ticularly severe energetic stress on women. A further increase in fertility associated with the water-supply project could contribute to an already great need for maternal health services and an increase in the currently low demand for contraception.

References Cited

BAILEY, R. C., M. R. JENIKE, P. T. ELLISON, G. R. BENTLEY, A. M. HARRIGAN, AND N. R. PEACOCK. 1992. The ecology of birth seasonality among agriculturalists in Central Africa. *Journal of Biosocial Sciences* 24:393–412.

BEITENS, I. Z., J. W. MC ARTHUR, B. A. TURNBULL, G. S. SKRINAR, AND B. A. BULLEN. 1991. Exercise induces two types of hormone luteal dysfunction: Confirmation by urinary free progesterone. *Journal of Clinical Endocrinological Metabolism* 72:1350–58.

ELLISON, P. T. 2001. *On fertile ground*. Cambridge: Harvard University Press.

ELLISON, P. T., N. R. PEACOCK, AND C. LAGER. 1989. Ecology and ovarian function among Lese women of the Ituri Forest. *American Journal of Physical Anthropology* 78:519–26.

FEENEY, G. A., AND J. A. ROSS. 1984. Analyzing open birth interval distributions. *Population Studies: Journal of Demography* 38:473–78.

FERRO-LUZZI, A., S. SETTER, M. FRANKLIN, AND W. P. T. JAMES. 1992. A simplified approach of assessing chronic energy deficiency. *European Journal of Clinical Nutrition* 46: 173–86.

GIBSON, M., AND R. MACE. 2002. The impact of a labor-saving technology on first birth intervals in rural Ethiopia. *Human Biology* 74:111–28.

HILL, K., AND A. M. HURTADO. 1996. *Ache life history: The ecology and demography of a foraging people.* New York: Aldine de Gruyter.

HUFFMAN, S. L., H. A. CHOWDURY, AND L. NAHAR. 1987. Nutrition and fertility in Bangladesh: Breast-feeding and post-partum amenorrhoea. *Population Studies* 41:447–62.

JASIENSKA, G., AND P. ELLISON. 1998. Physical work causes suppression of ovarian function in women. *Proceedings of Royal Society of London* B 265:1847–51.

JONES, R. E., AND A. PALLONI. 1989. Breast-feeding and postpartum amenorrhoea in Indonesia. *Journal of Biosocial Science* 21:83–100.

LOHMAN, T. G., A. F. ROCHE, AND R. MARTORELL. 1988. *Anthropometric standardization reference manual.* Champaign, Ill.: Human Kinetics Books.

PANTER-BRICK, C., D. S. LOTSTEIN, AND P. T. ELLISON. 1993. Seasonality of reproduction function and weight loss in rural Nepali women. *Human Reproduction* 8:684–90.

SHANGOLD, M., R. FREEMAN, B. THYSEN, AND M. GATZ. 1979. The relationship between long-distance running, plasma progesterone, and luteal phase length. *Fertility and Sterility* 31:130–33.

SRINIVASAN, K. 1972. *Analytical models for two types of birth intervals with applications to an Indian population.* Tivandrum, India: St. Joseph's Press.

TRACER, D. P. 1991. Fertility-related changes in maternal body composition among the Au of Papua New Guinea. *American Journal of Physical Anthropology* 85:393–405.

Paleoanthropological Traces of a Neolithic Demographic Transition[1]

JEAN-PIERRE BOCQUET-APPEL
CNRS, EP 2147 44, rue de l'Amiral Mouchez 75014
Paris, France (bocquet-appel@ivry.cnrs.fr). 5 X 01

Since Childe's (1925) detection of a ceramics gradient from the Middle East to Europe that he called the "Neolithic Revolution," various explanations of this gradient have been proposed which turn around the topics of cultural diffusion, population diffusion, or both. The number of humans is at the heart of this so-called Neolithic Revolution, either as a cause or as an effect of its geographical expansion. A kind of demographic revolution corresponding to this Neolithic revolution—a significant change from the former regime of foragers, in the form of a substantial increase in human numbers—can therefore be expected. In demographic language, such a change is called a transition.

This Neolithic demographic transition, if it took place, might be detected through three types of data and interpretive models: cultural (for example, density of archaeological sites), genetic (indications of migration), and paleoanthropological (skeletons in cemeteries). To date, demography has been inferred mainly from genetic

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[1] This work is dedicated to Claude Masset, iconoclastic researcher in paleodemographics, on his 75th birthday. I thank the referees for their valuable comments on the early draft, in particular for the anonymous reference to heroes. My thanks go to María Paz de Miguel Ibáñez (Departamento de Prehistoria, Universidad de Alicante, Spain), who helped me to start this improbable study, and to Max Baldia (Czech-American Research Program, Columbus, Ohio, U.S.A.), Jérome Dubouloz (CNRS, Soisson, France), Suzanne Eades (Departement d' Anthropologie, Université de Genève, Switzerland), M. S. Hernández Pérez (Departamento de Prehistoria, Universidad de Alicante, Spain), Mary Jackes (Department of Anthropology, University of Alberta, Canada), Christian Jeunesse (Service Régional de l'Archéologie, Strasbourg, France). Per Karsten (Riksantikvarieämbetet, Sweden), Valérie Liebs (Johannes Gutenberg-Universität, Mainz, Germany), Gilles Loison (Association pour les Fouilles Archéologiques Nationales, Montpellier, France), Bernabeu Martí (Servei d'Investigaciò Prehistorica de València, Spain), Robert McCaa (University of Minnesota Population Center, Minneapolis, Minn., U.S.A.) Chris Meiklejohn (Department of Anthropology, University of Winnipeg, Canada), Daniel Mordant (Service Départemental d'Archéologie de Seine et Marne, Dammarie-Les-Lys, France), Evžen Neustupný (Department of Archaeology, University of West Bohemia, Plzeň, Czech Republic), M. J. de Perdro (Servei d'Investigaciò Prehistorica de València, Spain), Daniel Simonin (Musée de Préhistoire d'Ile de France, Nemours, France), Arkadiusz Soltysiak (Institute of Archaeology, Warsaw University, Poland), Laszlo Szathmary (Department of Evolutionary Zoology and Human Biology, Debrecen University, Hungary), Herbert Ullrich (Humboldt Universität, Berlin, Germany), K. Zsuzsanna Zoffmann (Magyar Nemzeti Muzeum, Budapest, Hungary), and Renée A. García. [Supplementary material appears in the electronic edition of this issue on the journal's web page (http://www.journals.uchicago.edu/CA/home.html).]

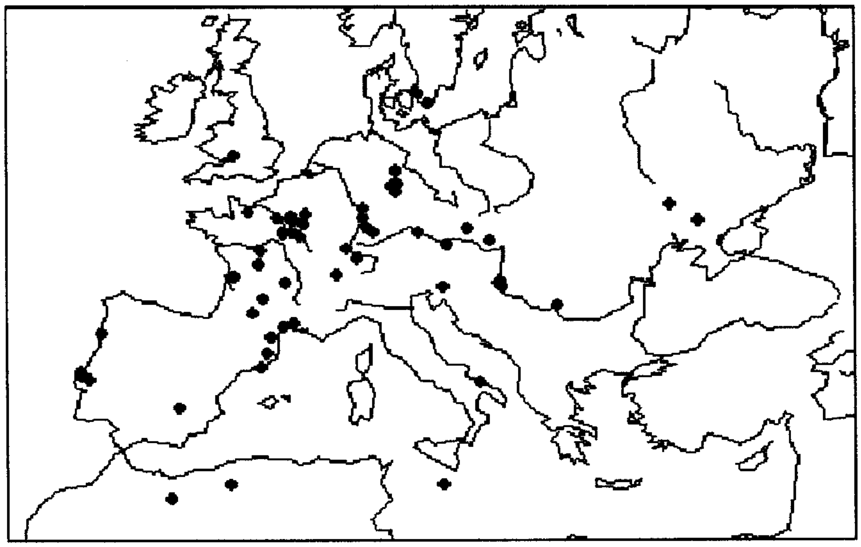

Fig. 1. *Geographical distribution of the cemetery samples.*

data, using the demic-expansion model of Ammerman and Cavalli-Sforza (1971, 1984; Cavalli-Sforza and Cavalli-Sforza 1995) via the construction of an interface between allele frequencies and the generating population process. In the demic model, the variation of the growth rate at the Neolithic diffusion front is like a wave followed by a relatively rapid decline with chronological distance (Ammerman and Cavalli-Sforza 1984:74, fig. 5.5). Five hundred years after the initial diffusion, the population reaches its carrying capacity and the growth rate returns to zero. This pattern of variation corresponds to a frontier demography (Sgaramella-Zonta and Cavalli-Sforza 1973, Ammerman and Cavalli-Sforza 1984, Bogucki 1988). The demographic signal itself—the change representing the transition—is not, however, directly observable in the data, and the model suffers from ambiguity of interpretation; the genetic pattern showing a northwest-southeast gradient can just as easily be interpreted as adaptation to the cultural diffusion of agriculture and domestication (Fix 1996).

Unlike genetic data, paleoanthropological data from cemeteries are relatively well dated and therefore capable of providing simple and relatively reliable demographic information. This information is represented as the ratio of immatures to the total skeletal population. All demographic variables being equal (life expectancy, migration, sex ratio), the proportion of immatures in a population reflects its birth rate. In a growing population the proportion of immatures is high; in a declining population it is low. Is it possible, from a paleodemographic database representing a sample of the space-time distribution of this ratio, to detect the signal of a demographic change during the Mesolithic-Neolithic transition and, if so, to characterize the importance of this change?

MATERIALS AND METHODS

The data are represented by the proportion of immature (child and young adult) skeletons uncovered in European cemeteries. Four criteria for the selection of these cemeteries were established: (1) the possibility, with a reasonable amount of manipulation, of redistributing the skeletons from unstandardized age-groups into demographic age-classes, (2) cultural homogeneity (cemeteries in which several periods were mixed were rejected), (3) the existence of absolute or relative dates for the materials, and (4) the apparently "natural death" of the individuals (cemeteries suspected to be the result of mass violent death were excluded). The geographical distribution of these cemeteries is shown in figure 1.

In spite of some progress in recent years, the literature groups skeletal materials in rather unstandardized age subdivisions. To arrive at two demographically usable age-groups, individual data were reclassified or (in the absence of individual data) nonstandard age-groups were redistributed into standard demographic age-classes (for example, the 4–6-year group into 0–4- and 5–9-year classes). [Details of this procedure appear in the electronic edition of this issue on the journal's web page.] Of the cemeteries initially retained, only four were Mesolithic (Djerdap, Moita do Sebastiào, Skateholm, and Vedbæk), not enough to represent this period. Two other cemeteries— Columnata and Taforalt, whose samples are relatively large—were subsequently added. The state of preservation of the skeletons at these sites is excellent, and the excavations have been exhaustive. They are both located in northern North Africa, but there is no a priori reason to think that the North African Mesolithic differed dramatically from its European counterpart. Basically, the scarcity of the sampled Mesolithic cemeteries is a reflection of the small size of the Mesolithic population itself, and there is not much that can be done about it. This yielded a sample of 68 cemeteries (table 1). On the hypothesis that the Neolithic demographic transition in Europe was a single demographic process, geography was eliminated from the space-time distribution of the data to preserve only the time distribution in reference to the Neolithic diffusion front.

The chronological distance of a cemetery from the Neolithic diffusion front, both situated on X, is the time interval dt separating the date of the front, $t_o(X)$, from the date of the cemetery, $t(X)$: $dt(X) = t_0(X)-t(X) = dt$. The dates of the Neolithic front were taken from Ammerman and Cavalli-Sforza (1984:59, isochrons of chart 4.5) and calibrated (Stuiver et al. 1998). To take into account recent improvements on these dates, dates from Bogucki (1996:247, chart 5) were substituted for the above when they differed, as were the chronologies of regional syntheses (Binder 1995; Chambon and Salanova 1996; Chancerel and Billard 1991; Constantin and Ilett 1997; S. Eades, personal communication, 2001; Evin, Fortin, and Oberlin 1995; Farruggia 1997; Gronenborn 1999; Lenneis, Neugebauer-Maresch, and Ruttkay 1995; Lenneis, Stadler, and Windl 1996; Lüning 1988; Stadler 1995; Voruz 1987, 1991). The (calibrated) dates of the cemeteries were either those of the original publications or the average dates of the cultures (or horizons) of these cemeteries (Arnal, Bœuf, and Fontan 1991; Binder 1987; Camps 1974; Whittle 1996:tables 3.4 and 6.3). When the chronological distance is negative, the site is located in the Mesolithic.

Nearly 25 years ago, using nonconventional demographic information provided by the juvenility index (defined as the number of skeletons of individuals that died between ages 5 and 14 divided by the number of individuals that died at age 20 or above),[2] various demographic parameters were obtained by regressions on simulated stable populations (Bocquet and Masset 1977, 1996).[3] These stable populations (simulated between a growth rate $r = -2.5\%$ and 2.5% with a step of 0.25%) were generated from 45 reference life tables with preindustrial mortality (without mass immunization and public health). To take into account the constraints of the skeletal data in the literature analyzed below, the regressions were recomputed using the ratio P of immature skeletons (5–19 years) (minus small children [0–4 years], who are notoriously underrepresented in cemeteries), to the total number of skeletons. The relationship between this ratio and life expectancy at birth (for **r** [growth rate]=0) is reasonably good, and no systematic chronological influence (17th–20th century), socioeconomic influence (farmers, horticulturists, pastoralists, rural versus urban), and/or geographical influence (Europe, Latin America, Africa, Asia) is seen on the scatterplot.

Three estimators—birth rate (**b**), growth rate (**r**), and ratio of immatures, P(*5–19*) (**e**o) will be presented, but

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[2] The original juvenility index has recently been criticized: For stable populations, its variance is large, and the variance of the resulting demographic estimates is therefore also large — larger than the estimates obtained with a technique using five parameters and even larger than the variance of the quotient $d(30+)/d(5+)$ (Paine and Harpending 1996). The reason for this large variance is simple. Let us rewrite $d(5–14)$ as a binomial variable, with $n = d(5–14)$, $N =$ the total living population, and $p = n/N$. In a table of a life expectancy at birth of 50 years such as the target table used by Paine and Harpending to test the juvenility index and two other indicators, the ratio of dead children aged 5–14 years to the total living population is relatively small ($p = 4.2\%$ [United Nations 1956: table 19]). This proportion is even smaller if the population is decreasing at a rate of 1% as Paine and Harpending simulate, since the proportion of old people in the population is increasing. For a proportion p small, if the frequency (count) becomes small, the variance var(p) becomes large and the distribution of the observed frequencies of a binominal variable, f, becomes very dissymmetrical, approaching 0. The index $d(30+)/d(5+)$ represents a more stable proportion than the juvenility index when the frequency (count) N becomes small. Certainly, using the age distribution of five age-groups in a cemetery as Paine and Harpending do—that is, working with 2.5 times more information than that provided by the juvenility index produces a smaller variance of the estimate. But these two estimators have an anthropological shortcoming that makes them difficult to use: the information they require (age-classes) is not available in a cemetery. Finally, Paine and Harpending test the informative value of the juvenility index on a population with a life expectancy at birth of 50 years ($p = 4.2\%$)—a level reached in Europe only at the beginning of the 20th century and one very different from the one for which the index was conceived (20–35 years, where $p = 25\%$ [United Nations 1956: table 35]). Testing the juvenility index on a population with a life expectancy of 80 years with practically no deaths at 5–14 years would undoubtedly have produced even worse results then those obtained by Paine and Harpending (with $p = 0$). To construct a comparative test of paleodemographic tools by measuring their relative values on parameters that cannot be found in cemeteries (age-classes) and a demographic target corresponding to the Industrial Revolution in Europe (eo = 50 years) is not an approach that can be considered rigorous.

[3] The 40 original life tables (Bocquet and Masset 1977) were as follows: *17th-century Europe*: Geneva 1625–84, social class II (eo = 26.1 years), Geneva 1625–84, social class III (eo = 19.6 years), Halley table 1694 (eo = 27.6 years); *18th-century Europe*: France 1740–49 (eo = 24.7 years), France 1750–59 (eo = 27.9 years), France 1760–69 (eo = 27.7 years), France 1770–79 (eo = 28.9 years), France 1780–89 (eo = 27.8 years), Sweden 1755–57 (eo = 35.4 years), Sweden 1761–63 (eo = 33.3 years), Süssmilch table 1765 (eo = 29.2 years), Norwich 1741–69 (eo = 22.9 years), Northampton 1741–69 (eo = 25.1 years), London 1759–68 (eo = 18.1 years), Dupré de Saint-Maur 1774 (eo = 25.2 years); *19th-century America*: Mexico 1895 (eo = 24.4 years), Paraguay 1886 (eo = 23.6 years), Paraguay 1899 (eo = 26.1 years), Costa Rica 1864 (eo = 26.6 years), Costa Rica 1883 (eo = 28.9 years), Costa Rica 1892 (eo = 30.5 years), Guatemala 1893 (eo = 23.6 years); *19th-century Asia*: India 1891–1901 (eo = 23.8 years); *19th-century Europe:* Austria 1880–82 (eo = 26 years); *20th-century America*: Bolivia 1900 (eo = 25.4 years), Brazil 1900 (eo = 29.4 years), Brazil 1920 (eo = 32.0 years), Dominican Republic 1935 (eo = 29.9 years), Guatemala 1921 (eo = 25.8 years), Guatemala 1940 (eo = 30.3 years), Honduras 1930 (eo = 34.0 years), Mexico 1900 (eo = 25.3 years), Mexico 1910 (eo = 27.6 years), Nicaragua 1920 (eo = 24.3 years), Nicaragua 1940 (eo = 34.5 years), Venezuela 1926 (eo = 32.2 years), Venezuela 1936 (eo = 33.9 years), Panama 1930 (eo = 35.9 years), El Salvador 1930 (eo = 28.7 years); *20th-century Asia*: Korea 1925–30 (eo = 37.5 years). Five new tables were added (Bocquet-Appel and Masset 1996) from geographical areas (Africa, Japan), periods (18th-century Japanese), or economies (nomadic pastoralists) which were not represented: Ogen-Ji (1776, 1796, 1816, 1836), central Japan, Temple Death Register peasants (Jannetta and Preston 1991); Dogon (1977), Mali, retrospective information, nomadic pastoralists, no medical service (Brown and Cazes 1993). [The data set for the 45 reference life tables appears in the electronic edition of this issue on the journal's web page.]

TABLE 1
The Mesolithic and Neolithic Cemeteries Analyzed

		^{14}C Date B.C.			Numbers of Skeletons				
Site	Source	Front	Site	dt[a]	0–4 yr.	5–19 yr.	20+ yr.	Total	Ratio of Immatures to Total
Aisne series	Allard, Dubouloz, and Hachem (1997), Farruggia, Guichard, and Hachem (1996), Lebolloch, Dubouloz, and Plateaux (1986)	5000	4900	100	10.00	15.00	25.00	50	0.375
Aiterhofen Ödmühle	Nieszery (1995)	5400	5300	100	5.40	21.43	115.17	142	0.1569
Ajdovska Jama	Corrian and Capiano (1991)	5500	4394	1106	6.00	8.00	11.00	25	0.4210
Aven de la Boucle	Duday (1980, 1987*a*, *b*), Herouin (2001)	5500	3176	2324	3.20	7.80	49.00	60	0.1373
Bade-Wutemberg	Orschiedt (1997)	5400	5250	150	7.20	12.80	11.00	31	0.5378
Baume Bourbon 2	Coste et al. (1983)	5500	4700	800	1.75	3.91	9.33	15	0.2953
Belleville	Baudouin (1911), Bocquet and Masset (1977)	4900	2548	2352	9.80	35.65	95.55	141	0.2717
Breuil-en-Vexin	Gatto (1998)	4900	2700	2200	28.00	20.00	40.00	38	0.3333
Brochtorff Circle	Malone et al. (1995)	5900	3900	2000	2.00	15.00	55.00	72	0.2142
Bruchstedt	Bach (1978)	5400	5250	150	8.20	18.80	34.00	61	0.3560
Cabeço da Arruda	Silva (1999)	5000	4000	1000	7.00	11.00	53.00	71	0.1718
Cala Colombo	Lucia et al. (1977)	5900	3250	2650	4.00	6.25	13.75	24	0.3125
Calle Sant Pau	Anfrus, Majo, and Oms (1991)	5500	3750	1750	9.00	10.00	7.00	26	0.5882
Casa da Moura	Jackes (1988)	5000	3100	1900	27.00	61.00	126.00	214	0.3262
Cauna de Bélesta 7	Claustre, Zammit, and Blaize (1993)	5400	4514	886	6.00	11.00	15.00	32	0.4230
Central Portugal	Silva (in preparation)	5200	2100	3100	11.00	16.00	103.00	130	0.1344
Cerro Ortega	Gil Pitarch et al. (1999)	5400	2000	3400	2.00	5.00	12.00	19	0.2941
Chamblandes	Moina and Simon (1985–86), Voruz (1991)	4500	4000	500	25.00	24.00	67.00	116	0.2637
Columnata	Chamla (1970)	6500	8850	−2350	50.37	16.62	47.00	114	0.2612
Cova de Avellaner	Mercadal Fernández et al. (1990)	5500	4771	729	4.00	4.00	11.00	19	0.2666
Dedeleben	Bach (1981), Behrens (1981)	5400	2967	2433	2.60	9.42	11.00	23	0.4613
Derenburg	Bach (1981), Behrens (1981)	5400	2967	2433	10.80	17.22	32.00	60	0.3498
Diconche	Semlier (1999)	5300	2392	2908	1.00	2.00	24.00	27	0.0769
Djerdap	Jackes et al. (2001)	6000	6630	−630	53.00	22.00	112.00	187	0.1641
Eybral	Ben-Ncer (1991)	5300	2100	3200	11.00	14.00	50.00	75	0.2187
Fontenay del Marmion	Dastugue, Torre, and Buchet (1973–74)	4800	4000	800	9.33	16.67	36.00	62	0.3164
Gours aux Lions 2	Masset and Mordant (1967), Baron, Demetz, and Monmignaut (1967)	4900	2548	2352	11.00	11.00	32.00	54	0.2558
Grossbrembach	Ullrich (1972)	5400	2400	3000	18.50	28.23	58.33	105	0.3261
Hazleton North	Rogers (1990)	4000	3642	358	3.00	16.00	21.00	40	0.4324
Heidelsheim	Lichardus (1986)	5400	3350	2050	4.30	9.80	6.90	21	0.5868
Jungsteinzeit	Ullrich (1972)	5400	2400	3000	10.00	20.00	64.00	94	0.2380
La Clape 8	Guilaine (1972), Lavergne (1972)	5500	2500	3000	7.00	14.00	8.00	29	0.6363
Laris Groguet	Bendezu-Sarmiento (1996)	4900	3000	1900	16.00	16.00	78.00	110	0.1702
Lenzburg	Scheffrahn (1967)	4500	4000	500	11.00	25.87	39.12	76	0.3980
Les Mournouards 2	Leroi-Gourhan, Bailloud, and Brézillon (1962), Leroi-Gourhan and Monmignaut (1962), Brézillon (1962)	5000	2126	2874	9.23	19.77	31.00	60	0.3894

TABLE 1
(*Continued*)

		^{14}C Date B.C.			Numbers of Skeletons				
Site	Source	Front	Site	*dt*^{a}	0–4 yr.	5–19 yr.	20+ yr.	Total	Ratio of Immatures to Total
Loisy en Brie	Bocquet-Appel (1977, 1994)	5000	2404	2596	19.00	31.00	114.00	164	0.2137
Maillets	Patte (1979), Baumann (1979)	4900	2484	2416	5.00	4.50	33.00	42.5	0.1200
Malesherbes-Orville	Simonin et al. (1997)	4900	4550	350	1.00	5.50	17.50	24	0.2391
Moita do Sebastiào	Ferembach (1974)	5500	6751	−1250	22.70	17.33	96.00	136	0.1529
Monte Canelas 1	Silva (1996, 1997), Silva and Cunha (n.d.)	5000	3120	1880	25.00	25.00	97.00	147	0.2049
Montigny-Esb	Masset (1975)	5000	2200	2800	6.00	26.00	79.00	111	0.2476
Moragy B 1	Zoffmann (1999)	5800	4750	1050	16.20	25.80	39.00	81	0.3981
Niederbösa	Bach (1979)	5400	3119	2281	14.40	28.60	50.00	93	0.3638
Nitra	Pavúk (1972)	5600	5300	300	12.00	13.00	47.00	72	0.2166
Nordhausen	Feustel and Ullrich (1965), Ullrich (1972)	5400	2400	3000	3.00	23.00	24.00	50	0.4893
Octrois	Jeunesse (1997 and personal communication, 2000)	5300	5100	200	2.00	6.00	33.00	41	0.1538
Paradis	Girard (1973)	4900	3176	1724	2.00	7.50	7.50	17	0.5
Pech 1	Riquet (1970), Carrière and Clottes (1970)	5000	2350	2650	7.00	7.00	28.00	42	0.2
Pierre Folle	Joussaume (1976), Brabant (1976)	5000	2350	2650	5.00	11.00	24.00	40	0.3142
Pontcharaud 2	Loison (1998), Gisclon (1993)	5000	4197	803	21.00	22.42	54.58	98	0.2911
Réaudins	Chambon (1997), Mordant (1997)	4900	4350	550	8.00	7.00	24.00	39	0.2258
Rutzing Haid	Veit (1992)	5400	5250	150	0	2.00	9.00	11	0.1818
Sammelserie	Bach (1978)	5400	5250	150	6.60	15.40	59.00	81	0.2069
Schönstedt	Bach (1981)	5400	3100	2300	17.10	18.90	28.00	64	0.4029
Skateholm	Meiklejohn et al. (1997)	3900	5000	−1100	6.00	8.00	44.00	58	0.1538
Sondershausen	Bach (1978)	5400	5250	150	4.20	10.80	32.00	47	0.2523
Stuttgart	Seitz (1989)	5400	5150	250	3.60	20.39	58.00	82	0.2601
Taforalt	Ferembach (1962)	5500	9000	−3500	78.00	21.00	80.00	179	0.2079
Trebur	Spatz (1999)	5400	4944	456	6.17	17.39	81.44	105	0.1759
Vedbæk	Albrethsen and Brunch Petersen (1976)	4000	4100	−100	5.00	5.00	13.00	23	0.2777
Vedrovice	Crubézy et al. (1995)	5500	5500	0	15.00	12.00	77.00	104	0.1348
Vikletice	Buchvaldek and Koutecky (1970)	5400	2700	2700	22.50	28.50	90.00	141	0.2404
Villaine	Cordier et al. (1972)	4900	2000	2900	21.00	17.33	96.67	135	0.1520
Villanykovesd	Zoffmann (1968)	5800	4750	1050	5.00	5.00	14.00	24	0.2631
Vilnyanka	Telegin and Potekhina (1987), Potekhina and Telegin (1995), Zvelebil and Lillie (2000)	5150	4165	985	3.00	18.00	27.00	48	0.4
Wandersleben	Bach (1986)	5400	2812	2588	38.00	60.00	118.00	216	0.3370
Yasinovatka	Telegin and Potekhina (1987), Potekhina and Telegin (1995), Zvelebil and Lillie (2000)	5150	5005	145	0	16.00	48.00	64	0.25
Zengovarkony	Zoffmann (1969–70)	5800	4750	1050	3.00	5.00	56.00	64	0.0819

[a] Chronological distance of the site from the Neolithic front.

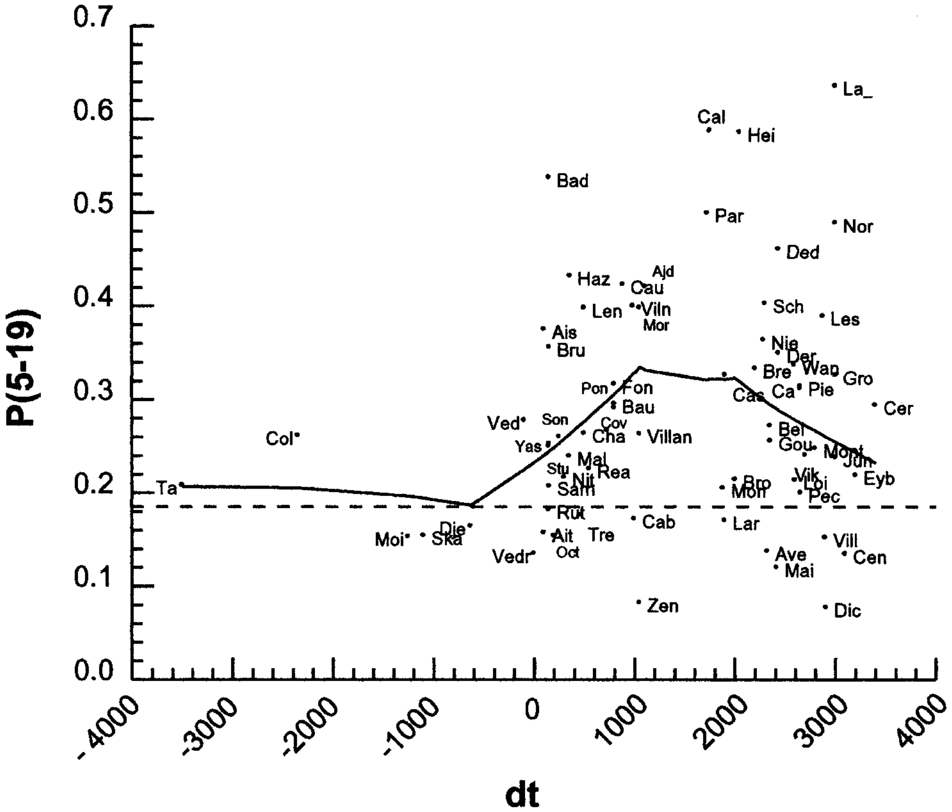

FIG. 2. *Observed profile of* P(5–19) (*68 cemeteries*) *on the chronological distance from the Neolithic diffusion front* dt, *using the Loess fitting procedure* (*proportion* $\alpha = 0.5$) (U*-test* = *6*, $\chi^2 = 20.450$ *with 1 d.f.*, p = 0.000). *The dashed line represents the estimated value of* P(5–19) *for a growth rate* r = 0 (*inverse regression of* r = f [P(5–19)], *table 2*).

only growth rate will be used here. Regressions are given in table 2. The relationships are quite satisfactory (correlation coefficients [r^2] ranging from 0.875 to 0.963, $p = 0.00000$). It should be noted that whereas other estimators, such as life expectancy at birth and mortality rates require the introduction of a supplementary demographic variable (for instance, **r** or **e**0) in addition to *P(5–19)*, this is not the case for birth and growth rates. Clearly, *P(5–19)* provides information (via the dead) on the shape of the age pyramid, which is mainly an effect of the input into the population, the birth rate (see Sattenspiel and Harpending 1983, Johansson and Horowitz 1986, McCaa 2001), and can be expressed through the growth rate.

The *P(5–19)* values are considered as a random space-time sample of cemeteries, generated by living local populations over a relatively short time span (say, < 500 years). As in the stepping-stone model of population genetics, migratory movements between localities are considered to compensate for one another in such a way that the influence of migration on the *P(5–19)* values is considered negligible. Let us call the observed demographic pattern the profile variation of *P(5–19)* with the chronological distance from the Neolithic diffusion front (*dt*). As stated above, variation of *P(5–19)* mainly reflects variation of the birth rate and the growth rate.

Ignoring the functional relationship expressing the *P(5–19)* profile on *dt*, a procedure called robust Loess fitting (Cleveland and Devlin 1988) was used to estimate the observed demographic profile from the data points. It is local polynomial (first-degree) regression fitting. The fit *P(5–19)*(*X*) at point *dt*(*X*) is made using a proportion (α = a window size of the data points), weighted by their distance from *dt*(*X*). This nonparametric regression procedure can be considered a kind of moving "average"—the estimated *P(5–19)* at *dt*(*X*)—calculated in a window (α) which represents a proportion of the data points around the point value to be estimated. In this window, the distances of the points of *dt*(*X*) from the point estimate are taken into account by the introduction of a weighting (called the tricube). This procedure of moving local fit was chosen because it exhibits good flexibility with the covariation of the data and is robust to the influence of outliers. A vast literature exists on the subject, which is outside the scope of this paper (see Simonoff 1996), along with many software programs (SAS,

TABLE 2
Three Paleodemographic Estimators, Obtained from Simulated Stable Populations (N = *945*), *Generated from 45 Reference Life Tables at Short Life Expectancies at Birth*

Estimator	Adj. R^2	a	b	c	S.E.	F
Birth rate $= a + b\,P(5\text{–}19)^{c}$	0.963	0.00375	0.15334	0.89074	0.00304	12484.6
Growth rate $= a + b\,P(5\text{–}19)^{c}$	0.875	−0.05389	0.12555	0.47788	0.00534	3317.8
Ratio of immatures $= a + b\,(\ln \mathbf{e}o) / \mathbf{e}o + c \exp^{(1+2)/(1+2)0.3379}$	0.960	−0.28538	2.25384	0.18303	0.019010	11408.2

NOTE: The stable populations vary from −2.5% to 2.5% at a step of 0.25%. For all regressions p (*observed* $F >$ *theoretical* F) $<$ 0.000001.

S-PLUS, SPSS, STATA, and SYSTAT, to name only a few). Since the Loess fitting procedure is a nonparametric regression, the usual significance tests of linear regression models do not apply. To test the significance (deviation from randomness) of a profile obtained by Loess fitting, Mann-Whitney's nonparametric U-test was used. On the estimated profile considered as true, 25 points $\bar{P}(5\text{–}19)_i$ ($i = 1{,}25$) were drawn, evenly spaced on dt. The (binary) rank variable $a_i = 0$ if $\bar{P}(5\text{–}19)_i \leq$ median values, and $a_i = 1$ otherwise. The U-test was used to see if the ranks were randomly distributed between the Mesolithic ($dt < 0$) and Neolithic ($dt \geq 0$) samples. If the result of the U-test was not significant, the profile would be considered flat; if it was significant, the profile would exhibit a trend and a change would be detected. Because the sampling point does not come from a random drawing, the probability of rejecting the null hypothesis of no trend is only nominal.

DATA ANALYSIS

Figure 2 represents the observed profile of $P(5\text{–}19)$ (68 cemeteries) on the chronological distance (dt) using the Loess fitting procedure (U-test = 6, $\chi^2 = 20.450$ with 1 d.f., $p = 0.000$). A transition is detected. This profile could easily be interpreted as representing (up to a transformation) the demographic pattern sought (expressed, for instance, by the growth rate) with, during the Mesolithic, from −4000 to −600, a roughly constant value of $P(5\text{–}19)$, close to the expected value of the reference life tables (by inverse regression of $\mathbf{r} = f[P(5\text{–}19)]$, table 2) under the demographic hypothesis of $\mathbf{r} = 0$. Then, starting at the end of the Mesolithic, $P(5\text{–}19)$ values could be interpreted as a demographic increase culminating at around 1000, followed by a plateau from 1000 to 2000 and then a return to a stationary state. In spite of the attractiveness of the profile, this is not true. Two sampling effects upset the profile.

Figure 3 shows the observed values of $P(5\text{–}19)$ versus the cemetery sample size omitting children under 5. It is clear that there is a marked deviation toward a high ratio of immatures to adults in cemeteries where the sample is small. Two archaeological hypotheses were examined to try to understand this deviation: a chronological seriation of cemetery sizes and a truncated observed distribution of cemeteries.

The chronological-seriation hypothesis is that small cemeteries are also older than large cemeteries either in absolute value or in chronological distance from the diffusion front and consequently the apparent relationship between cemetery size and variation of $P(5\text{–}19)$ actually masks a real demographic phenomenon comparable to a time series. Correlations between $P(5\text{–}19)$, chronology, and chronological distance are null ($r = -0.167$, $p = 0.17$; $r = 0.178$, $p = 0.15$), however, and the chronological-seriation hypothesis is therefore rejected.

The truncated-distribution hypothesis is that small cemeteries with few or no immatures have not been recognized as such by archaeologists—that because a normal cemetery is expected to have immatures these deviant cemeteries have therefore been listed under another label such as "anthropological series." A glance at the literature shows publications of "anthropological series" consisting only of adults, with no reference to any cemetery. A truncated distribution of cemeteries, inducing a statistical bias, seems to be the main cause of the tendency for small cemeteries to have high values of $P(5\text{–}19)$. With 50 skeletons, this bias disappears (Bocquet-Appel and Paz de Miguel Ibáñez 2000; see also fig. 3), and therefore only the observed values of $P(5\text{–}19)$ for which $d(5+)$ was 50 or more are analyzed here. The resulting data set includes 38 cemeteries (5 Mesolithic and 33 Neolithic).

Beyond thus is the question whether the observed density of cemeteries on the chronological distance from the diffusion front (with, for instance, no cemetery between 500 and 0) sufficient to capture a pattern such as the demic model that extends over the relatively short period of 500 years. A further question is whether cemetery size influences the pattern estimate. The Loess fitting procedure has a parameter for controlling the proportion α of neighboring points (the window size) kept in the estimate given the observed data density on the chronological distance. In figure 2 this parameter had the customary value 0.5 (50% of the points around the estimated $P[5\text{–}19]$ values), but in the case of an abrupt change such as the "wave" of the demic model (i.e., a phenomenon not subject to the direct influence of the former Mesolithic demographic trend), one can hypothesize that the α-value must express a local influence — that of points contemporary with the demographic phenomenon. The

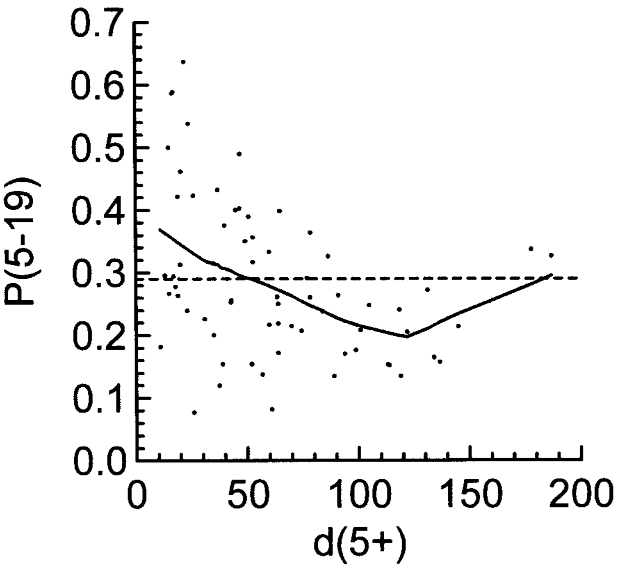

FIG. 3. *Ratio of immature skeletons* (P[5–19]) *versus cemetery sample size omitting children 0–4 years of age* (d[5+]). *The curve represents the value of* P(5–19) *smoothed by Loess fitting. The dashed line represents the smoothed value of* P(5–19) *when the sample is large* (> 175).

shape of the profile obtained by the Loess fitting procedure thus seems to depend mainly on three parameters: (1) the density distribution of cemeteries on the chronological distance from the diffusion front, (2) the cemetery sizes, and (3) the window size α of neighboring points in the fitting procedure. Using simulations,[4] it can be demonstrated that between the high density of sites on the chronological distance (average of 7 sites per unit of 500 × years 14 subdivisions, from −4000 to 3000, = 98 sites on the *dt* axis) with small site sizes (average 90 skeletons) and the low density of sites (average of 2 sites per unit of 500 years × 14 subdivisions = 28 sites on the *dt* axis) with large site sizes (average 180 skeletons), it is the influence of site density on chronological distance rather than site size which prevails. In order of importance, the wave of the demic model is detected when (1) the window-size parameter α of the fitting procedure expresses a local temporal influence (α = 0.2–0.3) and not a general one ($\alpha \geq 0.5$) and (2) the density of sites on the chronological distance is reasonably high. In the simulations, the demic pattern was most often detected with the window size $\alpha = 0.2$, even with a relatively low density of sites (28 on the *dt* axis).

With 38 cemeteries and an average of 91 skeletons we are, on the whole, in a situation more favorable than the least favorable of simulations but with a handicap for the distributions of the Mesolithic sites (0.7 cemeteries per subdivision of 500 years). In sum, if the sampled part of the Mesolithic profile is accurate, the complete estimated Mesolithic-Neolithic profile should be accurate. In the absence of additional data there is nothing that can be done here. Figure 4 shows the demographic pattern observed by Loess fitting with the window-size α = 0.3, in which a significant demographic change is detected (*U*-test = 26.5, χ^2 = 11.04 with 1 d.f. p = 0.0001). The value $\alpha < 0.3$ yielded an erratic profile (overfitting of the data), which was discarded, and the value $\alpha = 0.4$ produced a profile almost identical to that for $\alpha = 0.3$. The observed profile up to the diffusion front is roughly flat but with a slight pre-Neolithic depression lasting roughly a millennium. Then, at the front, there are two bumps, one at 0–1000 (maximum value of *P*[*5–19*] at about 500) and another at 1900–3000 years (maximum value of *P*[*5–19*] at about 2200). The data clearly signal an important demographic change at the very beginning of the Neolithic.

The profile of the growth rate corresponding to *P*(*5–19*) is also interesting. In order to focus on the transition in Europe, the two African Mesolithic sites were eliminated from the sample. The new sample has 3 Mesolithic and 33 Neolithic cemeteries. This restricts the chronological framework to the final period of the Mesolithic, the segment −1500 to 3500 years. The growth rate profile (fig. 5) comes directly from the Loess fitting of *P*(*5–19*) on the chronological distance from the diffusion front via the corresponding paleodemographic estimator (table 2).

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[4] To generate a paleodemographic pattern of growth rate variation on the chronological distance from the diffusion front randomly, two main components are needed: a demographic model and a cemetery model.

On a duration expressed in units of chronological distance from the diffusion front from −4000 to 3000, subdivided into $q-1$ intervals of 500 years, the demic-wave model is represented by q values of *P*(*5–19*). These values, obtained from the reference tables (inverse regression of $\mathbf{r} = f[P(5\text{–}19)]$, table 2), represent the null demographic hypothesis (**e**o = 25 years and **r** = 0) during the Mesolithic from −4000 to 0 (with *P*[*5–19*] = 0.188), then the demographic hypothesis of demic expansion, **r** = 1% (with **e**o = 25 years) from 0 to 500 (Ammerman and Cavalli-Sforza 1984:74, fig 5.5 [with *P*(*5–19*) = 0.251]), then, again, the null hypothesis for all posterior subdivisions corresponding to the saturation of the carrying capacity, 500–1000, 1000–1500, and so on, to the end—i.e., $\mathbf{P}(5\text{–}19) = (p_1 = 0.188, p_2 = 0.188, p_9 = 0.251, p_{10} = 0.188, \ldots, p_q = 0.188)$, with **P**(*5–19*) a vector (1 × q).

The cemetery model distinguishes (1) the number *M* of cemeteries in an interval of chronological distance (density), (2) the size *d*(*5*+) of each cemetery, and (3) the frequency (count) of *d*(*5–19*) in *d*(*5*+). The model is based on a random drawing in three successive distributions: the densities *M* are drawn from a uniform distribution (of parameter *R* = *M* max – *M* min, the maximum and minimum possible densities); the cemetery sizes are drawn from a Poisson distribution (of parameter λ = average size of the cemeteries); the sample size of *d*(*5–19*) in a cemetery, given its size *d*(*5*+), is drawn from a binomial distribution of parameters *d*(*5*+), *P*(*5–19*).

Simulation is carried out as follows: Given the demographic model **P**(*5–19*), for each interval of *dt* the program draws randomly: the density of cemeteries in the uniform distribution (*R*), for each cemetery: the *dt* value in a uniform distribution (*dt*+ −*dt*−, where *dt*+ and *dt*− are the upper and lower limits of the subdivision), the value of *d*(*5*+) in a Poisson distribution (with parameter λ), and the value of *d*(*5–19*) in a binomial distribution *d*(*5*+), *P*(*5–19*). Examples of simulation results are shown in Bocquet-Appel and Paz de Miguel Ibáñez (2000).

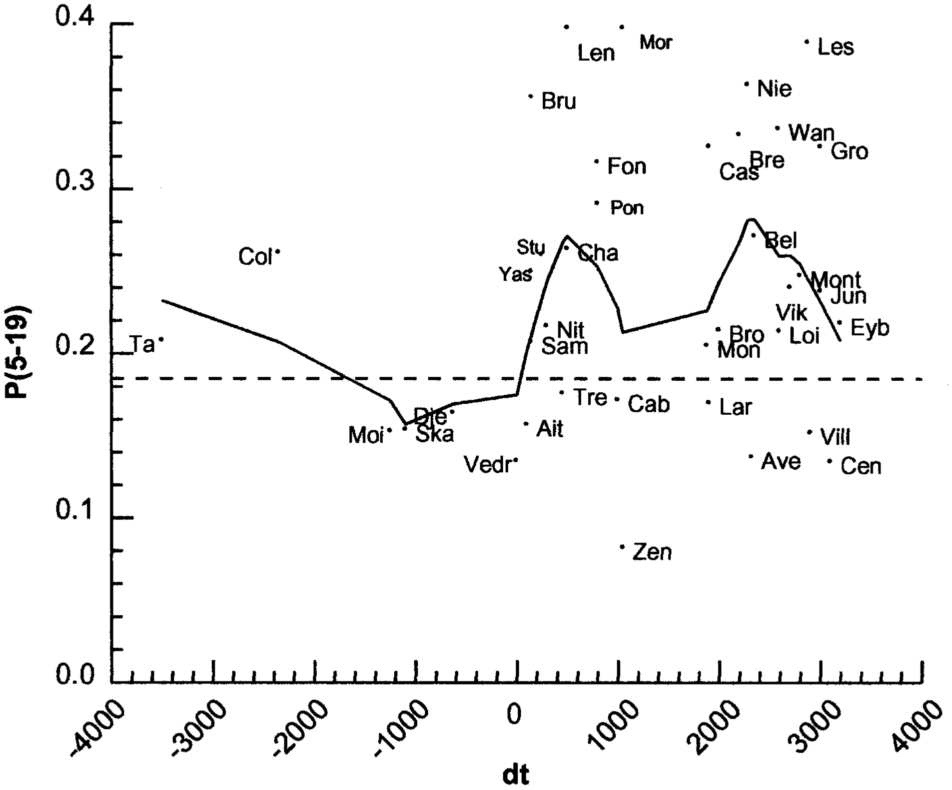

FIG. 4. *Observed demographic profile obtained by Loess fitting with a window size* $\alpha = 0.3$ (U-*test* = *26.5*, $\chi^2 = 11.04$ *with 1 d.f.*, p = *0.001*). *The dashed line represents the estimated value of* P(5–19) *for a growth rate* $\mathbf{r} = 0$ (*inverse regression of* r = f[P(5–19)], *table 2*).

Since the limits of the 95% confidence interval for the growth rate are relatively large (±1.07%), to characterize the whole observed demographic pattern, five chronological zones were distinguished in terms of whether the stationarity hypothesis (**r** = 0) was excluded from the confidence interval.

There are five chronological zones satisfying this criterion: (1) from the Mesolithic (−1500) to about 300 years, including the stationarity hypothesis (average **r** ≅ 0.05%); (2) at the onset of the Neolithic at about 300–800 years, excluding the stationarity hypothesis (average **r** 1.24%); (3) at about 800–1800, including the stationarity hypothesis (average **r** 1.16%); (4) at about 2000–2800, excluding the stationarity hypothesis (average **r** 1.22%); and (5) beyond, again including the stationarity hypothesis (average **r** 0.87%). The zone at the diffusion front is especially interesting, as it indicates the rate and magnitude of the change. If the maximum of the first bump on the *dt* axis is considered as representing the upper limit of the Neolithic demographic transition, at the onset it covers a relatively short period of roughly 500 years. On the profile, from 0 to the maximum of the first bump (about 500), the smoothed value of the ratio of immature skeletons increases from 0.16 to 0.27—an increase of 70% relative to *d*(5+)—and the corresponding estimated growth rate increases from −0.3% to 1.3% (±1.07%). This very substantial change in the ratio of immatures relative to the Mesolithic continues throughout almost all of the Neolithic period. Its subsequent decline until about 1100 could easily be interpreted as a return to quasi-homeostatic equilibrium (Lee 1987).[5] Nevertheless, the absence of data at 1050–1800 also leaves the door open to artefactual causes of the two bumps and therefore of their slopes.

DISCUSSION AND CONCLUSION

In the Mesolithic data, might there not be a sampling effect favorable to stationary or increasing populations with relatively high local density, attested to by unusually large cemeteries, and unfavorable to small popu-

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[5] Over the long term, human ingenuity has increased productivity and had a tendency to increase carrying capacity. However, regulating mechanisms of all kinds, mediated by social processes, on average usually lag behind the tendentially increasing carrying capacity. It can be expected that after a major disturbance in a demographic system, a return to strict equilibrium is rarely reached because the system reacts using old regulating mechanisms. This generates a slight positive or negative deviation for the growth rate. I call this type of regulation, producing a (small) deviation after a disturbance, "quasi-homeostatic equilibrium."

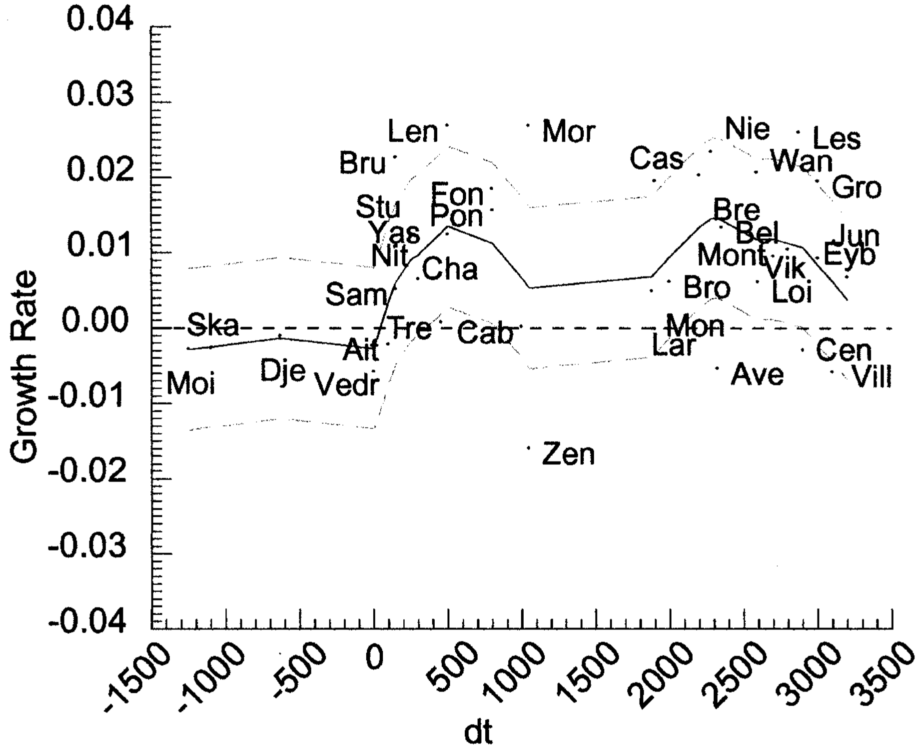

FIG. 5. *Growth rate profile obtained by Loess fitting of* P(5–19) *on the chronological distance from the diffusion front* (dt) *via the corresponding paleodemographic estimator (see table 2). The light dashed line represents the 95% confidence interval for the growth rate (± 1.07%).*

lations, more susceptible to small-scale collapse? Might there not be a link between palaeoanthropological sampling and demographic process that produces a structural demographic bias in the data? The Mesolithic pattern of the peopling of Europe and human population ecology do not support this hypothetical covariation.

First, as Price (2000*a*) reports, it now seems clear that Mesolithic foragers were concentrated in marine, riverine, and rich lacustrine environments supporting permanent settlements in many parts of Europe (Iron Gates of the Danube, Scandinavia, and Ireland). The dense canopy of the mixed oak forest of Atlantic Europe would not have provided substantial biomass for hunters and their prey (Price 2000*b*:5).

Second, the hypothesis of covariation is based on an unrealistic demographic mode, that of small populations living in isolation from one another in zones of (very) low density without demographic exchange and thus subjected to strong stochasticity. The model which seems more realistic is that of small connected groups exchanging migrants and thus counterbalancing the influence of environmental or demographic stochasticity (Bocquet-Appel 1986). Thus, if small samples of dispersed Mesolithic skeletons were gathered, *P*(*5–19*) would be expected to indicate a stationary regime.

The reduction of the space-time variation of *P*(*5–19*) to only one dimension on chronological distance is a simplification whose purpose is to concentrate relatively few data on a single reference axis in order to detect a signal which can be expected to be weak. This approach has satisfactorily served its purpose. The final result is, perhaps, a mixture of the demographic patterns of several geographical areas that may have differed depending on the nature of the Neolithic diffusion processes which were taking place regionally (demic, cultural, or both), their mechanisms (leapfrog colonization, elite predominance, infiltration, folk migration [see Zvelebil and Lillie 2000]), and their rates. Aside from a hypothetical sampling-density effect, the superimposition of several patterns could have helped to generate the demographic profile with two bumps. It can be hoped that, in the future, additional archaeological information will allow a finer space-time subdivision of the data.

This paper also contributes to the suggestion of a scenario for the Neolithic transition in terms of the succession of demographic events. On the hypothesis that any natural population lives in quasi-homeostatic equilibrium, this transition can be subdivided into two phases. In the initial phase of the Mesolithic-Neolithic transition, on the hypothesis of a life expectancy at birth which remained roughly constant at the transition point between the two periods, population increase could only come from an increase in birth rate (verified with the data via *P*[*5–19*]) and thus in fertility. In the demographic data on traditional societies, farmers have higher average fertility than hunter-gatherers and horticulturists (Bentley, Goldberg, and Jasienska 1993; see also Sellen and Mace 1997). Since the fertile life span of women remains roughly constant (15–50 years), a fertility increase could only be caused by a reduction in the length of the birth interval. The decisive factor for the length of the birth interval, aside from postpartum sex taboos, is age at weaning. The probable effect of the Neolithic on fertility is to have reduced (by three to four months) the average age at weaning. Change in diet during the Mesolithic-Neolithic transition (introduction of grains, dairy products) and social factors such as a new division of labor may have made earlier weaning technically possible, with a concomitant rise in fertility. A similar hyopothesis was advanced by Sellen (2001) to explain the higher fertility of farmers in traditional societies (including gatherers, horticulturists, and farmers). During the second phase of the demographic transition (about 500–1,100 years?), with fertility remaining high, the halting of population increase and a return to quasi-stationary equilibrium could only be caused by a corresponding increase in mortality. It may be hypothesized that this substantial increase in mortality was caused by the promiscuity of humans and animals and by the anastomotic process of village populations during this period, promiscuity facilitating both the emergence of new pathogens and their geographical diffusion. Here one rejoins Fix's (1996) hypothesis.

In short, in this scenario of the first human demographic transition, that of the Neolithic, the actors and the directions they took (fertility increase, then mortality increase) were in the opposite order and direction from the second demographic transition in the Western countries (mortality decline, then fertility decline [see, e.g., Chesnais 1986]) that followed a few thousand years later.

This study shows that paleoanthropological data from cemeteries contain demographic information which reveal a pattern of genuine demographic Mesolithic-Neolithic transition in Europe. With the data currently available, this transition is characterized by a clear rupture with the previous stationary regime of foragers over a period of some 500 years. This rupture was of the same order of magnitude as but in the opposite direction from the demographic transition which is being experienced today.

References Cited

ALBRETHSEN, S. E., AND E. BRUNCH PETERSEN. 1976. Excavation of a Mesolithic cemetery at Vedbæk, Denmark. *Acta Archaeologia* 47:1–28.

ALLARD, P. J., DUBOULOZ, AND L. HACHEM. 1997. "Premiers éléments sur cinq tombes rubanées à Berry-au-Bac (Aisne-France)," in *Le Néolithique danubien et ses marges entre Rhin et Seine* (*Acts du 22ème colloque interrégional sur le Néolithique Strasbourg 27–29 Octobre 1995*), pp. 31–43. Cahiers de l'Association pour la Promotion de la Recherche Archéologique en Alsace, suppl. 3.

AMMERMAN, A. J., AND L. L. CAVALLI-SFORZA. 1971. Measuring the rate of spread of early farming in Europe. *Man* 6:674–88.

———. 1984. *The Neolithic transition and the genetics of populations in Europe.* Princeton: Princeton University Press.

ANFRUS, J., T. MAJO, AND J. L. OMS. 1991. Estudio preliminar de los restos humanos neolíticos procedentes del yacimiento de la calle Sant Pau (Barcelona). *Nuevas Perspectivas en Antropología*, pp. 43–51.

ARNAL, G. B., M. BŒUF, AND P. FONTAN. 1991. "Mésolithique et Néolithique dans les massifs méridionaux: Mésolithique et Néolithisation en France et dans les régions limitrophes," in *Actes du 113ème Congrès National des Sociétés Savantes* (*Strasbourg, 1988*), pp. 77–85. Paris: Editions du Comité des Travaux Historiques et Scientifiques.

BACH, A. 1978. *Neolitische populationen im Mittelelbe-Saale-Gabiet.* Weimar.

———. 1979. *Zur anthropologie des Neolithikums im Mittelelbe-Saale-Gebiet unter besonderer Berücksichtigung der Bandkeramiker.* Weimar.

———. 1981. Skelettreste aus zwei Kollektivgräbern der Bernburger Kultur (Derenburg, Kr. Wernigerode, und Dedeleben, Kr. Halberstadt). *Jahresschrift für mitteldeutsche Vorgeschichte* 63: 67–74.

———. 1986. Einige Befunde an den Skeletten aus den Körpergräbern des linienbandkeramischen Gräberfeldes von Wandersleben, Kr. Gotha. *Anthropologie* (*Brno*) 24:111–44.

BARON, R., J. L. DEMETZ, AND C. MONMIGNAUT 1967. Les sépultures collectives de Marolles-sur-Seine (Seine-et-Marne): Les hommes de la sépulture II. *Gallia Préhistoire* 10(1):140–55.

BAUDOUIN, M. 1911. *La sépulture néolithique de Belleville à Vendrest* (*Seine et Marne*)*: Fouille et restauration.* Paris: Société Préhistorique Française.

BAUMANN, F. 1979. La sépulture collective des Maillets à Germigny-l'Evêque (Seine-et-Marne): Les fouilles et la structure, interprétation. *Gallia Préhistoire* 22(1):143–53.

BEHRENS, H. 1981. Radiocarbon-daten für das Neolithikum des Mittelelbe-Saale-Gebiets. *Jahresschrift für mitteldeutsche Vorgeschichte* 63:189–93.

BENDEZU-SARMIENTO, J. 1996. *La* grotte sepulcrale néolithique du "Laris Groguet" à Feigneux (Oise), approche archéologique: Les sujets immatures. Master's thesis, Université de Paris 1, Paris, France.

BEN-NCER, A. 1991. La sépulture collective d'Eybral (Coux-et-Bigaroque, Dordogne): Etude anthropologique. Diss., Université de Bordeaux 1, Bordeaux, France.

BENTLEY, R. G. T. GOLDBERG, AND G. JASIENSKA. 1993. The fertility of agricultural and non-agricultural traditional societies. *Population Studies* 47:269–81.

BINDER, D. 1987. Le Néolithique ancien provençal: Typologie et technologie des outillages lithiques. *Gallia Préhistoire* suppl. 24:28.

———. 1995. "Eléments pour la chronologie du Néolithique ancien à céramique imprimée dans le Midi," in *Chronologies néolithiques: De 6000 à 2000 avant notre ère dans le bans le Bassin rhodanien* (*Actes du Colloque d'Ambérieu en Bugey*), pp. 55–65. Documents du Département d'Anthropologie de l'Université de Genève 20. Ambérieu-en-Bugey: Editions de la Société Préhistorique Rhodanienne.

BOCQUET-APPEL, J. P. 1977. Perspectives paléodémographiques. Ph. D. diss., Ecole des Hautes Etudes en Sciences Sociales, Paris, France.

———. 1986. Small populations: Demography and paleoanthropological inferences. *Journal of Human Evolution* 14:683–91.

———. 1994. L'hypogée néolithique de Loisy-en-Brie (Marne), lieu-dit Les Gouttes-d'Or: L'interprétation démographique. *Préhistoire et Protohistoire en Champagne Ardenne* 18:55–60.

BOCQUET-APPEL, J. P., AND C. MASSET. 1977. Estimateurs en paléodémographie. *L'Homme* 17(4):65–90.

———. 1996. Paleodemography: Expectancy and false hope. *American Journal of Physical Anthropology* 99:571–83.

BOCQUET-APPEL, J. P., AND M. PAZ DE MIGUEL IBÁ-

ÑEZ. 2000. Demografía de la difusión neolítica en Europa y los datos paleoantropológicos. Paper presented at the conference "El paisaje en el Neolítico Mediterraneo," Valencia, Spain, November 15–18.

BOGUCKI, P. 1988. *Forest farmers and stockherders.* Cambridge: Cambridge University Press.

———. 1996. The spread of early farming in Europe. *American Scientist* 84: 242–53.

BRABANT, H. 1976. Le dolmen Angevin de Pierre-Folle a Thiré (Vendée): Etude odontologique. *Gallia Préhistoire* 19(1): 51–60.

BRÉZILLON, M. 1962. "Demographie," in L'hypogée II des Mournouards (Mesnil-sur-Ogar, Marne), by A. Leroi-Gourhan, G. Bailloud, and M. Brézillon. *Gallia Préhistoire* 5(1): 50–63.

BROWN, E., AND M. H. CAZES 1993. Differences de mortalité chez les Dogons de Boné. *Social Science and Medicine* 36: 129–96.

BUCHVALDEK, M., AND D. KOUTECKY. 1970. *Vikletice: Ein schnurkeramisches Gräberfeld.* Praha.

CAMPS, G. 1974. *Les civilisations préhistoriques de l'Afrique du nord et du Sahara.* Paris: CNRS.

CARRIÈRE, M., AND J. CLOTTES 1970. Le dolmen du Pech no. 1 a Alvignac (Lot): Etude archéologique. *Gallia Préhistoire* 12(1):110–35.

CAVALLI-SFORZA, L. L., AND F. CAVALLI-SFORZA. 1995. *The great human diasporas: The history of diversity and evolution.* New York: Addison-Wesley.

CHAMBON, P. 1997. "La nécropole de Balloy 'Les Réaudins': Approche archéo-anthropologique," *in La culture de Cerny: Actes du Colloque International de Nemours 1994*, pp. 489–98. Mémoire du Musée de Préhistoire d'Ile de France 6.

CHAMBON, P., AND L. SALANOVA 1996. Chronologie des sépultures du IIIe millénaire dans le Bassin de la Seine, *Bulletin de la Société Préhistorique Française* 93(1)L 103–18.

CHAMLA, M. C. 1970. *Les hommes épipaléolithiques de Columnata (Algérie Occidentale): Etude anthropologique.* Mémoires du Centre de Recherches Anthropologiques, Préhistoriques et Ethnographiques 15.

CHANCEREL, A., AND C. BILLARD 1991. "Le Chasséen en Normandie," in *Identité du Chasséen (Colloque International de Nemours, 1989)*, pp. 165–73. Mémoire du Musée de Préhistoire d'Ile-de-France 4.

CHESNAIS, J. C. 1986. *La transition démographique: Etapes, formes, implications économiques*. Paris: Presses Universitaires de France.

CHILDE, V. GORDON. 1925. *The dawn of European civilization.* London: Kegan Paul.

CLAUSTRE, F., J. ZAMMIT, AND Y. BLAIZE. 1993. *La Caune de Bélesta: Una tombe collective il y a 6000 ans*. Toulouse: Centre d'Anthropologie des Sociétés Rurales, CNRS/EHESS.

CLEVELAND, W. S., AND S. DEVLIN. 1988. Locally weighted regression analysis by local fitting. *Journal of the American Statistical Association* 83:596–640.

CONSTANTIN, C., AND M. ILETT. 1997. "Une étape finale dans le Rubané récent du Bassin parisien," in *Le Néolithique danubien et ses marges entre Rhin et Seine (Actes du 22ème colloque interrégional sur le Néolithique), Strasbourg 27–29 Octobre 1995*, pp. 281–300. Cahiers de l'Association pour la Promotion de la Recherche l'Archéologique en Alsace suppl. 3.

CORDIER, G., R. RIQUET, H. BRABANT, AND T. POULAINT. 1972. Le site archéologique du dolmen de Villaine à Sublaines (Indre-et-Loire). *Gallia Préhistoire* 15(1):31–135.

CORRIAN, C., AND M. CAPIANO. 1991. La necropoli neolitica di Ajdovska jama (Slovenia). *Archivo per l'Antropologia e la Etnologia 121:*85–136.

COSTE, A., H. DUDAY, X. GUTHERZ, AND J. L. ROUDIL. 1983. "Les sépultures de la baume Bourbon à Cabrières (Gard)," in *Premières communautés paysannes en Mediterranée occidentale,* pp. 532–35. Paris: CNRS.

CRUBÉZY, E., P. MURAIL, J. BRUZEK, J. JELINEK, V. ONDRUS, J. PAVÚK, AND M. TESCHLER-NICOLA. 1995. "Sample characterization of Danubian cemeteries in Central Europe: The examples of Verdovice (Moravia) and Nitra-Horne Krskany (Slovakia)."*Le Néolithique danubien et ses marges entre Rhin et Seine (Actes du 22ème colloque interrégional sur le Néolithique, Strasbourg 27–29 octobre 1995)*, pp. 9–16. Cahiers de l'Association pour la Promotion de la Recherche Archéologique en Alsace suppl. 3.

DASTUGUE, J., S. TORRE, AND L. BUCHET. 1973–74. Néolithique de Basse-Normandie. *L'Anthropologie* 77:579–620; 78: 113–64.

DUDAY, H. 1980. "Les rites funeraires en Languedoc au cours du troisiéme millenaire," in *Le groupe de Véraza et la fin des temps néolithiques,* pp. 273–82. Paris: CNRS.

———. 1987*a*. "Contribution des observations osteologiques à la chronologie interne des sepultures collectives," in *Anthropologie physique et archéologie,* pp. 51–65. Paris: CNRS.

———. 1987*b*. "Organisation et fonctionnement d'une sepulture collective Néolithique: L'Aven de la Boucle a Corconne (Gard)," in *Anthropologie physique et archéologie,* pp. 89–109. Paris: CNRS.

EVIN, J., P. FORTIN, AND C. OBERLIN. 1995. "Calibration et modes de représentation des datations radiocarbones concernant le Néolithique de l'Est et du sud-est de la France," in *Chronologies néolithiques: De* 6000 *à* 2000 *avant notre ère dans le Bassin rhodanien (Actes du Colloque d'Ambérieu en Bugey)*, pp. 31–39. Documents du Département d'Anthropologie de l'Université de Genève 20. Ambérieu-en-Bugey: Editions de la Société Préhistorique Rhodanienne.

FARRUGGIA, J. P. 1997. "Hinkelstein, explication d'une sériation," in *Le Néolithique danubien et ses marges entre Rhin et Seine (Actes du 22ème colloque interrégional sur le Néolithique, Strasbourg 27–29 octobre 1995)*, pp. 467–517. Cahiers de l'Association pour la Promotion de la Recherche Archéologique en Alsace suppl. 3.

FARRUGIA, J. P., Y. GUICHARD, AND L. HACHEM. 1996. Les ensembles funéraires rubanés de Menneville "Derrière le village" (Aisne). *Revue Archéologique de l'Est* suppl. 14: 119–74.

FEREMBACH, D. 1962. *La nécropole épipaléolithique de Taforalt (Maroc oriental): Etude des squelettes humains.* Rabat: CNRS et Mission Universitaire et Culturelle Française au Maroc.

———. 1974. *Le gisement mésolithique de Moita do Sebastião, Muge, Portugal*. 2. *Antropologia*. Lisbon: Direcção-Geral dos Assuntos Culturais.

FEUSTEL, R., AND H. ULLRICH. 1965. Totenhütten der neolithischen Walternienburger Gruppe. *Alt-Thuringen* 4:104–202.

FIX, A. G. 1996. Gene frequency clines in Europe: Demic diffusion or natural selection? *Journal of the Royal Anthropological Institute,* n.s., 2:625–43.

GATTO, E. 1998. Breuil-en-Vexin, une allée sépulcrale fouillée au XIX et XXème siècle: Etude archéologique et anthropologique. Master's thesis, Université de Paris 1, Paris, France.

GIL PITARCH, P., M. J. MIQUEL FEUCHT, M. C. NEGRE MUÑOZ, M. POLO CERDÁ, AND J. D. VILLALAÍN BLANCO. 1999. "Estudio antropológico y paleopatológico de los restos óseos del yacimiento neolítico de Villanueva de la Fuente (Ciudad Real)," in *II Congrés del Neolític a la Península Ibèrica,* pp.387–91. Saguntum-PLAV suppl. 2.

GIRARD, C. 1973. "Les vestiges anthropologiques," in *La sépulture collective du Paradis à Noisy-sur-Ecole (Seine-et-Marne)*, pp. 20–31. Cahier du Centre de Recherches Préhistoriques 2.

GISCLON, J. L. 1993. *La nécropole néolithique de Pontcharaud, Clermont-Ferrand (63): Rapport anthropologique de synthèse 1993.* Bordeaux: Laboratoire d' Anthropologie de l'Université de Bordeaux 1.

GRONENBORN, D. 1999. A variation on a basic theme: The transition to farming in southern central Europe. *Journal of World Prehistory* 13:123–210.

GUILAINE, J. 1972. *La nécropole mégalithique de la Clape (Laroque-de-Fa, Aude).* Carcassonne: Laboratoire de Préhistoire et de Palethnologie.

HEROUIN, S. 2001. *La sépulture collective de Corconne (Gard).* MS.

JACKES, M. K. 1988. Demographic change at the Mesolithic-

Neolithic transition: Evidence from Portugal. *Rivista di Antropologia* suppl. 16:141–58.

JACKES, M., M. ROKSANDIC, C. MEIKLEJOHN, AND D. LUBELL. 2001. "The demography of the Djerdap Mesolithic/ Neolithic transition," in *The Iron Gates in prehistory: New perspectives.* Oxford: Archaeopress. In press.

JANNETTA, A. B., AND S. H. PRESTON. 1991. Two centuries of mortality change in central Japan: The evidence from the Temple Death Register. *Population Studies* 45:417–36.

JEUNESSE, CH. 1997. *Pratiques funéraires au Néolithique ancien: Sépultures et nécropoles danubiennes, 5500–4900 av. J.-C.* Paris: Errance.

JOHANSSON, S. R., AND S. HOROWITZ. 1986. Estimating mortality in skeletal populations: Influence of the growth rate on the interpretation of levels and trends during the transition to agriculture. *American Journal of Physical Anthropology* 71: 233–50.

JOUSSAUME, R. 1976. Le dolmen Angevin de Pierre-Folle a Thiré (Vendée): Etude architecturale et archéologique. *Gallia Préhistoire* 19(1):1–37.

LAVERGNE, M. J. 1972. "Etude odontologique," in *La nécropole mégalithique de la Clape* (*Laroque-de-fa, Aude*), by J. Guilaine, pp. 126–57. Carcassonne: Laboratoire de Préhistoire et de Palethnologie.

LEBOLLOCH, M. J. DUBOULOZ, AND M. PLATEAUX 1986. Sauvetage archéologique à Maizy (Aisne). *Revue Archéologique de Picardie* 1–2:3–12.

LEE, R. D. 1987. Population dynamics of humans and other animals. *Demography* 24:443–65.

LENNEIS, E., CH. NEUGEBAUER-MARESCH, AND E. RUTTKAY. 1995. *Jungsteinzeit im Osten Österreichs.* St. Pölten: Wissenschaftliche Schriftenreihe Niederösterreich.

LENNEIS, E., P. STADLER, AND H. WINDL. 1996. Neue 14C-Daten zum Frühneolithikum in Österreich. *Préhistoire Européenne* 8:97–116.

LEROI-GOURHAN, A., G. BAILLOUD, AND M. BRÉZILLON. 1962. L'hypogée II des Mournouards (Mesnil-sur-Oger, Marne).*Gallia Préhistoire* 5(1):23–133.

LEROI-GOURHAN, A. AND C. MONMIGNAUT 1962. Les dents" L'hypogée II des Mournouards (Mesnil-sur-Oger, Marne), by A. Leroi-Gourhan, G. Bailloud, and M. Brézillon. *Gallia Préhistoire* 5(1):68–73.

LICHARDUS, J. 1986 "Le rituel funéraire de la culture de Michelsberg dans la région du Rhin supérieur et moyen," in *Le Néolithique de la France.* Edited by P. Demoule and J. Guilaine, pp. 343–59. Paris: CNRS.

LOISON, G. 1998. "La nécropole de Pontcharaud en Basse-Auvergne," in *Sépultures d'Occident et genèses des mègalithismes* (*9000–3500 avant notre ère*). Edited by J. Guilaine, pp. 189–206. Paris: Errance.

LUCIA, A., D. FERR, A. GENIOLA, C. GIOVE, M. MAGGIORE, N. MELONE, V. PESCE DELFINO, P. PIERI, AND V. SCATTARELLA. 1977. *La comunita neolitica di Cala Colombo presso Torre a Mare* (*Bari*). Società di Storia Patria per la Puglia, Documenti e Monografia 62.

LÜNING, J. 1988. Frühe Bauern in Mitteleuropa im 6. und 5. Jahrtausend v. Chr. *Jahrbuch des Römisch-Germanischen Zentralmuseums Mainz* 35: 27–93.

MC CAA, R. 2001. "Paleodemography of the Americas: From ancient times to colonialism and beyond," in *The backbone of history: Health and nutrition in the Western Hemisphere.* Edited by R. H. Steckel and J. C. Rose. Cambridge: Cambridge University Press. In press.

MALONE, C., S. STODDART, A. BONANNO, T. GOUDER, AND D. TRUMP. 1995. Mortuary ritual of 4th millennium B.C. Malta: The Zebbug period chambered tomb from the Brochtorff Circle at Xaghra (Gozo). *Proceedings of the Prehistoric Society* 61:303–45.

MASSET, C. 1975. Problèmes de demographie préhistoriques. Ph.D. diss., Université de Paris I, Paris, France.

MASSET, C., AND C. MORDANT. 1967. Les sépultures collectives de Marolles-sur-Seine (Seine-et-Marne). *Gallia Préhistoire* 10(1): 75–136.

MEIKLEJOHN, C., J. M. WYMAN, K. JACOBS, AND M. K. JACKES. 1997. "Issues in the archaeological demography of the agriculture transition in western and northern Europe: A view from the Mesolithic," in *Integrating archaeological demography: Multidisciplinary approaches to prehistoric population.* Edited by R. R. Paine, pp. 311–26. Center for Archaeological Investigations Occasional Paper 24.

MERCADAL FERNÁNDEZ, O., I. DEFAUS, J. M. CONGOST, I. ALACAMBRA, P. J. SÁNCHEZ, I. CHIMENOS, E. KÜSTNER, I. CAMPILLO, D. VALERO, AND A. PÉREZ-PÉREZ. 1990. 'L'anàlisi antropològic," in *La Cova sepulcral del Neolític Antic de l'Avellaner* (*Cogolls, Les Planes, La Garrotxa*). Edited by I. Boch, A. Lloret, I. Tarrús, and J. Galter, pp. 33–57. Centre d'Investigacons Arqueològiques de Girona. Sèrie Monogràfica 11.

MOINA, P., AND C. SIMON. 1985–86. "La nécropole néolithique de Chamblandes (Pully, VD)," in *Première céramique, premier métal: du Néolithique à âge de bronze dans le domaine circum-alpin,* pp. 109–12. Lons-le-Samnier: Musée Archéologique.

MORDANT, D. 1997 "Le complexe des Réaudins à Balloy: Enceinte et nécropole monumentale," in *La culture de Cerny: Actes du Colloque International de Nemours 1994,* pp. 449–79. Mémoire du Musée de Préhistoire d'Ile de France 6.

NIESZERY, N. 1995. *Linienbandkeramische Gräberfelder in Niederbavern.* Internationale Archäologie 16. Espelkamp: Verlag Marie Leidorf.

ORSCHIEDT, J. 1997. "Sépultures rubanées en habitat dans Bade-Wutemberg," in *Le Néolithique danubien et ses marges entre Rhin et Seine* (*Actes du 22ème colloque interrégional sur le Néolithique, Strasbourg 27–29 octobre 1995*), pp. 57–63. Cahiers de l'Association pour la Promotion de la Recherche Archéologique en Alsace suppl. 3.

PAINE, R. R., AND H, HARPENDING. 1996. Assessing the reliability of paleodemographic fertility estimators using simulated skeletal distributions. *American Journal of Physical Anthopology* 101:151–59.

PATTE, E. 1979. La sépulture collective des Maillets à Germigny-l'Evêque (Seine-et-Marne). 4. Etude anthropologique. *Gallia Préhistoire* 22(1):179–200.

PAVÚK, J. 1972. Neolithisches Gräberfeld in Nitra. *Slovenská Archeológia* 20(1).

POTEKHINA, I., AND D. TELEGIN. 1995. On the dating of the Ukrainian Mesolithic-Neolithic transition. CURRENT ANTHROPOLOGY 36:823–26.

PRICE, T. D. 2000*a*. "Lessons in the transition to agriculture," in *Europe's first farmers.* Edited by T. D. Price, pp. 301–18. Cambridge: Cambridge University Press.

———. 2000*b*. Editor. *Europe's first farmers.* Cambridge: Cambridge University Press.

RIQUET, R 1970. Le dolmen du Pech no. 1 a Alvignac (Lot): Etude anthropologique. *Gallia Préhistoire* 12 (1):137–49.

ROGERS, J. 1990. "The human skeletal material," in *Hazleton North: The excavation of a Neolithic long cairn of the Cotswold-Seven Group,* by A. Saville, pp. 182–98. English Heritage Archaeological Report 13.

SATTENSPIEL, L., AND H. HARPENDING. 1983. Stable populations and skeletal age. *American Antiquity* 48:489–98.

SCHEFFRAHN, W. 1967. Paläodemographische Beobachtungen an den Neolithikern von Lenzburg, kt Aargau. *Germania* 45: 34–42.

SEITZ, M. 1989. Das linearbandkeramische Gräberfeld von Stuttgart-Mühlhausen, Viesenhäuser Hof. Master's thesis, Tübingen University, Tübingen, Germany.

SELLEN, D. W. 2001. "Relationships between fertility, mortality, and subsistence: Results of recent phylogenetic analyses," in *Humanity from African naissance to coming millennia*. Edited by P. V. Tobias, M. A. Rath, J. Moggi-Cecchi, and G. A. Doyle, pp. 51–64. Florence: University of Florence Press.

SELLEN, D. W. AND R. MACE. 1997. Fertility and mode of subsistence: A phylogenetic analysis. CURRENT ANTHROPOLOGY 38:878–89.

SEMLIER, P. 1999. "Le matérial anthropologique," in *Les en-*

ceintes néolithiques de Diconche à Saintes (Charente-Maritime): Une périodisation de l'Artenac. Edited by C. Burnez and P. Fouéré. Mémoire de la Société Préhistorique Française 25/Mémoire de l'Association des Publications Chauvinoises 15.

SGARAMELLA-ZONTA, L., AND L. L. CAVALLI-SFORZA. 1973. "A method for the detection of a demic cline: Genetic structure of populations," in *Population genetics monographs* 3. Edited by N. E. Morton, pp. 128–35. Honolulu: University Press of Hawaii.

SILVA, A. M. 1996. "Paleobiology of the population inhumated in the hipogeum of Monte Canelas I (Alcalar), Portugal." *Proceedings of the XIII Congress of the International Union of Prehistoric and Protohistoric Sciences,* vol. 3, pp. 137–46. Forlì.

———. 1997. "O hipogeo de Monte Canelas I: Contribução da antropologia de campo e da paleobiologia na interpretação dos gestos funerarios do IV–III milénios a.C.," in *II Congreso de Arqueología Peninsular*, vol. 2 Edited by R. de Balbín Behrmann and P. Bueno Ramírez, pp. 241–48. Zamora.

———. 1999. "A necrópole neolítica do Cabeço da Arruda (Torres Vedras, Portugal): Os dados paleobiológicos," in *II Congrés del Neolític a la Península Ibèrica.* Saguntum-PLAV suppl. 2: 355–60.

SILVA, A. M., AND E. CUNHA. n.d. "Paleopathological study of the community exhumed from the hipogeum of Monte Canelas I (Alcalar-Portugal)." *V Congreso Nacional de Paleopatología, Alcalá la Real (Jaén), 1999.* In press.

SIMONIN, D., S. BACH, G. RICHARD, AND J. VINTROU. 1997. "Les sépultures sous dalle de type Malesherbes et la nécropole d'Orville," in *La culture de Cerny: Nouvelle économie, nouvelle société au Néolithique (Actes du Colloque International de Nemours 1994),* pp. 341–79. Memoires du Musée de Préhistoire d'Ile de France 6.

SIMONOFF, J. S. 1996. *Smoothing methods in statistics.* New York: Springer-Verlag.

SPATZ, H. 1999. *Das Mittelneolithische Gräberfeld von Trebur, Kreis Gross-Gerau.* Materialien zur Vor- und Frühgeschichte von Hessen 19. Wiesbaden: Landesamt für Denkmalpflege Hessen.

STADLER, P. 1995. "Ein Beitrag zur Absolutchronologie des Neolithikums in Ostösterreich aufgrund der ^{14}C-Daten," in *Jungsteinzeit im Osterreichs.* Edited by E. Lenneis, Ch. Neugebauer-Maresch, and E. Ruttkay, pp. 102–5, 210–24. St. Pölten: Wissenschaftliche Schriftenreihe Niederösterreich.

STUIVER, M., P. J. REIMER, E. BARD, J. W. BECK, G. S. BURR, K. A. HUGHEN, B. KROMER, G. MC CORMAC, J. VAN DER PLICHT, AND M. SPURK. 1988. INTCAL98 radiocarbon age calibration, 24000–0 cal b.p. *Radiocarbon* 40: 1041–83.

TELEGIN, D., AND I. POTEKHINA. 1987. *Neolithic cemeteries and populations in the Dnieper Basin.* British Archaeological Reports International Series 383.

ULLRICH, H. 1972. *Das Aunjetitzer Gräberfeld von Grossbrembach.* Part 1. Weimar: Hermann Boehlaus.

UNITED NATIONS. 1956. *Le concept de populations stables: Application à l'étude des populations des pays ne disposant pas de bonnes statistiques démographiques.* Publication des Nations Unies 65 (13).

VEIT, U. 1992. Burials within settlements of the Linienbandkeramik and Stichbandkeramik cultures of Central Europe: On the social construction of death in early Neolithic society. *Journal of European Archaeology* 1:107–40.

VORUZ, J. L. 1987. Chronologie du Néolithique d'origine méditerranéenne: Actes du 14ème colloque inter-régional sur le Néolithique. *Bulletin de la Société Archéologique Scientifique et Littéraire du Vendômois* suppl., pp. 5–33.

———. 1991. *Le Néolithique suisse: Bilan documentaire.* Document du Département d'Anthropologie et d'Ecologie de l'Université de Genève 16.

WHITTLE, A. 1996. *Europe in the Neolithic.* Cambridge: Cambridge University Press.

ZOFFMANN, K. Z. 1968. An anthropological study of the Neolithic cemetery at Villanykovesd (Lengyel culture), Hungary. *Annales Musei de Iano Pannonio Nominati* 13:25–37.

———. 1969–70. Anthropological analysis of the cemetery at Zengovarkony and the Neolithical Lengyel culture in SW-Hungary. *Annales Musei de Iano Pannonio Nominati* 14–15:53–73.

———. 1999. Anthropological data in the Transdanubian prehistoric populations in the Neolithic, the Copper, the Bronze, and the Iron Ages. *Savaria* 24(3):33–49.

ZVELEBIL, M., AND M. LILLIE. 2000. "Transition to agriculture in Eastern Europe," in *Europe's first farmers.* Edited by T. D. Price, pp. 57–92. Cambridge: Cambridge University Press.

Fire-Making in Tasmania: Absence of Evidence Is Not Evidence of Absence[1]

BETH GOTT
Department of Biological Sciences, Monash University, Clayton, Vic. 3168, Australia. 25 X 01

Australian Aboriginal people lived in Tasmania, a large island off the southeastern corner of the Australian continent, from 35,000 years B.P. (Cosgrove 1995), but around 12,000 years B.P. they were cut off from the main continent by rising sea levels. During its long period of isolation, technological change took a different course on the island from that on the Australian mainland, and the first Europeans found the Tasmanians to be employing what Jones (1977:196) has called "the simplest tool kit in the world"—simple spears, throwing sticks, and unhafted and unground stone tools, only about two dozen types in all. Various European visitors touched upon Tasmanian coasts from 1773 onward, but after British settlement in 1803 massacre and disease decimated the population and by 1830 none were living in their original fashion (Jones 1974:321). By 1847 only 45 fullblood individuals remained, and the last of these, Trugannini, died in 1876. There continues to be a community of people who identify themselves as Tasmanian, many from the Furneaux group of islands off the northeast coast, settled by families of mixed Tasmanian, European, and Australian Aboriginal descent (Ryan 1996: 71). In view of this history, ethnographic sources are very limited, and their reliability is difficult to assess (Jones 1974:321)—a problem not unique to Tasmanians (see Tylor 1964[1878]:247).

That the Tasmanian Aborigines used fire for cooking and warmth has never been disputed, and their observed practice of burning areas of vegetation has been inter-

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