the subsequent decadese; nonetheless infant and child mortality never again reached the levels of before 1780.

In the same period we can see the beginning of another long-range development, which led to the constant rise in the average age at marriage. It begins with a drastic increase (from 115 to 158) in the number of complete, i.e., long-range, stable marriages. Seen absolutely, the number of young men under 25, who have already come into a position to support a family, remains approximately constant (a minimal increase from 47 to 53); on the other hand, the number of those who have to wait longer increases sharply (among those between 25 and 30 years of age, from 37 to 65; in the following period even to 107 and finally to 152; comparably more are pushed into still higher ages). From this age displacement, which also occurs with a slight delay among

women, there results a cumulative effect, in that the life expectancy in the third decade of life (during which most marriages are contracted) declines much less quickly than in that age in which positions are set free for the next generation. A simple recalculation of the data in the mortality pattern for 1780—1809 produces the following significant results. If in this period 1 000 men married at the age of 20, 750 of them reached their 50th year, 642 their 55th, and 528 their 60th year. Out of 1 000 who married at 25, however, 790 lived to be 50, 676 to be 55, and 556 to be 60. And for those who married at the age of 30, the figures are 808, 692, and 569 for the ages of 50, 55 and 60 respectively. On the average, the later one married, the longer more and more positions remained blocked for the next generation.

3. *Developmental Phase 2 (period 1810—1839)*

In this period the situation becomes more serious in that the mortality pattern even at the greatest ages slows down drastically, with more persons getting older. The youngest age groups profit most from the increased life expectancy, which rises at birth from 31,7 to 35,8 years; at the age of one year it even rises five full years: from 38,5 to 43,5. The century-old form of the population, once pyramidal, begins to swell out in the direction of its present urn-shape.

4. *Developmental Phase 3 (period 1840—1869)*

Whereas the above-mentioned relapse into a higher infant and child mortality once again reduces the life expectancy at birth and leaves it practically the same at the ages of one year and five years, the life expectancy at all other ages increases noticeably, most clearly in the early and middle years of adulthood. At the age of 20, an individual can now count on another 41,8 as opposed to 39,2 in the previous period. At 30 it is 35,4 as opposed to 32,6; at 40 it is 28,4 as opposed to 25,0; and at 50 still as high as 21,2 as opposed to 18,6 or even 16,6 two periods earlier. Here one can see a rapid superannuation, which (although subsequently somewhat slower) has continued up to the present. From 1690 to 1809 the life expectancy at the age of 60 stood between 11,0 and 11,6 years; between 1810 and 1839 it rose for the first time clearly to 12,6 and reached, in the period under consideration here, 14,4 years. Today it is 15,5 for the male population of the Federal Republic of Germany 1971—74 (*Daten des Gesundheitswesens* 1977, 25).

In answer, then, to our theoretical question about the beginning and the causes of the demographic transition, it can thus be shown that the decline in mortality in the period 1780—1809 begins with infants and children. A clear increase in the life-expectancy of adults comes only decades later. The departure from century-old structures of mortality begins at the bottom, that is, with the youngest age groups. This conclusion justifies the assumption that the demographic transition was initiated neither by the achievements of medicine and medicaments nor by a quantitative or qualitative improvement of the food supply, both of which would have had to effect adults in equal measure; rather it resulted from a change in the attitude of parents towards their descendants, above all on the basis of an increased responsibility toward the child once conceived and born. It is not improbable that parental concern in this regard had already been sharpened in the previous period. Never before had so few children lived in so many families as from 1750 to 1779. Still to be examined are the means in each case by which the reduction of infant and child mortality was achieved (among others, better hygiene, more careful breast-feeding by mother or nurse, more

suitable substitute nourishment, etc.) (Shorter, 1977). In the following decades the interest of parents in the survival of their children was probably raised further by the longer wait to marry that was imposed on young people by the general increase in life expectancy. The later in life a marriage was contracted, the more did the phase of biological reproduction shrink and the smaller were the chances of replacing a child who had died.

The construction of life expectancy tables and mortality patterns for the time before the establishment of statistics offices is rather complicated and tiresome. Without the aid of the computer the task could scarcely be accomplished; and without these tables we would have lacked the central basis of argument for the discussion held above.

All told, the effectiveness and the goal-directed employment of the computer allowed us to reach two goals. First, it enabled us to reorganize very disparate, extensive data material in a manner that stimulated members of the research team to conceptualize their problems, to solve, partially, historical-demographic questions, and above and beyond that, to attempt general historical and interdisciplinary questions. Secondly, it was possible on a higher level of research to come a bit closer to the solution to a theoretically guided question.

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