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OR CHANGE IN INTERNATIONAL AFFAIRS?

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Disaster as Transition

The three earlier essays in this section on `disaster diplomacy' explore the argument that natural disasters, and the interactions among nations initiated in response to them, facilitate better cooperation amongst states that are normally considered to be in conflict. The assumption underlying this argument is that relations among nations are managed through negotiation, the work of ambassadors and envoys, and that the (temporary) suspension of distrust between peoples in disaster offers an opportunity for policy makers to redefine existing conflicts in light of greater understanding of their respective nations' needs and to create a more constructive interpretation of common goals.

The essays explore the argument of disaster diplomacy both theoretically and empirically through a set of cases in which disaster and the potential or consequent effects of these events have influenced relations among the nations involved. A review of major international disasters over the past decade provides an interesting, if mixed, set of cases as evidence that while disaster events indeed produce changes in relationships among nations, these changes are not necessarily positive nor enduring. Yet, some events lead to positive change in relations among former rivals, representing substantive reversals of decades-old hostilities. This section will explore three basic questions regarding the process of change initiated in the context of environments that are vulnerable to disaster. They are:

1. What conditions and processes initiated in environments vulnerable to disaster facilitate constructive change in relations among states that have a prior history of conflict?

2. What conditions and processes inhibit constructive change in relations among nations following disaster events?

3. What policy interventions sustain constructive processes, initiated under the urgency of disaster, among former rivals as their set of interactions broadens to include other areas of possible cooperation and competition?

Disaster environments present unusual laboratories for the study of change and change processes. Disaster tends to shatter the existing norms and practices among nations, creating a (momentary) opportunity for fresh recognition of the fragility of life and common humanity that bond all peoples. In most cases, the disaster event is only a triggering factor for conditions and policies long in practice that have created a vulnerability to sudden, unexpected events which result in severe destruction and loss of life in the affected communities. Nonetheless, even the temporary suspension of old rivalries can aid in a redefinition of a more constructive profile of cooperation among nations exposed to common environmental and technological risks, leading to more productive modes of interaction. Identifying common elements that facilitate constructive engagement in reducing shared risk, and anticipating obstacles that may hinder such engagement offer an important opportunity to build cooperation among nations in other areas of interaction as well as disaster reduction.

The three cases presented in this section represent a comparative analysis of nations previously considered to be in conflict that undertook operations either to avert or respond to disaster in different areas of the world. The disasters are triggered by different agents, continue for varying periods of time, and disrupt governmental performance at different levels of jurisdiction to varying degrees, but in each case, the existing governments faced severe dysfunction in meeting the immediate requirements of its threatened population[1], and in sustaining basic operations in the

disaster region without external assistance. It is not the disaster event, but the kind and mode of cooperation that is fostered among nations in an environment threatened or altered by severe destruction that creates the opportunity for change in relations among states previously in conflict.

Recognition of each nation as a member of the world community is an important consequence of disaster. Acting on that recognition is a challenge to international policy making. Devising international strategies for disaster reduction becomes a means by which all nations can both participate in creating, and benefit from, a more stable, less vulnerable world. But such a strategy becomes a multi-layered process of inquiry, as it necessarily addresses conditions of vulnerability that began to deepen long before the actual triggering event. In most cases, vulnerability to disaster is the cumulative product of political, social and economic decisions made over time that expose human communities to high risk from changes in geological, meteorological, or technological conditions. Such changes may be sudden or slow. The effects are equally devastating, if these conditions are not factored into the on-going policy processes and practices of developing the resources and governing the populations that inhabit risk-prone areas. Since these policies and practices involve difficult trade-offs between efficiency and equity, risk and safety in the short term, they are often ignored or postponed for the longer term, leading to nearly inevitable disaster when a random event threatens the vulnerable community. Disaster becomes a test of existing policy and practice in the design and maintenance of human communities.

With current global media coverage, disaster events capture the world's attention within minutes of occurrence and focus it (temporarily) on the loss and destruction that follow from a sudden, unexpected event or a slowly evolving crisis that crosses the threshold into chaos. This global focus creates an opportunity for documenting risk that nations share from natural,

technological and biological hazards. But the moment of global attention is fleeting, and the goal of common action needs to be articulated clearly in terms of shared responsibility for any significant change to occur in practices that contributed to the scope and extent of disaster. This task requires policy and analytical skills, as well as a base of shared knowledge that is only now developing among nations facing common risk from environmental hazards, such as earthquakes, hurricanes or drought. Such skills are not yet widely practiced in regions vulnerable to disaster, but increasing incidence and costs of disaster world-wide are driving a re-examination of policy and practice in disaster mitigation, response, and recovery in the international community (Jeggle 2000; Comfort 1999b; Shawcross 2000).

Four recurrent themes drive this process of re-examining international policy making in response to the uncertain threat of natural disaster. They include: 1) the urgency of need for states at risk or in crisis (GDIN Task Force 1997); 2) the complexity and interdependence of the problems they face (Haas P.M. 1992); 3) the need for fresh conceptual approaches to these problems in a world of expanding populations and limited resources (Haas, E.R. 1990); and 4) the largely unexplored potential of information technology to support public policy making and administrative systems in this complex, dynamic world (National Research Council 1996). Designing international policy in a way that enhances the ability of the nation not only to cope with its immediate needs, but also to plan for the future requires change in the assumptions and strategies for decision making both in the internal policies of individual nations and the collective approach of the international community. Disaster environments represent communities in transition, and are highly dynamic. Effective policies for international collaboration to mitigate risk of disaster and to provide appropriate assistance following disaster need to incorporate the dynamics of this transition process. Such

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policies require fresh approaches in both concepts and methods (Maskrey, Bender and Peacock 1999).

Within the framework of laws and norms that govern the international community, disaster reduction provides a common focus for nations that confront shared risk. Shared risk is public risk, one which affects all nations in a risk-prone region, whether or not they have contributed to the conditions producing the threat. Shared risk, consequently, invokes public response to mitigate the threat of danger to a specific region (Comfort 1999a:1). The problem is complex, and involves a full range of activities that include mitigation, response and recovery from severe natural or technological events. The three cases presented in this section illustrate different phases and dynamics of disaster management. Mitigation includes the activities of monitoring and assessment prior to an actual event, such as tracking hurricanes across the Caribbean Sea and sharing that information among all nations that lie in their paths. Michael Glantz, in his analysis of "Climate-Related Disaster Diplomacy" presents a case study of US-Cuban relations in coping with the shared risk of hurricanes emerging from the tropical Atlantic Ocean.

Response activities involve the rapid mobilization of assistance following a severe event, such as the timely deployment of search and rescue teams after the Greek-Turkish earthquakes. James Ker-Lindsay presents a thoughtful analysis of reciprocal Greek-Turkish response activities following the Marmara and Athens Earthquakes of 1999 in the context of growing acknowledgment of shared diplomatic interests in the larger European arena. Recovery involves activities directed toward rebuilding communities ravaged by a disaster, such as restoring croplands and forest after severe drought in southern Africa in 1991-1992. Ailsa Holloway documents the role of the Southern African Development Community in transporting food and materials to avoid famine, given the

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variable rainfall in the region of southern Africa, and notes the subsequent need for continued international collaboration in replanting drought-stricken croplands to renew food production for the next agricultural season.

Events such as hurricanes, earthquakes, and drought are regional, and the hazards involved do not respect national boundaries. The consequences from these severe events are also regional, and nations at risk share a common interest in minimizing the severity and frequency of recurring hazards. Further, management of human communities exposed to recurring natural hazards requires continuing inquiry into the scientific basis for these events, so that informed policy and practices may be adopted to reduce losses in lives and property for human populations (Haas, Keohane and Levy 1993).

The concept of disaster diplomacy is based upon identifying the common interests of nations at a level of scientific understanding of shared risk. The impact of natural hazards upon human communities can be most effectively reduced through informed decisions regarding the location and construction of built environments, informed actions taken by the public exposed to risk, and timely communication and exchange of information among the organizations and jurisdictions that have designated responsibilities for protection of life and property. As such, shared risk leads to shared responsibility among all nations exposed to threat (Comfort 1999a:1). Determining the degree, characteristics, and frequency of exposure to hazard for the region is fundamental to reducing its impact upon human communities.

Since scientific knowledge affects the capacity not only of individual nations, but all states in an exposed region to reduce that risk, shared scientific inquiry offers nations a basis for building collaborative relationships to support collective action to reduce the destructive impact of that hazard

on their respective cities and communities (Haas 1990). In this unique environment, the benefits of collective action undertaken to achieve a common goal, reduction of shared risk, may outweigh older hostilities based upon economic, religious, ethnic or political rivalries.

Hazardous events are inherently interdisciplinary, dynamic, and seemingly unpredictable. They require modes of inquiry and measurement that allow integration of knowledge across time, disciplines, organizations, jurisdictions, and nations. Scientific inquiry into natural hazards and their consequences for human communities requires a different conceptual model than traditional disciplinary studies. Complexity theory offers promising insight into the dynamics of disaster environments (Comfort, 1999a; Kiel, 1994), which may be extended to interaction with other nations in the process of redefining existing relationships based on newly discovered goals for disaster reduction. Complexity theory applies aptly to the set of problems that occur when the government of the nation seeking assistance is itself in crisis.

The focus of scientific inquiry into the conditions and mechanisms that lead to natural disaster is toward the future, and the collective benefit for all participants can only be achieved through cooperation and acceptance of shared responsibility. Carried out effectively, collective inquiry into the causes and consequences of natural hazards can provide a basis for building collaborative relations among states for the reduction of environmental and technological risk, that is, creating a scientific knowledge base to support "disaster diplomacy." Without a basis in scientific inquiry, cooperative relationships among states forged under the urgent stress of dramatic disaster events are likely to founder, with new-found collaboration dissipating over time under the friction of ordinary competitive interactions.

Developing collaborative relations among states for the reduction of losses in lives and property associated with natural hazards requires a policy that engages other nations in coordinated action to achieve a common goal. This goal is the capacity of a nation to manage its known risk effectively by developing its own strategies for risk reduction and resilience as a responsible member of the international community (Comfort 1993). The policy process operates at three levels of decision-making simultaneously: 1) the individual nation(s) exposed to risk; 2) donor nations offering expertise, resources and assistance; and 3) the international exchange between risk-prone and donor nations. Actions taken at each level create opportunities and set constraints on possible actions at the other two levels. This interactive, dynamic policy process generates a "complex, adaptive system" through which actions are taken to ameliorate crisis for nations at risk.

Nations experience disruption of their governmental systems from at least three major sources: massive natural disasters, such as earthquakes, hurricanes, or drought; internal civil strife; or external conflict/war with neighboring states. Although these three sources may be interrelated, adding to the complexity and dynamics characterizing the event, this inquiry focuses on natural disasters. During periods of disruption, the stages of transition in governmental function are not clearly demarcated one from the other. Failure in one part of the system may, and often does, precipitate failure in others. Consequently, a nation that has previously been in conflict with a disaster-stricken nation but is seeking to improve relations, needs to consider the problem on at least two levels: the macro level of the stricken nation's performance within the wider international arena, and the micro level of the specific area of damage or loss and its impact upon the nation's internal operations. The macro and micro levels of operation require different types of information and resources for informed action, and represent different modes of learning and feedback for the

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participants at each level. Interestingly, each level can provide a lever for change at the other level, which, if used effectively, can stimulate dynamic interaction within the whole disaster reduction system. Instances of this type of reciprocal interaction between micro and macro level performance are documented in the three cases included in this section.

The experience of disaster has a substantial impact upon continuity of performance in the affected nations. The immediacy of human needs requires expenditure of scarce resources which, in recurring or prolonged crises, creates a cumulative deficit that may limit future development (Lavell 1993). The particular challenge in designing international policy for nations exposed to recurring hazards is to do so in a way that promotes a responsible governmental and social system, capable not only of meeting immediate needs but also of sustaining viable operations over the long term and contributing substantively to the environmental security of populations in the region.

In this essay, I undertake four tasks: 1) to present briefly the conceptual model of complex, adaptive systems in the context of disaster management; 2) to examine transition as a learning process for the system undergoing change; 3) to suggest a model of complex adaptive systems as a framework for analysis of actual systems that are vulnerable to disaster; and 4) to consider the potential of information technology as a mechanism to facilitate collective learning in systems undergoing transition. I review the earlier analysis of specific cases in terms of the theoretical model of complex adaptive systems, and suggest a set of tasks that, if integrated successfully into international policy, may contribute to long-term disaster reduction and the development of constructive relations among former enemies. These tasks are: 1) building an information infrastructure to support collective scientific inquiry by nations that are exposed to shared risk; 2) assessing the absorptive capacity within the organizations and institutions of these nations for valid

scientific data, innovative approaches, and new techniques for hazard reduction; 3) identifying

appropriate times and modes of intervention in existing policies and practices in risk-prone regions;

and 4) coordinating collective efforts to reduce shared risk. The result is not `disaster diplomacy'

defined narrowly as the work of negotiation through official representatives of national governments,

but a much broader process of organizational and interorganizational learning that views nations as

one level of aggregation within a larger and more complex global system.

Complex adaptive systems

The task of transforming crisis into opportunity for constructive change requires a different

conceptual model than the traditional linear concept of governmental authority as a hierarchical

model exercising command and control (Rosenau 1997; Comfort 1999a). This task may vary

according to the initial conditions of economic, social and political development in nations exposed

to risk. In developing nations that have experienced disaster, governmental systems are often

vulnerable to internal failure, fragile from the drain on limited resources, or, in extreme cases,

nonexistent. In developed nations, the basic governmental system may remain stable, but the disaster

may affect economic performance for the whole society and dislocate substantial numbers of people

who will need assistance in rebuilding their lives.

For example, the continuing costs of multiple natural disasters in the US has reached $400

billion per year (GDIN 1997), a figure that has caused a major redirection of national policy toward

mitigation of disaster (Krimm 1997). The continuing costs of the 1995 Hanshin Earthquake has had

a substantial effect on the slow economic recovery of Japan (Toyoda, 1997). The estimated costs of

rebuilding the infrastructure and cities damaged by the 1999 Earthquakes in Turkey is over US$16

billion, or 7 % of the Gross National Product (GNP) of the nation (ERI, Bogazici University 1999).

After the 1999 Duzce Earthquake, analysts estimated the cost of reconstruction from the 1999 earthquakes in Turkey at 10% of GNP, a sobering setback for an economy that is struggling to stabilize a chronically high inflation rate (DMC, METU 1999). These costs, in turn, affect the global economic system and are borne, in part, by other nations directly or indirectly through international organizations such as the World Bank. The effect of disaster on existing governmental systems is decidedly nonlinear, making them subject to unpredictable changes in the exercise of authority and allocation of resources for public welfare. The effect of disaster on both developed and developing governmental systems differs also from the ecological model that assumes a system returns to a stable equilibrium with its environment, after a severe disturbance (Dryzek, 1987; Costanza, 1991; Kreimer and Munasinghe, 1992). All governmental systems exhibit change in their operating procedures, both internally and in relations with other nations. Less clear, however, is the direction and degree of that change, and the potential it may have for improving relations between the affected nation and its neighbors.

The conceptual model of complex, adaptive systems offers a means of assessing the change process in nations that are exposed to potential disaster or have experienced severe disruption in their governmental systems. This model focuses on the transition between different states of evolving social, economic, and political performance. It combines elements of both the economic and ecological perspectives, but accepts the fundamental premise of nonlinearity in social systems. It recognizes that social systems engage, to varying degrees, in continuous learning and self organization in reciprocal interactions with the environments in which they are embedded.

The model of complex, adaptive systems (CAS) is drawn from a substantial literature (Prigogine and Stengers, 1984; Prigogine, 1987; Ruelle, 1991, Nicolis and Prigogine, 1989;

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Kauffman, 1993; Gell-Mann, 1994; Kiel, 1994; Ditto and Pecora, 1994). This literature addresses two basic issues regarding CAS: 1) the conditions under which they emerge and function; and 2) the actual properties and mechanisms which characterize their operations. The two issues are interactive.

CAS evolve in conditions that demand change in the existing order of performance. They emerge out of interaction among component units at the micro or local level which, in turn, produces a macro level response. The link between the dynamics of CAS observed in physical and mechanical systems and the application of these concepts to social systems is the assumption that there are generic properties in the process of change, involving interacting components, that can be identified in all systems. Understanding the dynamics of CAS offers insight into potential types of emergent macro organization that are likely to be produced by interaction among components of a social system. More specifically, understanding the dynamics of CAS offers the potential for influencing the outcome of the new phase of order that would evolve out of the interaction among organizational units at a micro level. Such potential would prove immensely valuable to interacting nations seeking to reduce the likelihood of, and losses from, escalating crisis in nations under stress. It also offers a means of linking the micro processes of disaster response to the macro process of change in relations among states engaged in response to the disaster. For difficult problems such as defining appropriate disaster reduction policies in the international arena, the study of CAS offers an important theoretical and methodological tool.

The initial conditions that give rise to CAS set the direction for their subsequent trajectories over time. These conditions amplify or reduce the pattern of interaction among organizational units at the local level, which, in turn, calibrates the emergent form of order at the macro level. This

evolving set of interdependent interactions establishes the rate and form of change in the system. While conditions that demand urgent action often generate CAS, the challenge to public policy makers is to understand, guide, and facilitate this process of change in ways that are humane, cost-efficient, and effective.

John Holland (1995), an interdisciplinary theorist working in the field of complex, adaptive systems, defines a set of basic elements that characterize them. Holland's characterization offers a beginning model that allows us to examine actual cases of governments which have requested international assistance to resolve an urgent crisis or internal disruption of performance. Holland's (1995:10-36) set of elements include four central properties and three mechanisms of operation. These elements include the properties of aggregation, nonlinearity, flow, and diversity, as well as the mechanisms of tagging, internal model, and building blocks. While other theories characterize the conditions under which complex, adaptive systems evolve (Kauffman 1993; Prigogine 1987; Gell-Mann 1994), Holland's model addresses the actual process of the emergence of complex systems. Understanding this process is critical to determining effective policy at any given level of decision making, and it is especially useful in determining policy at the level of interorganizational decision making that formulates action for nations at risk or in crisis.

Holland's model of CAS allows us to compare different cases of emergent order and their processes of evolution in a common framework. The four properties may vary by degree or form, but to Holland, these properties are essential to the emergence of CAS. Aggregation represents the capacity for individual units to interact in a recurring pattern to accomplish a shared goal. For example, the capacity of Greece to assemble a well-equipped and trained search and rescue team within hours to respond to the 17 August 1999 earthquake in the Marmara Region of Turkey set the

example of spontaneous action to assist its neighbor in need. This action was matched, in turn, by Turkey in its immediate dispatch of the volunteer search and rescue team, AKUT, to Athens within hours of the 7 September 1999 earthquake. The examples set by the Greek and Turkish SAR teams spurred individuals and organizations in both nations to contribute money, goods and time to disaster relief in a reciprocal shower of mutual aid. This spontaneous effort illustrates the aggregation of many acts of generosity in both countries, and led to a favorable shift in the perception of each country by the other. Aggregation, in this case, illustrates the capacity of two nations, long rivals, to mobilize specialized resources quickly to meet the urgent needs of life safety in disaster, a common goal.

Nonlinearity, or the condition in which small changes in a system's performance over time produce large differences in outcome, reflects the shift in energy and action within the component units of the system toward accomplishing a shared goal. For example, the weakening of winds off the western coast of South America lead to flooding rains in Ecuador and Peru, but droughts in Malaysia, Indonesia, and Australia in an El Nino Southern Oscillation cycle. In Cuba, El Nino events can lead to floods and drought in different parts of the country. Small changes in the temperature of the ocean currents in the western Pacific result in large differences in rainfall in other parts of the world.

Flow is the current of actions, materials, ideas, and people through a common arena that energizes interaction among the individual units. For example, the extraordinary influx of money, food, medicine, tents and volunteers from communities in Greece to the disaster-devastated cities of Turkey following the Marmara Earthquake on 17 August 1999 illustrates this concept in practice. Diversity acknowledges that specific types of individuals or units may respond differently to the

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same events in the flow of ideas and actions, and interact accordingly to generate new flow among the components. For example, different organizations – local, national, regional, international -- responded to different requirements for the transport of food and supplies to the nations of Malawi, Mozambique, Zambia and Zimbabwe during the drought emergency in southern Africa of 1991-1992. Each mode of transport used contributed to the success of the overall effort, but the varied range of types of transport proved invaluable in meeting the urgent needs for food and other supplies in communities in different locations with varying conditions of access in the region.   The transport policy followed by South Africa during this emergency period contributed to improved relations between South Africa and the Southern Africa Development Community and visible demonstration of its constructive role in this emergency to international assistance organizations.

The three mechanisms create the patterns of exchange among administrative units at the local level. First, tagging facilitates the process of matching a unit seeking assistance with a unit providing assistance. The mechanism of tagging operated, in an emergent form, in the mobilization of search-and-rescue teams to search for live persons trapped under the rubble of collapsed buildings following the Marmara Earthquake. Each team arrived with specific skills and equipment. Dispatching those teams according to operational demands of the different disaster sites proved critical to effective performance in SAR operations.

The internal model reflects the set of shared assumptions upon which reciprocal actions among components of the system are based. For example, the shift in basic assumptions regarding Greek-Turkish collaboration initiated by the prime ministers of Greece and Turkey proved vital to changing the perceptions of collaborative action among Greek and Turkish citizens in response to the Marmara and Athens Earthquakes of 1999. Building blocks are the elemental units of performance that are used in creating a complex set of recurring interactions, such as communicative

acts (Luhmann, 1989). For example, the set of meteorological stations established since 1873 to track the movement of hurricanes in the Caribbean Region provide the means by which observations of developing storms may be made and reported to nations in the Region. Together, this set of properties and mechanisms create the dynamics of interaction that produce an emergent complex system which adapts more effectively to changes in its environment.

Complex systems in operation exhibit an evolving pattern of adaptation in the relationships among its internal components as well as in the relationship between the system as a whole and its environment. This pattern of internal and external adaptation, like a mobius loop, shapes the continuing evolution of the system. Five characteristics, in particular, drive this process of continuing adapation. They include:

1.   Sensitive dependence upon initial conditions

2.   Different rates of absorption of information and skills among different segments of the society, leading to different levels of autonomy and dependency within the system

3.   "Strange attractors" developing over time that serve as focal points for change in a system

4.   Vulnerability to random events that substantially alter performance of different components of the system

5.   A capacity for self organization

Each of these characteristics is apparent in the process of designing policy for nations exposed to risk and in the conduct of disaster diplomacy. First, sensitive dependence upon initial conditions means that each system is governed by local conditions that shape and limit the alternatives for action in later stages of disaster operations. This characteristic reflects the basic element of nonlinearity in Holland's model. That is, small changes in initial conditions, iterated over time, lead to large differences in outcomes. For example, disaster assistance that is externally designed often does not take fully into account the local conditions which include beliefs, needs,

resources, previous alliances, and leadership (or lack of same) among people in the target communities. These local conditions create differences in the implementation of proposed mitigation, response and recovery programs that may make them vulnerable to disruption or corruption from unanticipated sources over time.

Second, each national system undergoing change is composed of subunits and sub-subunits that have different rates of absorption of new information, skills, and resources over time. Consequently, these different units perform their respective functions at different levels of autonomy and dependence, which generate diversity, the second element of Holland's model. Diversity may either produce dysfunctional dynamics among its component parts or lead to the exchange of ideas, actions, and resources that spur creative solutions. The task of guiding transition in governmental systems among nations with a history of rivalry and conflict involves re-orienting the subunits of, first, the separate national systems and second, the international system, toward the same system-wide goal, disaster reduction. Further, it means encouraging maximum performance of each unit toward that goal, albeit at different rates. Reorientation may, and often does, entail a re-examination of the basic values and priorities of the sub-unit in order to place its functions within the context of the larger, long-term, system-wide goal. This process of collective learning may be supported by design.

Given different rates of learning, absorption, and adaptation, particular components of a complex system may alter their behavior slightly from prior patterns of performance. Over time, this variance may increase and attract other components into the divergent pattern of performance. This capacity to draw other components operating within the same system into divergent performance creates, in complexity theory, a "strange attractor" that may substantively alter the performance of the entire system (Kauffman 1993). In disaster-prone environments, the performance of single

organizations or individual managers often serves as a "strange attractor" that sets the example for a new approach to a previously difficult and insoluble problem. For example, in the US-Cuban case, the detailed weather reports of Padre Benito Vines served as an initial variation in performance of hurricane observation that led to the establishment of the network of meteorological stations throughout the West Indies. This capacity for aggregating small changes to produce a large outcome represents a third element of Holland's model of CAS and illustrates the dynamic that can evolve to shift the entire system.

Successful transition requires continual circulation of information, energy, materials, and feedback to allow the subunits to adjust their performance not only to the new goal, but also to the near-neighbors whose performance affects theirs. This circulation represents the fourth element of Holland's basic set, flow. The dynamics of flow create the opportunity for exchange among the internal components of the system and between the system and its environment. This process of exchange is facilitated by the mechanism of tagging (Holland, 1995:12-15) which matches a specific need with an available resource. Transition can also be facilitated by interjecting a timing mechanism for monitoring performance and feedback of these results into the respective decision processes within the system (Priesmeyer, 1992). Such a mechanism focuses attention of the component units on the system-wide goal and provides opportunity for review, reflection, and revision, all requirements for learning among the system's participants.

Fourth, complex, adaptive systems are subject to chance as well as choice. Random events may alter the performance of the system, disrupting previous plans and requiring reallocation of resources and attention. Systems in transition need to be able to adapt to unexpected situations, yet keep their focus on the system-wide goal. This condition provides further illustration of the nonlinearity of CAS.

Finally, the capacity for self organization is the spontaneous effort to reallocate energy and action to achieve a system-wide goal (Comfort, 1994a; 1999). This characteristic is based upon the assumption that all systems operate on a continuum that ranges from order to chaos (Kauffman, 1993). Systems at either end of the continuum continually seek to move toward the center. At the center of the continuum exists a narrow region called the "edge of chaos" (Kauffman, 1993: 174, 208-227) where there is sufficient structure to hold and exchange information, but sufficient flexibility to adapt to changing conditions in the environment. Consequently, according to Kauffman, systems that have experienced disaster or chaos will seek to move toward order. The middle region of the continuum, or the `edge of chaos', provides the greatest opportunity for creative change. It is in this region where the shifts in constructive interaction among nations as they seek to mitigate or respond to disaster, or `disaster diplomacy,' are most likely to occur.

Using this set of characteristics as a metric for systems undergoing transition, the application of this model to the design of international policy toward nations vulnerable to disaster builds on the potential of human populations for spontaneous self organization. Such systems depend heavily upon communication and information networks, and rely upon the capacity of individuals and organizations to learn new values, beliefs, and skills in responsible interaction with more experienced actors (Comfort, 1996b, 1999).

Transition as a Learning Process

If one accepts the model of complex, adaptive systems for nations in transition, then the actual existence of chaos need not be wholly negative. Disaster, by shattering existing habits of thought and action, also creates opportunity for rebuilding governmental systems in a healthier, stronger way. While the tragic losses incurred under the chaotic conditions of disaster cannot be undone, the challenge to the international community lies in facilitating the transition from chaos

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toward the center region of creative change. The requirements are clear. First, sufficient structure to hold and exchange information must be established. In emerging democratic governmental systems, this is the basic infrastructure for the exercise of legitimate authority: a legal system, a judicial system, a police system, a prison system for those who act outside the law, and the design of governmental institutions that ensure informed, voluntary choice by the citizens. These systems take time to establish, but recognizing the need and providing resources and expertise to aid the process is a valid, and valuable, service by the international community.

Second, sufficient flexibility to adapt to changing conditions must be ensured through a professional administrative system. Such a system includes the establishment and training of a professional civil service, the establishment of financial management systems, macroeconomic monitoring and policy development capacity, information management, effective central/local relations, resource management, and planning and analysis capability. Again, international assistance can be instrumental in facilitating this process.

Once the basic balance between structure and flexibility is established within a nation anticipating or undergoing crisis, it enables local communities to create new ways of meeting their own needs. The system then is in healthy transition, and self organizing processes will likely evolve. Yet, it is critical not to underestimate the forces of resistance and obstruction to this process of transition, as long-established interests fear that they will lose control of previous sources of privilege and power. The process of facilitating healthy change in a system under stress includes identifying the subunits, or sub-subunits, that are still functioning with some degree of autonomy and competence and supporting their performance in ways that, in turn, influence the performance of their near-neighbors in the system (Ditto and Pecora, 1994). As the influence and example of

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competent performance spread throughout the system, the dynamics of the system change. Resistance collapses, and the system moves toward the creative center of the continuum.

For nations in transition, chaotic conditions, while destructive and damaging, also provide the opportunity for different segments of the population to learn new skills and develop local capacities that shift the components of the system to a different level of interaction. Whether that dynamic is constructive and moves the system toward order, or deepens the destructive drive toward chaos and total collapse, may depend upon external support. The content and mechanism of international policy

prior to an extremely hazardous event, or assistance extended to a nation following disaster may determine the direction and strength of the dynamic for change.

CAS as an Analytical Framework for Disaster Operations

The three earlier analyses of nations with histories of conflict as they interacted in reference to the threat or actual occurrence of disaster offer an opportunity to review these cases in terms of the CAS framework. This examination explores whether insights may be gained using a CAS framework that would inform policy makers and lead to more constructive outcomes in recurring hazardous events. In each case, it is possible to identify the basic terms of Holland's model of CAS. A closer look shows where the functions of CAS tended to be strong and, conversely, where they were weak, inhibiting the process of change.

Climate-Related Disaster Diplomacy: A US-Cuban Case Study

In his analysis of the process of monitoring climate change in the tropical Atlantic, James Glantz concludes that substantive opportunities for greater cooperation between the US and Cuba were blocked by the intransigent positions of both the US and Cuban governments. These positions

restricted travel between the two countries, limited the exchange of information that might affect local governmental operations in each country, and ignored the unequal levels of technical equipment and training needed to interpret shared meteorological data. Using the CAS model, gaps in the evolution of an adaptive system may be identified in the US-Cuban case, revealing points at which new initiatives might be taken to improve cooperation between the two countries.

Three of the four properties in Holland's model of CAS -- aggregation, nonlinearity, and diversity – are easily identified in the US-Cuban case. Aggregation is evident in the cumulative collection of scientific records and information about hurricanes, conducted and maintained by scientists in both countries over decades, and the growing commitment among US and Cuban scientists of the need for an international framework to manage the recurring threat of hurricanes more effectively. Nonlinearity characterizes the phenomena of tropical storms under study, in which they emerge, shift, disappear and recur with a wide range of intensity over time. Given the existing legal constraints on interactions between the two nations, exchanges of hurricane-related information, policies, and materiel between Cuban and US organizations reflect this same nonlinearity, depending more upon informal networks of contacts than any systematic program of shared effort in disaster mitigation. Diversity is evident in the different groups that are interested in bridging this critical gap in a policy of hurricane disaster reduction. The groups include scientists, researchers, managers of nonprofit and private organizations, policy makers at different jurisdictional levels, and citizens in both countries.

The missing property of CAS in this case is flow. The US embargo on trade with Cuba, in effect since 1960, has seriously restricted the exchange of goods, information and people between the two nations. The 1992 and 1996 acts added to the barriers between the two governments. These acts, instead of compelling Cuba to change its form of government in order to participate in

economic trade with the US and its allies, have had the opposite effect. Cuba, under Castro's leadership, has actively and defiantly sought to limit its relations with the US, seeking to brand the US as the aggressor and doubling the constraints on flow between the two nations. Recent activity since the case of Elian Gonzalez indicates some change in this area, but clearly legal constraints have limited the communication and information exchange between the two nations that are central to adaptive performance in reducing their shared risk of hurricanes.

The severe constraints on the rate and content of flow between the two nations have inhibited the development of mechanisms central to adaptation in relations between the US and Cuba. Without free and full exchange of information, goods, and people, the mechanism of tagging cannot function well. Nor can an "internal model" or vision of improved relations between the two countries develop to any significant degree. Some change is documented by Glantz in the exchange of scientific information between the two nations, and hurricane monitoring falls in this category. As noted earlier, a significant set of building blocks is already in place for improved relations between the US and Cuba. The network of meteorological monitoring stations that developed as the relatively unnoticed product of scientific exchange between the US and Cuba has gained significant respect and international recognition, not only by different groups and organizations in the US and Cuba, but also by the wider set of nations interested in climate change and international disaster reduction in the region. While this case currently does not fit the narrow definition of "disaster diplomacy," elements of an emerging CAS are identifiable.

"Disaster diplomacy" in this case would require the sustained support of communication among Cuban and US scientists, the development of a shared knowledge base, and responsible investment in information infrastructure to facilitate rapid access and dissemination of relevant information among diverse groups in both societies. Small shifts in the practice and perception of

individuals and organizations regarding the need to share data about climate change for disaster mitigation could serve as the "strange attractor" that draws other organizations and groups into the position of favoring substantial shifts in the respective policies of the US and Cuba. If this shift occurred, disaster diplomacy would not be the work of national policy makers in reference to a single disaster event, but the cumulative process of organizational and interorganizational learning over time that allows a redefinition of specific national interests in a broader international context.

<u>Greek-Turkish Rapprochement: The Impact of Disaster Diplomacy</u>

In public accounts, the case of reciprocal exchange of search and rescue teams and mutual assistance between Greece and Turkey following the 17 August 1999 Earthquake in the Marmara Region of Turkey and the 7 September 1999 Earthquake in Athens, Greece appears to be a classic case of "disaster diplomacy." Yet, James Ker-Lindsay's thoughtful analysis reveals that other factors were operative in changing the relations between the two nations, long hostile, before the earthquakes occurred. In his assessment, the shift in redefinition of national interests toward a more constructive, cooperative strategy had begun months before the earthquakes. The substantive actions were taken by the prime ministers of the two countries, and their respective actions once the earthquakes occurred, based upon new premises of national interests, served to re-orient and mobilize popular perceptions in their respective nations in favor of an already designed strategy of greater cooperation. The dynamics of change in the relations between the two states becomes clearer, when viewed from the perspective of CAS.

The four properties of CAS outlined by Holland can be identified in this case of Greek-Turkish interactions in disaster response. But key mechanisms preceded the earthquakes, enabling the response system to function once the earthquakes occurred. Understanding this sequence of interactions is important, not only in characterizing accurately relations between the two nations,

but also in probing more rigorously the concept of disaster diplomacy. Aggregation is evident in the cumulative effect of discussions between the two prime ministers, Ismail Cem of Turkey and George Papandreou of Greece, initiated not in response to seismic threat, but to the shared need to cope with the unstable situation in the Kosovo as well as the economic advantage of meeting membership requirements for the European Union. These discussions led to reciprocal offers of disaster assistance when the earthquakes occurred, and set the example for reciprocal exchange of voluntary contributions from public, private and nonprofit organizations.

The prime ministers' strategy of moving toward greater cooperation exhibited nonlinearity when the earthquakes, unrelated to previous discussions regarding Kosovo and economic strategy in Europe, abruptly shifted the direction and content of the exchange to the immediate needs of disaster assistance. The property of flow was illustrated by the reciprocal exchange of SAR teams following the earthquakes. The flow continued with a remarkable level of voluntary contributions from Greece to Turkey in response to the Marmara Earthquake, followed by a similar level of contributions from Turkey to Greece in response to the Athens Earthquake. The level of contacts between the Greek and Turkish peoples increased dramatically following the two earthquakes. Diversity was represented by the range of views articulated on issues involving the two nations, including differences in religion, defense, and the treatment of minorities.

The mechanisms of CAS were more problematic. The process of tagging – matching contributed resource to demonstrated need, and vice versa – was under development. After years of hostile relations between the two nations, the infrastructure for this kind of information exchange and matching process was not fully functional. The internal model – or a set of valid goals for improved cooperation between the two states – had just been initiated by the two prime ministers and had not yet been fully articulated and explained to their respective publics. The building blocks

of cooperative action were just being formed. With a basic shift in policy between the two countries only months old, the basis for cooperative action was still not clearly defined.

Although a range of new initiatives for improving collaboration between the two countries was introduced after the earthquakes, no systematic set of actions developed that could serve as building blocks for subsequent programs. As the first flush of empathy faded after the earthquakes, spontaneous contributions of time, money and goods to earthquake victims appeared to drop. This drop indicated a return to daily interests and possibly skepticism regarding continued collaboration between the two nations. The case illustrates that systematic efforts to build upon the exchange of mutual assistance initiated after the earthquakes are needed to sustain the redefinition of interests and shift the balance toward continued cooperation between the two nations. This is a matter not only for prime ministers, but the full range of scientific, voluntary and private organizations in both societies.

Drought emergency, yes....Drought disaster, no

The case of the Southern African Development Community (SADC) in anticipating the threat of famine and organizing an effective response to avoid disaster represents the clearest case of CAS in action. Ailsa Holloway's perceptive analysis of the changes in strategy and practice by a range of local, national and international organizations in response to the threat of famine in southern Africa illustrates the powerful influence of a clearly articulated goal upon an existing set of properties and mechanisms that evolved to form a functioning complex adaptive system. This process of adaptation led to the implementation of an effective strategy to avoid famine, and contributed to a redefinition of relations among the southern African states that formed the SADC and South Africa. But this process of adaptation was more complex than the initial concept of `disaster diplomacy' and to be sustained, must be understood as such.

Each of the properties and mechanisms identified by Holland as essential to CAS are present in the evolving relations among nations of the SADC and the wider set of international organizations that responded to the call for assistance. Aggregation is evident in the cumulative support for the strategy of food transport that built within each nation of the SADC as public and private organizations agreed to participate. It developed further as international organizations and donor nations outside Africa contributed money and goods to sustain the operation. The effective mobilization of money and goods from many external sources, aided by the network of transport services offered by South Africa and linked to local transport modes within each nation, created the resources needed to maintain minimum food requirements in the region. Nonlinearity is shown by the variable rainfall in the region that precipitated the emergency. Flow is shown by the intense levels of communication and information exchange that developed among the member nations of the SADC and between the SADC and its international donors. Diversity is found in the range of organizations that participated in the food transport strategy – international, national, local, public, private and nonprofit.

The mechanisms identified by Holland also functioned well in this complex operation. Aided by high levels of communication and information exchange, the mechanism of tagging proved effective in matching available goods to expressed needs. The internal model of providing sufficient food to the nations of southern Africa to avoid the specter of famine was clearly articulated. Painful memories of the 1982-84 famine in southern Africa reinforced this model for international as well as national organizations. The building blocks of South Africa's transport network were already in operation, and South Africa's willingness to adapt its transport strategy to meet the urgent needs of other southern African countries proved an important element in the evolution of the system.

The conditions and characteristics of this case fit the requirements for an operation at the "edge of chaos," where there was sufficient structure in the form of an existing regional organization, the SADC, as well as international organizations and public, private and nonprofit organizations within each nation, but also sufficient flexibility to allow the participating nations and organizations to adapt previous strategies to meet the urgent need of food security in the region. The success of the operation demonstrated the capacity of the SADC to carry out a cooperative strategy, supported by donor nations and international organizations, for the benefit of the peoples of southern Africa. This strategy successfully averted the potential disaster of famine.

To classify this case as an example of 'disaster diplomacy,' narrowly defined, misses the complexity of issues and interorganizational changes involved. The threat of famine provided the clear goal around which other activities and strategies were organized, but the shifts in perception and practice occurred system-wide, among organizations at local, national, regional and international levels of operation. Rather, the case more accurately represents the successful evolution of a complex adaptive system to meet a specific goal. The challenge becomes, in less urgent times, to sustain the adaptiveness of this functioning system in relations among southern African states, lest it drift toward either extreme, order or chaos.

The Potential of Information Technology to Facilitate Transition

As shown in the case involving the international mobilization of food transport to avoid famine for the nations of southern Africa, the capacity for intense levels of communication and exchange of information is vital to coordinating the activities of many organizations engaged in a common task of disaster mitigation or response. The potential for using information technology to support coordinated action to avert or respond to disaster has been explored in other contexts (Comfort 1999; Beroggi, Bouter, Mendonca and Wallace 1999). As illustrated in each of the three

cases discussed above, the complexity of the operations is such that the flow of information needed to support adaptive performance requires an information infrastructure to support it.

Investment in an information infrastructure that spans the communications channels of the nations involved in collective efforts to minimize losses from disaster can create the structure essential to hold and exchange information among nations engaged in operations to avert, or respond to, disaster. In doing so, it creates a `sociotechnical system' that represents a distinct system for the nations exposed to risk from disaster (Comfort 1994; Petak 2000). In times of threat or exposure to natural disaster, this overarching system may supersede the separate national systems that have histories of conflict on other issues. Once the technical, legal, and organizational structure for the timely exchange of information on disaster mitigation and response is in place, then the flexibility of alternatives designed by governmental policy makers can facilitate the learning processes needed to sustain a shift from conflicting to cooperative relations among participating nations. Without both structure and flexibility, diplomatic approaches regarding disaster are not likely to be effective.

Conclusions

Disaster events clearly produce an opportunity for change in relationships among the participants in response to shared risk. The challenge is to use that opportunity to guide actions at the micro level of disaster management so they will support and lead to substantive change at the macro level of greater cooperation among nations previously in conflict as they discover common goals in the reduction of risk or response to disaster. If small actions taken cooperatively at local levels to reduce risk or recover from disaster are understood as levers for change on larger issues of shared risk at national and international levels, it is possible to build a cumulative flow of actions, concepts, material goods, and knowledge that shifts the whole pattern of interaction among the nations in a positive direction. To do so, however, it is vital to ensure that the mechanisms of

"tagging", "internal model" and "building blocks," terms in Holland's concept of complex adaptive systems, are active and used appropriately.

International policy, designed in accordance with the concept of disaster management as operating within a complex adaptive system, can support this function. If incoming materials, experts, and techniques are "tagged", or matched with their appropriate needs in a nation at risk or already damaged, they become "building blocks" for a new pattern of interaction among donor and recipient nations. If these building blocks of cooperative actions are fitted, cumulatively, to an "internal model" or set of shared goals for disaster reduction, they are aggregated into a new set of assumptions that differs from the previous pattern that resulted in collapse. This new order represents the ability of the system to aggregate the flow of incoming ideas, materials and skills at a new level of stable performance. This level of performance likely includes a more diverse set of elements and occurs, as an outcome of disaster events, in a nonlinear way.

The critical process of transforming actions taken by nations in disaster environments into a process of building cooperative relations in future interactions depends upon creating an information infrastructure for the timely and accurate exchange of information among the participants in the response system. Through an evolving process of integrating new information more effectively, providing feedback to all participants in a more timely manner, and fitting new ideas to old problems, significant steps can be made in advancing constructive relations among nations following disaster.

In summary, five conclusions may be drawn regarding the concept of disaster diplomacy:

1. `Disaster diplomacy,' narrowly defined, captures only a partial aspect of the more complex set of interactions that characterize nations as they search for sustainable means of mitigating hazards and reducing losses from disaster.

2. Information flow is crucial to enabling actors at the micro level of households, neighborhoods and cities to adapt their performance in accordance with changes at state, national and international levels to reduce hazards and losses from disaster.

3. Disaster – or threat of disaster – provides opportunities for enhancing collaboration among nations, but the properties and mechanisms for adaptation must either exist or be developed for effective results.

4. Creative diplomacy for disaster reduction is most effective at the `edge of chaos', that region where there is sufficient structure to hold and exchange information, but sufficient flexibility to adapt new alternatives to meet urgent needs.

5. Maintaining creativity for disaster reduction as well as developing cooperation among nations perceived to be in conflict requires a broader conception of their shared goals, as well as practical engagement by a range of local, state/provincial, national and international public organizations, as well as private and nonprofit organizations in achieving this clearly articulated set of common goals.

NOTES

1. In large nations such as the US, local city and county governments may be overwhelmed in a given event, but have recourse to state and national governments for assistance. For example, in the massive Hurricane Andrew, 1992, the small town and county governments of Dade and Broward Counties in the State of Florida were severely incapacitated by the hurricane. The county governments requested assistance from the State of Florida. The state government, in turn, turned to the Federal Emergency Management Agency. But the process of negotiation over the terms of assistance and degrees of responsibility between city, county, state and federal agencies within a single national system may be as complex and conflictual as negotiations in relations among national states.

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