



Resilience and disaster risk reduction: an etymological journey

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Abstract. This paper examines the development over historical time of the meaning and uses of the term resilience. The objective is to deepen our understanding of how the term came to be adopted in disaster risk reduction and resolve some of the conflicts and controversies that have arisen when it has been used. The paper traces the development of resilience through the sciences, humanities, and legal and political spheres. It considers how mechanics passed the word to ecology and psychology, and how from there it was adopted by social research and sustainability science. As other authors have noted, as a concept, resilience involves some potentially serious conflicts or contradictions, for example between stability and dynamism, or between dynamic equilibrium (homeostasis) and evolution. Moreover, although the resilience concept works quite well within the confines of general systems theory, in situations in which a systems formulation inhibits rather than fosters explanation, a different interpretation of the term is warranted. This may be the case for disaster risk reduction, which involves transformation rather than preservation of the “state of the system”. The article concludes that the modern conception of resilience derives benefit from a rich history of meanings and applications, but that it is dangerous – or at least potentially disappointing – to read too much into the term as a model and a paradigm.

Sagitta in lapidem numquam figitur, interdum resiliens percutit dirigentem.

“An arrow never lodges in a stone: often it recoils upon its sender.” St John Chrysostom (ca. 347–407), Archbishop of Constantinople

1 Introduction

The purpose of this paper is to clarify some issues regarding the ways in which the word *resilience* is used in the field of disaster risk reduction (DRR). The term has become fashionable in recent years, but the multitude of interpretations and usages to which it has been subjected has led to confusion. Moreover, few scholars seem to be aware of the term’s long and distinguished history, yet this clearly has a bearing on how it is employed in its modern context.

The specific aims of the paper are as follows:

- to trace the history of the term “resilience” in order to illuminate its development and give the modern usage some historical depth and continuity;
- by means of a selective review of the literature, to investigate some of the ways in which the modern adoption of the term could be problematic;
- to examine the rift between academic and practical work in DRR and to suggest a way in which it might be healed;
- to attempt a reconciliation between some divergent views of what resilience means.

The accumulation of articles and books on resilience in its various contexts is now so large that a full review of how the term is used is beyond the scope of this article. However, some general lineaments can be traced, starting with the origins and early use of the word.

2 The historical etymology of the term resilience

The word *resilience*, together with its various derivatives, has a long and diverse history. In order to gain a deeper and more



Fig. 1. Canonbury Tower, North London (photo: author).

mature perspective on the term and its many shades of meaning, I believe its modern evolution needs to be reconnected to its early history.

Many students of the robustness of people, objects and systems believe that “resilience” was coined by C. S. Holling in his landmark 1973 paper on systems ecology (Holling, 1973). For example, Berkes (2007, p. 286) wrote, “Originally developed as an ecological concept, resilience is being applied to coupled human-environment systems.” Djalale et al. (2011, p. 3) wrote “the concept of resilience was originally developed in the field of ecology”. Goldstein and Brooks (2006, p. 3) were a little more generous with time when they stated that “The study of resilience traces its roots back a scant 50 years”. In reality, the word has a very much longer history (OED, 2013). It stems from *resilire*, *resilio*, Latin for “bounce” – hence the idea of “bouncing back” (Manyena et al., 2011).

The etymology of *resilire*, *resilio* is unknown, which indicates that it was probably a part of standard Latin – as much as any such thing existed – in Classical times, and was thus a word used occasionally by accomplished men of letters. The term appears in the writings of Seneca the Elder, Pliny the Elder, Ovid, Cicero and Livy. In his collection of imaginary legal cases, Seneca used the term, in the sense of “to leap”¹. In the *Metamorphoses* (12.480), Ovid used it as

¹...quanto minus quam in templum resiliuit? Annaei Senecae *Oratorum et rhetorum sententiae divisiones colores*. Seneca the Elder, Adolf Gotthlieb Kiessling, in aedibus B. G. Teubneri, Leipzig, 1872.

“to shrink or contract”. Quintilian (Marcus Fabius Quintilianus, *Istitutio Oratoria*, 12, 10.56) used it in the sense of “to avoid”². However, the most common uses were to describe leaping, jumping or rebounding. Pliny the Elder (*Natural History* 9.71, 11.39) used the term to refer to the leaping of fleas and frogs. Cicero, in his *Orations*, used it in the sense of rebounding³.

This meaning was strongly perpetuated in the proverbs of St. Jerome (AD 347–420)⁴. It is of note that many of these uses had negative connotations – e.g. the rebounding was not a happy result, or the subject person recoiled in his desire to dissociate himself from what was going on.

Much later, the term passed into Middle French (*résiler*), in which it came to mean “to retract” or “to cancel”, and then it migrated across the Channel into English as the verb *resile*, a word that appears in the State Papers of King Henry VIII in 1529 and evidently relates to his troubles with his first queen, Catherine of Aragon (1485–1536). Here, it was used again in the sense of “retract”, “return to a former position” or “desist”⁵.

Canonbury Tower (Fig. 1) was constructed in the North London in 1509 on the site of Roman remains. The builder was William Bolton, Prior of St Bartholomew, the forerunner of the eponymous London hospital. In 1537, when Henry VIII dissolved the monasteries, the tower passed to Thomas Cromwell, First Earl of Essex (1485–1540). It was later sold to John Spencer, Lord Mayor of London. In 1610 it passed to the Earl of Northampton, who for the period 1616–26 leased

²“...we must press the points that we see commend themselves to him, and draw back from those which are ill-received”, (Marcus Fabius Quintilianus, *Istitutio Oratoria*, 12 10.56).

³“...when you strike upon such a rock that you not only see the accusation rebound back from it, but perceive that every suspicion falls upon you yourself”. M. Tullius Cicero, *For Sextus Roscius of Ameria* (29.79).

⁴See opening quotation, which has also been attributed to St. Jerome.

⁵Stephen Gardiner (1483–1555), secretary to Cardinal Wolsey and future Bishop of Winchester, writing at Woodstock on 1 September 1529 to Thomas Wolsey (1473–1530):

Lord Chancellor: “Your Grace therfor his most harty thankes; trusting that Your Grace hath in all circumstances soe pro[ceeded], as, if the Quene wold herafter **resile** and goo b[ack] from that, she semeth nowe to be contented with, it shuld [not be] in her power soo to doo; but that this acte, doon [before] Your Grace and the Cardinal Campegius, ma[y] be] prejudicial to her here, at Rome, or elleswhere, [by the] letting and empeching of further prosecution, [and of] any citation or processe impetrare, or to be [impetrare], by her, or her proctours, herafter.”

Henry VIII State Papers, 1. page 343. State Papers Published under the Authority of his Majesty’s Commission: King Henry the Eighth, 1830–1852. Vol. 1: Part I: Correspondence between the King and Cardinal Wolsey, 1518–1530, CLXXX; p. 343.

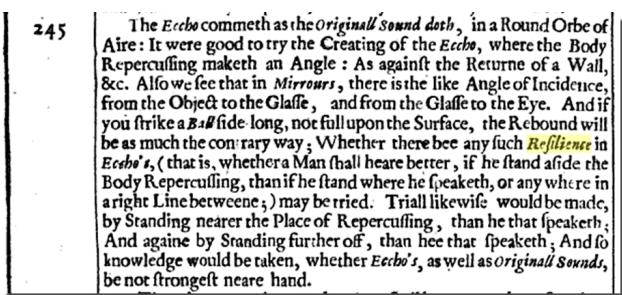


Fig. 2. Resilience in the *Sylva Sylvarum* of Francis Bacon.

it to Sir Francis Bacon, Attorney General of England (Glinert, 2012, p. 359). Here, Bacon is credited with devising the modern scientific method, or at least the inductive version of it. Herein, he was also responsible for the first known scientific use in English of the word “resilience”.

Bacon was unusual for his time in that he wrote in both Latin and in English, the latter for a greater divulgence of his work. Hence, there was bound to be some transfer of terminology between the two languages. In 1625 he published a compendium of writings on natural history, the *Sylva Sylvarum*. In this, during a musing on the strength of echoes, he first used the term resilience (Bacon, 1625, p. 245, Fig. 2).

In the late sixteenth century, the term seemed to have enjoyed greater use by the Scottish intelligentsia than by its English counterpart, and it became interwoven into the Scots dialect. Although *resile* faded from use in the 1700s, ever since then it has periodically been revived by those authors who like to make use of anachronisms.

The first known dictionary definition of resilience comes from the *Glossographia* compiled by the lawyer and antiquarian Thomas Blount (1618–79, Fig. 3). It is interesting that Blount chose the word *resilience* to be among the 11 000 terms that he felt were far enough from common parlance to merit defining. He attributed it a dual meaning: to rebound and to go back on one’s word (as in *resilement*, an obsolete derivative). Blount’s lexicon (1656) went through several editions and was imitated by eighteenth century authors (whose works also included the term resilience) on both sides of the Atlantic, but the *Glossographia* faded into obscurity with the publication of more authoritative lexicons.

It is interesting to note that the appearance of the word “resiliency” post-dates “resilience” by several years. Apparently, the former was first employed in 1651 in the English translation of *Lumen divinum reformatae synopsis* (“Natural Philosophy Reformed by Divine Light”), which was written by the Moravian theologian John Amos Comenius (1592–1670). This work was originally published (in Latin) in Leipzig in 1633 as part of Comenius’s *Didactica magna omnibus*. At the time, bidden by the Queen of Sweden, Comenius was busy making Swedish schools resilient. In the European context, it would be useful to continue the etymological trail by examining the diversities of meanings of resilience in

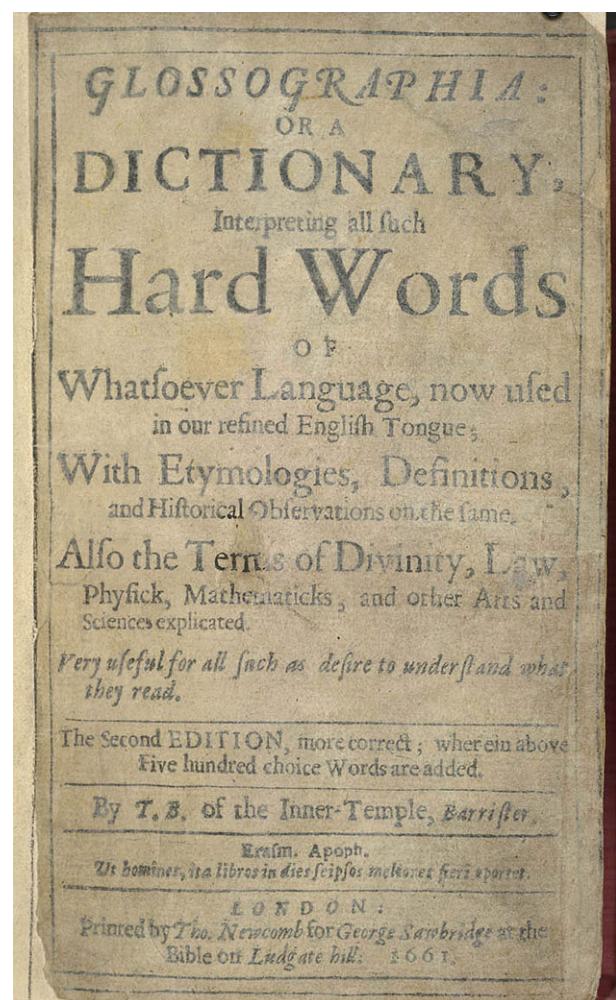


Fig. 3. Title page of Thomas Blount’s *Glossographia*, 1661 edition.

languages such as German (*Elastizität* [f], *Unverwüstlichkeit* [f, figurative]).

In the first half of the nineteenth century, resilience was still used in the sense of rebounding. Samuel Taylor Coleridge employed it thus in *Hymn to the Earth in Friendship’s Offering*, a rather mediocre paean to the bounty of nature (Fig. 4).

Thus did the word retain one of its most important functions: as a means of expressing emotion.

At this time the two nouns, and the verb, were used in various ways to denote the rather varied concepts of rebounding, elasticity and fickleness. The last of these is, of course, a negative connotation, and one that was vigorously employed by authors from Samuel Johnson in 1751 to Henry Best in 1826). Portentously, from 1839 the term was also used to signify the ability to recover from adversity, in the sense of fortitude (Bell, 1839, p. 344). The word “resiliency” was used in the sense of the ability to withstand the effects of earthquake with respect to observations made by Americans during the recovery of the city of Shimoda, southwest of Tokyo, after

Deep was the shudder, O Earth ! the throe of thy self-retention :
 Inly thou strovest to flee, and didst seek thyself at thy center !
 Mightier far was the joy of thy sudden resilience : and forthwith
 Myriad myriads of lives teemed forth from the mighty embracement.
 Thousand-fold tribes of dwellers, impelled by thousand-fold instincts,

Fig. 4. Resilience in Coleridge's *Hymn to the Earth*, 1834.

Resilience or **Spring** is the quantity of *mechanical work* required to produce the proof strain, and is equal to the product of that strain, by the *mean stress* in its own direction which takes place during the production of that strain,—such stress being either exactly or nearly equal to one-half of the stress corresponding to the proof strain. Hence the **resilience** of a solid is exactly or nearly one-half of the product of its proof toughness by its proof strength ; in other words, one-half of the product of the square of its proof toughness by its stiffness.

Each solid has as many different kinds of stiffness, toughness, strength, and **resilience** as there are different ways of straining it, as the following table shows. In that table *pliability* is used as a general term to denote the inverse of *stiffness* :

Fig. 5. William Rankine defined resilience for mechanics in 1867.

two major seismic catastrophes in December 1854. American observers found the Japanese to be resourceful and industrious (Tomes, 1857, p. 379).

The first serious use of the term *resilience* in mechanics appeared in 1858, when the eminent Scottish engineer William J. M. Rankine (1820–72) employed it to describe the strength and ductility of steel beams (Fig. 5; Rankine, 1867). In an applied context, it was used in 1867 as a descriptor of the robustness of the cladding of the prototype iron ships. Herein lies the origin of the modern use of the term in civil protection. A resilient steel beam survives the application of a force by resisting it with strength (rigidity) and absorbing it with deformation (ductility). By analogy, the strength of a human society under stress is its ability to devise means of resisting disaster and maintaining its integrity (coherence), while the ductility lies in its ability to adapt to circumstances produced by the calamity in order to lessen their impact (Alexander, 2012).

At about the same time, further applications of the term were being made in coronary surgery, anatomy and watchmaking. Resilience and resiliency are synonyms. Their broad use in mechanics, and in particular to the resistance properties of steel, parallels their application to analogous properties of yarn and woven fabrics (Hoffmann, 1948).

The adoption of the concept by Holling was specifically related to a systems theory approach to analysis of the stability of ecological assemblages (Von Bertalanffy, 1950). This

derivation does not work well when it is transposed to situations in which the general systems characteristics are less formally defined.

In the 1950s, the term resilience started to be used in psychology and it finally became popular in this field in the late 1980s (Flach, 1988). It has been used particularly in relation to the psychiatric problems of children (Goldstein and Brooks, 2006).

Independently of developments in psychology, at the end of the 1990s resilience made the transition from natural ecology to human ecology (i.e. social sciences) thanks to the work of economists (e.g. Batabyal, 1998) and geographers (e.g. Adger, 2000). Under human ecology, people adapt to their environments, and especially environmental extremes. One legacy of ecology is an enduring emphasis on system stability as a hallmark of resilience. Perhaps questioning that ought to be a goal of future theoretical work.

In synthesis, a good definition of resilience, as the term is currently used in disaster risk reduction, is as follows:

“The ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions.” (UNISDR, 2009, p. 24).

In this, the various prior meanings of the term can be seen: rebounding, adapting, overcoming and maintaining integrity. It should be evident from the foregoing discussion that some of the meanings are potentially contradictory, such as restoring equilibrium and getting away from it by moving to a new system state.

Lastly, if “resilience” were indeed first coined in Bacon’s writing room in Canonbury Tower, there could not have been a more appropriate place for that to happen. Apparently, Bolton had the tower built because he was much troubled by the predictions of astrologers that there would soon be a return of the universal deluge. Hence, to guarantee his own resilience, he had it stocked with two months’ supply of food.

I have purposefully condensed the overview of the modern uses of the term resilience (i.e. the last 60 yr) in order to deal with them in more detail in the next section. Meanwhile, the essential message of this section is that resilience (*resiliency*, *resile*) has a long history of multiple, interconnected meanings in art, literature, law, science and engineering. Some of the uses invoked a positive outcome or state of being, while others invoked a negative one. In synthesis, before the 20th century, the core meaning was “to bounce back”. Mechanics, aided by politics, had already started to change that: in both the literal and the figurative sense, under the aegis of the resilience concept, ductility had been added to elasticity. Now let us consider how the idea was extended to ecology.

3 Resilience in the ecological sciences

There is no doubt that the adoption of the scientific concept of resilience outside mechanics owes much to the theoretical work of Crawford Stanley Holling, the US-Canadian ecologist (Holling, 1973). However, it is important to note that Holling was by no means the first in his field to use the term (Lindseth 2011), as it had been in use some years earlier. Nevertheless, he brought it to prominence. The first two thirds of Holling's seminal paper were concerned with the different trajectories of ecological systems in phase space as they sought equilibrium. The response to perturbations owes much to the twin concepts of homeostasis (Haimes, 2011) and thresholds (Renaud et al., 2010)⁶:

"The whole sequence of environmental changes can be viewed as changes in parameters or driving variables and the long persistence in the face of these major changes suggests that natural systems have a high capacity to absorb change without dramatically altering. But this resilient character has its limits, and when the limits are passed ... the system rapidly changes to another condition." (Holling, 1973, p. 7)

Holling did not attempt to define resilience until two thirds of the way through his paper:

"But there is another property, termed resilience, that is a measure of the persistence of systems and of their ability to absorb change and disturbance and still maintain the same relationships between populations or state variables." (Holling, 1973, p. 14).

He argued that, paradoxically, instability can induce resilience as a homeostatic reaction. He concluded that an ecological system can be very resilient and still fluctuate greatly, providing it can absorb shocks without major loss of form and function.

Ecology is a science that lends itself to being conceptualised in system terms. Indeed, it would be difficult to practise it without doing so. Holling's main contribution in his seminal 1973 paper is to use the term resilience to characterise dynamic equilibrium, including that which can exist in several different state spaces.

When, in 1950, the biologist Ludwig Von Bertalanffy published his manifesto for general systems theory (GST), the concept of the "system" was already well established in science. Von Bertalanffy's main innovations were to promote the "open system" model and give emphasis to holism instead of reductionism. When reading his writings, one can sense his enthusiasm for GST and his desire to launch it as the overriding paradigm of scientific investigation. This evangelism took some time to bear fruit, perhaps because science and society had first to recover from the depredations of the Second World War (Weinberg, 1975). However, the flow-

ering of the sciences – including the social sciences – in the 1960s gave GST free reign. It proved particularly attractive to those who were grappling with the new use of automatic calculation (i.e. computers) to solve problems and open up new vistas for investigation. As others soon noted (e.g. Chisholm, 1967), general systems theory does not have the power to be a full-scale scientific paradigm. Chisholm saw GST as an analogy rather than a model, but that may be going too far in terms of reducing its significance. He also argued that concepts of entropy and closed system behaviour are irrelevant in the natural world, where all systems are, to a greater or lesser extent, open ones. Hence, pertinent criticisms of general systems theory can be summarised as follows:

- it is more a methodology (or at least a meta-hypothesis) than an explanatory model;
- it explains little, however much it provides the tools to achieve explanation using other theories;
- it relies on one's ability to formulate scientific problems in systems terms, and on the utility of doing so (in terms of explanatory power added);
- it recombines existing ideas in ways that fail to enhance them.

The functionality of the method depends on its ability to define the boundaries and components of a system in a meaningful way, which is almost inevitably carried out by simplifying a complex reality. If it is not useful to conceptualise a problem in terms of inputs, throughputs, outputs, subsystems, and so on, then the general systems theory loses its appeal. Confusion about whether resilience is a process, a state or a quality has not helped resolve this problem (Reghezza-Zitt et al., 2012, p. 3).

Holling's conception of resilience drew attention to the tensions that exist between efficiency and persistence, constancy and change, and predictability and unpredictability (Gunderson, 1999, p. 3). Others have tended to prefer a definition allied to the concept of equilibrium (i.e. homeostasis) on the grounds that ecosystems, like all open systems, need to tend towards equilibrium in order to maintain their integrity.

The eminent ecologists Howard and Eugene Odum both researched extensively into the robustness of ecosystems, utilising the general systems principle that they would tend to develop homeostasis (Odum, E. P., 1985; Odum, H. T., 1988). Odum, H. T. (1988, p. 421) saw stress as the motor of homeostasis, in which the forces applied to the ecosystem would induce changes that tended to preserve its overall stability. This idea has since been questioned, for example, by Sundt (2010), who saw it as an unrealistic expectation of ecosystem development. In the context of vegetational systems, Sundt saw resilience as a catch-all term for the function and behaviour of individual organisms. He argued (Sundt, 2010, p. 32–33) that this does not necessarily add up to stability but can denote constant change. Hence, resilience could

⁶The idea of adaptation thresholds was fundamental to the work in natural hazards of Burton et al. (1968). Inability to adapt to a given magnitude of event should push a society or community to utilise new and more sophisticated forms of adaptation.

be a mark of an ecosystem's ability to keep adapting, not its propensity to keep returning to any given equilibrium.

Regardless of whether one accepts that any such ideas can be transferred from ecology to disaster risk reduction, there is no doubt that Holling and the other ecologists made a significant innovation when they began to utilise adaptive management in resilience studies (Lee, 1999). Recent work (Djalate et al., 2011) has extended this concept to adaptive governance – i.e. adaptive co-management as a continuous problem-solving process.

A gift to ecology from developmental psychology is Bronfenbrenner's bioecological theory (Bronfenbrenner, 2004). In this, resilience arises from interaction across multiple levels of functioning (Boon et al., 2012, p. 389), a concept that fits well with the taxonomic bent of sociology (Drabek, 1986). It does appear that lack of resilience at one level (from the individual to the world) can undermine resilience at other levels, but it is not easy to scale up psychological resilience to the various social levels, especially community resilience. In synthesis, community and societal resilience do not exactly amount to the sum of people's inner resistance. However, Hutter et al. (2011) felt that there is no prospect of obtaining a viable overarching social perspective on resilience. Hence, not all researchers have accepted the concept of "panarchy" (Hatt, 2013)⁷, as a means of codifying Holling's cycle of adaptive management; nor did structural functionalism work very well, as it too relies on equilibrium tendencies that may not be helpful in analysing social systems. In this case, it is not only whether equilibrium exists or is the final goal of the system, but whether it is a useful concept at all. Homeostasis is a fundamental tendency of open systems, but if one abandons the systems concept is one necessarily still lumbered with the equilibrium concept? Holling (1973) was interested in the *survival* of ecological systems, which may require homeostasis, in order to preserve the integrity and functionality of the system.

At this point, the term "resilience" has clearly made the transition from ecological to socio-ecological work, or at least to human (cultural) ecology. The clearest articulation of this transition appears in the work of Berkes and Ross (2013, p. 14):

"Resilience is a systems concept, and the social-ecological system, as an integrated and interdependent unit, may itself be considered a complex adaptive system."

One hopes that "socio-ecological" does not imply a resurgence of environmental determinism. In any case, despite these models and linkages, ecology is not the root of the resilience concept, as in science this is more properly mechan-

⁷Panarchy in this sense means "a self-organising system seen from the inside", but it is one that spans many different interactions between people, organisms and the physical environment (Gunderson and Holling, 2002, p. 105). Gunderson and Holling imply in their paper that they coined the term "panarchy", but it was in use in the arts in the mid-nineteenth century (OED, 2013).

ics, which furnishes a different sort of analogy for disaster risk reduction to follow.

4 Social sciences

The migration of the term resilience from mechanics, manufacturing and medicine to the social sciences began in a small way the 1950s (Clarke et al., 1958). The use of the term "resilience" in the developmental psychopathology of children owes much to the work of the American psychiatrist Norman Garmezy (1918–2009). He began in the 1940s by studying schizophrenia, but the bulk of his findings on resilience were published in the 1980s (Garmezy et al., 1984). In the 1970s, it became fashionable to compare children with differing degrees of psychological vulnerability to abrupt shocks (violence, bereavement, disaster and so on). Besides psychopathological problems such as schizophrenia, researchers were interested in resilience as a part of a child's psychological growth and development (Bloch et al., 1956). After some years of accumulated research it became clear that the concept of an "invulnerable" child (i.e. one, however theoretical, with a high degree of adaptability and resistance) was too rigid (Rutter, 1985). Because it could be used in relative terms, "resilience" proved to be a better concept. The means by which the term was introduced into psychology is not entirely clear, but it appears to have arrived via anthropology in the period 1969–71 (Kagan, 1975 – the anthropologists had been using the term in various contexts since the 1950s – Herskovitz, 1952). In the 1970s, Garmezy used the term "competence" as the measure of a child's psychological robustness (Garmezy, 1973), but by the 1980s he was more inclined to write about resilience (Garmezy et al., 1984). It is clear that the anthropologists received the idea from the ecologists (Lasker, 1969, p. 1486). However, in so doing they acknowledged some of the non-scientific uses of the term, in that it is psychological, does not specifically require a systems approach: the system, as it were, is the mind of the patient.

Timmerman (1981, p. 20) saw resilience as the building of "buffering capacity" into society to make it resistant to disaster shocks. If resilience is associated with stability, or central tendency, Timmerman noted that there are at least seven different kinds of equilibrium, including the dynamic and statistical kinds. In developing the concept of resilience as a "bounce forward" notion, Manyena et al. (2011, p. 417) saw the positive gains that it implies as a means of "limiting poverty (by conserving and developing resources) and vulnerability (by reducing risk to people and assets)."

When finally the concept of resilience entered into sociology and human geography (Tobin, 1999; Adger, 2000), in the sense of *resilient communities*⁸, this triggered a problem of

⁸In a long, critical essay on community resilience, Tobin (1999) questioned the concept by drawing attention to the many ways in which local communities are complex (and therefore potentially at

reconciling the use of the term with the ways in which it has been employed in psychology (Kolar, 2011). It is self-evident that psychology concentrates on the individual, albeit influenced by his or her social, cultural and physical environment, while sociology is the science of social relations. With regard to research on disasters and crises, the overlap between the two disciplines has not always produced harmonious views of the same phenomena. For example, the psychological and sociological definitions of panic are virtually irreconcilable (Alexander, 1995, p. 176). Thus, it is hardly surprising that there have been problems defining resilience in a manner that is acceptable to both constituencies.

One aspect of cultural ecology is the need for human societies to adapt to environmental extremes. In this respect, a definition of resilience based on Rankine's articulation for the mechanics of materials (see above), but used by analogy to express the robustness and adaptation capacity of social networks is one of the most promising developments for disaster risk reduction. Klein et al. (2003, p. 43) went so far as to argue that maintaining and enhancing adaptive capacity should be the overall goal of resilience. However, rather than adaptation being a property of resilience, Klein et al. (2003) saw resilience as part of the capacity to adapt that every society needs during these times of high hazard and climate change. The other parts are exposure management and resistance (Pelling, 2003). The definitional problem is a product of the difficulties experienced in making resilience operational – i.e. designing strategies to achieve it in diverse, and often dynamic, circumstances. In this respect, if only language were kept simple in scholarly work on resilience, one feels that much of the debate about what terms mean and how to interpret them would be quite unnecessary.

5 Discussion

Disaster risk reduction needs theory in order to make sense of apparently chaotic events. In effect, theory is the road map of mitigation, response and recovery (Drabek, 1989). However, the field is exceptional in that there is an imperative need to validate theory according to its immediate utility. The urgency with which problems of disaster and emergency response, and hazard and risk mitigation, need to be solved is such that we cannot afford the luxury of producing theory for its own sake in the hope that some day it might somehow be useful (Yin and Moore, 1985).

There is, of course, a difference between the casual and the purposeful deployment of the term resilience in scientific literature. The etymological history of previous centuries, indeed millennia, shows that the word can be used with varied degrees of formality and meaning, stretching from a simple descriptor of a property to something that conveys a whole body of thought. The pace has been forced in recent years

odds with themselves) and deprived of power by outside intervention in, or control of, their affairs.

with attempts to create a resilience *paradigm* in various disciplines. In theory, the term can be applied to any phenomenon that involves shocks to a system, whether it be physical or social, and whether the shock involve disasters or merely a hard knock in the literal or figurative sense. The amount of literature on resilience is now so copious that it is becoming increasingly difficult to summarise. Comparative tables of definitions of the term appear in Zhou et al. (2008) and Garschagen (2013), mirroring similar compilations for vulnerability (Weichselgartner, 2001, p. 88) and risk (Brooks 2003, p. 7). Manyena (2006) listed 12 definitions of resilience and 20 of vulnerability (the number of definitions of the latter present in the disaster risk reduction literature has swollen to at least twice that – Haimes, 2011). After two books on “What is a Disaster” (Quarantelli, 1998; Perry and Quarantelli, 2005), it seems that no one can agree on the meaning of terms in the disaster risk reduction field.

There is now a plethora of literature on resilience, especially regarding the persona of individuals, and above all children; the properties of metals, plastics, fabrics and yarns; the integrity of ecological and environmental systems; and the ability of communities to face up to and address disaster risks, as well as their capacity to adapt to climate change. Not all potential users of the term are happy with this situation, and some feel that adoption of the term, or perhaps the concept, has done more harm than good. Thus, Comfort et al. (2001), Park (2011) and Reghezza-Zitt et al. (2012) are all suspicious that resilience is being used as little more than a fashionable buzz-word.

I believe that there is bound to be a sense of disillusionment if the term is pushed to represent more than it can deliver. “Resilience”, “resiliency” and “resilient” are very good descriptors of objectives, intentions, states of mind and body, and the behaviour of people and things. The problem lies in attempts to make resilience a full-scale paradigm or even a science. To do so effectively will require the resolution of a series of problems. To begin with, it is striking how the term is used in different disciplines without any reference to how it is employed in other fields, as if there were nothing to learn or transfer from one branch of science to another. Secondly, the use of resilience to describe homeostasis in systems is at variance with the “resilience ideology” of people and communities that need to be protected – by means of dynamic changes (Reghezza-Zitt et al., 2012). Moreover, the boundaries of the social system may be considerably harder to define than those of the ecological systems that have been so intensively studied in the name of resilience. That social systems are akin to ecological ones may have been the idea that gave birth to “human ecology” and “cultural ecology” (Barrows, 1923, Burton et al., 1968), but this does not mean that social interaction is fundamentally the same as the ecological pyramid of species and trophic levels.

At this point, it is worth adding that many other terms used in disaster risk reduction have long and rich histories that involve a fair degree of ambiguity. For example, the

term “governance” entered the English language in the late 1300s from Old French and Mediaeval Latin. For centuries, its sole meaning appears to have been “the action or manner of governing” (OED, 2013), although this often had benign overtones. Since the Second World War it has also been used as a euphemism for repressive national civil administrations when dealing with the civil administrations of dictatorships (cf. Jenkins, 2001) and also the transfer of power from states to corporations (Peine and McMichael, 2005), but in its more recent period of being fashionable has reverted to a more traditional meaning as one of “good government”. In line with the modern desire to promote democratic values, this has tended to signify participatory forms of democracy (UNDP, 2012).

Finally, there is now a journal entitled *Resilience*⁹, a sign, perhaps, that the concept has acquired a degree of common orthodoxy in social studies. This may be a good thing if it promotes cross-disciplinary work between the natural and social sciences, and management studies. On the other hand, some may argue that there is a strong element of “new wine in old bottles”, and merely adding a new term will not change the ability to understand and tackle problems connected with poverty, vulnerability, marginalisation and the riskiness of life. One person’s resilience may be another’s vulnerability, and one would not want the concept to be used as a means of reinforcing unethical practices or hegemonies.

6 Conclusions

Figure 6 is a schema of the evolution of the term “resilience”. For clarity, only the most important linkages are included. In rhetoric and literature, resilience is a concept that is free to find its own level. In mechanics, it is an innate quality of materials, and thus one needs to alter the inherent characteristics of the material if one wants to increase it. Hence, it is a calculable property determined, in the main, experimentally. Resilience in ecological systems is about how they preserve their integrity, while in social systems the concept is more complex and diffuse. Adaptation of the character, culture, activities and decision processes of communities should enable them to be better attuned to extreme situations. Rather than an ecological “threshold in state space”, this is a social “mountain that must be climbed”. The one consistent linking feature of the definitions given in Fig. 6 is that, one way or another, they all express dynamism.

In conclusion, resilience has a bright future ahead of it as an explanatory concept in various allied fields that deal with environmental extremes. However, its success in this respect will depend on not overworking it or expecting that it can provide more insight and greater modelling capacity than it is capable of furnishing. In the rush to employ the term ever more widely, contrary and cautionary voices have

⁹Published by Taylor & Francis, see: http://www.tandfonline.com/loi/resi20#UheDZT_TSSo.

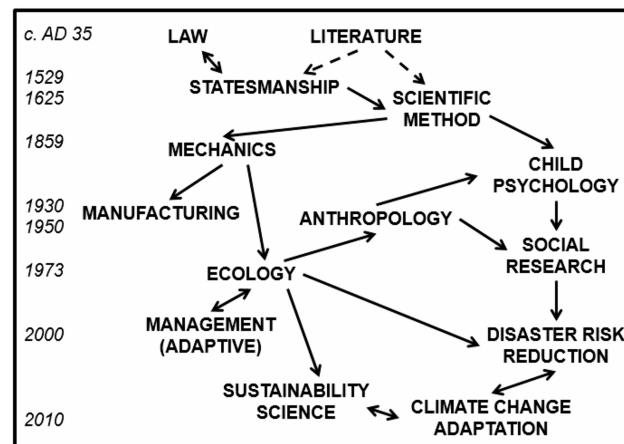


Fig. 6. Schematic diagram of the evolution of the term “resilience”.

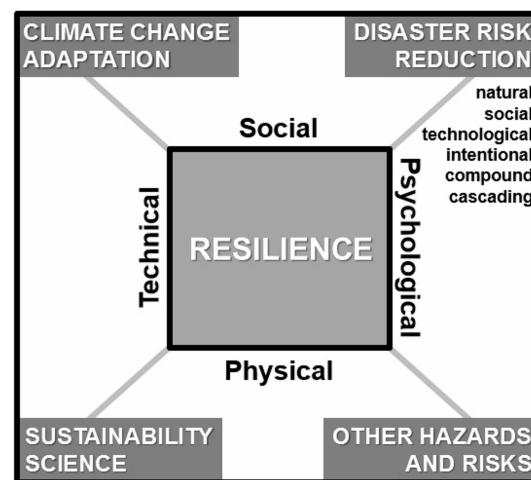


Fig. 7. Summary of the position of resilience studies in the sciences.

been raised. For example, Hornborg (2009) argued that resilience thinking consistently relies on the assumption that the social order is based upon consensus, while the neoliberal capitalist system involves dispossession and exploitation, in ways that are inimical to the acquisition of safety and robust defences against hazards. Ideas of this kind are capable of changing the conception of societal resilience radically, and they therefore deserve careful consideration (Alexander and Davis, 2012).

Finally, Fig. 7 summarises the position of resilience studies within the modern sciences. Resilience is a multi-faceted concept that is adaptable to various uses and contexts, but in different ways. As a concept, resilience shows promise in that it encourages the researcher to bridge the “shear zone” between (dynamic) adaptation and (static) resistance. No doubt it will continue to accumulate a rich catalogue of meanings and uses in the future.

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References

- Adger, W. N.: Social and ecological resilience; are they related?, *Prog. Hum. Geog.*, 24, 347–364, 2000.
- Alexander, D. E.: Panic during earthquakes and its urban and cultural contexts, *Built Environment*, 21, 171–182, 1995.
- Alexander, D. E.: Resilience against earthquakes: some practical suggestions for planners and managers, *Journal of Seismology and Earthquake Engineering*, 13, 109–115, 2012.
- Alexander, D. and Davis, I.: Disaster risk reduction: an alternative viewpoint, *International Journal of Disaster Risk Reduction*, 2, 1–5, 2012.
- Bacon, Francis: *Sylva Sylvarum, or of Natural History in ten Centuries*, Lee, W., London, 1625.
- Barrows, H. H.: Geography as human ecology, *Ann. Assoc. Am. Geogr.*, 13, 1–14, 1923.
- Batabyal, A. A.: The concept of resilience: retrospect and prospect, *Environ. Dev. Econ.*, 3, 235–239, 1998.
- Bell, R.: *Eminent Literary and Scientific Men*. Vol. 2. English Poets, Dionysius Lardner's Cabinet of Biography series, Longman, London, 1839.
- Berkes, F.: Understanding uncertainty and reducing vulnerability: lessons from resilience thinking, *Nat. Hazards*, 41, 283–295, 2007.
- Berkes, F. and Ross, H.: Community resilience: toward an integrated approach, *Soc. Nat. Resour.*, 26, 5–20, 2013.
- Bloch, D. A., Silber, E., and Perry, S. E.: Some factors in the emotional reaction of children to disaster, *Am. J. Psychiat.*, 113, 416–422, 1956.
- Blount, T.: *Glossographia; or, a dictionary interpreting the hard words of whatsoever language, now used in our refined English tongue*, The Newcomb, London, 1656.
- Boon, H. J., Cottrell, A., King, D., and Stevenson, R. B.: Bronfenbrenner's bioecological theory for modelling community resilience to natural disasters, *Nat. Hazards*, 60, 381–408, 2012.
- Bronfenbrenner, U.: *Making Human Beings Human: Bioecological Perspectives on Human Development*, Sage, Thousand Oaks, California, 2004.
- Brooks, N.: Vulnerability, risk and adaptation: a conceptual framework, Working Paper no. 38, Tyndall Centre for Climate Change Research, University of East Anglia, Norwich, 2003.
- Burton, I., Kates, R. W., and White, G. F.: The Human Ecology of Extreme Geophysical Events. Working Paper no. 1, Natural Hazards Research and Applications Information Centre, University of Colorado, Boulder, Colorado, 1968.
- Chisholm, M.: General Systems Theory and geography, *T. I. Brit. Geogr.*, 42, 45–52, 1967.
- Clarke, A. D. B., Clarke, A. M., and Reiman, S.: Cognitive and social changes in the feeble-minded: three further studies, *Brit. Psychol.*, 49, 144–157, 1958.
- Comenius, John Amos: *Natural Philosophy Reformed by Divine Light: Or lumen divinum reformatum synopsis* (Leipzig, 1633), London, 1651.
- Comfort, L. K., Sungu, Y., Johnson, D., and Dunn, M.: Complex systems in crisis: anticipation and resilience in dynamic environments, *Journal of Contingencies and Crisis Management*, 9, 144–158, 2001.
- Djalante, R., Holley, C., and Thomalla, F.: Adaptive governance and managing resilience to natural hazards, *International Journal of Disaster Risk Science*, 2, 1–14, 2011.
- Drabek, T. E.: *Human System Response to Disaster: An Inventory of Sociological Findings*, Springer-Verlag, New York, 1986.
- Drabek, T. E.: Taxonomy and disaster: theoretical and applied issues, in: *Social Structure and Disaster*, edited by: Kreps, G. A., University of Delaware Press, Newark, Delaware, 317–345, 1989.
- Flach, F. F.: *Resilience – Discovering a New Strength in Times of Stress*, Fawcett Books, New York, 1988.
- Garmezy, N.: Competence and adaptation in adult schizophrenic patients and children at risk, in: *Schizophrenia: The First Ten Dean Award Lectures*, edited by: Dean, S. R., MSS Information Corp., New York, 163–204, 1973.
- Garmezy, N., Masten, A. S., and Tellegen, A.: The study of stress and competence in children: a building block for developmental psychopathology, *Child Dev.*, 55, 97–111, 1984.
- Garschagen, M.: Resilience and organisational institutionalism from a cross-cultural perspective: an exploration based on urban climate change adaptation in Vietnam, *Nat. Hazards*, 67, 25–46, 2013.
- Glinert, E.: *The London Compendium*, Penguin, Harmondsworth, England, 2012.
- Goldstein, S. and Brooks, R. B.: *Handbook of Resilience in Children*, Springer, New York, 2006.
- Gunderson, L. S.: Resilience, flexibility and adaptive management: antidotes for spurious certitude? *Ecology and Society*, 3, Article 7, <http://www.ecologyandsociety.org/vol3/iss1/art7/> (last access: 15 February 2013), 1999.
- Gunderson, L. S. and Holling, C. S. (Eds.): *Panarchy: Understanding Transformations in Human and Natural Systems*, Island Press, Washington, D.C., 2002.
- Haines, Y. Y.: On some recent definitions and analysis frameworks for risk, vulnerability and resilience, *Risk Anal.*, 31, 689–692, 2011.
- Hatt, K.: Social attractors: a proposal to enhance “resilience thinking” about the social, *Soc. Nat. Resour.*, 26, 30–43, 2013.
- Herskovits, M. J.: Some problems of land tenure in contemporary Africa, *Land Econ.*, 28, 37–45, 1952.
- Hoffman, R. M.: A generalised concept of resilience, *Text. Res. J.*, 18, 141–148, 1948.
- Holling, C. S.: Resilience and stability of ecological systems, *Ann. Rev. Ecol. Syst.*, 4, 1–23, 1973.
- Hornborg, A.: Zero-sum world: challenges in conceptualizing environmental load displacement and ecologically unequal exchange in the world-System, *Int. J. Comp. Sociol.*, 50, 237–262, 2009.
- Hutter, G., Kuhlicke, C., Glade, T., and Felgentreff, C.: Natural hazards and resilience: exploring institutional and organizational dimensions of social resilience, *Nat. Hazards*, 60, 1–6, 2011.
- Jenkins, R.: Mistaking “governance” for “politics”: foreign aid, democracy and the construction of civil society, in: *Civil Society: History and Possibilities*, edited by: Kaviraj, S. and Khilnani, S., Cambridge University Press, Cambridge, 250–268, 2001.
- Kagan, J.: Resilience in cognitive development, *Ethos*, 3, 231–247, 1975.

- Klein, R. J. T., Nicholls, R. J., and Thomalla, F.: Resilience to natural hazards: how useful is this concept?, *Environmental Hazards*, 5, 35–45, 2003.
- Kolar, K.: Resilience: revisiting the concept and its utility for social research, *International Journal of Mental Health and Addiction*, 9, 421–433, 2011.
- Lasker, G. W.: The ecological approach in physical anthropology, *Science*, 166, 1480–1486, 1969.
- Lee, K. N.: Appraising adaptive management, *Ecology and Society*, 3, Article 3, <http://www.ecologyandsociety.org/vol3/iss2/art3/> (last access: 13 February 2013), 1999.
- Lindseth, B.: The pre-history of resilience in ecological research.(manuscript), http://dss.ucsd.edu/~blindset/lindseth_resilience_short.pdf (last access: 14 August 2013), 2011.
- Manyena, S. B.: The concept of resilience revisited, *Disasters*, 30, 434–450, 2006.
- Manyena, S. B., O'Brien, G., O'Keefe, P., and Rose, J.: Disaster resilience: a bounce back or bounce forward ability?, *Local Environment*, 16, 417–424, 2011.
- Odum, E. P.: Trends expected in stressed ecosystems, *Bioscience*, 35, 419–422, 1985.
- Odum, H. T.: Self-organization, transformity, and information, *Science*, 242, 1132–1139, 1988.
- OED: Oxford English Dictionary online, www.oed.com (last access: 6 February 2013), 2013.
- Park, A.: Beware paradigm creep and buzzword mutation, *Forest Chron.*, 87, 337–344, 2011.
- Peine, E. and McMichael, P.: Globalization and global governance, in: *Agricultural Governance: Globalization and the New Politics of Regulation*, edited by: Higgins, V. and Lawrence, G., Routledge, London, 19–34, 2005.
- Pelling, M.: *The Vulnerability of Cities: Natural Disasters and Social Resilience*, Earthscan, London, 2003.
- Perry, R. W. and Quarantelli, E. L. (Eds.): *What is a Disaster? New Answers to Old Questions*, Xlibris Press, Philadelphia, 2005.
- Quarantelli, E. L. (Ed.): *What is a Disaster? Perspectives on the Question*, Routledge, London, 1998.
- Rankine, W. J. M.: *A Manual of Applied Mechanics*, Charles Griffin and Co., London, 1867.
- Reghezza-Zitt, M., Rufat, S., Djament-Tran, G., Le Blanc, A., and L'Homme, S.: What resilience is not: uses and abuses, *CyberGeo* 2012/621, 1–23, 2012.
- Renaud, F. G., Birkmann, J., Damm, M., and Gallopín, G. C.: Understanding multiple thresholds of coupled social-ecological systems exposed to natural hazards as external shocks, *Nat. Hazards*, 55, 749–763, 2010.
- Rutter, M.: Resilience in the face of adversity: protective factors and resistance to psychiatric disorder, *Brit. J. Psychiat.*, 147, 598–611, 1985.
- Sundt, P.: Conceptual pitfalls and rangeland resilience, *Rangelands*, 32, 30–33, 2010.
- Timmerman, P.: Vulnerability, resilience and the collapse of society: a review of models and possible climatic applications, *Environmental Monograph no. 1*, Institute for Environmental Studies, University of Toronto, Toronto, 1981.
- Tobin, G. A.: Sustainability and community resilience: the holy grail of hazards planning?, *Global Environ. Chang. Part B: Environmental Hazards*, 1, 13–25, 1999.
- Tomes, R.: *The Americans in Japan; An Abridgment of the Government Narrative of the U.S. Expedition to Japan Under Commodore Perry*, D. Appleton, New York, 1857.
- UNDP: Issue Brief: Disaster Risk Governance, United Nations Development Programme, Nairobi, 2012.
- UNISDR: Terminology on Disaster Risk Reduction. United Nations International Strategy for Disaster Risk Reduction, Geneva, 2009.
- Von Bertalanffy, K. L.: An outline of General Systems Theory, *Brit. J. Philos. Sci.*, 1, 139–164, 1950.
- Weichselgartner, J.: Disaster mitigation: the concept of vulnerability revisited, *Disaster Prevention and Management*, 10, 85–94, 2001.
- Weinberg, G.: *An Introduction to General Systems Thinking. Series on Systems Engineering and Analysis*, Wiley-Interscience, New York, 1975.
- Yin, R. and Moore, G.: *The Utilization of Research: Lessons Learned from the Natural Hazards Field*, Cosmos Corporation, Washington, D.C., 1985.
- Zhou, H., Wang, J., Wan, J., and Jia, H.: Resilience to natural hazards: a geographic perspective, *Nat. Hazards*, 53, 21–41, 2008.