Human Sociogeophysics — Phase I:
Explaining the Macroscopic Patterns of Man on Earth

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Abstract: The demography of man on earth is treated by a physical model for that forward transport for the subspecies in time. By examining the distribution of man and his Neanderthal precursor, it is inferred, as a likely hypothesis, that the initial "Phase I" expansion of man on earth (40,000—15,000 ybp) was at a constant density of about 0.04 persons per sq.km with little or no remixing. We suggest that the nature of the physical process was a diffusion, a "random walk" process with a diffusive velocity of one roaming range (30 km) per generation, i.e., 1.5 km per year. The physics and physiology of the breeding process permits us to estimate the total earth population, the birth rate b, the death rate d, and the net difference (that is the Malthusian constant K, \( dP/dt = KP \), where K = b—d, P = population, and dP/dt is the rate of change in population).

From a thermodynamic point of view, man in society is an open fluid-like system. Intrinsic to that openness are both man's ability, and his need, for relatively free movement on the surface of the earth. That movement engenders the local constraints on human land use. There has been no historical attempt to provide the space-time scaling for human movements in any systematic way. This is a first such attempt from a socio-physical point of view. We will expect such motion to be, loosely speaking, a diffusion of ethnicity (the coherence associated with a breeding pool), as moving ethnic band enter new areas and mingle with extant breeding pools.

Density and Distribution of Neanderthalers
90,000 — 40,000 ybp

To introduce the setting, we begin with modern man's precursors. Constable (1973) provides a glimpse of the Neanderthalers (e.g., 60,000 ybp) showing clearly the known concentration of key sites in the temperate latitudes (then tundra and savanna), mainly in Europe. Covering about 70,000 to about 35,000 ybp (Riss/Würm Interglacial to the end of the Mousterian, Middle Würm II/III), Klein (1973) identifies about another 25 Neanderthal (Mousterian) sites in the Ukraine. These mappings suggest an average separation of such sites of perhaps 160 km. One very crude estimate of the population density of such a collection of sites is an occupancy of 0.04 to 4 persons per sq.km (Wobst in Milisauskas 1978).

One of us has suggested, in an earlier study (Iberall 1973a), that a functional estimate of hunter-gatherer group sizes of the order of 25 to a few hundred seemed compatible with ethnographic studies (Murdoch 1967). If the group size is considered similar for Neanderthal and for Cro-Magnon man (a very bold assumption), then — as Milisauskas (1978) discusses — group sizes of 25 people up to perhaps 500 people are conceivable for Paleolithic bands. The earlier study (Iberall 1973a) also suggested that the human (as omnivore) daily roaming range might be of the order of 40 km radius; in that case the implied 80 km diameter may serve as a measure of band separation, with nearly complete separation at the 160 km distance, while close cultural coupling might exist at distances as close as 8—16 km. Murdoch (1967) suggests that several hundred kilometers (or 1,000 years) are conditions for essentially complete cultural independence.

All such estimates are loosely compatible with a population density in the range 0.01 to 0.5 Neanderthalers per sqkm (our estimate) which overlaps Wobst's estimate.
of 0.04 to 4 Neanderthals per sqkm (Wobst in Milisaukas 1978). The argument advanced by Wobst is that a minimum band (25 people) exploits a territory of about 1,200 sqkm. But we have no real evidence that middle Paleolithic (Neanderthal) groups were that tightly clustered. Thus we incline more to the nominal empirical separation of perhaps 160 km, and Wobst's lower estimate of density. A 10-20 fold increase in number of sites would move the density estimate toward the higher range of Wobst; barring such increase, we prefer the lower estimate of density.

Judging from Constable (1973) and Klein (1973) Neanderthals could be found in land areas of the order of 25 million square kilometers (the available temperate northern zones: for some notion of the total spatial range of Neanderthal see Clark 1967). If so, the Neanderthal population might be represented by a total of 1000 range sites with a total population of perhaps 25,000–500,000 members (Wobst's densities would yield 150,000–15,000,000). Our 'best' estimate would be of the order of 200,000 members, about the same as Deevey (1960).

**Human Phase I: Density and Diffusion of Early Modern Man 40,000 – 15,000 ybp**

Modern man, the advanced hunter, homo sapiens, emerged about 40,000 ybp. If we examine Klein (1973), we find that the number (and, approximately, the density) of upper Paleolithic (modern man) middle Würm sites (40,000–24,000 ybp) in and around the Ukraine has not increased tremendously over the previous epoch; only in the late Würm (24,000–13,000 ybp) do they show a large increase. Since he indicates an order of 100 sites in a region of the order of 1,600,000 sqkm, the average separation of settlements has been reduced to about 130 km, instead of 160 km. In the epoch 40,000–25,000 ybp, the population density of man might not have been appreciably different from the earlier Neanderthal population.

In the absence of better data, we shall imagine this region (40°–55°N, 20°–50°E) to be the locus of origin of homo sapiens, Man. Quite early in his subspecies history (40,000–35,000 ybp), his habitat range began to spread rather quickly, at a diffusion rate of the order of 1.5 km per year throughout the Old World. At that rate of diffusion, in that period, it would be just possible to reach the southern tip of Africa, southeastern Asia, eastern Siberia, and the nearer shores of Australia.

We conceive diffusion as a random walk. A prehistoric human random walk through the land-connected earth habitat in search of niches would have to cross a (topographically and climatically) most inhomogeneous territory. Such a diffusive expansion, therefore, would be by no means uniform, but rather a swarming, hiving diffusion in which geographic inhomogeneity would produce some reflections, some refractions, some condensations, during a process that could only lightly populate the earth. Subsequent diffusions might be expected to tend toward more uniformity, and perhaps somewhat greater homogeneity.)

The initial explosion might be expected to be that of a common breeding pool, one "race", i.e., one homogeneous ethnic composition. But the inhomogeneous niches in the geographic-climate milieu, the size of that milieu, ish shape with respect to the original population (which radiated divergently from a central location), and the long distances of diffusion (and the consequent long time delays for re-diffusion) assured the evolution of many and varied breeding pools. Races were born, perhaps within 5 or 10 thousand years (40,000–35,000 or 30,000 ybp).

We can make an estimate, say, of the population as of 35,000 ybp. If we take the now available land areas as about 80 million sqkm (the Eurasiatic band extended into northern climes, Africa), but the separation and density as before (3,000 sites), we now could expect a three-fold increase in population, i.e., perhaps 600,000 population, assuming the same size hunter-gatherer band (say averaging 200 persons, with about 8 camps of 25). Deevey's estimate (1960) is about 3 million.

If now we imagine a jump in the density of sites, that is if we imagine land use to become somewhat more crowded, a little more interactive in the period 35,000–20,000 ybp, even the separation reduction from 160 km to 130 km would increase the population by 50 %, i.e., implying a population of the order of one million (Deevey's estimate is about four million).

We can turn for a sharper starting point to Prideaux (1973). This presents a picture of modern man's spread as of 18,000 ybp. One finds perhaps 250 sites depicted (i.e., known, say, as of 1972). We would regard this to be a fair sample of what we estimate might be a total of 4,500 sites (50 % increase over 3,000 sites). Again we would tend to believe that our population estimate of one million, perhaps even two million is a fair estimate.

In any case we are willing to accept that picture (Prideaux) as a fair sample of modern man, dispersed, racialized, through Eurasia, Africa, even into Australia, but not yet likely in the Americas, as of say 18,000 ybp.

The 'last', initial diffusion into a heretofore unoccupied land mass, the Americas, it is conjectured (e.g. Martin 1967) took place in a relatively narrow time slot (about 13,000 ybp) across the Bering Strait land bridge. We would conjecture that it may have taken place in a number of waves, but that a major diffusion took place at that time suggested by Martin. In any case, continuing the diffusive process, it may very well have taken 5,000–10,000 years to diffuse all across the Americas (e.g., 15,000–10,000 ybp, 18,000–8,000 ybp). Martin further conjectures that newly entering man, the hunter-gatherer, killed all the large mammals in the Americas (except the bison) in perhaps a thousand years.