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2006 CONFERENCE OF THE INTERNATIONAL HORMESIS SOCIETY
**STRESS RESPONSE MECHANISMS: FROM SINGLE CELLS TO
MULTINATIONAL ORGANIZATIONS**

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□ Can a literal comparison be made between biological phenomena in organisms and phenomena in human organizations? The evidence provided by simplified but useful examples appears to suggest that a phenomenon simulating hormesis can and does occur in organizational contexts. Similarities between stress response behaviors of organisms and stress response behaviors in organizations are discussed. Cellular stress response mechanisms stimulate and repair, as well as defend the organism against further attacks. Organizational hormesis describes actions that stimulate the organization by increasing its focus and protecting it against future attacks. The common aim for the organism as well as the organization is to increase the probability of survival. The following describes examples of organizational survival that demonstrate a number of hormetic parallels between organisms and organisations.

INTRODUCTION

The idea that organizations can be likened to living organisms is not new. For example Keeley, (1980); Young, (1990); Bloom, (1995); and Pech, (2001) provides only a short list of authors who have compared or contrasted behavior within organizations, or super-organisms as Bloom (1995) has termed organizations, to that of a living organism. Can a literal comparison be made between biological phenomena in organisms and phenomena in human organizations? And if so, can phenomena in living organisms provide lessons for organisations?

Calabrese and Baldwin's (2001) research demonstrating that exposure to small levels of some toxins may be beneficial to organisms, has sparked an interest in identifying whether parallels can be drawn between the beneficial effects of toxic exposure to larger collective organic structures such as organizations. Calabrese and Baldwin (2001) argue that some organisms exposed to small doses of toxins will overcompensate and readapt, thereby providing two advantages for the newly adapted organism:

1. ensuring that the repair was adequately accomplished in a timely fashion,
2. ensuring some measure of protection against a subsequent and more massive onslaught.

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If similar hormetic effects can be identified in organizations, it will transform the organism-organization analogy from a simple abstract comparison to one with more literal implications. The difficulty lies in identifying whether there is a biologically plausible comparison between organisms and organized human structures - organizations. The example of hormesis may provide a useful starting point. This requires firstly identifying comparable hormetic phenomena, as well as identifying whether toxic exposure in the biological sense is comparable with toxic exposure within an organizational context. Pech and Oakley (2005) have argued that this is certainly the case, citing examples of organizations that were once exposed to levels of 'toxicity', and as a consequence emerging stronger and better equipped to survive subsequent onslaughts.

CAN AN ORGANIZATION BE LIKENED TO AN ORGANISM?

Cognitive psychologist Andy Clark (1997) uses the example of slime molds to compare organisms operating as organizations. He discusses the species *dictyostelium discoideum* whose life-cycle starts as an individual amoeba-like cell (*myxamoebae*). The cells feed on bacteria and grow and divide—until food sources run out. At that point the cells converge into something resembling a slug, which then searches for an appropriate source of nourishment, at which point it again changes form into a stalk and fruiting body that restarts the cycle propagating spores with a fresh population of myxamoebae.

Dawkins (2004) discusses examples of cooperative behavior such as the Great Barrier Reef, where the clustering of complex three dimensional structures of the coral organisms inflate their effective surface for biological activity. Each organism builds on the skeletons of previous generations, resulting in the construction of massive eco structures. Dawkins delves into the origins of life on Earth, arguing that bacteria may have clustered together during the early stages of the evolutionary process, sacrificing their individuality for the advantages offered by evolving within a larger collective, perhaps to form the first eukaryotic cells containing hereditary information and thus kick starting evolution by natural selection. As with the construction of the Great Barrier Reef, it may be speculated that larger organisms are the consequence of cooperation, joining, and subsuming of smaller organisms to form a competitively fitter entity. Perhaps organizations can be viewed similarly, with a joining and subsuming of individual entities for the beneficial purposes of the organizational body and its stakeholders.

Bloom (1995) goes further when he describes society's cooperative behavior and our communication of information as a neural net (p. 140). He argues that humans develop interdependencies, eating food that is grown and processed by complete strangers in countries far away from the point of purchase. An individual may develop a medical break-

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through that enables thousands of complete strangers to benefit from its application. Similarly, human networks may conspire to compete with other networks. Recent aggressive activities by religious fundamentalist groups seeking to displace governments and/or ideologies may provide a painful example. Sometimes competitive behavior between groups can also be used in a positive manner, such as the use of sports teams for fostering relations between nations and people with conflicting views (table tennis in China, rugby in South Africa).

THE INFLUENCE OF THE MIND/BRAIN

These collectives and networks of individuals may act as hosts for what could be termed as thought contagion or a virus of the mind. One example may be found in the manner in which society or groups sometimes unquestioningly follow the tenets of myths buried deeply within the mists of time. Dennett (2003, p. 306) explains,

... tradition usually has a free ride ... Doctrines that are endorsed by tradition should be left unexamined if at all possible, people are inclined to think, as a matter of tactical wisdom, since it will only stir up a hornet's nest if we question them. And so traditional thinking lives on, largely unchallenged, and accretes a pearly coating of spurious invulnerability over the years.

Clark (1997) explains how the brain, while being critical to human productivity, is more of a mediator of intellectual processes and products rather than its sole and direct source and inspiration. The brain utilises complex feedback loops encompassing external props and media such as books, databases, and notes, as well as other minds. The brain collects fragmentary pieces of knowledge and reorganises them with existing and incoming relevant information through repeated interactions to produce 'good ideas' and to encourage caution and critical reflection before implementing 'bad ideas'. This supportive knowledge and feedback learning process could be regarded as an enlargement on the pioneering Soviet psychologist Lev Vygotsky's (1978) suggestion of a scaffolding effect. The knowledge with which a society surrounds itself and in which it embeds itself, provides the scaffolding to support its cultural decision-making edifice. Such a 'thought' scaffold provides an external memory field, motivating and directing human actions—and inactions as one.

Donald (2002, p. 316) describes the external memory field that provides the internal structures (the laws, boundaries, rules, procedures, values) for decision scaffolding as a type of cultural Trojan Horse that can be easily implanted within the mind. He claims that this Trojan Horse can 'play our cognitive instrument, directing our minds to predetermined end states along a set course' (p. 316). He argues that this can make the

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human mind externally programmable to an extraordinary degree, and that we are ‘married to culture and fated to play out its algorithm in our conscious acts’ (p. 316).

Donald (2002) further claims that the ‘nature and range of human conscious experience are no longer a biological given. Rather they depend on a somewhat unpredictable chemistry of brain and culture, whereby the processes of mind can be endlessly rewritten and rearranged by cultural forces ... Evolution has nudged us in this direction, interlocking brain and culture, toward the absorption of individuals by communities of mind’ (p. 321-322). Every gathering of people expresses elements of culture providing the construct from which each individual receives instructions regarding behaviour, expectations, standards, outputs, what matters and what does not. Words, symbols, gestures, narratives, these are the defining parts of culture; they paint the colours and provide the glue that sustains its internal message. They are also the elements that facilitate mimicking behavior, reinforcing and spreading specific rules and unquestioned traditions of a culture amongst those who are susceptible to its message. This message replication and mimicking can sometimes be likened to the behaviors of a viral agent (see Pech & Slade, 2004).

Edelman and Tononi (2000, p. 29) reinforce Donald’s argument when they point out that consciousness cannot be explained from a purely biological perspective, as our conscious state requires interactions with the world as well as others, all of which serve to create scaffolding around our decision processes. This scaffolding comprises the culture, the rules, the values, and the ambitions and hopes of society. Schwartz and Begley (2002) add another dynamic when attempting to understand human cognition and that is the powerful influence of emotion. All of these elements combine to influence decision behavior in the super organism. People who comprise the super organism could therefore be viewed as programmable parts, each working independently and yet cooperatively to fulfil the ‘mission’ embedded within the organisation’s cultural scaffold.

While people work together to achieve an organizational goal, there is an underlying biological need for each individual to reduce a sense of uncertainty that he or she may experience. The brain’s ability to categorise and recall information is partially driven by the need for this ‘reduction of uncertainty’ (Edelman & Tononi, 2000, p. 29). Wilson (2004) explains that groups of individual organisms can have, or can be thought of, as having minds in something like the way in which individual organisms themselves can have minds (p. 267). This collective psychology provides the individual with decision scaffolds that direct, guide, and generally serve to reduce the element of uncertainty that may otherwise accrue if left to think and act alone. The evolutionary process may have equipped such collectives with the capability to transform themselves to exploit or survive their environments. This may be likened to the

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manner in which the slime mold transforms from a slug-like creature to a stalk and fruiting body, without conscious leadership or an articulated set of instructions (except for the information provided in its DNA).

The biological urge to reduce uncertainty in humans may result in an overt expression of informational attraction. The information that is attracted is then processed through a series of memory recognition filters, thereby shaping the level and intensity of the understanding that eventuates. Group and cultural norms further aid in the interpretation of information, removing uncertainty in the mind of the individual. This may result in wisdom and learning but it may also produce narrow-mindedness and unquestioning loyalty to questionable beliefs.

THE GREATER COLLECTIVE AND THE POSSIBILITY OF HORMETIC EFFECTS

Clark describes a concept he has called *emergence*. Clark (1997, p. 74) divides the phenomenon of *emergence* into two distinct categories. The first, *direct emergence*, occurs where the properties and relations between individual elements primarily take on a life of their own and environmental elements have only background influence. Clark's notion of *indirect emergence* describes the predominant influence of the environment in triggering behaviours both individual and collective. The example of the slime mold describes indirect emergence, as the pseudoplasmodium only changes shape once it has found a location with adequate nourishment. Its environment therefore prescribes the timing for each stage in its lifecycle.

Transformation of the shape or purpose of a collective could occur as a consequence of Clark's phenomenon of emergence. As an example, people with a common outlook or cause may unite to further the goals of that cause. They will reduce uncertainty by a number of strategies that may range from objective and critical searches and evaluation of all pertinent information, through to adherence to dogma and unquestioning loyalty to information from dubious sources. Their collective activity and subsequent survival may be completely dependent on the impact that Clark's direct or indirect emergence has on their organization.

Using the example of a religiously-focused group, their 'shape' and purpose may be influenced by direct emergence where they develop rules, rituals, and hierarchies based on the tenets of their faith. Indirect emergence may influence the shape of this group through some form of sudden and violent persecution. Assuming the group survives the initial onslaught, it now changes shape, pursuing its goals in a less open manner, perhaps operating by stealth rather than the public forum. Survival is dependent on the group's ability to evolve in response to the pressures under which it has suddenly found itself. Such pressures could be viewed as toxic, having poisoned the 'landscape' to which the group had become

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acculturated. History is replete with examples, including Roman persecutions of members of the Christian faith and the Nazi regime's systematic extermination of the Jewish people. In these two examples members of the collective suffered horrendously for their part in maintaining the scaffolds of the culture to which they have been born or within which they chose to live. The effects of the holocaust produced world-wide revulsion and resulted in the re-establishment of the nation of Israel. This could be viewed as a consequence of indirect emergence, with factors external to those being persecuted facilitating the establishing of a new nation in order to prevent recurring events. Direct emergence could also be witnessed by the determination and perseverance of the Jewish people against their persecutors, producing ever increasing levels of internal cohesive activity in an attempt to establish a position of survival and self-determined control.

It could be suggested that the above examples (simplified for the sake of this argument) of super organisms struggling to survive in hostile environments naturally reflect elements of hormetic phenomena. Calabrese and Baldwin's (2001) findings 'suggest that hormetic effects represent evolutionary-based adaptive responses to environmentally induced disruption in homeostasis' (p. 353). Whether such disruptions are the consequence of direct emergence (i.e. the splitting of the Catholic Church to form an off-shoot that resulted in the establishment of the Anglican Church), or indirect emergence (i.e. persecution of the Jewish people, ultimately resulting in the establishment of the nation of Israel), such disruptions may arguably result in re-establishment of homeostasis and adaptation. In the former example, England under the rule of Henry VIII, was able to pursue its own interests without interference from the last remnant of the Roman Empire, embodied within the form of the Catholic Church. In the latter example, the Jewish people became legitimised as a recognised nation and were able to legally defend themselves against further instances of persecution.

If viewed as organisms, both of the above examples demonstrate the key elements of Calabrese and Baldwin's (2001) four hormetic features:

1. disruption of homeostasis
2. overcompensation
3. re-establishment of homeostasis
4. adaptation.

The above examples describe instances where environmental 'toxins' initiated indirect emergence, prompting actions that have resulted in disruption of homeostasis. Each group was vulnerable but as a consequence became involved in modifying their structure, behaviors, and their environment, which could be viewed as deliberate acts of overcompensation.

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They then successfully re-established homeostasis, and adapted. Such hormetic processes could be viewed as ‘healing with foresight’ as hormesis prepares and improves the organism’s ability to repel future and more intense attacks. Toxic attacks and evolutionary development appear to be interlinked in an ironic arms struggle. The phenomenon of hormesis offers organisms an advantage in this struggle through the facilities of adaptation and hardening of defences. Within the given context, the irony lies in the fact that the attacking agent may inadvertently be responsible for facilitating the success and greater longevity of its intended victim.

FACILITATING RECOVERY THROUGH ORGANIZATIONAL HORMESIS

Pech and Oakley (2005, p. 685) argue that the term hormesis describes a specific organisational phenomenon of repair, overcompensation, and adaptation that currently falls under a variety of loosely defined terms including *learning organisations*, *organisation development*, and *change management*. Eustress is sometimes referred to synonymously with hormesis, however the focus on positive stress and its supposed benefits, which remain an issue of contention (see Le Fevre, et al, 2003), suggest that this only encapsulates one aspect of the hormetic phenomenon. None of these terms accurately or adequately describe the repair and adaptation processes that commence after disruption to homeostasis. The key element for successful adaptation appears to be at the overcompensation and adaptation stages.

As an example, when Fujio Mitarai took over as CEO of Canon on 1995, he immediately reviewed the company’s profitability. He divested the company of the personal-computer business, shortly followed by liquid-crystal displays, photovoltaic batteries, and electric typewriters, as well as three other non-profitable businesses. During the eleven years of his tenure as CEO, Mitarai has transformed Canon from a debt-ridden and rudderless company into the world’s largest manufacturer of office copying equipment, as well as deposing Sony as the world’s number 1 maker of digital cameras. Canon’s share price has made a three-fold improvement since 1995. Such radical recovery and business growth cannot be simply explained away as *learning*, leadership, or clever change management. Chandler (2006) explains that prior to Mitarai’s sudden rise to CEO, Canon’s culture was dominated by scientists and technicians pursuing their own interests without regard for the rest of the company. Money-losing projects staggered on year after year while factions fought to take control. Mitarai literally ripped the organization apart, going through it like a dose of poison, but he carefully ensured that core competencies and core capability were never lost. He experimented with a new manufacturing approach known as cell production that made conveyor belt production redundant. From a strategic perspective he:

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1. cut costs
2. created islands of strength
3. increased production speed and,
4. focused on competitor and market responsiveness.

Before Canon could move forward, it had to change its unproductive and non-responsive culture. In hormetic terms Mitarai dramatically disrupted homeostasis by severing unprofitable activities, causing shock waves throughout Japan and great resistance within his own company. Chandler (2006) claims that Mitarai had to wait two years for the 'old guard' to move on before he could exert enough authority to make the necessary changes. Mitarai's restructuring of Canon mimicked toxic exposure that created expectations of disaster for the company. The 'dosage' was however low enough to create the opposite effect, it jump-started repair mechanisms that strengthened the company. In order to assure the company's recovery, Mitarai then overcompensated by increasing the R&D budget, slashing inventories, increasing response speed, and introducing new designs to market more quickly. Thus homeostasis was re-established at a far higher level of focus and output, and adaptation within its environment ensured that Canon would become a world leader in its chosen markets. It could be speculated that Canon could not have re-engineered itself into such a formidable player without toxic exposure, which then initiated hormetic events, reflected by a subsequent strengthening of the organization.

When considering change, many firms may be tempted to minimise or completely ignore one or more of the hormetic stages as they feel that their recovery from crisis has been successfully managed. It is argued that by ignoring stages of the hormetic process, firms will not experience hormesis, and when confronted with further and more severe disruptions, their level of vulnerability may be unnecessarily high as the following example from Pech and Oakley (2005, p. 677) demonstrates.

On February 9th 1990 Ronald Davis, President of the Perrier Group of America learned that traces of benzene had been found in some of their bottles. He immediately withdrew all Perrier bottles from distribution in North America. At this stage Davis knew few details of the cause and magnitude of the problem when making his product recall decision. Arguably Davis overcompensated, thus initiating one of the hormetic stages. Perrier stated to the media that the product would be unavailable for up to three months while a supposed problem with the production line for North America was rectified. They claimed that an employee had mistakenly used cleaning fluid containing benzene to clean machinery on the production line (Freedman & King, 1990). A few days later all bottled products around the globe had to be recalled as the company now admitted that all production lines had been contaminated. Perrier's slow

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return to the market (five months rather than the expected three) and the adverse publicity surrounding the contamination as well as the discovery that the company had lied about the cause as well as the duration of the contamination, seriously undermined the company's market share.

Perrier's crisis management plan failed to include the adaptation stage. Instead they attempted to re-establish homeostasis through a product recall and by lying to the media about the cause of the problem. On their return to the market, Perrier found that an uncontrollable shift had occurred in their environment. A number of aggressive competitors had now established themselves in the bottled water market during their five-month crisis and they were not about to retreat with Perrier's return. Although hindsight often gives critics a superior position from which to base their advice, it is argued that the Perrier case provides an example where a hormetic approach could perhaps have maintained or restored the company's original market position, or given it the capability to better adapt to its altered environment.

The phenomenon of hormesis suggests that repair and adaptation are naturally occurring biological survival mechanisms. An argument has been made that organizations are simply another form of organism. Distressed firms, or organizations that find themselves in a toxic environment should be given the same opportunity to enact and imitate this biological survival mechanism. Liquidation should therefore be viewed as a strategy of last resort. There may be a temptation to liquidate firms as a consequence of severe disruptions, such as was nearly the case for Xerox when liquidation was posited as the company's best strategy for damage control in 2000. As subsequent events at Xerox have demonstrated, a brush with 'death' may have been the best thing to have happened to that company.

SIMULATING HORMETIC EFFECTS IN ORGANIZATIONS

How would an organization under attack or one that is emersed in a toxic environment initiate a strategy simulating hormetic effects? Donald (2002) has described the interlocking nature between mind and culture as 'communities of mind' (p. 322). Such communities of mind have the ability to change their shape, their purpose, and their mode of operation (think back to the changes demonstrated by slime mold). Such communities are held together by information, whether it is communicated in the form of DNA, religious teachings, or core business processes, information provides identity, purpose, and heredity.

Perhaps some organizations have become too precious about their shape and activities, thereby ignoring the critical requirement of being able to adapt. Management theorist Alfred Chandler once stated that "structure follows strategy" (Chandler, 1962), yet organizations continue to meander between strategies without reconsidering their shape. Before

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Mitarai, Canon grew product lines and special projects without examining its core structure in the context of its changing environment, Xerox did the same until it was forced to re-examine itself and its intent after 2000. Organizations do not need to suffer the slowly accumulated and progressive evolutionary changes that are forced upon organisms. Organisms can only build incrementally on existing structures, thus limiting their ability to adapt to changes in their environment. Organizations can re-engineer themselves as and when required, and yet they often choose to react to change by using incrementally-based responses, unnecessarily limiting themselves to an 'organic' range of actions.

Organizational hormesis offers a solution. A low level injection of an appropriate toxin could enable the organization to develop constructive and appropriate response, repair, and adaptation mechanisms. This will allow it to re-establish itself at a new and (when compared with competitors) advantageous level of homeostasis through overcompensation and adaptation, thus preparing itself for possible future attacks. Paul Rogers and Marcia Blenko report findings from comprehensive global research on high-performance organizations completed by business consulting firm Bain & Co. Their research has identified that it is the firm's internal barriers that produce the main obstacle to growth (Rogers & Blenko, 2005, p. 135). This suggests that health (if growth can be viewed as an indicator of health) is largely determined by the organization's managerial decision processes. Failure to recognize and exploit opportunities, or to adapt to a changing environment, or to respond appropriately to an attack, can be blamed largely on the actions or inactions of the firm's management.

What steps can a manager initiate to maximize the benefits of hormesis in an organizational context? It has been recognised that hormesis may be the consequence of cellular stress response mechanisms. Resources are deployed against the attacking agent, resulting in a stronger, healthier cell, in effect creating the opposite effect to that of exposure to larger doses. Could organizations intentionally mimic such complex biological defence mechanisms?

This paper has argued that organizations are larger forms of living organisms. Even the wide geographic dispersal of the multinationals doesn't preclude them from being categorised as organisms. They are simply examples of organisms with far-reaching tentacles (or 'hands' if that is a more acceptable term). Distance doesn't hinder their ability to achieve the mission of the collective, provided the structure, command and control, and communication channels have been adapted for such purposes. An exploratory mission to the outer reaches of the galaxy could be regarded as advancement of the human endeavour, and it could be regarded as growth of the human organism as it extends its influence and impact across increasingly greater distances. The return of such a space

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mission contaminated with toxic alien biological agents could certainly have calamitous consequences for the human species, potentially communicating its harmful effects from human to human as effectively as if we were all one organism.

Organizational stress response mechanisms are generally initiated by decision makers located in managerial positions, the equivalent of the cell's nerve centre. In 1990 David Packard, at the age of 80, came out of retirement to turn Hewlett-Packard back into a profit-making business from its then struggling and unprofitable position. His restructuring of HP had an immediate impact on its competitor IBM, who responded to their struggling position by laying off 20,000 staff in 1991 as well as announcing their first annual loss in the firm's 80 year history. The announced loss was \$2.8 billion! In 1992 another 20,000 staff lost their jobs at IBM.

IBM responded to its unprofitable status and the new competitive behavior of Hewlett-Packard with a predictable pattern of layoffs that failed to inspire or motivate remaining staff. Instead it triggered an exodus of some of their best employees. IBM haemorrhaged, bleeding out while Hewlett-Packard inoculated itself and bounced back stronger (IBM did eventually recover but it took a long time and cost the firm a great deal in staff morale and in lowered investor confidence). David Packard's interventions at HP resulted in the restructuring of the company into two semi-autonomous divisions, and the abolition of management by committee, thereby increasing the firm's decision speed. These changes helped to make HP a leader in innovations and pricing standards (Pitta, 1993). HP appeared to experience hormetic effects by overcompensating, adapting to its evolving environment, and inoculating itself against further onslaughts by competitors. In 2005 HP once again found itself in difficulties with its new CEO Mark Hurd announcing major restructurings. However, Fortune magazine has ranked HP as one of ten 'sturdy stocks' for investors in 2006 (Birger & Stires, 2005), suggesting that HP continues to maintain strong investor confidence. Such confidence could perhaps be based on hormetic effects, as HP's stress response mechanisms have already proven themselves in the past.

Calabrese (2005) discusses a number of factors that have contributed to the field of toxicology's historical rejection of the concept of hormesis. One of these factors he describes as 'biological/societal implications not appreciated nor anticipated (p. 651). Organizational researchers have yet to recognize or acknowledge the presence of hormetic effects, possibly because the counterintuitive principles and implications underlying the hormetic phenomenon in organizations have also not been recognized or appreciated. It could also be argued that because hormesis is a naturally occurring defence mechanism; its stimulatory effect and reparative overcompensation in organizations may only be recognized through a

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seemingly unconnected series of causes, actions, and effects. This may mask hormetic phenomena. Unprepared or casual observers may incorrectly credit examples of business turnaround to leadership, or restructuring, or change management, when the truth is far more complicated.

The anecdotal evidence provided in this paper arguing a case for the existence of organizational hormesis requires empirical support. Suggestions for initiating hormesis in organizations for the improvement of organizational health and longevity would constitute a premature step at this early stage, but the evidence to date does lend itself to infer the existence of several stages and actions.

POTENTIAL APPLICATION

It may be hypothesised that hormetic effects in organizations may occur under the following circumstances:

1. Disruption in the form of deliberate actions taken by managers or disruption due to a crisis or in response to unexpected changes in the environment.
2. Restructuring that involves severing of liabilities or non-performing functions. In order for such restructuring to be beneficial, it must mimic small doses of toxin, creating the opposite effect of larger doses. The difficulty lies in the dose, it must be adequate to jumpstart repair and overcompensation mechanisms, but not be so large as to overwhelm and destroy such mechanisms, or create paradoxical effects where small doses causes damage that cannot be repaired.
3. Restructuring that builds on strengths or refocuses the organization toward areas of potential strength. This stage will result in overcompensation to increase the organisation's defence mechanisms, change its shape to be more responsive, improve its resource utilisation, and/or increase or improve its speed, quality, internal character, external image, or whatever is required to raise the competitive nature of the organization beyond the level of its rivals.
4. Adaptation that results in a more robust, more efficient, and more competitive organization, which is often quantified through increased profitability and/or growth.

The above actions and/or circumstances may be seen as responses to real or perceived threats and attacks. In some instances these hormetic effects could be initiated by an astute manager in preparation for a predatory 'attack', before a launch into a new market, or in response to a new entrant into an existing market. Cultural robustness and strong visionary leadership appear to be common elements in these processes regardless of the form in which these hormetic effects occur. An organization that fails to demonstrate hormetic capability places itself in a vulnerable position.

CONCLUSION

In the introduction the question was asked, can a literal comparison be made between biological phenomena in organisms and phenomena in human organizations? The evidence provided by simplified but useful examples appears to suggest that a phenomenon simulating hormesis can and does occur in an organizational context. It has been possible to identify similarities between stress response behaviors of organisms with stress response behaviors in organizations. Cellular stress response mechanisms stimulate and repair, as well as defend the organism against further attacks. Organizational hormesis describes actions that stimulate the organization by increasing its focus. Damage is repaired, and the organization is strengthened against further attacks. The common aim for the organism as well as the organization is to increase the probability of survival.

Organizational hormesis appears to display some recognizable identifying traits. These traits are stimulated by direct managerial interventions resulting in:

- restructurings based on an information exchange between internal conditions and external threats,
- shedding of non-core functions,
- redirection of focus and resources on core and market-responsive activities, and
- intra-organizational cultural changes that raise the level of competitive awareness and competitive behavior within the organization.

These activities could be likened to biological stress response behaviors where the organism restructures by shedding non-critical energy-intensive functions, developing defensive mechanisms, and subsequently facilitating the organism's adaptation to a changing environment. The restructuring process is a critical step. Burke and Nelson (1997, p. 327) provide detailed evidence of the risks and failures associated with downsizing and the subsequent restructuring that occurs. In the US, 89 per cent of downsizing firms sought to reduce costs while only 46 per cent achieved this goal. 71 per cent of firms used a downsizing strategy in an attempt to increase productivity but only 22 per cent successfully achieved this goal. Burke and Nelson (1997) also provide evidence that poor restructuring can destroy careers, lower morale, reduce employee commitment, increase stress levels, and cause 'survivors' to work harder for fewer rewards (p. 328). Incidences of organizational hormesis appear to be uncommon, perhaps because few firms are able to complete the hormetic stages of repair and overcompensation once they have suffered significant damage.

Hambrick, et al (1993) found that executives who remained in the same industry for a long period came to rely upon industry 'recipes for

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success', applying the same strategies over and over. This 'habitual management' could also explain why hormesis rarely occurs in the organizational context. The catalyst for change is often a combination between internal and external factors—direct and indirect emergence. External factors (resulting in indirect emergence) can include increased competition and market shifts, while internal factors (resulting in direct emergence) may include an inability to recognize the need for change and/or an inability to take appropriate actions. This may be evidenced by the low rate of organizational survival in a competitive environment. Mische, 2001, points out that approximately one-third of the Fortune 500 companies in 1970 no longer existed in 1983. Industry recipes appear to be less successful in a rapidly changing environment, and the use of such 'recipes' would also preclude the possibility of initiating hormetic effects when the organization finds itself under attack.

It would be simplistic and foolish to pounce upon one cause and one cure for the casualty rates suffered amongst our organizations. However, within the context of this discussion it could be argued that informational asymmetry between the organization's environment and its internal response mechanisms will increase the probability for failure. Nutt (1999) claims that almost half of all major decisions made in organizations fail. This is an indictment on organizational decision processes as well those who make the decisions. In order for hormesis to occur in the biological context, a cell's stress response mechanism must respond appropriately to its chemical attacker. An overly simplistic explanation may claim that this has resulted in an exchange of information between the toxin and the cell, with the appropriate responses occurring as a consequence of what the toxic information is 'telling' the cell. The cell will only survive if it makes and implements the 'right' decisions.

The examples of Canon and Hewlett-Packard as well as the recent turnaround experienced at Xerox demonstrate that the 'stressed' organization only succeeds after dramatic restructuring, often driven by one individual who is at the hub of the external/internal information nexus. This person is then in a position to initiate changes that could be described as restructuring through overcompensation and adaptation, resulting in a subsequent increase in fitness to pursue the organization's—often new—goals. Hormesis in the biological context requires an information exchange that triggers appropriate response mechanisms. Similarly, in the organizational context, if the informational exchange fails to occur or fails to elicit appropriate responses, hormetic effects will not occur. It is apparent that the restructuring efforts of these individuals often have the opposite effects to what is expected, with observers declaring that the firm will be destroyed by such actions.

Although further research is required to study the specific details of hormetic effects in organizations, it may be argued that one of the key

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elements for initiating such healing phenomena resides in the organization's culture. Culture is communicated through the behavioral and decision scaffolds that differentiate one organization from another. A responsive culture that is information hungry, evoking timely and well-considered decisions with appropriate actions will be more likely to survive in a rapidly changing environment. Rogers and Blenko (2005) point out that 'one sign of a strong, effective culture is that everyone in the company understands what to do without being told' (p. 140). This statement may have biological parallels at the cellular level as the intricate networks of organelles within a cellular structure are required to work cooperatively when a stress response is evoked.

The organization that is capable of working together, knowing what to do when under 'attack', and which is capable of initiating hormetic effects, should find that its level of fitness and its chances for future survival will exceed the survival rates of 'non-hormetic' competitors inhabiting the same environment. The challenge lies in the ability to balance the dose-response equation. How much 'toxic' exposure will be beneficial and in what form and ratio should it be administered?

This paper has focused on hormesis in an organizational context. Examples of strategies for restructuring organizations and mention of issues related to change management have been abbreviated and simplified to enable a greater focus for a hormetic-related discussion. For more detailed information on the right and wrong ways to restructure an organization, see Burke and Nelson (1997), Hayes, (2002), Palmer, et al, (2006), and Pech (2006).

REFERENCES

- Birger, J. and Stires, D. 2005. Built to last. *Fortune* 152, 13, 31-40.
- Bloom, H. 1995. *The Lucifer principle: A scientific expedition into the forces of history*. Atlantic Monthly, New York.
- Burke, R.J. and Nelson, D.L. 1997. Downsizing and restructuring: lessons from the firing line for revitalizing organizations. *Leadership and Organization Development Journal* 18, 7, 325-334.
- Calabrese, E.J. 2005. Historical blunders: how toxicology got the dose response relationship half right. *Cellular and molecular biology* 51, 643-654.
- Calabrese, E.J. and Baldwin, L.A. 2001. Hormesis: A generalizable and unifying hypothesis. *Critical Reviews in Toxicology* July, 31, 4/5, 353.
- Chandler, A.D. 1962. *Strategy and structure: chapters in the history of the American industrial enterprise*. MIT Press, Cambridge, Mass.
- Chandler, C. 2006. Canon's big guns. *Fortune*, 153, 2, 92-95.
- Clark, A. 1997. *Being there: putting brain, body, and world together again*. Bradford Books, Cambridge, Mass.
- Dawkins, R. 2004. *The ancestor's tale: A pilgrimage to the dawn of life*. Phoenix, London.
- Dennett, D. 2003. *Freedom evolves*. Penguin Books, London.
- Donald, M. 2002. *A mind so rare: The evolution of human consciousness*. Norton, New York.
- Edelman, G.M. and Tononi, G. 2000. *Consciousness: How matter becomes imagination*. Penguin, London.
- Freedman, A.M. and King, T.R. 1990. Perrier expands North American recall to rest of globe. *Wall Street Journal* Feb 15, B1.

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- Hambrick, D.C., Geletkancycz, M.A., and Fredrickson, J.F. 1993. Top executive commitment to the status quo. *Strategic Management Journal* 14, 401-418.
- Hayes, J. 2002. *The theory and practice of change management*. Palgrave, London.
- Keeley, M. 1980. Organizational analogy: A comparison of organismic and social contract models. *Administrative Science Quarterly* 25, 2, 337.
- Le Fevre, M., Matheny, J. and Kolt, G.S. 2003. Eustress, distress, and interpretation in occupational stress. *Journal of Managerial Psychology* 18, 7, 726-744.
- Mische, M.A. 2001. *Strategic renewal: becoming a high performance organisation*. Prentice Hall, Upper Saddle River, NJ.
- Nutt, P. C. 1999. Surprising but true: Half the decisions in organizations fail. *The Academy of Management Executive* 13, 4, 75-90.
- Palmer, I., Dunford, R. and Akin, G. 2006. *Managing organizational change: a multiple perspective approach*. McGraw-Hill Irwin, New York.
- Pech, R.J. 2001. Termites, group behaviour and the loss of innovation: Conformity rules! *Journal of Managerial Psychology* 16, 7, Nov. 559-574.
- Pech, R.J. and Slade, B. 2004. Memetic engineering: a framework for organisational diagnosis and development. *Leadership and Organization Development Journal* 25, 5, 452-465.
- Pech, R.J. and Oakley, K.E. 2005. Hormesis: An evolutionary 'predict and prepare' survival mechanism. *Leadership and Organization Development Journal* 26, 8, 673-687.
- Pech, R.J. 2006. Leaping forward by first stepping back: downscoping to create a strategic platform for growth. *Handbook of Business Strategy 2007* 1, forthcoming.
- Pitta, J. 1993. Wise old men rescue their brainchild. *Business Review Weekly* 7 May, 60-63.
- Rogers, P. and Blenko, M. 2005. The high-performance organization: making good decisions and making them happen. *Handbook of Business Strategy 2006* 1, 133-141.
- Schwartz, J.M. and Begley, S. 2002. *The mind & the brain: Neuroplasticity and the power of mental force*. Harper Collins, New York.
- Vygotsky, L.S. 1978. *Mind in society: The development of higher psychological processes*. Harvard University Press, Cambridge, Massachusetts.
- Wilson, R.A. 2004. *Boundaries of the mind: The individual in the fragile sciences*. Cambridge University Press, Cambridge, UK.
- Young, A. 1990. Big business: How the economic system grows and evolves like a living organism—what will become of the small retailer? *Journal of Economic Studies* 17, 3/4, 161.