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Selection of Organization at the Social Level: obstacles and facilitators of metasystem transitions

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ABSTRACT. This paper examines in how far Turchin's concept of metasystem transition, as the evolutionary integration and control of individual systems, can be applied to the development of social systems. Principles of collective evolution are reviewed, and different types of competitive or synergetic configurations are distinguished. Similar systems tend to get involved in negative sum competition, and this precludes optimization at the group level. The development of shared controls (e.g. through conformist transmission) may overcome the erosion of group level cooperation, and thus facilitate the emergence of a division-of-labor organization. The resulting social metasystem transition is exemplified by the emergence of multicellularity, insect societies and human sociality. For humans, however, the on-going competition between the cooperators produces an ambivalent sociality, and a weakly integrated social metasystem. Strengths and weaknesses of the main social control mechanisms are reviewed: mutual monitoring, internalized restraint, legal control and market mechanisms. Competition between individuals and (fuzzily defined) groups at different levels of aggregation very much complicates evolutionary optimization of society. Some suggestions are made for a more effective social organization, but it is noted that the possible path to social integration at the world level will be long and difficult.

KEYWORDS: metasystem transition, co-evolution, competition, group selection, conformist transmission, division of labor, human sociality, social control mechanisms, internalized restraint, legal control, market mechanisms, part-whole competition, memetic drift.

1. Introduction

Turchin's (1977, this issue) definition of a metasystem transition (MST), as the evolutionary integration of lower level systems together with the emergence of a higher level system controlling them, would seem to naturally apply to social systems. Turchin effectively analyses society as a metasystem, which he sees as a super-organism or super-*being*: a system integrating the individual beings that constitute it, and preserving its wholeness using certain control mechanisms. It is in that sense similar to a multicellular organism, integrating the cells of which its constituted. Control is effectuated by culture, which steers the creation of new ways of thinking or models of reality.

He forecasts that this integration will increase in width and in depth, through ever closer connections between individuals: "It is hardly likely that at present anyone would undertake to predict how far the integration of individuals will go, and what forms it will take. There is, however, no doubt that the direct exchange of information among the nervous systems of individual people, and their physical integration will become possible. It is probable that physical integration will give rise to higher and qualitatively new forms of suprapersonal consciousness; and that will be a process that could be described as merging the souls of individual people into an Over-Soul (to use Emerson's coinage)." (Turchin, 1981)

This view is rather controversial. Many people abhor the idea of individuals being controlled by some collective, impersonal "system", as this seems to deny them their personal freedom. Turchin spends quite some effort defending his views against any associations with the totalitarianism he knows so well (Turchin, 1981), by emphasizing again and again the essential role of freedom and creativity. The rejection of control systems at the social level is more than a superficial emotional reaction to the negative connotations of the word "control", though.

Within MST theory in the broad sense (that is, the study of the evolutionary origin of hierarchical or control levels), the opposite position is taken most radically by William Powers, the originator of Perceptual Control Theory (Powers, 1974). According to Powers's definition of control (including the presence of a goal or reference level, a comparator, a sensor and an effector), there simply is no control at the social level. Individuals may try to influence other individuals, but there is no overarching, collective system with a unified goal, common perceptions, or goal-directed actions. Although Powers does not deny the existence of *systems* at the social level, he denies the existence of *control systems* at this level: the highest level of control is the one governing the actions of an individual (Powers, 1980).

An even stronger methodological individualism is at the base of most social sciences, including economics, psychology and much of sociology. It starts from the dogma that all social processes are to be explained by laws of individual behavior, that social systems have no separate ontological reality, and that all references to social systems are merely convenient summaries for patterns of individual behavior.

The position we will take is intermediary between Turchin's view of society as a super-organism and Powers's outright rejection of social control systems, a position that is more pragmatic, and, we hope, more realistic. We assume that social organizations do obey laws that cannot be reduced to the attributes of individual persons, even though we find human organizations "fuzzier" than clear-cut systems such as atoms, molecules, cells, multicellular organisms, or ant nests (cf. Campbell, 1958, 1990). Although in every-day life few people would deny the reality of social systems or organizations, such as firms, states or associations, it is difficult to draw a clear boundary between "system" and "environment". Does an employee working for a firm still belong to the system when he is at home after working hours, watching television? Does a child become a member of society at birth, or only after several years of socialization at school and in the family? Most social systems are even fuzzier than firms, states or societies. Just consider families (is the cousin of my brother-in-law still a member of my family?), or groups of friends.

The first difficulty with social systems is simply to delimit the system. The second problem is to determine whether the system is a control system. The typical examples of control systems (organisms, cells, thermostats, ...) are definitely much better integrated than the examples above, and this makes it easier to determine the presence of control. We will here not go into the subtle issue of what defines control (see the papers of Heylighen, Joslyn, Turchin and Powers in this issue), but take a broad view of social control as any constraining mechanism that makes individuals produce actions that are more to the benefit of the social system to which they belong than the actions they would produce without that constraint. Given these assumptions we will attempt to understand the degree of (or lack of) social control-system status of social organization on the basis of evolutionary arguments. The third question then is: does evolution tend to make social systems stronger and more integrated?

2. Collective Evolution

2.1. Fitness Considerations for Co-Evolving Systems

The basis of the theory of metasystem transitions is the trial-and-error process of evolution. Systems will evolve if they can arise through subsequent variations of existing designs, and if each of these variations is "fitter" (or at least not significantly less fit) than competing designs. Turchin and others have argued that a system that is formed by an integration of a variety of subsystems, together with a control co-ordinating and steering the actions of the subsystems, will be fitter than a mere aggregate of subsystems without overall control. It is intuitively obvious that if subsystems collaborate systematically in achieving a goal, they will be more effective than if they would behave anarchistically, without plan or co-ordination.

The presently fashionable argument that no overarching plan is needed, since interacting actors will self-organize into stable and efficient patterns of interaction (the "invisible hand" of market forces), does not invalidate this proposition. The spontaneous ordering of a market is the result of complex communications and negotiations that lead to an overall co-ordination and constraint of the different actors' behaviors. Once a perfectly competitive market has reached equilibrium, no participating actor is able to set prices that significantly diverge from those resulting from supply and demand requirements without being eliminated from the scene ("going broke"). One can debate whether the resulting economic order *controls* the actions of the participating actors, but it certainly *constrains* them (cf. Heylighen, this volume).

In order to better understand the benefits and the difficulties involved in evolving collective action, we need to review some principles of collective evolution. We will first present the standard model of competition between already existing systems. Subsequently we will deal with the problem of competition between different levels of organization within a hierarchical system, the competition of a part or subsystem with the larger organization to which it belongs. Such competition can delay or prevent the emergence of new encompassing levels of organization, and may remain as a permanent limiting problem after the establishment of an encompassing system.

Systems evolving through variation and selection can be modelled as trying to maximize or optimize fitness, where fitness is a complex function of the system and its environment, an index of the likelihood that the system would persist and replicate. Those systems will be selected that have the highest fitness. Variation can be seen as an exploration of possible configurations with different degrees of fitness. This exploration can be visualized as a movement through a *fitness landscape,* where configurations correspond to points in a two-dimensional (horizontal) space and fitness corresponds to the value of the configuration along a third (vertical) dimension (cf. Kauffman, 1993). Local maxima of fitness then correspond to peaks in the landscape, local minima to valleys or sinks.

Since variation normally proceeds by small steps, not by major jumps, evolution can be represented as a continuous trajectory through the fitness landscape where gradually higher (fitter) grounds are reached, with occasional transitions to lower regions when variations are not adaptive, but not so bad as to directly eliminate the system. It is clear that without such non-adaptive variations the mechanism can only reach local maxima of fitness, which in general are much lower than eventual global maxima. Once the system has reached a local maximum, evolution would come to a stand-still, as no further local variation would be able to increase fitness.

This “freezing” of evolution in non-optimal configurations can be avoided, first, by the fact that large variations, while rare, do occur, possibly allowing the bridging of a valley separating local maxima, second, by the fact that *the fitness landscape itself undergoes evolution*. This change in the fitness function is caused by the change in the environmental parameters that determine the chances for survival and reproduction. The environment changes in part because it also often consists of evolving systems that try to optimize their fitness. This interdependency, where the change in fitness of one system changes the fitness function for another system, and vice-versa, is called *co-evolution*.

A typical example of co-evolution is the “arms race” between predators (say foxes) and prey (say rabbits): when rabbits evolve to run faster, thus increasing their chances to escape foxes, they not only increase their own fitness, they also decrease the fitness of the foxes, thus augmenting the selective pressure on the foxes to run faster themselves. This typically leads to a non-linear, positive feedback type of interaction, where the two species pressure each other to run faster and faster. In certain cases, though, the local decrease of the foxes’ fitness function for the “running” configuration may be sufficient to make the local maximum disappear, so that evolution can start exploring totally new avenues for catching prey (e.g. digging the rabbits out of their holes), leading to potentially much higher fitness peaks. (On the other hand, it may also be sufficient to let the foxes go extinct, if no sufficiently high fitness configuration is available in the neighbourhood they started from).

The continuous change implied by this kind of interaction is expressed most forcefully by the *Red Queen Principle* (van Valen, 1973). Its name is based on the observation to Alice by the Red Queen in Lewis Carroll's "Through the Looking Glass" that "in this place it takes all the running you can do, to keep in the same place." The principle says that for an evolutionary system, continuing development is needed just in order to maintain its (relative) fitness. Variation will normally continuously produce increases in fitness in one system or another. However, improvement in one system implies that it will get a competitive advantage on the systems with which it is co-evolving, and thus be able to capture a larger share of the common resources, decreasing the fitness of its competitors. The only way that a system can maintain its fitness *relative* to the others is by adapting its design each time a competitor gets more fit.

2.2. Competitive and cooperative patterns of co-evolution

Several distinct types of co-evolution may be distinguished: zero sum or negative sum competitive interactions, producing "arms races", will be discussed first. Subsequently, we will discuss positive sum "games" which may produce cooperation or symbiosis, and which in the animal kingdom are perhaps more likely between genetically unrelated species, as for example, bees and orchids, or ants and their aphid "cows."

Let us first pick up the example of the “arms race”. Arms races take place not just between predators and prey, but even more strongly between similar systems sharing the same resources. Whereas competition may lead to an increase in absolute fitness for the competitors (both rabbits and foxes running more efficiently), the net effect may also be an absolute fitness *decrease*. Trees in a forest are normally competing for access to sunlight. If one tree grows a little bit taller than its neighbours it can capture part of their sunlight. This forces the other trees in turn to grow taller, in order not to be overshadowed. The net effect is that all trees tend to become taller and taller, yet still gather on average just the same amount of sunlight. The competition-induced height increase not only requires more resources (water, nutrients, sunlight, etc.) for its build-up and maintenance, but also makes the tree much more vulnerable to wind, earthquakes, lightning, wood-eating insects, etc. The result is that trees will lose overall fitness while trying to keep up their fitness relative to their competitors. Yet none of the trees can afford not to participate in the race for ever increased height: if one tree would remain at what would be its ideal height without competition, it would be completely overshadowed by its neighbours.

This is a beautiful illustration of the more general *principle of suboptimization* (Machol, 1965): the principle states that suboptimization, i.e. optimizing the outcome for each subsystem (e.g. a tree) individually, does not in general lead to an optimal outcome for the global system (e.g. the forest) to which these subsystems belong. The principle follows directly from the more basic systemic principle that "the whole is more than the sum of its parts". Indeed, if the global system would be a mere aggregate or sum of its subsystems, then the outcome (say total fitness) for that system would be merely a sum of the outcomes for its parts. If all partial outcomes would independently reach their optimal or maximal value, then by definition their sum would also reach its maximum. So, for an aggregate ("sum"), suboptimization equals global optimization. However, for a real system, where the relative variations of the subsystems are constrained (see Heylighen, this issue), a change in fitness for one subsystem will in general produce a change in fitness for the other systems.

When the changes are in the same direction (higher fitness for one subsystem produces higher fitness for all), the global system may be called *synergetic* or *cooperative*: everybody profits from the progress made by one. However, the more likely configuration is *competitive*: increase for one subsystem implies decrease for others. This is the case when the different subsystems share scarce resources. Higher fitness for one subsystem implies better use of those resources and therefore less resources left for the other systems. The normal evolutionary competition between different individuals or species living in the same niche falls in this category. Also the predator-prey arms race belongs to this type: rabbits and foxes are competing for the same resource: rabbit flesh.

This competitive type of interaction corresponds to what is called a *zero-sum game* in game theory: the sum of resources that can be gained or lost is constant; what is lost by one actor (say the rabbit) is gained by another actor (say the fox), and vice-versa. If we equate use of resources with fitness, this is perhaps the simplest alternative to the aggregate or sum model of optimization: global fitness is no longer a sum of independently varying subsystem fitnesses, but is constrained to be constant. This entails that the increase in one term of the sum is necessarily accompanied by a decrease in one or more of the other terms.

This zero-sum model is still too simple for most real situations. In practice, resources do not constitute a fixed, finite store, ready to be exhausted by whichever system is most fit in consuming them. Resources should rather be ordered on a scale from directly accessible to impossible to use. Most resources should be situated somewhere in between these extremes: they are available in principle, but consuming them requires a variable amount of effort. Different systems have different competencies in accessing and consuming these resources. Foxes could in principle use the energy stored in grass as a resource, but their digestive system is ill-prepared for that purpose. Rabbits could in principle feed on fox meat, but are virtually incapable of accessing it. The only resource used by both foxes and rabbits is rabbit meat (though they obviously use it in a very different way). Their competition will be limited to that single shared resource.

Changes in a system (e.g. in digestive mechanisms or in hunting strategies) may enable the access of resources which were previously unreachable. This implies that resources in general need neither to be shared nor to have a fixed limit. If we again equate total consumption of resources with global fitness, we see that global fitness does not need to be constant: it may increase as well as decrease with changes in individual fitness. Increased consumption of resources by one subsystem may lead as well to decreased as to increased consumption by other subsystems. Increased consumption by others can simply be a side-effect of the novel ways in which the original system accesses resources.

For example, more effective hunting strategies used by lions will produce more carcasses of large herbivores, which will in turn provide more food for vultures, hyenas and other scavengers. There is little competition between the lions and the scavengers since the latter tend to concentrate on pieces that are either too small or too difficult to reach (e.g. bone marrow) for the lions.

A more directly cooperative example is that of lichens. A lichen consists of two unrelated organisms, an alga and a fungus (mould), in symbiotic association. The alga, which contains chlorophyll, is capable of extracting carbon dioxide from the air and transforming it into organic matter, while the fungus can only use organic matter and convert it into further resources, which the alga is unable to produce. Every improvement in resource utilization by either the alga or the fungus will directly make more resources available for the other organism, and thus increase fitness for both systems.

An example with decreasing resource consumption is Hardin's (1968) famous "Tragedy of the Commons". Consider shared resources which are only slowly renewed, e.g. the grass on a pasture. If more animals graze on the common pasture, the grass will have less time to regrow and less of it will be available for the group of animals as a whole. Yet it is in the interest of each herd of animals (or of the animals' herdsman, in Hardin's original formulation) to consume more grass than their competitors. This leads to a positive feedback loop where grass is consumed more and more quickly, until overgrazing and erosion destroy the common pasture.

Summarizing, we can conceive of different types of co-evolutionary interaction of subsystems within a global system (see table 1). An increase in fitness in one subsystem can affect the fitness of the other systems in different ways:

1) no change. This is the null case where the global system is merely an aggregate of independent systems, and where suboptimization equals global optimization.

2) decrease with an amount equal to the increase for the original system (zero sum). This is a purely competitive configuration.

3) increase (positive sum). This configuration may be called synergetic.

4) decrease with an amount larger than the original increase (negative sum). This configuration may be called super-competitive. The trees in a forest or the "tragedy of the commons" provide an example of such a configuration.

5) finally, there is the mixed, partially competitive case, where there may be some synergetic effect, but not enough to compensate for the loss of fitness through competition. This case is perhaps the most common one, as it will appear in situations where some resources are shared (hence the loss by the other co-evolving systems of what is gained by one of them) and others are not, so that increased consumption of the non-shared resources either does not affect the co-evolving systems, or even produces more resources for them as a side-effect.

These 5 cases are summarized in Table 1.

Configuration	super-competitive	competitive	partially competitive	independent	synergetic
Change in fitness (ΔF)	$\Delta F < -A$	$\Delta F = -A$	$-A < \Delta F < 0$	$\Delta F = 0$	$\Delta F > 0$
Sum ($\Delta F + A$)	negative	zero	positive	positive	positive
Difference ($D = A - \Delta F$)	increased $D > 2A$	increased $D = 2A$	increased $2A > D > A$	constant $D = A$	decreased $D < A$

Table 1: different co-evolutionary configurations, listing the possible changes in fitness (ΔF) for a co-evolving system when the initial system's change in fitness has the (positive) value A.

If we look at the fitness *difference* rather than at the sum, we note that all competitive configurations increase the difference between the systems with respect to the initial change (A), whereas only the synergetic configuration diminishes it (see Table 1). (We might even imagine extreme cases of synergy, like in "strong altruism" (Campbell, 1983), where the difference becomes negative, i.e. where the system that made the initial move *loses* fitness relative to the system it is cooperating with). A larger fitness difference means that small moves will result in greater gains (or losses) in relative fitness, i.e. the fitness landscape becomes more steep. The net effect is an increase in selective pressure, producing a speeding up of local optimization, but a diminished probability of global optimization. Thus, if we look purely at the individual level, competition may either facilitate or hinder optimization, depending on the shape of the fitness landscape.

2.3. Similarity and differentiation in co-evolution

The more different or complementary co-evolving systems are, the less resources they will share, and thus the less competition and the more possibilities for synergy there will exist between them. On the other hand, similar systems will use mostly the same resources, and thus directly compete. If these resources have limited renewability, this competition will engender accelerated depletion. Moreover, similar systems will use essentially the same means or weapons to compete, and thus tend to get involved in arms races where the same features (e.g. tallness in trees or speed in rabbits) are amplified to the extreme by positive feedback. Sustaining ever heavier “weapons” without gains in relative fitness (since the competitors use the same weapons) will in general produce a loss in absolute fitness. This leads to a super-competitive configuration.

It *is* possible for similar systems to enter into a synergetic interaction. For examples, wolves together can kill much larger animals (e.g. a moose or deer) than each of them could kill individually, thus making more resources available for a team of wolves working cooperatively. Even then there must be some division of labor, i.e. a differentiation in the roles each of the cooperators play. If all wolves would follow exactly the same strategy, e.g. jump at the throat of the deer, they would hinder rather than help each other's efforts. Coordination of individuals aiming at the same target is in general extremely difficult (Powers, 1980). "Two blacksmiths controlling the same hammer will be able to strike twice as hard, but they will probably hit the anvil more often than the horseshoe" (Powers, personal communication). A smooth cooperation is achieved most easily if each individual focuses on a different subtask, e.g. one wolf would bite at the deer's throat, another one would immobilize a leg, and a third one would try to make the deer fall by jumping on its back.

Even then, in the short term, the relative gains made by competitive moves (e.g. stealing the prey killed by another wolf) tend to be greater than the gains made by cooperative moves, which only reap their effect after a long and tedious interaction (Heylighen, 1992a). Such a mixed competitive-cooperative type of situation is exemplified by the well-known "Prisoner's Dilemma" game, where non-cooperation ("defection") produces the optimal outcome in a one shot meeting, whereas cooperation produces best results for long-term, repeated interactions (Axelrod, 1984). (This game can be seen as having a small positive sum (synergy) if both parties cooperate, and a zero sum (competition) in all other cases, cf. Heylighen, 1992a). Since blind variation does not anticipate future rewards, evolution will only take into account short term benefits, and thus will tend to prefer competition to cooperation. This poses a fundamental difficulty for the emergence of a social system, seen as a metasystem transition leading to the integration and control of essentially similar individuals.

Turchin’s (1977; this issue) concept of metasystem transition emphasizes the differentiation between the subsystems taking place *after* the beginning of the transition. For example, in multicellular organisms, what were initially similar cells (like in sponges) have diversified during evolution in e.g. the liver cells, white blood cells, nerve cells, etc. that we find in higher organisms. To see that such development is not obvious, we may note that similar systems have similar fitness landscapes, and thus will tend to move towards the same optima. This effect is amplified by competition, which increases the steepness of the fitness landscape and thus decreases the probability of spontaneous divergence ("drift") of trajectories in that landscape. In this way, competition tends to hamper, rather than help, differentiation. (On the other hand, we must note that if the initial distance between the trajectories is sufficiently large as to bridge the gap between separate optima, increased steepness because of competition will accelerate further differentiation, dispersing the one-time competitors into distinct niches with minimal resource sharing). The question we must resolve then is how differentiation of similar systems, leading to complementarity and synergy, can take place starting from a competitive, or even super-competitive, configuration.

2.4. Selection at individual and at group levels

A simple solution to the above problem might be the following: instead of looking at the subsystems involved in competition we look at the global system, which can be seen as a “group” consisting of similar, individual systems. If we consider the fitness of the group as the sum (or the average) of the fitnesses of the individuals, then it is clear that only a wholly or partly synergetic interaction can increase group fitness. Natural selection of groups will prefer the more synergetic configurations and thus tend to eliminate all competitive or super-competitive configurations. However, the efficacy of such “group selection” for the development of cooperation is presently rejected by most evolutionary biologists. The argument can be reconstructed in our systemic framework as follows.

Evolution takes place simultaneously at different levels, including the level of the group and the level of the individual. Each level at which systems as a whole are either retained or eliminated may be called a "node of selection" (Campbell, 1974a, 1990). Systems at all these levels will try to optimize fitness. However, as implied by the principle of suboptimization, what is best for a system at one level will in general not be the best for a system at another level. Thus, the different levels will enter into competition, the systems at each level trying to steer activity into what is optimal for their own survival.

In general, we may expect that evolution will be faster and more effective at the individual level. The reason is that the variety of possible configurations that evolution can explore will be much larger for the global system than for the subsystems, since the global variety is the product of the possible varieties for each subsystem. It thus increases exponentially with the number of these subsystems. The more configurations a system needs to explore, the less likely that it will hit on the optimal configuration, and the longer it will take on average to reach that optimal configuration. Therefore, the larger the global system, the more difficult it will be for variation to find its optimum. The argument is similar to the one used by Simon (1962) in his "Architecture of Complexity", when arguing that evolutionary integration of subsystems into supersystems will be in practice limited to small assemblies, since the probability of discovering the right configuration is much lower for large assemblies.

Thus, individual fitness will increase much more quickly than group fitness, leading to suboptimization rather than global optimization. In a competitive setting, suboptimization (maximizing relative fitness of an individual) moreover precludes global optimization (maximizing global fitness). If an individual can choose competitive moves that give a larger *immediate* reward in resources than corresponding cooperative moves, the competitive configuration will be selected, even though its contribution to global fitness will be much lower than that of a cooperative configuration.

Even if we assume that by a low probability combination of events, the group would nevertheless have reached a cooperative configuration with high global fitness, this configuration would be eroded by the on-going competition among the cooperators. Indeed, being near a global optimum does not preclude the inherently faster process of suboptimization from continuing, and, whatever the collective benefits of cooperation, competitive moves will in general still provide gains in relative fitness.

The problem is that everybody profits from cooperation, but that non-cooperators profit more, since they reap the additional resources produced by synergy, while investing nothing in return. This is the classical "free-rider" problem: everyone benefits from a public transport system funded by individual contributions, but the one who does not pay benefits most. Since evolution never stops, variation will sooner or later produce "free riders" in an otherwise optimized social system, and it is the latter that will be selected, not the earnest cooperators, resulting in the erosion and eventual collapse of the cooperative system.

2.5. Shared controls

The above scenario makes the simplifying assumption that individuals are free to develop either cooperative or competitive behavior. However, the spontaneous evolution of controls or "vicarious selectors" *constraining* a system's behavior is a central tenet of the Theory of Metasystem Transitions (see Heylighen, this issue). If actions are not chosen by blind trial-and-error, but are somehow preselected by a control system vicariously anticipating the possibly lethal effects of natural selection (Campbell, 1974b), the system will be obviously more fit. Once such a control is established, natural selection will primarily act on the control, rather than on the system itself.

The most direct control on the behavior of a biological system is the knowledge stored in its genes. Genes will dictate particular actions in particular circumstances, and preclude other actions. One way to solve the problem of cooperation then would be to have a configuration of individuals whose genes predispose them to cooperative moves. However, as long as the genes of different individuals in a group can vary independently, we should expect the evolution of deviant genes that predispose their carriers to selfishness and defection, through genetic competition among the cooperators (Campbell, 1983).

The cooperative configuration can only be salvaged if the genes for the whole group are *constrained to remain virtually identical,* i.e. are kept from diverging. In that case there is basically a single genetic control directing the action of the different group members, and the fitness of that control will be measured through the fitness of the group as a whole. In such a group with a *shared control*, suboptimization is equal to global optimization, since the good for an individual instance of the control is identical to the good for the control on the collective. The selection of the control will here be identical to selection at the level of the group. Moreover, our earlier argument that global optimization is much less likely to be achieved than suboptimization does not hold in this case, since the constraint that keeps individual controls identical simultaneously reduces the space of possible controls to the size for an individual control.

This "shared control" configuration is realized in the social insects: bees, ants and termites (Campbell, 1983). The different members of an ant colony are genetically very similar. Moreover, there is no independent evolution of genes, since only the queen of the colony is capable of reproducing her genes. This leads to a strongly cooperative system, since the workers will have the best chances to further the retention and replication of their (shared) genes by helping the colony as a whole to achieve a maximal production of offspring by the queen. "Free rider" genes would not survive as rebel workers are unable to reproduce.

In almost all other species of animals, however, the different members of a group are able to independently reproduce their genes and thus keep open the possibility for erosion of any cooperative arrangement. This includes human populations. Yet human groups present some of the most extensive cooperative systems, comparable only to the social insects. This can be explained by assuming shared controls additional to the genetic one. Though we will discuss different types of control mechanisms in a later section, the most typically human mechanism can be found in *culture*: knowledge or beliefs shared between individuals through communication. A belief, piece of knowledge or pattern of behavior that is transmitted from one individual to another one can be said to replicate. In analogy to genes, such cultural replicators can be called "memes" (Dawkins, 1976; Heylighen, 1992a; Moritz, this issue).

In order to get a shared control, in addition to replication of knowledge, we need to find a constraining mechanism that keeps copies of a piece of knowledge carried by different individuals virtually identical. This mechanism can be found in what Boyd & Richerson (1985) have called "conformist frequency-dependent non-linear (multiple-parenting) transmission". ("*conformist transmission*" for short.) Unlike biological reproduction, where genetic information is transmitted from one or two parents to offspring, in cultural reproduction information can be transmitted from several individuals ("parents") to the same individual ("multiple parenting"). In their mathematical model Boyd & Richerson find that under certain (plausible) conditions it would be optimal for the learners to adopt the majority or plurality beliefs, when several competing beliefs are transmitted by different individuals. Thus, individuals would tend to "conform" to the majority position of their elders and peers. In relatively small groups this leads quickly to internal homogeneity on all cultural traits.

The non-linear, positive feedback inherent in conformist transmission implies that small differences in initial distribution of beliefs between different groups will be intensified: if suffices that slightly more individuals initially share a belief for that belief to come to dominate all others. Thus, small variations between groups tend to be reinforced, while variations within groups tend to be erased. The resulting homogeneities within groups and sharp differences between groups provide the possibility for cultural group selection: the group whose set of beliefs is most beneficial will have a higher global fitness and tend to replace groups with less adaptive beliefs. Beneficial beliefs in this context mean beliefs that promote a synergetic or cooperative pattern of interaction within the group.

This ingroup solidarity, however, tends to be associated with out-group hostility, as ubiquitously noted in studies of ethnocentrism (LeVine & Campbell, 1972). This follows from the fact that selection now takes place on the group level, where relative fitness of one group with respect to the others is the dominant criterion. When different groups use similar tools and similar resources, this will produce a competitive configuration, and a tendency to arms races, as argued earlier. In practice, ingroup solidarity then becomes "*clique selfishness*": whatever the consequences for other groups, the action that will be preferred is the one best for this group.

2.6. Division of labor

Although control at the social level in the above analysis emerges from the *similarity* of controls at the individual level, its most important effect is that it facilitates *differentiation* of individual behavior, by decreasing the steepness of the fitness landscape and stopping the arms races that pressure individuals to follow every move of their competitors. The fact that individuals share certain controls, constraining their social behavior, does not imply that they should share all forms of behavior.

As we argued earlier, the most productive way to cooperate entails division of labor, each individual focusing on a different subtask while contributing to a common goal.

Such independent action is not only easier because it requires less coordination and exchange of information, it is potentially also much more productive because of synergetic complementarity. If different individuals focus on gathering different resources, they will not only be able to avoid the fitness reducing effects of direct competition and arms races, they may even be able to directly enhance each other's fitness by exchanging surplus resources, like in the symbiotic relationship between alga and fungus. For example, in primitive tribes, one part of the population might focus on gathering fruit, while another part might focus on hunting. This will allow each of the two subgroups to develop greater expertise in their domain of specialization, and thus greater efficiency in collecting resources. The more differentiated the specialization becomes, the larger the domain of resources that can be explored by the collective.

However, we started from the assumption that individuals in a social system are essentially similar, and thus have the same needs. Specialization entails one subgoal superseding all others. This means that a specialized individual will neglect most of his of her needs, and thus will become dependent on others for their satisfaction. The hunters will depend on the gatherers for an equilibrated diet, and vice versa. This dependence will be stronger when specialization becomes more focused: a blacksmith or scribe will be more dependent on the other members of the group than a hunter. This means that extension of the division of labor also requires extension of cooperation and resource sharing, and thus an increased need for social control mechanisms.

In conclusion, the competition between individual and group levels, which tends to be won by the inherently faster processes at the individual level, poses a fundamental obstacle to the emergence of an integrated, synergetic system at the group level. However, the development of a shared control, which restricts independent evolution on the individual level, provides a possible mechanism for overcoming this obstacle. Once some type of control is established, differentiation of roles within the social system is facilitated. In accordance with Turchin's (1977, this issue) "law of the branching growth of the penultimate level", increasing differentiation increases the selective pressure for developing social controls, which in turn feed back into increasing differentiation (see Heylighen, this issue). This process in essence constitutes a social metasystem transition. We are now ready to study in more detail some specific cases.

3. Social Metasystem Transitions

Our central focus is on the degree to which collectivities of humans become constrained systems. To set the problem, some brief attention to two other metasystem transitions seems useful: First, the transition of single-celled organisms to multicellular ones; second, the transition from solitary wasps or proto-ants to eusocial colonies with division of labor (or the transition from cockroaches to eusocial termites).

3.1. *Unicellular to multicellular organisms*

Leo W. Buss (1987) in a pioneering monograph has explored the transition from unicellular to multicellular organisms in great detail, and has exemplified how the competition among cells for differential propagation by fission created obstacles to the emergence of multicellular organisms with cellular differentiation (i.e., division of labor). He says:

> "The path from a unicellular condition to a multicellular one has been well-traveled. Of the same 23 monophyletic protist groups, fully 17 have multicellular representatives. The path from multicellularity to cellular differentiation, however, proved a far less porous filter. Of the 17 multicellular taxa, only 3 groups—the plants, the fungi, and the animals—have developed cellular differentiation in more than a handful of species. With the evolution of cellular differentiation, kingdoms were made of some protist

> groups; yet we know virtually nothing as to why this transition was closed to all but a few taxa." (Buss, 1987, p. 70)

In agreement with Turchin (1977, and this issue), Buss portrays the first stage of multicellularity without differentiation of function, except for accidents of location in the adhering mass. With differentiation comes the distinction between germ cells and somatic cells. Somehow the germ cells exchange proliferation by fission within the organism for reproduction by seed across generations, and the specialized somatic cells gain in reproductive opportunities by fission within the organism. It helps in achieving differentiated multicellularity that all of the cells are identical twins in terms of chromosomal genes (implying a shared genetic control). This has not removed the competition among cells for reproduction by fission. Adaptive distribution of such specialized cell proliferation requires additional controls. These are not under any centralized coordination, but are achieved through a widely distributed variety of inducing and inhibiting adjacencies (cf. Kauffman, 1993). Keeping these controls tuned so that the integrated division of labor which produces a multicellular-organismic functionality is preserved requires a node of selection at the whole organism level. Such a node was also a prerequisite for its development. This node is implemented by differential propagation of the seeds produced by the germ cells.

3.2. Solitary to social insect

The integrated division of labor within the insect colony (with the various castes of workers and soldiers) has in parallel been achieved by selection of single queens. (In later evolution, the nest acquires such strong entitativity that queen replacement and even multiple queens can occur.) In the ants, the probable initial stage was brood-care help by daughters with postponed fertility. This created an ecology in which only nests with such auxiliary helpers survived. Nest (or colony) selection began at this point. Postponed fertility was probably augmented by a pheromone exuded by the fertile mother.

Initially there was no division of labor or caste specialization. Mother and infertile daughters were all capable of all tasks of food-gathering and brood-care. While it was in the inclusive-fitness interests of each of the sterile workers to become fertile, it was also in the inclusive-fitness interests of each to keep her sisters sterile, as by distributing the queen's fertility-inhibiting pheromone to her sisters (including those in larval stages) and by eating the haploid drone eggs that some of her supposedly sterile sisters might produce. Once worker sterility was dependably achieved, then selection by colony could dominate because the individual-vs.-individual genetic competition had been almost completely eliminated. From this point on, the elaborate division of labor into the several worker and soldier castes could develop (Wilson, 1971; Campbell, 1983).

Note that in none of the social insects are the sterile workers and/or soldiers genetically identical, nor do the castes differ systematically in their genetic composition. The differentiation into worker, soldier, and queen is achieved by differential feeding and pheromone exposure in early development. Note, too, that in the social insects the genetic competition among the cooperators has not been entirely suppressed, and shows itself in many minor ways such as kin-favoritism of workers in caring for larvae, and among the bees, at least, when the queen is removed, disruptive genetic competition among the disinhibited formerly-sterile workers (Seeley, 1985, 1989; Winston and Slessor, 1992).

The anatomical differentiation among the castes is controlled by distributed (rather than centralized) inhibitions. So, too, the communication and coordination among the castes. Some dozen different pheromones are involved, all released and distributed in automatic reflex ways. Again, quasi-entropic effects of mutations produce discoordination. Again, it is selection by whole nest survival that keeps these dozens of adjustments tuned for whole-nest functionality. Unique nest odors prevent individuals from transferring membership from nest to nest, further ensuring whole-nest selection.

3.3. Human sociality

Humans form effective, coordinated, division-of-labor groupings at several levels of aggregation. At each level, there is a problem of metasystem transition. At each level, there is not only competition between other groupings at the same level, but also competition between the interests of the smaller incorporated units and the interests of the larger encompassing unit. Primary, face-to-face, groups are incorporated into organized city-states, and these into nations. A plausible node of selection and inter-organization competition can be envisaged at each of these levels. Our skepticism towards Turchin's prediction about the inevitable organizing of nations into a single world government comes from the lack of any obvious node of selection at the whole-world, multinational level.

As we have noted above, the great majority of evolutionary biologists deny the efficacy of biological group selection of those "altruistic" traits in which individuals act for the preservation of the group at the risk of their own well being and "inclusive fitness" (i.e., the representation of their own genes in future generations). This is not to deny the occurrence of group selection, but rather to say that its effects for self-sacrificial altruistic traits will be undermined by individual-vs.-individual selection. A group with heroically self-sacrificing altruists may thrive better. The inclusive fitness gains from this will be shared equally by the non-altruists within the group. For the altruists, these gains are in part undermined by the risks they run. The non-altruists pay no such costs, and thus out-breed the self-sacrificial altruists in the within-group genetic competition. (For the soldiers, etc., of the social insects, this intra-social-organization genetic competition has been eliminated by the sterility of each of the cooperating castes.)

Our previous position accepted the following: (1) Individual selection always dominates group selection at the biological level; (2) "Groups are real" (Campbell, 1958) as opposed to methodological individualism; (3) Self-sacrificial altruism in the service of human social groups genuinely exists; (4) Such altruism can only be produced by group selection. The solution was to limit group selection to non-biological cultural evolution and to see self-sacrificial altruism as a result of cultural group selection of ideologies, social-organizational traditions, moral indoctrination, and religious cosmologies (Campbell, 1972, 1975, 1983, 1991; Heylighen, 1992a, 1992b). This point of view had many plausible implications, among them an explanation of why moral commandments and lists of deadly sins contain explicit rejections of innate human nature. There is also the obvious group-coordination utility of beliefs in rewarding and punishing afterlives and reincarnations, which extend perceived self-interest into an afterlife and thus can promote self-sacrificial acts.

This simple point of view we are now ready to substantially modify for social control mechanisms within primary groups, retaining its relevance for secondary groups. One influence is the increased plausibility of biological group selection as seen by evolutionary biologists (cf. Wilson and Sober, 1994). All along, biological evolution has been credited for the human capacity for culture, including competent communication of useful information between individuals. But even in much less social animals, social communication creates a niche for self-serving deception, and biological group selection may be needed to keep the rate of such parasitism low enough so that there is a net collective communicative advantage. The resulting proximal mechanisms would include mutual monitoring and retaliation for "immoral" behavior (an analogue for the mutual enforcement of sterility among the social insect castes). We humans probably have an innate fear of ostracism, and a tendency to find painful the signs of hostility on the part of those we work or live with on a regular face-to-face basis. Innate tendencies to enforce group solidarity on others would be supported by both individual and group selection and may be identified as prerequisite for group selection.

The route to a cultural-evolutionary group selection that had been proposed contained several stages that built upon biologically evolved bases (Boyd and Richerson, 1985; Campbell, 1983, 1991). While these are presented as advantageous at the individual selection level, they are both plausible routes to biological group selection and might require group selection to avoid free rider parasitism and elimination by the negative costs of the self-sacrificial altruism they produce: (1) An innate tendency to "conformist transmission" (Boyd and Richerson, 1985) would be individually adaptive for skills and environmental wisdom, but would also lead to primary group homogeneity on neutrally adaptive beliefs and behaviors. (In analogy with the role of "genetic drift" in biological evolution, this can be called "memetic drift.") These ingroup homogeneities and chance-produced intergroup differences provide the necessary setting for group selection if some of these chance homogeneities produced superior group-vs.-group competition. (2) Trivers (1971) has posited an individually adaptive innate predisposition to joining reciprocally altruistic cliques, and a related innate tendency for "moralistic aggression" when such pacts are violated. (The latter might turn out to require group selection to supplement individual selection.) As we have noted above, this pattern may be summarized as "clique selfishness." It would be individually adaptive to join already existing selfish cliques. Culturally transmitted ingroup membership may be regarded as providing such opportunities (Brewer, 1981). Along with this individually adaptive cultural scaffolding innate predispositions might be selected. These would include a tendency to join and conform to such cliques, and also to pressure one's biological offspring to conform. (3) Effective ingroup or selfish clique membership is furthered by visible and audible clues to ingroup membership. The neutrally adaptive ingroup homogeneities produced by conformist transmission would be available for such use. This would further sharpen the ingroup homogeneities and intergroup heterogeneities necessary for group selection at the cultural or biological level.

As we (e.g. Campbell and Gatewood, 1994) understand their argument, Wilson and Sober (1994) propose that group selection and individual selection can be concurrent, producing an *ambivalence* on the group preservation vs. individual preservation dimension. In behavioral evolutionary jargon, this would be a "facultative polymorphism." (For example, the males in many species of monkeys have two incompatible innate behavioral repertoires, one for submission, one for dominance. The learned dominance rank determines which will be displayed in which encounter.)

Even if biological group selection has occurred in human evolution, the persistence of genetic competition among the cooperators has produced a profoundly ambivalent social animal, in sharp contrast with the sterile castes of the social insects. For humans in social organizations, organizational optimizing is in continuous conflict with optimizing individual well-being and inclusive fitness. In parallel, primary group social solidarity competes with secondary group optimization in industrial and governmental bureaucracies (as we will discuss in a further section). Let us first discuss the strengths and weaknesses of the different mechanisms that have evolved to keep these ongoing conflicts under control (cf. Campbell, 1982).

4. Social Control Mechanisms

4.1. *Mutual monitoring*

Individuals with deviating beliefs or patterns of behavior can be held in check by different forms of ostracism or "moralistic aggression" (Trivers, 1971). If they are not convinced by the ever repeated messages transmitted by the other members of the group, the other members can simply force them to obey the rules, by punishing them as soon as a transgression is witnessed. This is a form of *mutual monitoring*. It implements the reciprocity of cooperation that is also found in "tit-for-tat"-like strategies (Axelrod, 1984).

Conformist transmission and mutual monitoring together produce a sufficiently strong shared control to allow the evolution of extensive cooperation in small groups with close contacts: primary or "face-to-face-groups". However, when groups become so large that not all members are in direct contact with each other, it becomes difficult to maintain an overall shared control. Without reciprocal monitoring, deviant behaviors get a chance to develop. This can be controlled by two additional mechanisms (Campbell, 1982): 1) by making the belief so strong that it controls behavior even in the absence of other group members reinforcing it (*internalized restraint*); 2) by developing specialized subgroups (e.g. police, militia, the judiciary) whose task it is to monitor and enforce the following of rules (*legal control).*

4.2. Internalized restraint

We understand internalized restraint to be the functional goal of the moral preachings of the great religions, where belief in reward or punishment in the afterlife is used to motivate the obeying of rules here and now. Its function is primarily to suppress individuals' selfish and nepotistic tendencies, which are the product of selection at the genetic level.

To achieve such countergenetic restraint in archaic human societies required a complicated organization (Campbell, 1991). A dozen or so ancient city-states and nations (each probably independently) developed an ultrasocial organization characterized by full division of labor, with full-time priests, governors and soldiers who gathered no resources but were fed by the others. All were theocracies, believing in supernatural gods and god-stories far more incredible (from a modern scientific point of view) than those of the simpler human groups preceding them—and those are incredible enough. All invested heavily in temples, funeral monuments and graves for their rulers, and performed complicated rituals including the sacrifice of domesticated animals and human servants. This apparently lavish waste of resources needs to be explained by something other than increased biological efficiency.

One can see its function in achieving social control that is effective even when supervisors or worldly rewards and punishments are not present to shape individual behavior in the collectively optimal form. The beliefs about Valhallas that reward brave soldiers killed in battle or the hells that punish cowards, thieves and liars, were legitimated and made more credible by the royal funeral waste testifying to the leaders' belief in an afterlife. This interpretation is supported by the fit between the selfish biases in human nature, produced by genetic competition, and the lists of sins and temptations typical for religious commandments. The genes say "Thou shalt covet"; the religious tradition says "Thou shalt *not* covet".

Large, heterogeneous groups pose difficulties for this type of control. Without recurring communication and reinforcement between all the members of the group, non-conformist beliefs ("heresies") get a chance to develop. Some of these beliefs (memes) will travel well and spread to large subgroups, others may remain limited to small, local gatherings or even to single individuals. This engenders a diversity of beliefs that undermines internalized restraint, since different beliefs lead to different forms of restraint, eroding any particular rule's claim to universal validity. Present-day secularization and religious pluralism, in which ethical norms only apply to co-religionists, both may lead to self-defeating political efforts to increase the burden delegated to the next type of social control, legal systems.

4.3. Legal control

Legal control, externalizing rules and systems for monitoring and reinforcing them, is typical for different types of modern states and bureaucratic organizations. From the different social control mechanisms it is the one that most strongly resembles the traditional concept of control as exerted by a separate, centralized, hierarchically superior system, that tries to reach an explicitly formulated goal by rewarding actions that contribute to reaching that goal, while punishing those that produce deviations. As a pure form, without mutual monitoring and internalized restraint, legal control requires an unaffordably large specialist corps to enforce it: you cannot put a policeman next to every citizen.

Because it relies on explicit rules written down in the form of a law, legal control suffers less from diversification of belief than internalized restraint. Yet it is not impervious to it either. Even if different individuals agree about the letter of the law, they are likely to disagree about its meaning or intent in practical situations. This is because the meaning of any symbolic or linguistic expression is necessarily context-dependent (this is sometimes called *indexicality* (Barnes & Law, 1976) or *deixis*). Only when different individuals share the same context, will they share their interpretation of the expression (Heylighen & Dewaele, 1996). Differences in belief and involvement will create differences in context, and thus disagreements about the meaning of the law. But law in its effort to achieve universality and fairness must pretend that words have situation-free, formal meanings, denying their indexicality. Written and interpreted 'literally', the wordings allow loopholes and unintended uses never envisaged in their construction. The result is that in modern states, such as the present-day USA, enormous amounts of money and effort are invested in lawyers and legal research, just in order to try to interpret the rules in one's proper interest. The only possible countermeasure seems to consist in making legal formulations ever more formal, precise and explicit, anticipating ever wider ranges of particular conditions. The net result is that law seems to get ever more complex and difficult to manage.

In formally defined groups such as states or firms, legal control tends to be consolidated in a subgroup or individual, e.g. the government, king, or board of directors. This leads to a bureaucratic type of organization, characterized by a hierarchy of control levels. The group is still characterized by a shared belief, namely that group members should follow the rules edicted by the controlling organism, but most of the concrete control knowledge is now concentrated in a specialized body.

Such a structure makes it possible to gather much more extensive and expert control knowledge, but has the disadvantage that this knowledge is farther removed from the practical situations in which it is to be applied. This leads to problems of shifts in context discussed above: the same message may have a different meaning for the one who gives the orders and for the one who executes them. It also leads to delays and communicative degradation since information needs to move up and down the control chain, making it likely that commands are no longer adequate to the situation at hand. This is exacerbated by the tendency of bureaucratic organizations to multiply the number of intermediate control levels, reflecting the differentiation of social ranks ("pecking order") rather than efficient cybernetic organization. Although they occur in all control systems, the delays and degradations are obviously much more important in social systems, where information has to travel between individuals rather than between contiguous nerve cells or transistors. Moreover, the capacity of the control system for anticipation, which normally compensates for the loss of information (Heylighen, this issue), is notably poor for social systems, which are inherently difficult to predict. In addition, too much power tends to get concentrated in the higher levels of bureaucracies, whereas cybernetic principles would suggest that the higher control levels restrict themselves to the setting of general goals or constraints, while leaving a maximal autonomy of implementation to the lower levels. This is linked to selfish optimization of the individuals in higher administrative positions, which will be discussed in a further section.

4.4. Market mechanisms

A fourth type of social control, *market mechanisms*, can again to some degree compensate the shortcomings of legal control, internal restraint and mutual monitoring. In market processes the intelligently selfish choices of all group members together curb the greed of single individuals, by making it unprofitable to ask for more than a "fair share". Similar to mutual monitoring, market mechanisms operate locally. This means they do not require an independent, centralized control organ, like legal control does. This makes them more tolerant and flexible, adapting quickly to new contexts or developments, but less reliable, and more prone to vicious cycles induced by small variations magnified by positive feedback ("boom and bust").

Market mechanisms are quite efficient in the allocation of the factors of production (natural resources, labor, capital). Their main function is to regulate the diversification of effort resulting from division of labor. Markets create an equilibrium between supply and demand of goods or resources by adjusting prices (which are a consensual measure for the average value of a good). This ensures that when a particular good or service is in demand, there will quickly develop a sufficiently large group of individuals or firms specialised in providing it to meet that demand. Complementarily, when demand diminishes or supply increases (e.g. because of more efficient technologies), the effort invested in providing these goods will be quickly adjusted downwards, making more effort available for meeting other needs.

The general mechanism is a negative feedback cycle where increase in supply via decrease in demand produces again a decrease in supply. Thus, large fluctuations are damped, and prices tend to stay around an equilibrium value. Although the negative feedback loop is the basis for cybernetic control, it is not sufficient on its own to create a control system. As Powers (1973) notes, cybernetic control requires *amplification* of the corrective reaction with respect to the initial perturbation: an increase in supply/demand above the reference level should produce a counteraction decreasing supply/demand more quickly than the initial deviation. Such a system very soon reaches a fixed reference or equilibrium state, from which it is very difficult to make it deviate. Market feedback, on the other hand, tends to be smaller than the fluctuation that caused it: after the demand goes up, it will go down again, but in general not so much as to reach its original level. Thus, the "equilibrium" value will slowly move, adjusting to outside conditions, which depend on the availability of resources, and the intrinsic needs of the public. It is this absence of an explicit norm or reference value that distinguishes market "control" from the other social control mechanisms, where religious values, moral and social rules, and laws provide the fixed reference against which behavior is evaluated. The variability of market feedback allows adaptation to new circumstances while still buffering the system against wild fluctuations.

However, the concurrent danger is that when there is no stable underlying need or fixed store of exhaustible resources, feedback may become positive, leading to run-away processes. A traditional example is speculation, where an increasing demand makes people anticipate even higher prices, and thus gains for goods or assets bought now and sold later. Another example is technological development, where increased adoption of an innovative technological product (say an airplane or computer system) diminishes the costs needed to produce further units, and encourages the public to use that technology, rather than less well-spread competing designs. Thus, increase of supply leads to both further increases of supply and increases of demand ("increasing returns", see Arthur, 1988).

Libertarian theorists and *laissez-faire* economists recommend using market mechanisms as the overall control, while avoiding all centralized interventions except for the protection of private property and inherited wealth. Yet, we believe that market mechanisms cannot operate effectively without the contribution of the other social control mechanisms. The building block of market processes is the transaction, in which one good or service is traded for another one (or its proxy, money). A transaction is basically a "Prisoner's Dilemma" type of interaction, in which there is a short term benefit in defecting, i.e. profiting from the other party's investment without fulfilling one's own part of the deal. (For example one might refuse to pay for a service, or pay with counterfeited bank notes, or supply a defective good). It is just to counteract such tendency to defection that mutual monitoring, internal restraint and legal control have evolved. In particular, legal control is needed to ensure that contracts are fulfilled, and that goods are not captured through violence rather than trade. On a different level, legal control is necessary to ensure that positive feedback loops do not get out of hand, and that investments are made in areas where the lack of local or short term benefits precludes private investment.

In a similar vein, Mancur Olson (1968) employs the tools of mainstream economics which are characterized by the hope that an "invisible hand" emerging from competition will provide the restraints needed for collective action. But he shows that from basic economic assumptions it follows that if each person is intelligently selfish in choices, "collective goods", including the benefits of cooperation, will be lost. (This agrees with Hardin's (1968) analysis of the “Tragedy of the Commons”, where competition exhausts the common resources.) He concludes that to solve "free-rider" problems some form of compulsion is needed.

As an additional argument, we may remember that competition between similar systems tends to lead to arms races which decrease absolute fitness. For example, two companies producing essentially similar products (e.g. soft drinks) by similar methods and selling them for similar prices can only hope to increase their market share by spending more and more on publicity. This may lead to situations where more than half of the product's price is made up by the cost of advertisements, trying to convince the customer that one's product is better than the competitor's product. Market competition will in general only produce a positive sum if there is a *differentiation* in resource usage and production methods between the competitors, but, as we discussed, when the initial differences are too small, competition will hinder rather than stimulate further differentiation. E.g. when a particular way of producing soft drinks is well established it is quite risky for an existing company to distinguish itself from its competitors by promoting a new recipe: the chances are higher that it will lose customers used to a particular taste than that it will make new converts.

4.5. Conclusion

A complex society like ours, characterized by a full division of labor, seems to require the presence of at least the four social control mechanisms outlined above. Each of these mechanisms functions at a different level of interaction. Internal restraint functions at the level of the single individual. Mutual monitoring functions between pairs (one to one) or small groups. Legal control is directed from an individual or small group to the whole (one to many)—and, if the controlling body is democratically elected, the other way around (many to one). Market equilibria emerge from interactions between all members of the group (many to many).

Of these, only legal control can (arguably) be fitted into the classical, hierarchical control paradigm. This may explain Powers’s (1980) reluctance to recognize any kind of control at the social level. Yet, all these control mechanisms can be viewed as social constraints, curbing and modifying the selfish and nepotistic goals that control individual actions. They are thus working at the metasystem level (as defined in Heylighen, this issue).

In spite of their sometimes wide-ranging and subtle effects it is obvious that the mixture of control mechanisms we see in our present society is far from optimal. What is most obviously lacking is any form of integration between these mechanisms. It is easy to imagine situations where the restrictions imposed by the different mechanisms are mutually inconsistent, religious tradition demanding one type of behavior, law another one, the market a third one, and peer pressure a fourth one. Moreover, each control mechanism on its own lacks an invariant focus: mutual monitoring varies with the local group of peers, legal control and internal restraint with national, organizational and religious frameworks, and market pressure with the vagaries of interacting positive and negative feedbacks, as exemplified by the chaotic movements of quotations at the stock exchange. Thus, in spite of the metalevel at which these mechanisms function it is as yet hard to recognize in society any integrated metasystem. The task of thinking through the problems of social control that are created by the on-going competition between the cooperators is merely starting. Let us look in more detail at some specific issues.

5. Some Problems of Complex Societies

5.1. Part-Whole Competition in Organizations

Businesses start up and go bankrupt at a high rate. This looks like a node of selection at the firm level. For fifty or more years, a substantial group of scholars has been employing this setting for developing a cultural evolutionary model of optimal organizational principles. Baum and Singh (1994) provide an up-to-date entry into this literature. In a chapter in that volume, Campbell (1994) focuses on the implications of part-whole competition. For optimal selection for firm efficiency, there should be a large number of firms competing in a shared ecology, with minimal interfirm transfer of personnel. What transfers of executives that do occur should be based upon *the company's* reputation for effectiveness, not the individual executive's reputation. Conglomerates and leveraged by-outs which saddle effective firms with externally induced debt are contra-indicated. Out-hiring of executives based upon their individual reputation for introducing changes in their original organization usually takes place before the efficacy of that innovation has been demonstrated. In all firms, "Management Information Systems" that are believed to affect personnel decisions lose their validity. Use of stock market values to evaluate managerial effectiveness leads to postponed maintenance and other decisions sacrificing long-term effectiveness. (On many of these points, Japanese industrial organization may be superior to American.)

An ubiquitous problem in all industrial organizations and government bureaucracies is the tendency for those who work together in face-to-face settings to establish primary group solidarity, treating as outgroups: 1.) the customers they are supposed to serve, 2.) rival face-to-face groups in other divisions of the organization, and 3.) higher management located in other buildings or cities. Particularly when organizational level conflicts are exacerbated by labor unions, this face-to-face solidarity operates to curb, rather than augment, overall firm productivity. (Again, possible advantages to Japanese industrial organizations, with their firm-level "patriotism" rituals, and requiring the whole face-to-face group of the assembly line to be collectively responsible for imperfect products.)

These proclivities are important considerations in addressing many current problems. Take social control of scientific honesty for one example. Ravetz (1971) has pointed out the special problems of validity in large-scale or "industrial" science. In considering the episodes of scientific fraud that have come to light in recent years, face-to-face-group solidarity processes are relevant in two ways. On the one hand, they explain the cruel ostracism that whistle-blowers experience when they call attention to defects that would undermine "truth," organizational goals, or national goals. On the other hand, most discoveries of fraud are due to the mutual monitoring of fellow workers in the face-to-face laboratories. A sociology of scientific validity might recommend both increased opportunity for mutual monitoring in laboratories, and a restructuring of perceived legitimacy so that whistle-blowing (or an earlier-stage substitute for it) was not stigmatized as disloyalty or interpersonal hostility, but rather routinized as always required minority reports.

5.2. Predicting the Shared and Unique Flaws of Capitalism and Socialism, plus Implications for the Design of a Better Society

Let us begin by considering the laboratory evolution of organizational structure, in a format introduced by Bavelas (1950; Guetzkow and Simon, 1955; Collins and Raven, 1969, pp. 137-155). Sets of five persons were provided with contrasting linkages. In "All Channel," each member had a two-way communication channel with each of the other four. In "Circle," each had a two-way link with two other persons, all arranged in a circle. In "Wheel" (which would have been better labeled "Hub and Spokes"), a central person had two-way links with each of the other four, but none of these four had any other links. Each member was given a few playing cards, with the group task being to pick out the best poker hand possible. The "Wheel" pattern was clearly superior, the "All Channel" was next, and the "Circle" clearly the worst. "Wheel" retained its superiority even when the least able of the five was in the Hub role, thus the effect was an organizational product, not a matter of individual leadership talent. Moreover, when "All Channel" groups repeatedly played the game, there was a drift toward the "Wheel" pattern, with many links going unused.

Without claiming that the task was representative, nor that the participants were performing independently of our cultural ideology on teamwork, one can nonetheless use this research to suggest an early and widely repeated cultural trial-and-error resulting in the discovery of the value of an organizational role of group coordinator, or communications clearinghouse. Let us posit this as a group-selected organizational principle of very great adaptive value, which has persisted in almost all subsequent human social organizations, at every level of complexity.

Our perspective on human ambivalent sociality leads to the prediction that for every role and level within the organization, there would be tendencies to role distortion in favor of individual inclusive fitness and well-being, and also, in more complex organizations toward face-to-face group advantage. Those in the communications clearinghouse role (and higher administrative roles more generally) have the greatest opportunity for such distortion. The organizational arrangement is so very group-beneficial that there will be a net group benefit even if individual optimizing (including *individual* inclusive fitness) of leaders produces a heavy parasitical load.

In the U. S. S. R., the special caste privileges of the higher nomenclatura, such as the special shops open to only the higher nomenclatura where Western goods were available at subsidized low prices, offer one example. Their special privileges in university admission for their children represent another. These privileges were not hidden from the ordinary workers, and produced alienation from the egalitarian ideology and cynicism, which furthered opportunistic individual optimizing on the worker's part.

The rank differentials in *official* salaries in the U. S. S. R. might not represent a parasitic individual optimization. It probably takes a monetary incentive to motivate a member of a work group to accept the role of supervisor of that work group. (The loss of primary group membership may be a real hedonic cost.) In other settings, a promotion represents such a hedonistic gain in decision-making autonomy that no additional monetary reward should be necessary. However, in most U. S. universities, the job of departmental chair is not one of them; bribes are needed. In U. S. capitalism, the rate of pay for C.E.O.'s (chief executive officers) no doubt represents a parasitic excess reimbursement. Reputedly, in the U. S., the ratio of pay of the C.E.O. vs. the lowest paid worker runs around 200 to 1, and occasionally gets as high as 2,000 to 1. That the real differential in C.E.O. effectiveness does not alone explain these differences is shown in the lavish retirement benefits to C.E.O.'s being dismissed for perceived incompetence. (These ratios are much lower in Japan and Western Europe.) The situations which create C.E.O. reputations are far from providing opportunities for valid identification of superior ability. Causal-perceptual illusions give figure-heads the praise (and blame) for fluctuations in group performance. Executive-caste clique selfishness is no doubt involved. The steady increase in the relative prosperity of the top 10% to the bottom 10% probably represents a parasitic pathology in the Western Capitalism, as does the increase in the rates of permanent unemployment.

When one considers the reward-differentials in the archaic tyrannies that first produced full-time division of labor, the situation may be more complex. The predecessor societies probably had monitoring mechanisms curbing leader power, such as are found in the simpler societies studied by anthropologists (Boehm, 1993). A difficult phase-transition was involved. Envy of rulers may have been reduced by cognitive-categorization of the rulers as God-like, and, therefore, incomparable to self. The wastefully lavish royal burials may have supported beliefs in an afterlife that would be rewarding and punishing to all group members, depending upon their dutiful performance of their social roles (Campbell, 1991). But the extreme cruelty of their obedience-enforcing mechanisms no doubt also created a social system in which lavish executive over-reward was possible.

The uniform experience in privatized industries in the formerly socialist states of Eastern Europe seems to show that worker industriousness had been very low under socialist management. This seems well explained by both individual optimizing and by face-to-face group solidarity, abetted no doubt by the absence of war-time national solidarity and by worker cynicism about collective goals. There was also an almost universal reputation for the production of imperfect products. These considerations have pointed to the need for market competition. Centralized planning of products and volumes is also now generally recognized to have been a failure, and also to represent an impossible computational problem. This again points to the need for market mechanisms of allocation.

But at what level should they be introduced? One of the useful inventions of Japanese factory management is to make the entire face-to-face work group responsible as a whole for imperfect products; that is, to reward and fine all such primary group members equally. Characteristic of face-to-face groups is mutual monitoring. (They know who is doing slovenly work.) But in both socialist and U. S. capitalist factories, this mutual monitoring is not used for quality or productivity control. Instead, primary group solidarity requires that fellow group members help cover-up delinquencies. In terms of face-to-face group morality, each experiences a feeling of moral righteousness in so doing. This suggests placing the level of competition at the level of whole factories versus whole factories (as pioneered in the producer cooperative movement, worker ownership and/or profit sharing, and speculatively in the concepts of guild socialism and market socialism). While such efforts have not been conspicuously successful, they have competed in markets in which already powerful traditionally capitalist organizations actively sought to kill them, as through temporarily cutting prices below actual production costs.

Mechanisms for curbing self-serving abuse of power on the part of leaders and administrators are still more needed. Democratic procedures for electing leaders are traditionally thought to have been such, but in modern societies with television sound bites as the major information media, those voting usually have neither first-hand information nor valid gossip to go upon. Such democratic procedures have also been lacking in both socialist bureaucracies and in capitalist business organizations. "Mutual criticism" rituals in organizations have no doubt often been supposed to include subordinate criticism of supervisors (e.g. Levine and Bunker, 1975), but these rituals have not lasted long in face of the ability of a superior to retaliate against a particular subordinate. Mechanisms for protecting subordinate identity easily lead to destructive perversions. Factory-versus-factory level competition would no doubt help curb administrative abuse within the factory, but this problem area needs much greater study and the brain-storming of many possible organizational inventions. It is worth noting that the charismatic leaders of new organizational movements often conspicuously reject any special privileges. But these same leaders may provide such indulgences to their offspring. Sociobiology has expanded the concept of selfishness to include nepotism (i.e. "inclusive fitness"). It is remarkable how the heroically self-sacrificing heroes of the "Long March" in Maoist China have protected the corruptions of their sons under peace-time conditions.

Evolution, both cultural and biological, has produced organization-optimizing (group-solidarity) mechanisms which are optimal in intergroup conflict and hence work against whole-world organizational optimizing. LeVine and Campbell (1972, pp. 7, 31) found that Sumner's principle, "the exigencies of war with outsiders are what make peace inside" or "real threat causes ingroup solidarity," was the most frequently endorsed or independently invented of all of the principles of intergroup conflict. If there is a "facultative polymorphism" for group vs. individual optimization, the threat of outgroup aggression is no doubt a powerful stimulus for group-optimizing behaviors. Such perceptions are open to manipulation by insecure national leaders and by their competitors for leadership, and such maneuvers are chronic saboteurs of intergroup peace. In proposing novel political arrangements, here is perhaps the greatest need for new arrangements and legitimacies. Perhaps the route could be through popular education as to these self-destructive mechanisms, plus a plausible design for world government which could offer the hope of righting injustices without war, plus a strong appeal to the motives of individual well-being and inclusive fitness done in such a manner as to not disrupt social coordination at sub-national levels of organization. Designing and implementing this final phase transition should be our highest priority.

5.3. Memetic Drift and Fuzzy Social Boundaries

Let us further examine the implications of "memetic drift", the spontaneous and continuous divergence of beliefs in a large social system. Until now we have conceived of groups mainly as assemblies of individuals in direct, physical contact. Two groups are distinct if they have no such contact (e.g. because they live in different locations and lack communication channels). However, in a large, complex society such as ours, where the possibilities for communication are unlimited, such a characterization of a group will not suffice. More generally, a group or social system can be defined as the maximal assembly of individuals that share a particular belief. Indeed, we have argued that a shared belief provides a constraint or control (of the internalized restraint type) on the actions of all individuals having that belief. A variety of elements with a shared constraint can be said to define a *system* (see Heylighen, this issue). A group in this sense can be seen as the physical counterpart or "sociotype" of a cognitive belief pattern or "memotype", in analogy with the "phenotype" embodying an informational "genotype". This analogy between social and biological systems is most clear for beliefs that constrain social behavior, and thus control the interaction between the group members.

For large overall groups, the picture that arises then is one of many overlapping subgroups of different sizes. For example, the group of Christians can be defined as all individuals who believe in the teachings of the New Testament. This groups contains several smaller subgroups, such as Catholics, Protestants and Orthodox Christians, which are distinguished by certain additional beliefs they hold. The group of Christians overlaps with, but does not include, or is not included in, the group of people who believe in capitalism or the group of people who believe in the existence of Hell.

A belief that diffuses through various channels from some center to neighbouring groups will necessarily undergo variations or distortions in the process (if only because of the shift in context noted earlier). This depends on the quality of the communication channels and the length of its journey. For example, a message transmitted in a circle by whispering it into one's neighbour's ear will come back to its original source in a hopelessly distorted way. The same message transmitted by writing, or by copying computer files, will be preserved much better.

The result of this communicative degradation is that beliefs will present continuous shifts when moving from individual to individual. It will therefore be difficult to establish clear boundaries where one belief or one subgroup ends and another one begins. For example, one can have many different interpretations of the teachings of the New Testament, leading to quite different codes of conduct, so that it becomes difficult to determine who is a real Christian and who is not. This explains our earlier observation that social systems are much fuzzier than most other types of systems.

Yet Christians still stand out as a group when compared to competing groups, such as Muslims. The reason that social boundaries, however fuzzy, still exist, can be found in the positive feedback processes mentioned earlier. Christians will communicate primarily with other Christians, and not with Muslims, thus continuously reinforcing their shared beliefs. The reason is not just that they live in the same geographical region (which is probably the reason why they got to share their beliefs in the first place), but also that individuals find it easier to communicate with individuals who have shared beliefs and who therefore can be expected to follow the appropriate code of conduct.

A shared belief to some extent determines a shared language (e.g. containing specialised expressions such as "the ten commandments", "the Virgin Mary" or "the original sin"), and thus a medium for mutual reinforcement of that belief. This group-specific language makes it more difficult for outsiders to learn the code and join the group. More generally, shared beliefs may entail shared values and thus more opportunities for cooperation, and less risks for conflict. Finally, as we have argued, beliefs defining groups evolve in continuous competition with other groups, and thus will be selected for promoting actions that are, if not hostile, at least non-cooperative towards competing groups (clique selfishness). Thus, friendly exchanges or communications with individuals holding different beliefs will tend to be avoided. All these effects point in the same direction: individuals with similar beliefs are most likely to reinforce each other's beliefs, and to minimize contacts with individuals having different beliefs that might weaken their own convictions.

The processes of self-reinforcing communication we just described explain the spontaneous development and maintenance of (fuzzy) social boundaries. However, such boundaries can also be introduced in a more formal, externally controlled way, when individuals are either forced into a group (e.g. by a conquering army) or decide to willingly enter or create a particular group (e.g. when joining a company). Even then, the long term survival of the group as such will depend on the existence of sustained communication channels reaching all group members. Otherwise, different parts of the group will develop incompatible subcultures that will eventually lead to a splitting up of the original group (e.g. as when an empire disintegrates into separate nations, or when a group leaves a firm to set up a rival company).

Both bureaucratic and spontaneous social groupings are characterized by a hierarchy of levels, where the higher levels embody the more general control that is shared by a larger number of individuals. Each higher level group encompasses several subgroups (e.g. the group of Christians, consists of Catholics, Protestants and Orthodox, whereas the USA consists of different states, such as Illinois, California, Wisconsin, etc.), which in turn consist of smaller subgroups, and so on, down to the level of the individual.

The eternal problem is that all groups, at all levels, will demonstrate some form of "clique selfishness". This applies over the whole spectrum, from the smallest units, families (that are strongly tied up by the genetically induced tendency to nepotism) and face-to-face groups (e.g. colleagues working in the same office space), to the largest (e.g. nations or groups of nations, such as the European Union, and the overarching religions or ideologies, such as the group of all Muslims). The fact that all these different fuzzily defined groups are nested or overlapping creates an extremely complicated picture, in which the same two individuals will either compete or cooperate, depending on the level at which their interaction takes places. This makes it extremely difficult to predict the further evolution of a complex society such as ours.

The strongest influence for the future is perhaps the emergence of ever more powerful and better integrated communication media, as exemplified by the explosive development of electronic networks such as the World-Wide Web. This makes it in principle possible for fit beliefs (memes) to spread quickly over the entire globe with minimal distortion. If beneficial beliefs thus manage to get shared world-wide, they may initialize a global pattern of cooperation. More specialized global control knowledge may similarly be developed and maintained within an overarching computer network (Heylighen, 1996), whose ubiquitousness, flexibility and intrinsic intelligence may be able to overcome the rigidities of bureaucratic organization and legal control, and the short-sightedness of market mechanisms. Nobody can predict how, when, or even whether, such global integration will take place. The only thing we can safely predict is that the various forces of individual and group selfishness will provide formidable obstacles, leading to major conflicts, on the road to world-wide cooperation.

6. Conclusion

We have examined in how far Turchin's concept of the metasystem transition can help us in understanding the evolution of social systems and the emergence of cooperative, division-of-labor organizations out of groups of selfish individuals.

A "social" MST can be seen as the emergence of an integrated, controlled supersystem out of similar, but initially independent control systems ("individuals"). It thus differs from others MST's discussed by Turchin (1977, this issue), such as the emergence of movement, learning or rational thought, where the systems to be integrated (neurons, muscles, cognitive patterns, ...) either are not similar or are already dependent on an integrated organism. This difference is what makes social MST's problematic. We have seen that since individuals share common resources, yet independently maximize their outcomes, they tend to get engaged in negative sum competition. Positive sum, cooperative arrangements, which optimize the fitness of the group as a whole, normally get eroded by this competition. Thus, the part-whole competition between groups and individuals tends to be won by the individual level. A social metasystem would overcome this negative sum development by simultaneously differentiating individual's roles (division of labor), and restraining their selfish optimizing (social control), thus creating the conditions for positive sum synergy. However, a necessary condition for such metasystem to evolve is a shift from selection of individuals to selection of groups. We have discussed one mechanism that makes this possible: the development of controls (genetic or learned) that are shared between members of a group. Shared genetic controls are characteristic of the cells in an organism and the individual insects in an ant's nest or beehive. They thus may explain the well-integrated social metasystems found in multicellular organisms and insect societies.

In human societies, on the other hand, competition at the genetic level continues, though group selection may have developed a genetic basis for certain innate social control mechanisms, like reciprocal altruism and moralistic aggression. This makes humans into profoundly ambivalent social animals. The predominant shared control for humans is cultural: beliefs spread through conformist transmission. However, the conformist mechanisms that keep beliefs similar are not sufficiently strong to keep context-dependence and communicative degradation from producing a continuous belief divergence or "memetic drift". Thus, human society becomes a patchwork of fuzzily defined groups at different levels of aggregation, characterized by clique selfishness and hostility towards competing groups. Different control mechanisms have evolved to complement the limited internalized restraint produced by shared beliefs: mutual monitoring, legal control and market mechanisms. However, each of these mechanisms has its intrinsic shortcomings, and as a whole they are characterized by inconsistency and lack of integration. Though there certainly exist methods and tools that may make social organization more effective, which must be examined urgently, we as yet do not see a straightforward path to social integration at the world level.

Coming back to our initial questions, we disagree (but can sympathize) with Turchin's view of society as a super-organism, which would imply a much stronger integration than presently exists, ignoring the on-going competition characteristic of human sociality and thus failing to make the fundamental distinction with multicellularity or insect sociality. We similarly disagree with Powers's denial of the existence of social control, which ignores the essential role of legal, market and moral constraints in steering social interaction towards a more group-optimal outcome, for the sake of a strict definition of control. Though we have discussed why social systems tend to be fuzzy, we have also seen mechanisms that create and maintain social boundaries. As a whole, there does seem to be an evolutionary trend towards greater social integration, which may be modelled by an eventual "fuzzified" version of metasystem transition theory, but the obstacles that lie on this road are more important than what one would naively expect or desire.

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