The Origin of Polities: A Preliminary Inquiry into the Evolution of Command and Control in Human Collectivities[1]

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ABSTRACT

In this article I examine the emergent physical properties and characteristic form-function configurations historically exhibited by human 'polities'. I trace the development of political organization and hierarchy from the earliest, proto-political 'Big Man redistributors' and fluid-like tribal chiefdoms to more fully-formed classical empires and highly-crystalline modern states. Throughout this elaboration of the evolution of the polity I stress the homeokinetic, hierarchical character of political association; and I note that every complex society contains a rich array of political mechanisms for regulating and mediating conflict and cooperativity at a variety of social scales, from family, village, and community to state, nation, and international system.

Drawing upon insights gleaned from such diverse intellectual traditions as classical social contract theory, neoclassical economic theory, public choice theory and political anthropology, and recasting these in the language and idiom of homeokinetic social physics, I begin the task of formulating a generalized field theory of political power and authority, form and function. My analysis encompasses, inter alia, *the origins of political association, the emergence and evolution of the state, the political economy of nationalism, the dynamics of political development, and the periodic, sudden (i.e., 'chaotic') breakdown of political order through revolution and war.*

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> When men live without other security than what their own strength and invention shall furnish them, ...the only way to erect such a common power as may be able to defend them from the invasion of foreigners and the injuries of one another... is to confer all their power and strength upon one man... or an assembly of men that may reduce their wills... unto one will.
>
> Thomas Hobbes (1651)

> We see the wandering group dispersing, dividing, held together by no bonds; the tribe with parts made more coherent by subordination to a dominant man; the cluster of tribes united in a political plexus under a chief with subchiefs; and so on up to the civilized nation, consolidated enough to hold together for a thousand years or more... Thus in all respects is fulfilled the formula of evolution. There is progress toward greater size, coherence, multiformity, and definiteness.
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> Herbert Spencer (1892)

> Group boundaries are established through conflict with the outside, so that a group defines itself by struggling with other groups... Outside conflict will strengthen the internal cohesion of the group and increase centralization.
>
> Lewis Coser (1956)

> [A]uthority relations provide net benefits in organizing certain transactions, as compared with bargaining between autonomous agents... [C]ertain desirable functions performed by authority relations ... could not be performed as well or as cheaply through direct negotiation... [U]nder conditions of uncertainty, bounded rationality and asset specificity, authority relations economize on costly bargaining when adaptation to novel situations is required.
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> Gregory Dow (1987)

Politics is concerned with the mechanisms and processes of command/control that regulate conflict and cooperation in complex social systems (Soodak and Iberall 1978). Not all social systems are equally complex; not all complex social systems have sharply-defined command/control mechanisms; and not all sharply-defined command/control mechanisms exhibit similar constitutional forms and configurations[2]. Recognizing the salience of such distinctions, political science is centrally concerned with identifying, classifying and analyzing the wide variety of observed patterns and processes of command/control in complex human societies (Deutsch 1963: ch. 9).

In this essay we examine the emergent physical properties and characteristic form-function continua historically exhibited by human 'polities'. We trace the development of − and phase transitions in − political organization and hierarchy from the earliest, proto-political 'Big Man redistributors' and fluid-like tribal chiefdoms to more fully-formed classical empires and highly-crystalline modern states. Throughout our elaboration of the evolution of the polity we stress the homeokinetic, hierarchical character of political association; and we note that every complex society contains a rich array of political mechanisms for regulating and mediating conflict and cooperativity at a variety of social scales, from family, village, and community to state, nation, and international system.

Drawing upon insights gleaned from such diverse intellectual traditions as classical social contract theory, neoclassical economic theory, public choice theory and political anthropology, and recasting these in the language and idiom of homeokinetic social physics, we begin the task of formulating a generalized field theory of political power and authority, form and function. Our analysis encompasses, *inter alia*, the origins of political association, the emergence and evolution of the state, the political economy of nationalism, the dynamics of political development, and the periodic, sudden (*i.e.*, 'chaotic') breakdown of political order through revolution and war.

THE VIEW OF CLASSICAL POLITICAL THEORY

Two contrasting − and seemingly irreconcilable − images of the origins of political life have dominated the literature of political theory for the past three centuries. The first image, fashioned most vividly by Thomas Hobbes, saw politics emerging from a 'war of all against all' that was man's postulated natural condition. In the Hobbesian view political authority, in the form of an awesome *Leviathan* state, arose out of a primordial social compact wherein men agreed to surrender a degree of personal autonomy in exchange for the state's protection against the grim vicissitudes of untrammeled human greed and self-aggrandizement. Predation and war were the postulated natural states of human life, which was

characterized by Hobbes as 'solitary, poor, nasty, brutish, and short'; cooperation for mutual benefit emerged only secondarily and artificially, under the coercive hand of the sovereign state.

Rejecting the dark, Hobbesian view of innate, mutually-assured human destructiveness, John Locke offered a radically different account of the origins of political life. In Locke's scenario, social cooperativity was the norm in the state of nature; consequently, political order emerged not to forcibly restrain man's violent, predatory impulses but to provide a coherent contractual framework within which the manifold, benign transactions of economic and social life could be conducted safely and predictably, with minimal risk of uncertainty, misunderstanding or conflict. For Locke, relations of reciprocity, trade, and trust were the normal modes of social intercourse; competition, predation and war were artificial and avoidable. These contrasting views of the 'state of nature' are broadly reflected in the contemporary 'conflict' and 'integration' schools of state formation, respectively (Service 1978: 21−34).

A major flaw in classical social contract theory was its inability to offer a viable solution to the '*e pluribus unum*' conundrum, *i.e.*, its failure to provide a dynamic mechanism capable of driving the hierarchical evolution of human associativity. For Hobbes as well as for Locke, both the social contract and the polity putatively emerged from a single, innate human predisposition − either toward greed (Hobbes) or toward cooperativity (Locke), unmediated by countervailing forces or impulses. For Hobbes, cooperation presupposed an empowered sovereign; but since empowerment is itself an act of 'cooperative coercion' we are left, in effect, with an endless loop − a classical chicken-egg problem. For Locke, on the other hand, the problem is precisely the obverse − how to account for the emergence of a coercive sovereign in a world of benign contractual reciprocity. In either case, the assumption of unmediated monocausality breaks down, striking no spark of evolutionary plausibility, no resonant architectonic chord.

A related weakness of classical contract theory is its assumption that a pre-political condition of pristine anarchy − the so-called

'state of nature' − actually existed in real historical time. Anthropologists long ago rejected the idea of a wholly atomistic, anarchistic state of nature as a convenient − but empirically implausible − myth. Rather than being non-associative and *a*political, primitive human hunter-gatherers, it seems, were loosely and intermittently socialized and politicized, oscillating between modalities of association and anarchy, reciprocal exchange and predation. Such loose-knit societies − which are more properly termed *proto*-polities − have been shown to be at once becalmed *and* potentially bellicose, benign *and* incipiently brutish (Service 1978).

Of all the classical social contract theorists, Jean Jacques Rousseau came closest to invoking the 'poverty principle' which lies at the heart of our homeokinetic account of the origins of polities. In Rousseau's view, the polity emerges 'when the strength of each individual is insufficient to overcome the resistance of the obstacles to his preservation', and when 'the only means [people] can employ for their preservation is to form by aggregation an assemblage of forces that may be able to overcome the resistance'. Here Rousseau explains state formation as a contingent, problematic phenomenon, stemming neither from innate human virtue nor viciousness, but rather from *conservational necessity* − that is, *survival*. Here we detect an early version of the Malthusian poverty principle at work: Why surrender personal freedom to a higher sovereign if autonomous individuals are capable of satisfying their own survival needs? (Alternatively expressed as *'Why buy the cow when the milk is free?')* Why indeed? Recognizing the conservational value of higher-level molecular association in the face of lower-level atomistic vulnerability, Rousseau posited the existence of a sovereign, organic 'general will' that was separate and distinct from the aggregate individual wills of its members. In so doing, he anticipated the homeokinetic principle that higher-ordered, thermodynamically-coupled systems possess distinctive conservational properties that are more than the mere sum of their constituent atomisms.

THE VIEW OF NEOCLASSICAL ECONOMIC THEORY

While political theorists continue to argue about the roots of the polity in the primordial baseness or nobility of the human spirit, neoclassical economists have come to view the issue of human conflict and cooperativity in terms of rational strategies of individual 'utility maximization'. Seen from this perspective, the *homo politicus* of Hobbes and Locke is merely Adam Smith's *homo economicus* in disguise; that is, given the opportunity, human beings will, it is assumed, strive to consume as much individual utility as possible − up to the point where the marginal cost of an added unit is equal to (or greater than) the expected marginal gain from that added unit.

According to classical *laissez faire* economic theory, popularized by Adam Smith, central authority exists primarily to maintain the tranquility and autonomy of the marketplace. The marketplace itself − to the extent that it is truly 'free' − putatively requires minimal (if any) direct state intervention or control, since the 'invisible hand' of supply and demand, operating without friction or fetter, automatically and spontaneously acts to ensure overall equilibrium among competing individual utility functions. Why, then, does centralized authority seem to arise universally in the real world? Why do real markets repeatedly − and almost invariably − tend to break down and fail? Why does the invisible hand so frequently give way to the audible command, and thence to the visible fist?

Neoclassical economists have attempted to shape an answer to this question. Spontaneous market-equilibrium solutions are difficult (if not impossible) to achieve, they argue, because real markets are always subject, in varying degree, to vagaries and distortions not anticipated by classical theories of perfect, friction-free competition. Among the most frequently-cited sources of market distortion are *uncertainty* (a function of inherent imperfections in the flow of information), *bounded rationality*, and the not inconsiderable (albeit often hidden) costs involved in *implementing and monitoring* complex market transactions.

These various sources of market distortion − known collectively as '*transaction costs*' (*i.e.*, the costs of market exchange) − have

been the subject of a burgeoning literature in microeconomic theory[3]. Transaction-cost economics emerged in answer to the fundamental question, analogous to the social contract conundrum posed by Hobbes, Locke, and Rousseau: 'Why do economic agents in real economic contexts tend to arrange themselves hierarchically and coordinate their decisions via central authority rather than relying upon voluntary exchange and the automatic coordination provided by the market?' (Moe 1984; Dow 1987). In response, transaction-cost economics postulated the key proposition that centralized, hierarchical authority (or 'vertical integration') emerges as a rational collective response to the high costs of coordinating individual behavior in any intensely competitive − but highly uncertain and imperfectly-rational − market environment (Williamson 1975). That is, to compensate for endemic market imperfections and uncertainties it becomes demonstrably rational, at a certain scale of transactional frequency and complexity, for previously-autonomous individual actors (*qua* utility maximizers) to band together − or incorporate − on an ongoing, obligatory basis to reduce transaction costs by both *sharing* and *internalizing* them, *i.e*., by moving from a system of volitional, independent exchange *via* the market to a system of centrally-mandated, coordinated exchange *via* hierarchical organization and control. This holds true, it is argued, because

> ... authority relations provide net benefits in organizing certain transactions, as compared with bargaining between autonomous agents... [C]ertain desirable functions performed by authority relations ... could not be performed as well or as cheaply through direct negotiation... [U]nder conditions of uncertainty, bounded rationality and asset specificity, authority relations economize on costly bargaining when adaptation to novel situations is required (Dow 1987: 19).

From the perspective of transaction-cost economics, human behavior is ultimately driven neither by pure selfishness and greed nor by pure altruism and cooperativity; rather it is driven by the *rational propensity to maximize utility* − a concept which readily encompasses both (atomistic) individual autonomy and (molecular) organizational hierarchy[4].

Neoclassical economics represents a clear improvement over social contract theory in two respects. First, it accepts (indeed it depends upon) the coexistence of potentials for both conflict and cooperation in human social behavior; and second, it provides a simple mechanism driving hierarchical integration and organization − *viz*., the rational calculus of cost and benefit. Yet neoclassical economics ultimately fails the test of explanatory adequacy. For one thing, most utility maximization theories assume that the individual rational actor is essentially an atomistic 'free agent', *i.e*., is able to alter his/her repertory of market-relevant behavioral responses at will, independent either of social milieu or systemic constraint. Able to reposition him/herself freely in the individual utility 'market', the rational actor ostensibly enjoys virtually unlimited degrees of freedom. To be out of work, for example, is simply to 'prefer' unemployment to all other possible marginal choices (*e.g*., relocation, retraining, accepting a lower wage, etc.). In this manner, virtually any aggregate societal distribution of goods and services, rewards and deprivations, arguably represents a 'Pareto-optimal' equilibrium outcome. As we shall argue below, this assumption of atomistic human free agency grossly underestimates the strength and 'stickiness' of the molecular and systemic (field) forces that bind individual actors to a pattern of socially-entrained – and highly change-resistant – behavior.

In addition to seriously overestimating the degrees of freedom enjoyed by individual rational actors, neoclassical economics also greatly overstates the case for the long-term metastability of Pareto-optimal equilibrium solutions. The assumption of metastability flies in the face of massive archeological, anthropological, and historical evidence concerning the periodic degeneration, decay, and dissolution of *all* systems of cooperativity, including both voluntary contractual associations and centralized coercive hierarchies. Indeed, flux is the rule, rather than the exception, in economic as in political life.

As we have seen, classical *laissez faire* economics lacked a mechanism adequately to explain either the inherent propensity of markets to fail or the related tendency for centralized hierarchies to emerge. On the other hand, neoclassical microeconomics has

generally suffered from the opposite shortcoming, *i.e.*, an inability to account for *systemic change*, including the tendency of centralized regimes (*e.g.*, ancient civilizations, medieval city states, feudal empires) toward dissipation and decay at certain characteristic temporal/spatial scalings. The sudden, unexpected collapse of the Soviet bloc is merely the most recent case in point. Insofar as it is demonstrably true that hierarchies tend to fail just about as frequently as markets, a viable theory of vertical integration must account not merely for the emergence of centralized order and authority, but for the cyclical recurrence of disorder and systemic dissolution as well.

THE VIEW OF 'PUBLIC CHOICE' THEORY

Cognizant of this systemic shortcoming of neoclassical microeconomic theory, social scientists have increasingly turned to 'public choice' models of economic and political organization. Designed to explore the systemic constraints imposed on individual behavior by the existence of centralized regimes, public choice theory starts with the observation that some individually-preferred goods and services – *e.g.*, schools, highways, social security, or nuclear deterrence – cannot reasonably be secured through scattered market transactions among autonomous actors, but must be obtained through large-scale cooperation and cost-sharing. The provision of such 'collective goods' (or public goods) involves the creation of superordinate regimes (*e.g.*, labor unions, tariff agreements, air quality control districts, etc.) that contractually bind individual members to participate in cost-sharing. But since collective goods (such as clean air, safe schools, or national security) cannot, by their very nature, be easily disaggregated or withheld at the level of the individual, all members of the group share, to some extent, in the benefit purchased – regardless of each individual's actual contribution to cost-sharing (Olson 1971). And therein lies the rub; for other things being equal, the larger the group sharing a collective good, the smaller the deprivation any single member must suffer who 'free rides' − *i.e.*, fails to pay his/her fair share of the costs. Hence, in any organization that provides collective benefits to its members, the rational propensity

for members to shirk responsibility tends to increase as a function of the size of the organization[5]. In this manner, all cooperativity regimes are subject to dissipative processes that are roughly proportional to scale, with larger organizations requiring increasingly frequent (and increasingly expensive) internal monitoring or external inducements to prevent 'free riders' from shirking responsibility − and thereby undermining the integrity of the organization. Interestingly, both Hobbes and Rousseau had anticipated the 'free rider' problem. For both men, the tendency to shirk responsibility was to be overcome by investing the authority to compel social compliance and punish social deviance in a sovereign body from which individual defection would not be tolerated. For Hobbes this body was the awesome *Leviathan* (or 'mortal God'); for Rousseau it was the 'general will'.

Commenting on the need for augmented internal monitoring and/or external inducements to discourage wholesale free-riding – and hence to forestall organizational decay – in large-scale collectivities, Olson has noted that

> ...in a large group in which no single individual's contribution makes a perceptible difference to the group as a whole, ... it is certain that a collective good will *not* be provided unless there is coercion or some outside inducements that will lead members of the large group to act in their common interest (Olson 1971: 44).

Here, we aver, is a partial answer to the paradoxical Hobbes/Locke conundrum posed earlier. For if mutual cooperation in pursuit of a public good is collectively rational, and if free riding to shirk responsibility for payment of apportioned costs becomes increasingly rational for each individual at larger scales of cooperativity, then the only reliable means for insuring continued provision of a collective good as the scale of organization increases is to create a higher-level enforcement vested with the power to monitor individual compliance and punish free riders[6].

Public choice theory thus clearly advances our quest for a dynamic mechanism to account for both the rise and the eventual decline of centralized power and authority. By embedding the atomized, 'rational' actor in an organizational milieu marked by

inherent, scale-amplified contradictions between the pursuit of short-term atomistic advantage (individual utility) and long-term molecular welfare (collective goods), public choice models permit us to locate the political process within an oscillatory, pulsating universe of countervailing forces and pressures toward organizational expansion and contraction, centralization and dispersion, voluntarism and coercion, cooperativity and predation[7].

Alas. For all its methodological sophistication, public choice theory also ultimately fails the test of 'sufficiency' in political explanation. For despite being both dynamic and scale-sensitive, public choice models generally assume that the processes of socio-economic and political adaptation and change are linear and continuous, rather than disorderly or catastrophic. Because rational choice models tend to view change in terms of sequential shifts from one Pareto-optimal local equilibrium solution to another, change appears orderly and gradual, rather than sudden or chaotic. That is, because of its methodological grounding in the mechanics of general equilibrium analysis, rational choice theory cannot readily account for the sudden, turbulent macrosystemic (or *supra*systemic) shifts associated with such seemingly non-linear, discontinuous phenomena as stock market crashes, panicking crowds, bandwagon effects, and revolutions[8]. Moreover, because they focus on only two levels of analysis − the (private) individual and the (public) collective − rational choice models are unable to account for the effects of far-field forces, operating at the level of the *global ecumene*, upon the behavior of individuals *and* collectivities within bounded social ensembles. Thus, for example, the sudden, cascading collapse of Communist regimes throughout East and Central Europe in 1989 cannot be explained using the simple dynamics of a two-level game, whose default mode is systemic equilibrium. Nor can the East Asian financial crisis of 1997−98 be understood in such terms. In both cases, *extra*-systemic field forces and catalytic contagion effects, propagated by rapid, globalized flows of information (and, in the latter case, capital), decisively undermined *intra*-systemic stability. Such field forces and effects are not easily factored into public choice models, with their assumption of general equilibrium and metastability[9].

Nor, finally, can such models be used to analyze emergent properties in complex social systems, for essentially the same reason, *viz.*, their assumption of systemic equilibrium and metastability.

THE VIEW OF SOCIAL PHYSICS

Confronted with the manifold shortcomings of social contract, neoclassical economic, and public choice theories, where are we to look for a more complete and adequate understanding of the nature and dynamics of emergent hierarchies of command and control in human society? Recent developments in the study of self-organizing, non-linear systems alert us to the possibility − indeed the very high probability − that neither the simple, one-dimensional contractual logic of Hobbes and Locke, nor the more highly nuanced, two-dimensional organizational logic of transaction-cost economics, nor even the dynamic, two-and-one-half dimensional calculus of public choice can furnish a sufficiently rich conceptual scaffolding for such an undertaking[10].

Elsewhere it has been argued that the laws of thermodynamics, applied to *all* complex systems − physical and biological, as well as social − preclude a linear, gradualist calculus of the origins and evolution of atomistic and molecular association, organization, hierarchy, command, and control (Soodak and Iberall 1987; Iberall and Soodak 1987). Below, we further develop this argument; and we suggest that it is the very interplay between social cooperativity at smaller (*intra*molecular) scales of hierarchical association, on the one hand, and social conflict at larger (*extra*molecular) scales, on the other, that gives the human polity its characteristic − indeed its essential − oscillatory, self-regulating dualism. We further suggest that it is precisely this interplay that ultimately both reveals and confirms the catalytic, thermodynamic engine-like nature of the polity.

Specifically, we shall argue that the first primitive human proto-polities could plausibly have emerged only through a *dynamic associative process* that was at once orderly *and* chaotic − a process wherein the inherently bifurcated human strategic alternatives of cooperation and competition became mutually entrained, at a certain critical threshold of (internal) social density

and (external) social pressure, creating thereby a loose, multitextured mosaic of collective action[11]. This mosaic − this heterarchical continuum of mutually-entrained form and function − included the first rudimentary apparatus of social command and control, *i.e*., the first recognizable system of *political stratification*.

In making this claim, we in no way seek to diminish either the enormous changes in form and function or the enormous institutional variations that have marked the evolution of the polity since the appearance of the first primitive 'Big Man redistributors' some 15,000 years ago; at the same time, however, we are strongly disposed to argue that in their characteristic action modes and behavioral repertories, modern polities (often misleadingly labeled 'nation-states') exhibit, *mutatis mutandis*, many of the same essential properties of command and control that have been observed in bio-social ensembles as widely divergent in evolutionary time and scale as the slime mold, the gorilla troop, and the human hunting band. The primary difference lies in the fact that in the modern polity, these properties are displayed in more functionally specific, differentiated, hierarchical, and crystalline (*i.e*., institutionally 'hardened') form.

In order to establish the validity − and, ultimately, the relevance − of these claims, we turn below to an examination of the anthropological record concerning the historical emergence of human political organization and hierarchy. By taking the cumulative observations and insights of political anthropologists and recasting these in the language and idiom of social physics, it becomes possible to sketch out the rudiments of a generalized field theory of political form and process, one which can fully and parsimoniously account for the bio-social origins and emergent properties of, as well as the long-term forces acting upon, the human polity. Such is our present objective.

THE EVIDENCE OF POLITICAL ANTHROPOLOGY

Political power and authority − the dual media of command and control in human societies − evidently emerged historically as a byproduct of a multi-dimensional process of human social

intensification[12]. In the first phase of this process, which began roughly 40,000 years ago, a few small, widely-scattered social 'droplets' − hunting/gathering bands – condensed in a primordial gas-like social milieu marked by near-random population diffusivity and interaction. Lacking strong central guidance and only intermittently bonded for purposes of reproduction and self-protection, these early bands secured their essential caloric and material requirements through simple harvesting of available flora, fauna, and other local physical resources. Spontaneous internal cooperativity was high (albeit sporadic), while local economic competition and intra-group predation were correspondingly low – indeed, virtually unknown in some cases[13].

With band size small, population densities low, and harvesting/storing techniques simple, early food-gathering societies were necessarily low-energy systems. Little surplus energy was available in such systems either for long-term storage or for kinetic mobilization; consequently no enduring civilizations or cultural complexes could be built upon them[14]. Nor was population growth rapid, since the requisite demographic densities and material and caloric energy surpluses needed to fuel a demographic 'explosion' were simply unavailable (Forde 1946; Boserup 1965). Yet insofar as sufficient harvestable calories and material resources were available (in at least some habitats) for producing, nourishing and protecting human offspring − and absent (or perhaps in spite of) such population-limiting devices as warfare, infanticide and epidemic disease − hunting/gathering bands did slowly increase in both size and number. And notwithstanding local variations in the carrying capacity of different human habitats, the overall rate of population growth tended to be rather uniform for the earth as a whole (Iberall and White 1988; Boserup 1965).

Band size could only increase up to a point. At a certain threshold of criticality (codetermined by resource availability and by internal conventions governing the resolution of interpersonal conflict), ***fission*** occurred: bands split apart with subgroups hiving off to form new segments, or 'camps'[15]. Despite the proliferation of new camps, however, the relatively small size, low density, wide dispersion, and modest energy budget of these early social molecularities continued to ensure a low-pressure, low-temperature

social process − a process marked by relatively little interactive social chemistry, low rates of repetitive inter-group contact, and hence little reticulation (or patterning) of social activities or networks[16].

Inter-group transactions were near-random, irregular events in the life of early hunting/gathering bands, and were generally confined to the purpose of maintaining the viability of the breeding pool (*e.g.*, through periodic exogamous mate selection and exchange). Except for a few very special occasions, such as periodic inter-band (or inter-camp) mate selection and ritual feasting, where ceremonial displays lent a modicum of continuity and viscosity, or enculturated 'collective memory', to the social life of the group, political authority was sporadic and non-continuous − indeed, almost non-existent[17]. Consequently, the social process remained highly gas-like and amorphous[18].

As camps grew, split, and dispersed, the interstitial spaces in the habitat eventually began to fill in. Overall population density increased, while available energy stores began to be depleted, albeit unevenly. Local kinship circles began to suffer a diminished capacity for economic self-sufficiency; and even previously 'affluent' camps eventually experienced diminishing returns on hunting/gathering. Under these circumstances, the near-random, gas-like social processes of hunting-gathering bands were subjected to intensified ecological (external) and demographic (internal) pressures.

Striving to maintain minimal subsistence levels of material and caloric input, individual camps at first responded to the mounting crisis by extending their roaming range and/or broadening their dietary base. Since habitable ecospace was becoming increasingly scarce, however, and since the amount of surplus energy that could be effectively stored was sharply limited, such extensification quickly reached the limits of practicality (governed by diminishing returns on expanded roaming, by available technologies of hunting/gathering/storing, and by the limited match between technology and resources within the local ecosystem).

There followed a Malthusian crisis − and a poverty-driven shift toward the *technological intensification* of production[19]. Harvesting skills and techniques were refined; available tools were improved; the simple pooling of labor was initiated to achieve economies of

scale; and productive/domestic roles were rudimentarily specialized to enhance group survivability (*e.g.*, strong, courageous males were specially selected and trained as hunters).

Eventually, however, intensive production also encountered diminishing returns, as pressures for increased food harvesting led to degradation of reproductive stocks[20]. At this critical juncture, and with survival clearly at stake for at least some groups, an important evolutionary bifurcation occurred. While some groups declined and eventually perished (either naturally or through conquest, annexation, or absorption by outgroups), others began to display the rudiments of a more complex division of labor, marked by the emergence of larger, more coherent molecular structures and by higher degrees of recurrent interactivity, reciprocity, and social viscosity.

Driven by the Malthusian engine of mounting demographic and ecological pressures, there thus began a new epoch in human history. Marked by the condensation of social matter from the sparse, near-randomly interactive, gas-like state of the hunting-gathering band to the more dense, richly-veined and highly-textured fluid state of the settled community, this epoch witnessed the parallel mobilization of two key, mutually-reinforcing modes of human adaptive response. The first of these adaptive responses, *technological innovation*, led eventually to the rise of a new economic mode of production − the domestic cultivation of plants and animals – and thence to substantial increases in the effective productivity of land and labor; the second, related response, *socio-political organization*, resulted in pronounced increases in the size, scale, and coherence of human social molecularities[21]. Together, these two parallel responses to the crisis of environmental degradation – the technological and the socio-political – brought about a virtual revolution in human associativity: on the one hand, the domestication of plants, animals, and the earth's resources enabled man to settle in place and accumulate a substantial economic surplus – two essential conditions for the emergence of systematic social stratification and the rise of urban centers (Adams 1966); on the other hand, the complex molecularities of the multi-camp society permitted large, non kinship- (or friendship-) based groups to coordinate exchange relations and to internally redistribute resources – essential requisites for the later

emergence of a true *political* economy (as opposed to a simple domestic subsistence economy)[22].

In seeking to account for a shift in the dominant characteristics of any field from one set of process currents, flows, and dynamics to another set, we confront the physical axiom that *potentials drive fluxes* (Soodak and Iberall 1978). In the case of the evolutionary shift from gas-like, atomistic hunting/gathering bands to more coherently-organized molecular agricultural communities, three physical forces were necessarily conjoined: (1) man's *epigenetic tool-rate potential*, *i.e.*, that cortical capacity, unique to man, which permitted appropriately adaptive technological innovation to occur (*e.g.*, the domestication of plants and animals); (2) man's *epigenetic value potential*, *i.e.*, that cortical capacity, also unique to man, which permitted new, long-chain social molecularities to be symbolically forged, sustained, and legitimated (*e.g.*, through in-group sanctioning of regular exchange with outgroups); and (3) the formation of an entirely new *conservation of value-in-trade*, again a uniquely human potential, which permitted low-energy, long-distance exchange and convection of goods, services, persons, and actions (*i.e.*, the 'marketplace' economic variable, wherein value is conserved in energy exchanges with outsiders). The harnessing and eventual synergizing, in a new and appropriate way, of these three factors – two epigenetic human potentials and one higher-level physical flux conservation – was to the birth of the human polity what the laws of conservation of matter, energy, and momentum were to the creation of galaxies, stars, and planets: the immanent, ultimate algorithm.

THE ORIGIN OF POLITIES

In our scenario of progressive social densification and environmental degradation, the intense social pressures generated by diminishing returns on hunting and gathering produced a fundamental human dilemma. For the first time, primary kinship/friendship groups in some habitats were unable to survive as self-sufficient producers. Nor was simple dispersion any longer a satisfactory solution for such groups, given the gradual filling-in of habitable ecospace. Under these circumstances, older modes of

human associativity simply could not be sustained; either new modes had to be found or group extinction would ensue[23].

In such a situation selection pressures clearly favored larger-scale, socialized mechanisms of exchange, with longer-chained networks of interaction and more elaborate rules of reciprocity. The result, we conjecture, was a new ingathering – or condensation – of human 'matter' leading to the creation of a higher level of field organization and to the appearance of new agents of macrosocietal 'order' and cohesion – *viz.*, political and economic *elites*.

Possessing the physical, on-board epigenetic potential both to innovate and to attach value to objects, paleolithic man had long before 'invented' the conservation of value-in-trade[24]. Now, however, with hunter/gatherers facing a mounting crisis of environmental degradation, some of them responded by developing the rudiments of a more coherent and regularly-interactive exchange-based economy, including intensive long-distance trade with outgroups.

Long-distance trade – or 'convective reciprocity' – required a degree of cortical complexity that was absolutely unique to man. Lesser species could exhibit various forms of interactive social behavior and task specialization, even life-long symbiosis; but none was biologically capable of purposefully transporting objects *for exchange at equal value* over both short and long distances. Initially a simple act of direct physical barter between suppliers and consumers of a product, convective trade was greatly enhanced by the advent of symbolic markers, or tokens – first 'currency', then 'credit' – which could represent the exchange value of an object without requiring a precisely equivalent counterflow of bartered goods to accompany each individual transaction. Along with the rise of urban centers, the introduction of token-based exchange systems greatly amplified the possibilities for the circulation of products, for the accumulation and redistribution of wealth, and consequently for the elaborate stratification of political communities (Day 1988).

The cultural entrainment of long-distance trade – especially when conducted with outgroups and strangers – also required a

rudimentary linguistic framework of partially-congruent symbolic meanings – *i.e.*, a common grammatical element shared among diverse groups. In the absence of common linguistic symbols, there could be no conservation of value in trade. It was one thing for family members (or members of the same camp or band) to conduct their exchanges according to established 'customary rules' of equivalence and propriety; but how could one trust strangers or outgroup members to abide by these conventions – particularly if they did not speak the same language or worship the same ancestral deities? What, for example, could a man's 'solemn oath' possibly be worth to a complete stranger?

Because the linguistic/cultural scaffolding needed to support the conservation of value in long-distance transactions with outgroups could not be constructed out of the near-random, sporadic, gas-like interactions among existing family/band units, more extensive, coherent (*i.e.*, fluid) social protocols were needed. That is, in order to enculturate the long-distance conservation of value-in-trade, larger and more complex forms of social bonding were needed – involving the emergence of extended human 'supermolecularities' held together not by kinship or friendship, but by more impersonal bonds of common linguistic symbols, common norms, common interests, and – eventually – common political authority[25].

Since individual families were no longer economically self-sufficient, and since trade with outgroups could not be conducted routinely or safely in the absence of mutually-understood and accepted rules of reciprocity, hunting/gathering groups were constrained to give up a certain measure of local autonomy for the augmented security afforded by a longer, more complex and linguistically-coherent molecular structure. It was in such a milieu, characterized by heightened social and environmental pressures for within-group coordination and by increasing without-group contacts (including such transactional modalities as trade, predation, and war), that the first political elites made their appearance: the so-called 'Big Man redistributors' – common forebears of tribal chieftains, kings, presidents, and corporate CEO's alike[26].

Driven by the positive forces of long-distance trade and reciprocity and by the negative force of increasing family/camp vulnerability, the Big Man collectivity emerged as a uniquely human, epigenetically-selected response to the crisis of social densification, environmental degradation, and incipient predation. With its more extensive network of group interaction, its more coherent language of symbolic exchange (centered around periodic ritual feasts), and its more highly articulated principles of command and control, the Big Man collectivity was arguably the first fluid proto-polity (Johnson and Earle 1987: ch. 7).

Among the manifold emergent social roles performed by Big Men (roles that came to include, *inter alia*, banquet host, tax assessor, entrepreneur, engineer, manager, mediator, diplomat, and general), none was more important than that of 'chief of [proto-] state'. The Big Man symbolically personified the prestige of the entire in-group in its ceremonial dealings with outgroups. Insofar as the Big Man's exalted status was conditional upon his ability to secure tangible benefits for his followers (a requirement that became progressively more difficult to satisfy under conditions of demographic densification and environmental depletion), the periodic ceremonial display (and occasional real-time demonstration) of his group's – and his own personal – potency *vis-à-vis* neighboring groups and their Big Men was a key element in the emergence of 'legitimate' political authority. Thus, one of the strongest forces promoting group cohesion within the Big-Man collectivity was competitive pressure originating at the periphery of the group, where the ability to dominate 'we/they' interactions (*e.g.*, through holding more sumptuous feasts, or through demonstrating superior martial skills or ceremonial rituals) provided the most important test of a Big Man's prestige – and his group's viability[27].

In the long-term cycle of demographic growth, fissioning, environmental depletion, technological intensification, outgroup exchange and in-group organization outlined above, the process of political condensation and 'thickening' was driven *internally* by increasing social densification and *externally* by competitive pressure and uncertainty at the boundaries of the collectivity,

where strangers (often speaking different languages and observing different rules of customary behavior) encountered one another at the margins of territoriality[28].

Competitive encounters with outsiders added to − and greatly amplified – existing internal pressures for higher-level organization and cohesion. To maintain and enhance group prestige at the outer edges of territoriality, where inter-group competition and conflict were most likely to occur, routinized, reticulated channels for regulating and facilitating the internal flow of natural resources, information and authority had to be extended from the interior core to the outer periphery. In this manner the incoherent, gas-like clumps of family and band interaction that characterized pre-political hunting-gathering bands were subjected to gradual but ineluctable pressures toward preliminary thickening, *i.e.*, toward the emergence of rudimentary structures of superordinate regulatory control. In this manner, too, the stage was set for the next major step in the evolution of the polity – the transition from Big Man collectivity to chiefdom.

Functionally speaking, the emergence of a political command/control function lends internal coherence – thereby adding strength and durability – to the weakly-entrained, near-random interactions and exchanges that define a primitive, gas-like social field. By the same token, the emergence of hierarchical processes of command and control exponentially increases the scale of potentially coherent social interactivity, thereby greatly amplifying the internal kinetic energy potential of a society and enhancing its capacity to influence − or dominate – its less-organized near-neighbors. Thus viewed as a thermodynamic regulator, the mechanism of political command and control − at first small-scale and localized (*e.g.*, the Big Man collectivity), later hierarchical and dispersed (*e.g.*, the chiefdom) − serves a catalytic function, quite literally 'governing' a series of high-energy internal social processes. By increasing the potential for coherence, hierarchy, and scale (and hence for efficiency) among a system's internal processes, the emergent governmental function enormously and unprecedentedly amplifies the 'power' of any human society[29].

A similar conclusion emerges from a consideration of the logic of inter-polity relations in pre-statal societies: In the initial frictional encounters between two densely-populated, resource-depleted hunting/gathering bands competing to occupy a single, shrinking ecological niche, advantage accrues in the first instance, *ceteris paribus,* to the side that is better able to mobilize its resources and focus them coherently – *i.e*., to the side that is *more effectively organized*. Therein lies the first – and perhaps the most important – principle of political evolution: He who mobilizes first, or better, wins[30].

Our conjecture that political authority first emerged as a catalyzed internal response to competitive pressures exerted at the 'we/they' boundary of group interaction draws support, in its key physical essentials, from the work of anthropologist Morton Fried. Fried (1983) rejected as merely 'legendary' a popular anthropological conjecture concerning the origins of the state which held that loosely-associated clusters (*i.e*., 'reticulated networks') of migratory camps or hamlets (*i.e*., 'tribes') gradually evolved into statehood in essentially linear fashion, driven by endogenous social forces and unaffected by the presence of outside entities. Fried found little ethnographic evidence to support either this notion or the related proposition that tribal associations were generally characterized by a high degree of congruence and synchronicity among their various functional networks – *i.e*., that tribal trade networks were essentially coterminous with ritual networks, kinship networks, alliance or military networks[31].

Rather than viewing tribes as solid or 'reticulated' networks, Fried adduced evidence to support the view that pre-statal societies were generally highly fluid, amorphous, and asynchronous; and he argued that rather than evolving gradually into states, migratory bands and camps had a propensity to crystallize rapidly into higher-level political forms in response to intensified boundary pressure from predatory external entities. Fried thus proposed a tribe-less scenario for the emergence of the state, a scenario that was essentially asynchronous, fluid mechanical, catalytic, and thermodynamically conservative:

> When we actually look at ethnographically known simple societies, we do not find any marked tendency to congruence of [their] several institutional networks... Economic networks are not particularly coordinated with religious ones. Such networks fail in many instances to fully occupy a particular linguistic space or idiolect, while in others, networks cross-cut rather drastic linguistic differences... [M]ilitary organization... is either entirely absent or it can be shown to be an artifact of encroachment on the populations in question [by] an already functioning state... *Pressures from the impinging state or states force congruence on the subsumed institutional systems so that these populations and their societies indeed become organized, bounded, reticulated networks. What is more, they quickly take on or develop centralized positions of command and coercive power. It is by encouraging this higher level of organization that states introduce a modicum of efficiency into... simpler societies* (Fried 1983: 475; emphasis added).

In other words, the pre-statal society is not a reticulated tribe at all, but a highly plastic entity that changes shape and size depending upon the immediate function being performed[32]. In such a milieu, statehood, if it occurs at all, occurs in response to predatory pressures at the periphery, *e.g.*, when a coherent external entity intrudes upon the life-support activities of a 'simpler' neighbor. In such a situation, the encounter is likely to result either in the annihilation, annexation, or absorption of the simpler entity, or else in the reactive, catalytic condensation of that entity into a more viscous and highly-reticulated chiefdom − and eventually, perhaps, into crystalline statehood[33].

Although Fried was dealing with a somewhat more advanced stage of political evolution than our pre-agricultural hunting/gathering band, the dynamics are essentially the same. In either case, the decisive pressure for higher-level organization of fluid, asynchronous networks comes primarily from the exterior. In the absence of exterior pressure, the earlier, time-tested survival strategy of extensification could be practiced indefinitely. Only under conditions of mounting environmental pressure does a shift toward intensification occur.

Potentials drive fluxes; the superior organizational coherence exhibited by predatory neighbors ('they') calls forth a reactive coalescence of internal field processes and pathways ('we'). In the words of sociologist Lewis Coser, 'group boundaries are established through conflict with the outside, so that a group defines itself by struggling with other groups... Outside conflict will strengthen the internal cohesion of the group and increase centralization' (Coser 1956: 87−88; Simmel 1955). Thus, the emergence of a renormalized, higher-order function of political command and control is presaged and made possible by the intensification of competitive pressures at the periphery – where 'we' encounters 'they'. It is precisely the existence of differential energy potentials across societal boundaries, we suggest, that drives what is perhaps the most potent political force of our time: *nationalism*[34].

Potentiated by boundary tensions at the point of 'we/they' partition and interaction, nationalism functions as a 'supercharger' that infuses the polity with coherent, polarizing energy[35]. In sociological terms this means that 'outside conflict... mobilizes the group's defenses among which is the reaffirmation of their value system against the outside enemy' (Coser 1956: 90). It is precisely this latent store of kinetic energy that political leaders tap into when they invoke the specter of a hostile, predatory 'they' – and thereby strengthen their claim to more complete and effective command over 'we'[36].

In the cycle of environmental degradation, territorial expansion, economic intensification, boundary pressurization and political organization sketched above, social cooperativity and conflict appeared not as alternative natural *steady*-states, *a là* Hobbes and Locke, but rather as the asynchronous phase-states of a single fluid, hierarchical, homeokinetic field process operating simultaneously at many different levels (spectral bands and frequencies) of social interaction and organization[37].

We have already conjectured that pressure for higher-level political organization originates at the 'we/they' boundary of a partitioned, internally-segmented field; we now further conjecture that under conditions of heightened boundary tension, pressure for

vertical integration in segmented societies intensifies and literally 'thrusts up' political unifiers (Big Men, chiefs, kings) who serve as catalysts for the 'gathering in' of hitherto locally-autonomous atomisms (families, camps, bands) and their condensation into more coherent, hierarchical molecularities (tribes, chiefdoms, states). It is precisely the simultaneous, asynchronous 'yo-yoing' of these two dynamic processes – *viz*., the horizontal 'inside-outside' fluctuations in ambient boundary tension which drive the 'hardening' (or 'softening') of fluid social networks, and the vertical 'up-down' fluctuations in internal pressure which drive the higher-level integration/disintegration of the society – that gives the polity its characteristic oscillatory quality. That is, boundary pressure from outgroups begets coherent association and higher-level organization among in-groups, which reduces the threat of outgroup predation, which promotes the decline of in-group cohesion, which invites outgroup predation – and so on. In such a manner, human societies fluctuate ceaselessly – and homeokinetically – between the worlds of Locke and Hobbes, between trade and war, between equality and hierarchy, between cooperation for the common weal and defection for the aggrandizement of self. Such is the nature of politics[38].

To recapitulate: politics is seen as a catalytic process that originates in boundary pressure at the periphery of a fluid social field undergoing progressive environmental degradation and internal social densification. Under increasing external pressure, a reactive internal thickening occurs, and a rudimentary structure of unified political command/control is established, initially in the person of a 'Big Man' redistributor. The cycle of social densification and degradation, pressure and condensation then begins anew, at a higher level of molecular association, with social pressure once again building at the periphery of the system, eventually calling forth new, more complex higher-level molecular associations within.

At each successive, pressure-cooked stage of this homeokinetic cycle, new and richer forms of political association emerge to satisfy the conservational requirements of the system. Throughout, evolutionary 'progress' is measured by the steady refinement of

three asynchronous processes: the *in-gathering of political power*, the *elaboration of political hierarchy*, and the *legitimation of political authority*.

The first of these processes – the in-gathering of power – involves the concentration of societal command over existing allocative and redistributive networks, the imposition of a 'social overhead tax' (*e.g.*, tribute, corveé, or conscription) on domestic economic surplus, and the establishment of punitive sanctions for social deviancy and non-compliance. As we have seen, centralized authority relations may arise initially either as a contractual response to the rising transaction costs of individual decision-making in an uncertain market environment or as a collective response to the problem of securing public goods.

With expansion in the scope and machinery of centralized authority comes the emergence of a higher-level political economy and with it a new series of contradictions between atomistic (Hobbesian) self-interest and molecularized (Lockean) cooperativity. As we have seen, the larger and more complex a levy-imposing, benefit-conferring collectivity – or polity – becomes, the harder it is to monitor individual performance and compliance, and hence the stronger is the incentive for individual members to defect opportunistically from the social compact and become 'free riders'. This, in turn, increases the demand for more effective techniques of monitoring individual performance, and hence for the elaboration of internal, hierarchical control mechanisms, with intermediate agents (*e.g.*, supervisory organs, local governments) interposed between principal actors (Big Men, chiefs, kings) and their local constituents[39].

The third process – political legitimation – emerges at the point where organizations become too large, complex and heterogeneous to permit direct monitoring or enforcement of compliance by Big Men, tribal chiefs, or other political elites[40]. Although political legitimacy is a variable physical property of *all* complex, stratified systems, its potential impact is limited by two main factors: (1) the degree of internal coherence (or mutual entrainment) among the various enculturated pathways and networks that comprise the system's energy exchange and transport processes[41] and (2) the

amplitude of differential energy potentials stored at the 'we/they' frontiers of group identification and interaction[42].

The existence of highly-charged boundary potentials may serve to enhance political legitimacy by partially offsetting (or neutralizing) residual internal field incoherence, turbulence, or friction. This, we suggest, is why nationalism has always been such a potent force. Nationalism acts, in effect, as a catalytic converter, transporting polarized potential energy from the periphery to the core of the polity. Activated by elite manipulation of common cultural symbols of in-group ('patriotic') solidarity, nationalism requires for its potentiation the clear demarcation and periodic reinforcement of a we/they boundary[43]. The boundary may be defined either *physically* (in material artifices such as The Great Wall, Hadrian's Wall, or the Berlin Wall), *transactionally* (in regulatory constraints on the flow of goods, services, and people, such as tariff barriers and immigration quotas), or *representationally*, through manipulation of ritualized, stereotyped symbols of national, racial, or cultural identity and exclusivity (*e.g.*, *Mein Kampf* or the U.S. Declaration of Independence). In either case, a vital polarization/potentiation function is served by highly-charged displays of in-group solidarity[44].

The conditional physical logic underlying the emergence of 'solid state' political systems may now be summarized: In the absence of both relatively high internal social densities and relatively clear we/they boundaries, differential chemical potentials cannot be created; without differential potentials, coherent energy transports cannot emerge; without coherent energy transports, reticulation of entrained networks cannot occur; no reticulation, no molecular bonding; no molecular bonding, no hierarchy; no hierarchy, no crystalline polity. In the final analysis, then, the 'state' is a flux-driven, thermodynamic engine for the enhancement of societal command/control. It operates catalytically through three asynchronous processes – the in-gathering of power, the elaboration of hierarchy, and the legitimation of authority. Through the interplay of these thermodynamically-linked field processes the emergent, crystalline polity ceaselessly cycles in fulfillment of its homeokinetic mandate: *e pluribus unum; ek kaous kosmos* – 'from

many, one; from chaos, order' − *and back again*. Such, we believe, are the essential driving forces and physical processes of the human polity.

NOTES

[1] This article is dedicated to the memory of my friend and mentor, Arthur S. Iberall (1918−2002), whose insights into the origins and dynamics of complex systems, physical and social, profoundly shaped my understanding of 'the way things work'. A preliminary version of the paper was presented at the Conference on Homeokinetics in Honor of Arthur S. Iberall, University of Connecticut, July 24−26, 1998.

[2] More than 2,000 years ago Aristotle identified six basic types of political system, classified according to two criteria: the locus of sovereign authority (rule by the *one*, the *few*, or the *many*), and the principal beneficiary of sovereign power (*self* interest vs. *public* interest). Although Aristotle's typology has been variously expanded, adjusted and modified throughout the intervening millennia, it remains the *locus classicus* of comparative political analysis.

[3] Coase (1937) defines transaction costs as the costs of contracting with autonomous actors for the provision of goods or services in a market environment. Such costs include the 'expense' of information gathering and evaluation, negotiating contracts, and ensuring their proper implementation.

[4] In theory, the limiting case – where any movement toward the imposition of superordinate authority would be considered marginally *ir*rational – occurs when an individual's utility function is such that no other value or combination of values (including survival itself) exceeds in importance that of absolute independence and autonomy. In such a case, *any* movement toward individual subordination would be ruled out as sub-optimal. This limiting case is epitomized in the classic 'zero-sum' exhortation of Patrick Henry: 'Give me liberty or give me death!'

[5] The 'free rider' phenomenon offers a compelling explanation for the universal failure of large-scale collective farming in socialist countries to achieve sustainable boosts in agricultural productivity, despite significant scale economies in the division of labor. It also explains why socialist countries have been powerfully constrained to reduce the scale of collective farming down to smaller and smaller units, reaching near-equilibrium at the level of the individual family farm.

[6] Note the essential similarity of this reasoning to Rousseau's argument for a sovereign 'general will'.

[7] For a rational choice analysis of state predation as a strategy for public welfare maximization, see Mosell and Polak (2001).

[8] One recent exception is Lohmann (1994), who uses a rational choice model to analyze the dramatic 'informational cascade' that occurred in Leipzig, East Germany, in the summer of 1989, when large numbers of demonstrators suddenly took to the streets to protest against an unpopular Communist government, culminating in the collapse of the regime.

[9] For evidence of long-term global meta-*in*stability, characterized by periodic, epochal changes in the size, scale, density, hierarchical forms and functions of socio-economic and political organization from the mesolithic era to the present, see Iberall and White (1988).

[10] For an introduction to the general theory of turbulence and catastrophic change in complex systems see Roger Lewin (1993). For an intensive methodological critique of equilibrium-based theories of bio-social cooperation and competition see Garfinkel (1987). In this essay Garfinkel explores the phenomena of self-organization and self-scaling in non-linear systems amd challenges Stephen Smale's widely-cited conjecture that a mathematized iteration of any two-person Prisoner's Dilemma game must eventually converge toward a global stability condition of mutual cooperation *independent of initial conditions* (a convergence subsequently referred to by Axelrod and Hamilton as the 'evolution of cooperation'); he further notes that 'a single game, a single set of rules, may have one kind of behavior (competition) for one range of conditions and another (cooperation) for other conditions. That result explains how both responses are possible (without attributing either to 'human nature') and how one can change or bifurcate into the other...' (p. 205). It is this propensity for strategic bifurcation to recur at successive scales and levels in the ascending hierarchy of political command and control that is of particular interest to students of the emergence and evolution of polities.

[11] 'Entrainments' are defined as mutually coherent behaviors that promote cooperative strategic game solutions (Garfinkel 1987: 206).

[12] The descriptions presented in the following passages portray a modal evolutionary sequence, and do not purport precisely to fit any particular historical case. In reconstructing this generic sequence we have profited from the work of Harris (1977), Fried (1983), Price (1978), and Johnson and Earle (1987).

[13] Paleoanthropologists have recently adduced physical evidence to support the conclusion that strategically-positioned hunting/gathering bands often did not have to work very hard or long to satisfy their daily caloric requirements; a finding which suggests that early man may have led a relatively abundant, low-stress life (Cohen and Armelagos 1984; Diamond 1987).

[14] Price (1978: 165) notes that the amount of storable energy available within a given society or culture is directly reflected in the artifacts and monuments created by that culture: 'Anything made by man represents the transformation [of matter by energy], energy produced by and circulated in a human community... *The criterion of relative scale [of cultural relics or monuments] is thus the material isomorph of the capital and labor required for the energy transformation in manufacture or construction*' (emphasis added). A similar point was made by Adams (1955: ch. 2).

[15] Anthropologists generally agree that the optimal outer limits of band expansion lie somewhere between 50−500 individuals, depending on the ecology of the local habitat (Steward 1977).

[16] Social pressure in any complex system (or social molecularity) emerges from the internal actions performed by the system's atomistic components. The

greater the atomistic density of a particular social molecularity, and the greater the coherence of its internal processes, the greater the social pressure generated − resulting, *e.g.*, in the type of intense discomfort normally experienced by a single jeans-clad individual entering a room full of people wearing formal dress, or the stress experienced by a religious fundamentalist at a punk-rock concert. *Social temperature*, on the other hand, relates to the amount of external energy generated by the actions of a system's atomistic components − as, for example, when a Presidential campaign 'heats up' as the result of an open policy conflict between leading candidates. In hunter-gatherer societies, because of the wide geographical scatter of the constituent bands, because of the low-energy nature of the band's internal processes, and because of the low degree of coherence (or high degree of randomness) exhibited by these internal processes, relatively little social pressure can be mobilized and relatively little external energy (heat) can be generated. Hence our characterization of such societies as low-pressure, low-temperature systems.

[17] Anthropologists generally agree that early hunting-gathering bands were only weakly and intermittently stratified. Conflict resolution was handled according to customary rules, rather than codified laws; and decision-making was an *ad hoc*, episodic activity rather than a continuous or specialized one. Elders in the band, whose lives bridged three (and sometimes four) generations, embodied the collective memory and customary rules of the band, and were generally deferred to in situations of social conflict. In this respect, elders quite literally comprised 'living constitutions' in pre-literate, pre-statal societies. This, we shall argue, is no mere historical curiosity, but a vitally important point, since the emergence of stable and coherent (*i.e.*, 'lawful') command/control structures in human society required, at the very minimum, a transmittable two- or three-generation memory span – something no lower animal species possessed the requisite epigenetic potential to achieve.

[18] Cottrell (1955: 24−25) provides a useful generalized description of the low-energy transactions that characterize hunting-gathering societies: 'Everything used must be transported. Their means of transportation are characteristically limited to human portage or sledge dogs. Consequently, tools must be simple and light in weight. Housing must either be improvised at many different sites or be very easily transportable. Clothing must be light and simple. No great energy can be devoted to erection of shrines... or worshipping the gods. The size of the social unit is necessarily small, for if any great number of people gather together, they soon exhaust the local supply of most of their energy sources and have to range far afield in search of new sources... At best the division of labor is limited, for almost everyone must spend a great deal of time and energy in the pursuit of food. Priests and other social functionaries who gather no food cannot contribute enough... to offset the energy lost in supporting them. The kinship groups among food gatherers... are [too small for] creating or transmitting any very large culture base; consequently tradition, law, and religion remain relatively simple, providing only a limited number of controls for the guidance of the head of the household'.

[19] Boserup (1965) notes that land is rarely − if ever − used intensively so long as cultivators are able expand into virgin territories. On the cultural ecology of labor intensification see Geertz (1963).

[20] The problem was one of individual interest (current consumption) vs. collective well-being (long-term conservation of resources) − a familiar public goods problem not unlike the classic 'tragedy of the commons'. For a graphic description of how ecological degradation adversely affected cooperativity among one African hunting/gathering band, see Turnbull (1972).

[21] Harris (1977) persuasively argues that contrary to conventional wisdom, the domestic cultivation of food was not 'invented' in response to a sharp decline in the productivity of hunting/gathering. Relatively sophisticated horticultural/husbandry techniques were known to have been discovered (though they were not widely practiced) in many regions *long before* ecological pressures became acute, and long before the first settled agricultural communities appeared. However, it was not until the process of environmental degradation reached crisis proportions that such exotic techniques were first widely popularized − or 'selected for' − bringing about a major revolution in the economic mode of production. Indeed, Harris argues, such is the ecopressure-cooked process of punctuated equilibrium that while local intellectual point mutations (*i.e.*, new or deviant ideas and inventions) have occurred rather widely and frequently throughout human history, the social amplification and entrainment of these mutations (*i.e.*, the broad acceptance of a new idea, or the successful diffusion of a new technology) is far more highly constrained and ecologically problematic. This is the physical principle behind the maxim, 'nothing is so powerful as an idea whose time has come'. With the depletion of hunting/gathering reserves, domestic food cultivation was clearly an idea whose time had come. See also MacIver (1947: 170−172).

[22] Johnson and Earle (1987: 323) define the transition from household subsistence economy to socialized political economy in terms of a marked reduction in the autonomy (or what physicists call 'degrees of freedom') enjoyed by local kinship groups under conditions of increased ecological and demographic pressure:

> ... [W]hat is it that *changes* about an individual family's self-interest that allows the political economy to evolve?... Households in family-level societies are amazingly independent and self-reliant... They are capable of mustering all the necessities and most of the desirables in life through their own efforts... The evolution of the political economy is accompanied by the steady erosion of the autonomy of the family. Each higher-order integration of the economy not only introduces new ('emergent') cultural processes, but also entails a further reduction in the sphere of free action of the family in the natural environment. More and more of a family's time and energy must be spent in the sociocultural environment; in a word, the economy is increasingly socialized.

[23] It should be emphasized that the pattern of mounting demographic pressure and environmental degradation was geographically uneven. This meant that groups in different regions and different habitats were differentially constrained to alter their strategies of survival. Thus, while some habitats (or ecological niches) continued to prove hospitable to small hunting/gathering bands, others grew

increasingly inhospitable. Such environmental/demographic heterogeneity led to the uneven, 'marbled' development of new forms of associativity, making it possible for hunting bands in some areas to coexist for rather extensive periods alongside pastoralists and agriculturalists.

[24] Recent evidence indicates that paleolithic bands may have engaged in periodic long-distance trade as early as 20−30,000 years ago.

[25] We have conjectured (note 17, above) that the three- (or more) generation social memory of band/camp elders, who were the 'constitutional' repositors of tradition and customary law in hunting/gathering societies, provided the minimal cultural scaffolding needed for the eventual emergence of more specialized, coherent structures of political authority. Clearly, at some point such information had to be codified; and so it was, almost 4,000 years ago, with the advent of the Code of Hammurabi. We also note in this connection that written language, itself a cultural codification first appeared only about 5,000 years ago. We conclude from this conjunction of script and scripture that the economic transformation from hunting/gathering to settled agriculture involved the parallel evolution of a new cultural hierarchy of politico-linguistic forms.

[26] Examining this phenomenon from the perspective of neoclassical economics, discussed earlier, it can be argued that the transaction costs of convective trading in primitive family or band-centered exchange economies rose dramatically under conditions of increased scarcity, extensification, specialization, and expanded contact with outgroups and strangers. Immediate causes of this cost increase included a geometric degradation in the quality of market information available to individual families/camps as the territorial range of long-distance trade was extended outward, and increased decisional uncertainty as contacts with strangers and outgroups increased at the periphery, with a corresponding rise in the potential for hostile or predatory encounters. Under such circumstances, once a critical threshold of diminishing returns on domestic exchange was reached, selection pressures favored a 'rational choice' creating a larger-scale *proto-hierarchical organization* of controlled exchange relations (the Big Man collectivity) − akin to a primitive 'firm'. In exchange for diminished local economic autonomy and fluidity, the family/camp gained access to the extended resources, information, and security devices (*e.g.*, feasts, rituals, alliances, and armed warriors) of the Big Man organization.

[27] It was at this critical nexus of 'we/they' interaction, we conjecture, that *proto-nationalism* (in the form of ceremonial displays of in-group potency and solidarity) had its origins. Below, we further elaborate this idea.

[28] It should be noted that it was at such peripheral points of friend-stranger contact that the two worlds of Lockean cooperativity and Hobbesian predation first collided and became mutually entrained. For, as we have seen, in the absence of 'we/they' competition and conflict (a là Hobbes), Big man collectivities clearly lacked a demonstrable *raison d'être*; while in the absence of 'we/we' cooperation and reciprocity (à la Locke), the emergent proto-polity lacked the very possibility of higher-level form and structure.

[29] In physical terms, the emergence of political authority in an otherwise gas-like field performs the function of a rudimentary 'baffle', *i.e.*, a device for partitioning − and thus rendering more 'orderly' − the near-random, dissipative energy flows that occur within turbulent fields. A hurricane lamp is a simple example of such a baffle. Placed over a low flame, a glass hurricane lamp creates a coherent, convective flow of energy, resulting in brighter illumination and more concentrated heat.

[30] The strategy of pre-emptive coalescence is the political equivalent of economic intensification, discussed earlier. The physical principle upon which the strategy rests - *viz.*, 'coherent process defeats incoherent process' - has been offered, *mutatis mutandis*, as a primary explanation for the historical emergence of political parties in America almost 200 years ago. By caucusing like-minded members of Congress before a critical vote, supporters (or opponents) of a particular bill could promote unified bloc voting, a technique which gave a relatively small (but coherent) group of legislators disproportionate power *vis-a-vis* their unorganized colleagues. With the advantages of intra-caucus coherence readily apparent to all concerned, however, reactive counter-mobilization of opposition caucuses quickly ensued, leading to higher-level coalitions, pork-barrel politics, and the eventual formation of aggregate American political parties as we know them (Chambers 1963). One strategic alternative to organizational coalescence and intensification, especially in systems with low rates of social mobilization and participation, is that of political *extensification*, *i.e.*, the attempt to enlarge the 'playing field' of conflict in order to draw new, previously marginal or peripheral groups into participatory roles, and thereby reverse an adverse balance of forces. This is the essence of Schattschneider's famous 'socialization of conflict' hypothesis, which has been invoked, *inter alia*, to explain the progressive enfranchisement of new groups of American voters in the late 19th and early 20th centuries as well as the continued efforts by contemporary political parties and interest groups to mobilize previously inert groups of voters (*e.g.*, voter registration in the South). In its original form, the hypothesis holds that 'it is the weak, not the strong, who appeal to [the] public for relief. It is the weak who want to socialize conflict, *i.e.*, to involve more and more people in the conflict until the balance of forces is changed...' (Schattschneider 1960: 36−43).

[31] Fried's views on this question are readily contrasted, *inter alia*, with those of Adams (1966).

[32] We may restate Fried's basic description in a way that seemingly contradicts his conclusion without altering the underlying spirit of his argument. The point he makes clearly is that the emergent system is not a reticulated 'network of networks' whose subsystems are congruent at their nodes (*e.g.*, cultural, religious, economic, political, ethnic). Rotating this around a bit, we point out a simple alternative hypothesis: the subsystems do, in fact, consist of a network of networks, *but without congruence among their nodes*. And the nodes tend to be rather fluid in their occupancy. Thus, simply put, a tribe is not a sharp 'thing' or structure, but a shifting, fluid, lumpy, heterogeneous 'field'.

[33] It is interesting to note that this scenario virtually (and by no means coincidentally) recapitulates, in all its essentials, the biological process of immunological response, described by Thomas (1974), wherein an attack on a living cell by a hostile intruder triggers a reactive mobilization by the cell's internal antibodies.

[34] In physical terms, the external boundary of a political system functions like the outer membrane of a cell; that is, it serves as a storage battery potentiating the high-energy transport processes needed to organize vital intra-cellular functions. Like water flowing over a dam, energy flows most coherently (and efficiently) across a partitioned, bounded field. In the absence of such partitioning, the potential energy of a homogeneous field is dissipated, *i.e*., discharged randomly rather than coherently. With the introduction of field partitioning (*e.g*., the storage cells of a battery, the glass baffle of a hurricane lamp, the localized impedance of a dam, or the wall of a medieval city), chemical potential can be stored and catalytically switched to drive a variety of coherent, energetic internal processes.

[35] We use the term 'nationalism' with the understanding that the conventional usage of this term implies the existence of something called a 'nation-state' wherein ethno-linguistic boundaries are coterminous with political boundaries. In our present usage, nationalism is a generic term that does not assume such congruence − indeed it does not even assume the existence of either 'nation' or 'state'; and it is more akin to such concepts as 'chauvinism' or 'ethnocentrism' in its emphasis upon collective human emotional attachment to *any* macrosocial 'we'.

[36] This, we conjecture, is the reason why no truly effective, stable global political order is ever likely to emerge in the absence of a globally-salient supraterrestrial threat to human survival. Whereas some analysts argue that the eventual emergence of a global state will be driven by an ongoing cycle of uncontrolled international predation, war, conquest, and imperial expansion, in our view the creation of a world political order involving the organization of a coherent, omniterrestrial 'we' would require an *exogenous force* − or supraterrestrial 'they' − of enormous energy to potentiate it, and to reduce to relative insignificance the internal impedances (*i.e*., local 'nationalisms') that have perennially undermined all attempts at world government. These contrasting views are presented in Carneiro (1987) and Wilkinson and Iberall (1986), respectively.

[37] We believe that it is the very hierarchy, complexity, fluidity, and asynchronicity of evolving socio-chemical field processes that provides all would-be unifiers of physical and social science with their greatest conceptual challenge. We further believe that it is precisely the ability of the present, physical systems approach to deal simultaneously and reductively with each of these qualities that lends the approach its compelling explanatory power.

[38] Such too, we conjecture, is the nature of *every other energetic process in the universe* − from the condensation of galaxies to the psychological birth of the human infant.

[39] The proliferation of principal-agent relations in hierarchical organizations also increases the need to guard against opportunistic behavior on the part of the agents themselves. On the emergence of centralized administrative offices and institutions in primitive political systems, see Etzioni (1959); Eisenstadt (1963); and Dow (1987).

[40] Political legitimation does not occur in simple hunter-gatherer societies, since these are by definition egalitarian, unstratified systems. Political legitimacy may be said to exist only when (and to the extent that): (1) a hierarchical polity exists; (2) non-egalitarian redistribution of societal resources occurs; and (3) organizational leaders refrain from the use of physical inducements (*i.e.*, coercive force or bribery) to secure opportunistic compliance in the extraction and redistribution of resources. On the difficulty of securing non-opportunistic compliance in large, hierarchical organizations with bounded spans of control, see Dow (1987: 25ff).

[41] That is, legitimacy is a measure of the relative absence of social friction, turbulence, or other structural impedances that limit the coherent transport of energy throughout the system. In this sense, legitimacy is a function of the overall 'conductivity' of a social system, and therefore of its potential responsiveness to centralized command/control.

[42] Boundary potentials are a function, *inter alia*, of such factors as linguistic and ethnic homogeneity, territorial integrity, and the intensity of antagonisms or rivalries with other groups or polities. The sociological logic of this argument is explored by Coser (1956).

[43] By importing coherent energy from the boundaries of a polity to its interior, nationalism provides a polarizing 'boost' for the internal processes of the system, in much the same way that a jump start serves to boost a stalled engine.

[44] In this connection it should be noted that patriotism, while often decried as the 'last refuge of scoundrels', is also – and for reasons already adduced – the *first* refuge of canny political elites.

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