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Delft University of Technology

AR2A011: Architectural History Thesis

# Resilience:

the term's evolution from 19th-century medicine  
to diverse applications today

AR2A011

Architectural History Thesis

Tutor: Dan Costa Baciú



## Abstract

Resilience has become an increasingly popular concept, particularly in the context of climate change and its impact on the environment and cities. Its history and meaning are multifaceted, with various definitions across different disciplines, geocultural contexts, and historical periods. What is the etymology of resilience? How was it used throughout recent history from the moment it was first used? How did the term gain, lose and regain popularity from the early 19th century until today? How did resilience affect diverse disciplines?

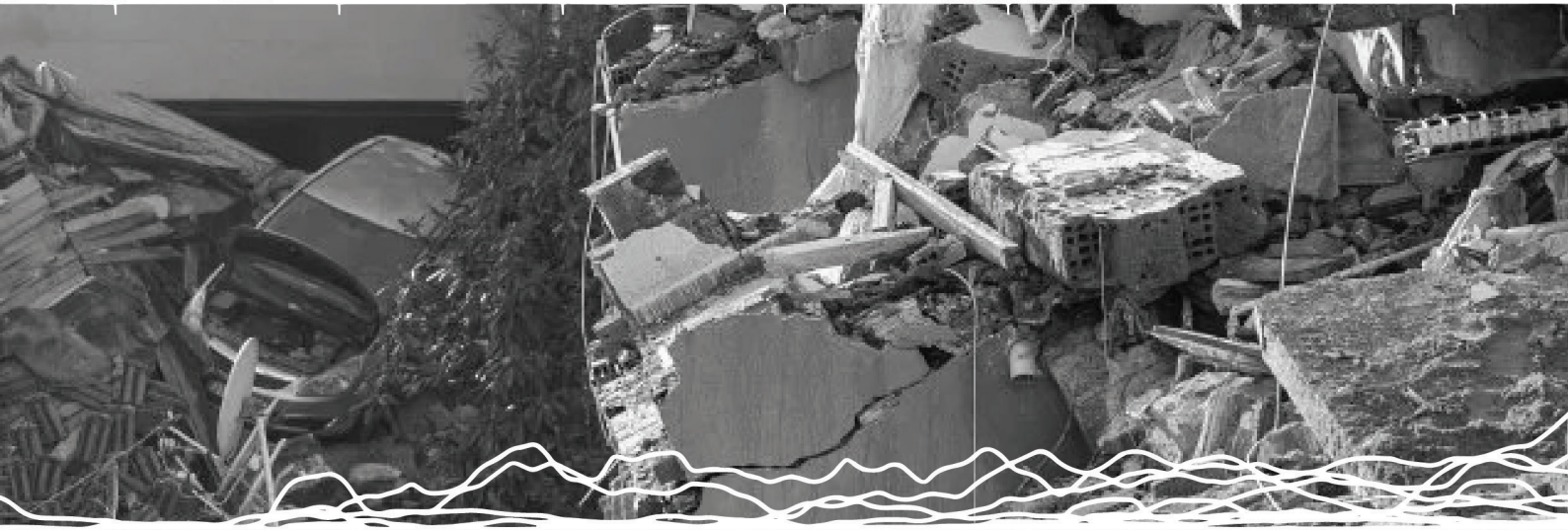
This research aims to answer all these questions and shed a light on the evolution of the term resilience.

The thesis is divided into two parts. The first part presents a historical narrative of resilience, combining a large-scale quantitative study of published books with a scholarly evaluation of outstanding source material to examine its evolution and diversification.

The second part provides a theoretical interpretation of the observations, using causal models to compare the history of resilience to other cultural phenomena such as “science” and “Chicago school.” The findings emphasize the significance of resilience in contemporary discourse and its role in shaping cultural narratives.

By analyzing the history and development of resilience, this research aims to provide a more nuanced understanding of what resilience means for our future living environment, taking into account its historical context. Furthermore, this study contributes to the hypothesis that the growth and diversification of cultural terms, including resilience, is an important aspect of cultural movements.







# Contents

<b>Introduction</b>	Abstract.....2
	Context & Concept of “resilience” .....4
	Research objective & methodology.....5
<b>Historical narrative</b>	.....7
	Origins & first uses of “resilience” .....9
	Resilience of the lungs.....9
	Resilience of the human.....10
	Resilience of the material.....13
	Resilience of the spring & rubber.....14
	Resilience of the system.....16
	Resilience of the American.....17
	Resilience of the people.....18
	Resilience of the economy & financial.....19
	Ecosystem resilience.....20
	Climate resilience & urban resilience.....23
	Japan.....24
	New Zealand.....27
<b>Theoretical interpretation</b>	.....30
	Period of formation.....31
	Period of growth.....31
	Period of reform.....32
<b>Discussion &amp; Conclusion</b>	.....34
<b>References</b>	.....37
<b>Appendices</b>	.....40



# Introduction

## Context & Concept of Resilience

Resilience has become a buzzword in recent times, particularly in discussions surrounding the future of our cities and the environment. The term is increasingly being used in place of sustainability, reflecting a shift in priorities towards preparing for and mitigating the impacts of environmental catastrophes. With events like the 2011 Tōhoku earthquake and tsunami and the 2012 Hurricane Sandy, it's becoming clear that resilient solutions are urgently needed for our long-term survival (Salingaros & Salingaros, 2021).

Interestingly, the concept of resilience extends beyond just cities and climate. It has a broad application in many disciplines, making it a fascinating and vital topic to explore. But where did this concept originate, and how did it become so widely used? This thesis seeks to answer questions about the history and diversification of resilience, shedding light on its evolution across different fields.

The term resilience, derived from the Latin word “resilire,” meaning to leap or spring back (OED, 1989), has been used in various contexts over the last two centuries. Its initial popularity can be traced back to 1820 when physician Carson used the term to describe the well-known property of elasticity in the lungs. Engineers later adopted the term to describe the property of springs, rubber, and other elastic materials. The ecosystem biologist Holling transformed the concept of resilience into a framework for understanding (eco-) systems. Holling's work on resilient systems remains influential in contemporary resilience discourse.

Throughout this thesis, we will therefore encounter physicists, biologists, engineers, psychologists, and architects, among others that all made use of the term resilience within their field of expertise. While the term assumes slightly different meanings in various fields, the concept of resilience generally describes the capacity of a system to deal with change (“The Resilience of the Resilience Debate,” 2019).

Resilience is a concept that has meaning in multiple fields of knowledge, unlike other concepts that are specific to individual disciplines and remain static over time.

Over the course of a century, the term has diversified, gaining traction in disciplines where it was previously overlooked. For example, it was originally applied in the field of materials science before being adopted in psychology and ecology. A causal model has been developed to explain the trend of diversification, which describes how the term has been increasingly applied to a growing number of disciplines over time. Interestingly, the concept of resilience is not unique in this trend. Terms such as “science” and “Chicago school” have also diversified in their applications. However, it is important to note that each term has its unique history of formation and growth towards diversification.



## Research Objective & Methodology

This present thesis combines a large-scale quantitative study of published books with a traditional scholarly evaluation of outstanding source material. It aims to examine how the many senses of resilience have evolved and diversified over time. More information about the methodology of the literature study can be found in Appendix A.

Using causal models, the thesis demonstrates that the history of the term “resilience” follows the same patterns of formation and growth as other terms describing cultural phenomena, such as “science” and “Chicago school.” This finding underscores the significance of the term in contemporary discourse and its role in shaping cultural narratives.

The thesis embraces the hypothesis that there is a striking equivalence between nature and culture, a concept articulated by Baciú (2020). This theoretical framework is applied to the analysis of resilience, providing a fresh perspective on the history and significance of the term.

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To fully comprehend the relevance of resilience in contemporary discourse, it is important to understand both its unique specificities and its similarities to other related concepts. By examining the historical context and evolution of resilience, I aim to provide insight into its contemporary significance and contribute to a more nuanced understanding of this important concept.

Figure 1

*Ngram Viewer results for “resilience of the \*\*” between 1800 and 2019*

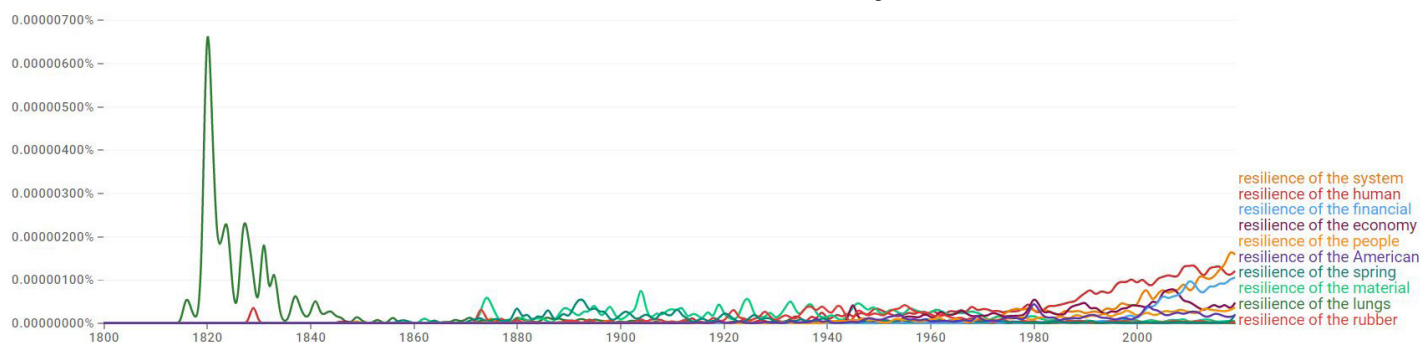
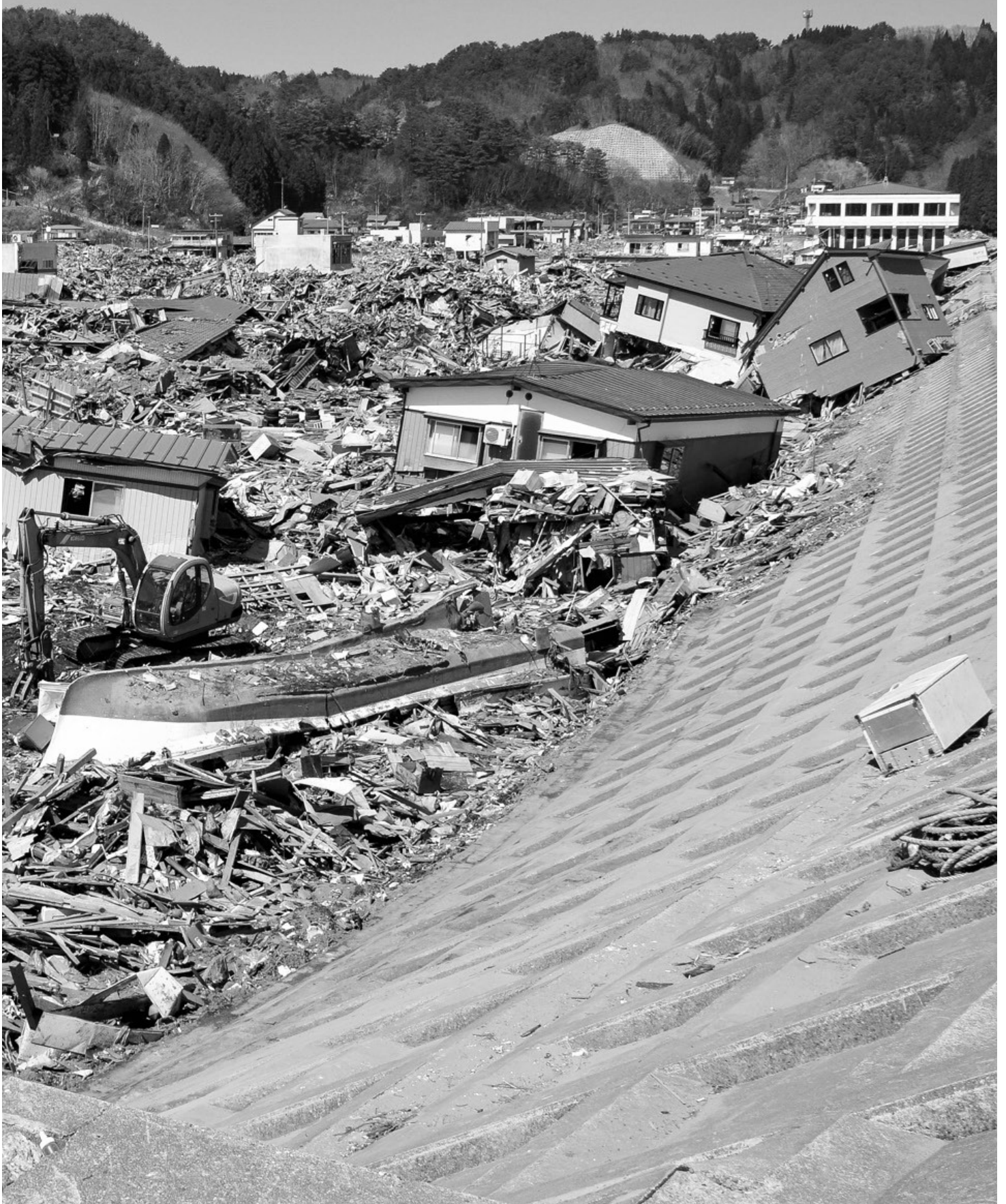




Figure 2

*The seawall (on the right) and the devastation in Taro, Iwate Prefecture, on April 6, 2011.  
Photo by Jim Peterson.*





## Historical Narrative

In 1820, a physician named James Carson became fascinated with the engineering of the human body. More specifically, he was intrigued with the elasticity of the lungs, which he referred to as the “resilience of the lungs”. Little did he know that this term would become increasingly popular over the next two centuries, used in tens of different disciplines. Today, 200 years later, the notion of resilience is more popular than ever before.

Throughout this first part of my thesis, I unfold the historical narrative of the term “resilience”. Rather than following a linear story, the notion of resilience stretches, sprouts, and interlaces like a tangled tree.

Figure 3 shows this tangled tree of “resilience” based on temporalities and connections between the various notions.

First, I recap the marginal use of the word before 1800 through a literature review. Then, I look at popular narratives between 1800 and 2020, selected from the most common n-grams shown in the Google Books Ngram Viewer. To observe the use of the word in the last decades, I make new n-gram searches for “resilience”.

Through secondary sources and two case studies, I bring the discussion on resilience to its hottest application: climate and urban resilience. Now, though, enriched by the faceted background that resilience revealed to have. Figure 4 illustrates the focus of my study in a rough timeline.

Figure 3

*Tangled tree of “resilience” as explored in this thesis*

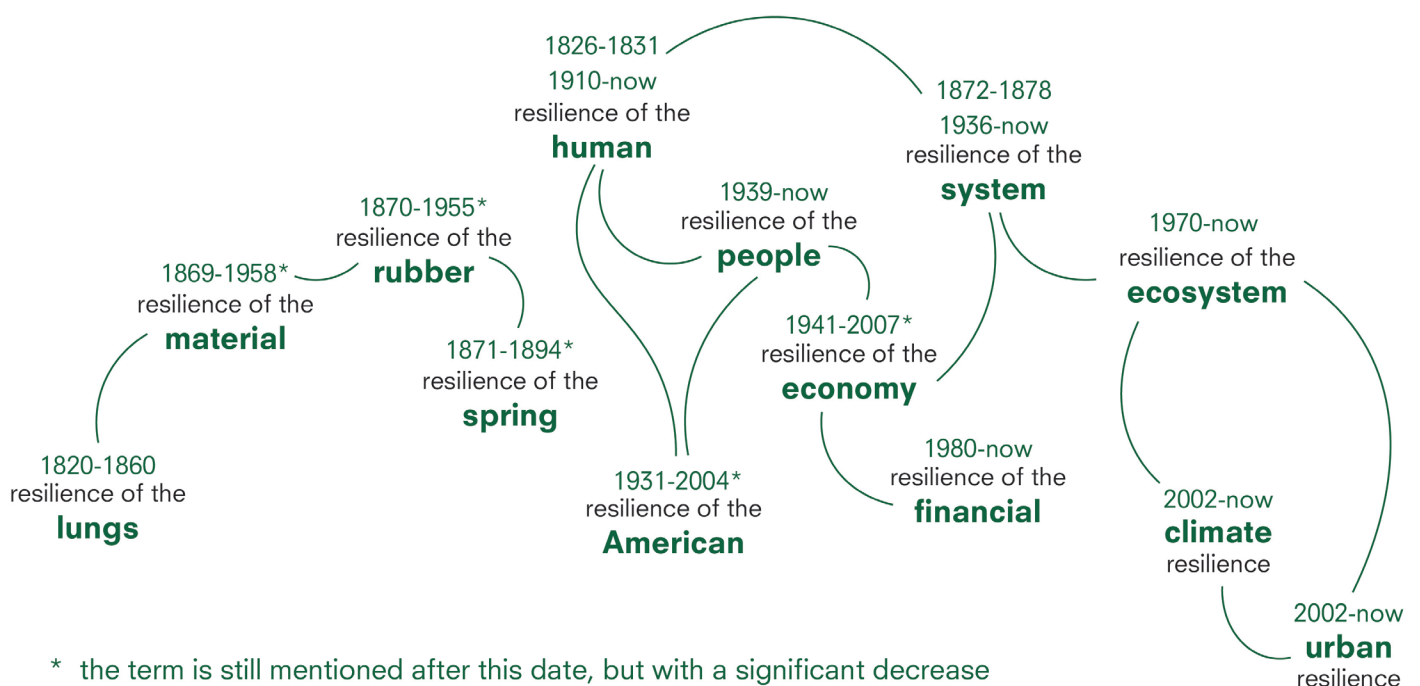
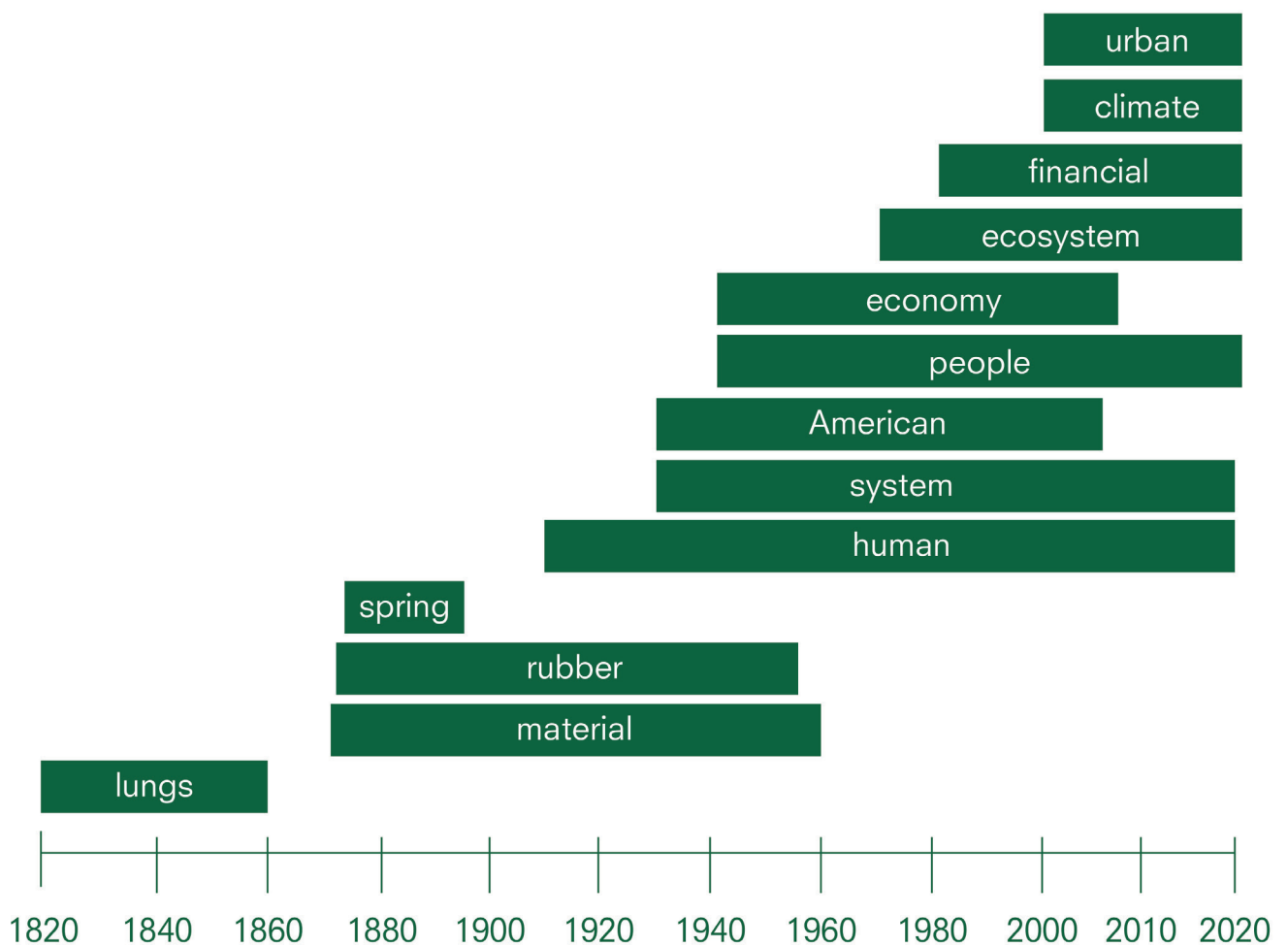




Figure 4

*Timeline of use of "resilience" as explored in this thesis*





## Origins & first uses of “resilience”

The term “resilience” originates from the Latin verb “resilire” as a figurative term for retrograde motions (jumping back, rebounding, reflecting, returning) (Hellige, 2019).

As of 1430, the word was used in French as a juridical term for the restoration of the original legal situation, in the verb form “résiler” or in the nouns “résiliation” and “résiliment” (Grand Larousse, 1989, as cited in Hellige, 2019). Stepping away from the juridical application, the English philosopher Francis Bacon was the first to imply the term “resilience” in a physical and mechanical context. (Bacon, 1631, as cited in Hellige, 2019).

During the second half of the 17th century, “resilience” or “resiliency” became standard terminology for physical counter-reactions of any kind and to indicate the return to the initial state.

Samuel Gott, who in 1670 wrote natural history and cosmology influenced by Bacon, used the term resilience to refer to both the “elasticity” of gases and liquids and the “springiness” of solid objects. He had already included electricity while considering retroactive forces (“retreat or resilience”). (Gott, 1670, as cited in Hellige 2019).

Additional references to “resiliency” and “motion of resilience” in natural philosophy works by Henry More (1676, as cited in Hellige, 2019) and Matthew Hale (1677, as cited in Hellige, 2019) demonstrate that the idea of resilience was already incorporated in the early modern physics. Richard Allstree (1684) and Robert Greene (1727) partially anticipated a diversification process that characterized resilience in the 19th and 20th centuries as they applied the physics term as a metaphor for the soul forces. Both Allstree’s “resiliency of the soul” and Greene’s “resiliency in the mind” referred to “the ability to regain one’s courage after emotional stress” (Hellige, 2019).

As mentioned later in this thesis, psychological resilience made a more consistent appearance in literature from the 19th century and became a topic of research in the mid-20th century (Hellige, 2019).

At the turn of the century, resilience found its first applications in mechanics through the definition by Thomas Young (see section “Resilience of the material”).

## Resilience of the lungs

Even though resilience was used for a couple of centuries already, it was not until the beginning of the 19th century that the term sparked significant interest in the public discourse. The first empirical data on the term resilience shows a close relation to the idea of elasticity. Interestingly, resilience –the physical capability of an object to return to its initial state after external stresses - does not refer to the spring or the rubber. Resilience is applied to describe the most natural activity our body carries on continuously: breathing. “Resilience of the lungs” was used by the physician James Carson as a synonym for “inspiration”. In the chapter *On the Elasticity of the Lungs* within the journal *Philosophical Transaction of the Royal Society of London, Volume 110* (1819) Dr Carson elaborates meticulously on the engineering of our body to introduce a set of experiments.



“The extent of the elasticity possessed by the lungs in their state of expansion in the living and sound body: or the extent of power by which the heart and diaphragm and perhaps various other organs are as necessary and as effectively influenced as the piston of the steam engine is by the expansive powers of steam. [...] To ascertain, then, the extent of the power required to distend the lungs to the dimensions which they occupy in the sound system, or, in other words, the extent of that force by which the walls of the chest are pressed, in consequence of the **resilience of the lungs**, is the object of the following experiments” (1819).

As intense as the peak of interest in the resilience of the lungs was, it was also of short duration. From 1846 onwards, interest in the topic significantly decreases. However, the elastic property described with regards to the lungs was further studied in physics and mechanics as a property of materials, as elaborated in the later sub-sections.

## Resilience of the human

Slightly after the rising of the resilience of the lungs, the term was paired up with the adjective “human”, opening a broad, important chapter of the history of the notion of resilience.

Throughout the 19th century, however, the resilience of the human had only a small appearance, mainly in the expression “the resilience of the human **mind**”.

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After a few decades of silence, the expression reappears in publications at the beginning of the 20th century. In the period between the two World Wars, the use of the resilience of the human often referred to the war itself: “It is only the resilience of the human spirit that makes it possible for a nation to undertake and carry through the truly heroic task of restoring the order of peace after the chaos of war” (1939).

But the popularity of the notion of resilience in this field does not only relate to the human spirit and/or human mind. The resilience of the human body also made a significant appearance in literature.

This interesting example connects the resilience of the human body with a study of the lungs.

The resilience of the lungs as mentioned during the peak of the 1820s and 1830s seems to raise attention on physical property as part of anatomic research. It seems difficult to establish a connection between the resilience of the lungs and the sense of urgency given by an epidemic.

However, more than a century later, the mention of “resilience of the human body” - in the general-interest magazine LIFE - relates to a study of ill lungs. The illustration in Figure 5 accompanies the explanation of a “controversial

technique to immobilize tuberculous organ without disfiguring the chest” (1948). Medical progress like this example of a new surgical method “attests both to the virtuosity of modern surgeons and the resilience of the human body” (1948).

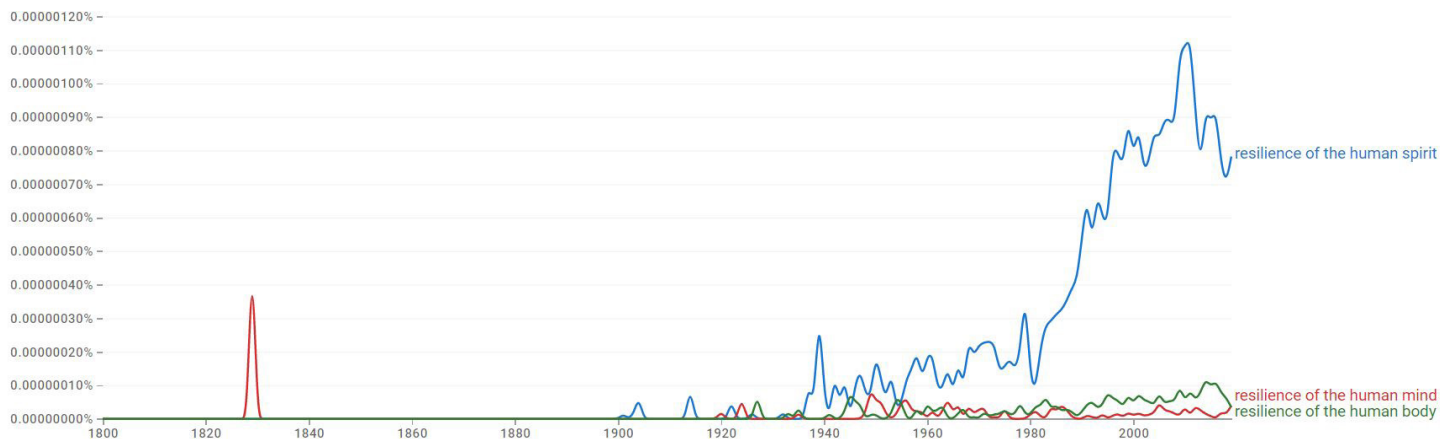
It is during the 20th century that resilience truly shifts from being purely a physical property to characterizing more complex systems (see Resilience of the \* system section) like the human body, as well as psychological and sociological realms.

“Resilience of the human” has been mentioned increasingly in more publications from 1910 until today. While increasing, these mentions seem to diversify: from the resilience of the human capital in the context of the changing fishing industry (OECD, 2007), to the resilience of the human voice in singing manuals (Harrison, 2006), to the resilience of the human glory in a study combining empirical research and virtue ethics (Titus, 2006), to the social resilience of the human systems when discussing ecology and human well-being (Kumar and Reddy, 2007). These are only a few of the many uses of this expression in recent years. Scholarly studies suggest that the most common notion remains the “resilience of the human spirit”, as clearly shown by the Google Books Ngram Viewer (see figure).

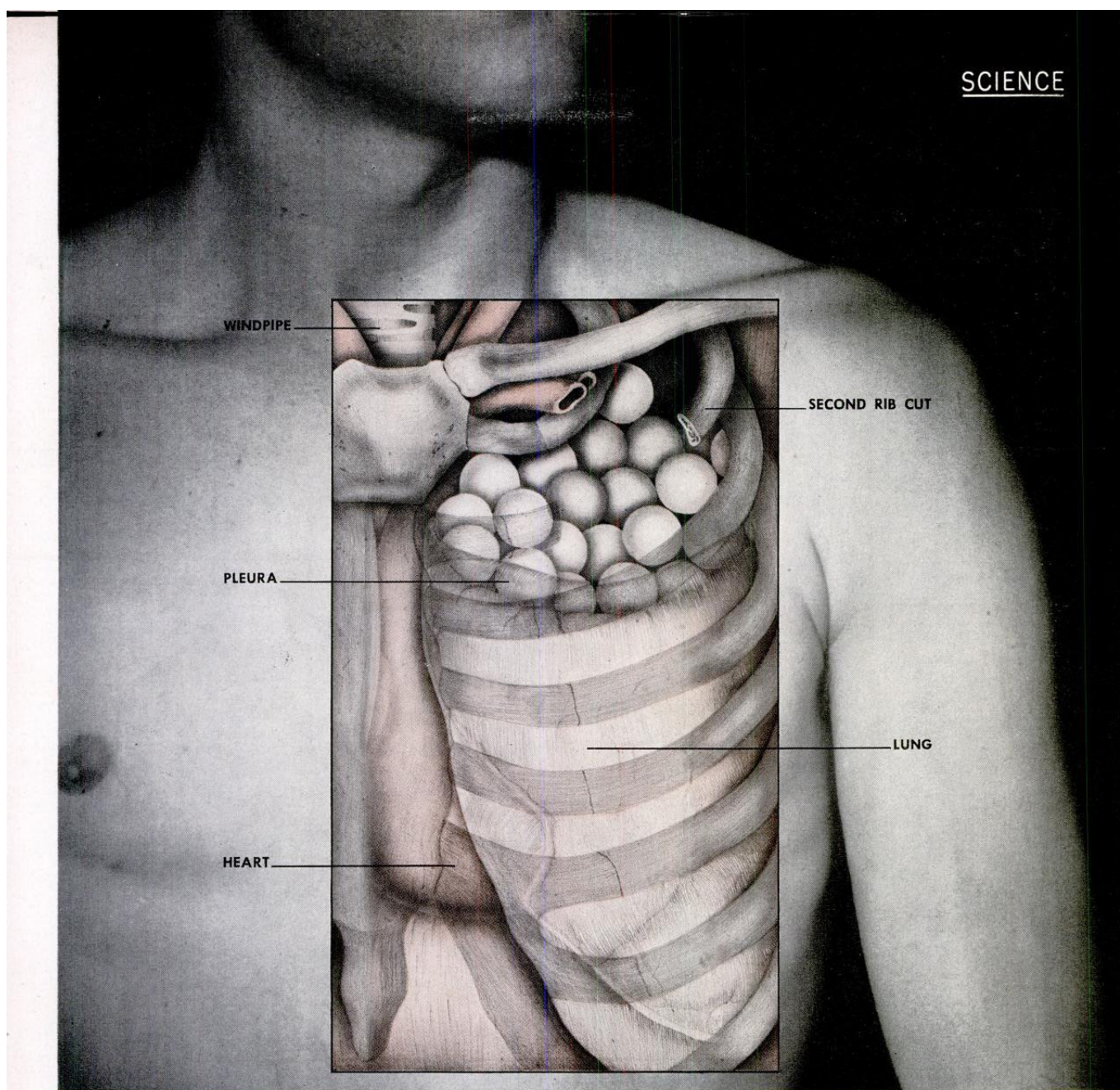
After reaching its absolute peak of popularity in 2008, this expression has been mentioned less.

Figure 6

*Ngram Viewer results for “resilience of the human mind, spirit and body”*







**CUTAWAY DRAWING** superimposed on a photograph of chest shows how plastic balls, inserted above the lung through 2-inch gap cut in second rib, collapse and im-

mobilize infected upper part of the organ. Balls do not touch the lung itself but rest on the pleura, a double layer of membrane which lies between the lung and the body wall.

## LUNG IS COLLAPSED BY PLASTIC BALLS

**New and controversial technique is designed to immobilize tuberculous organ without disfiguring the chest**

Ever since doctors discovered 50 years ago that a tuberculous lung would often heal if immobilized, they have been looking for the simplest and safest way to collapse the delicate organ. The oldest (but still the preferred) surgical method involves the removal of several ribs so that the chest caves in on the lung. The newest (but still unproved) method consists of packing hollow plastic balls inside the chest cavity to push down on the lung and collapse it (*above*)—an original and somewhat startling technique which attests both to the virtu-

osity of modern surgeons and the resilience of the human body.

Plastic balls are the newest addition to a long and varied list of materials (including fat, rubber, paraffin, gauze, balloons, oil and air) which have been used in attempts to collapse the lung without the radical and deforming surgery involved in removing a number of ribs. With the exception of air, which is often used to obtain a temporary collapse, none of these substances has been particularly successful. Most of them so irritated surrounding tis-

suces that many surgeons finally decided against using any foreign substances whatever inside the body. Yet plastic balls, light, insoluble and chemically inert, may eventually prove to be useful in certain types of tuberculosis. Some surgeons who have tried the new method have rejected it because of bad aftereffects. But at Denver's National Jewish Hospital, where the technique has been used for two years on selected cases, surgeons have generally obtained the ideal result: an apparently complete cure without permanent disfigurement.

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## Resilience of the material

Towards the middle of the 19th century, resilience entered significantly in the world of mechanics and engineering. *Engineering* volume 4 of *Pamphlets* (1850) asks the readers to “determine the elastic resilience of the material” in a mechanics exercise.

The application of resilience to the “mechanical arts” was already framed in 1807 by the leading English physicist Thomas Young (Young, 1807, as cited in Hellige, 2019). After conducting impact tests to determine the breaking strength of beams, Yung defined resilience as “the ultimate capability of a material to withstand a moving force, e.g. a falling weight, and formulated the first rules of thumb for the relationships between the stiffness, hardness, brittleness and resilience of a material” (Young, 1807, as cited in Hellige, 2019). From 1822 onwards, the English engineer Thomas Tredgold developed experiments on loading and impact to calculate the resilience of beams and more generally of iron and steel supporting structures, used in ships and steam engines (Hellige, 2019). Building on Young’s work, Tredgold defined the “modulus of resilience [...] which represents the power of a material to resist an impulsive force” (Tredgold, 1824, as cited in Hellige, 2019).

Resilience as a characteristic of structural materials was further investigated by physicists and applied mechanics experts, and collected in the manuals of science by William Rankine (1858), who laid out a calculation concept for the moduli of strength, stiffness, pliability, elasticity and resilience. This term is here addressed as an exact measure of the “capacity of the material for resisting shocks by tension” (Rankine, 1862, as cited in Hellige, 2019).

The quantitative perception of resilience investigated by Young and Rankine was used by William Thomson for the elasticity theory he developed in natural philosophy. The material sciences prompted the spreading of the term resilience in English-speaking countries, and consequently, it spread to France (Hellige, 2019).

It is worth noting that “material resilience” is the dominant use of the term resilience in the technical, natural and life sciences up until the 1950s (Hellige, 2019).

Moreover, from 1900, resilience expanded its application from material properties to diverse “resilient mechanisms”. These extensions of the notion of resilience activated experts like Robert M. Hoffman (1948) to make resilience a “unifying concept” through his *Generalized Concept of Resilience* (Hoffman, 1948). While “resilience of the material” did not expand beyond the field of mechanics and material science, resilience certainly diversified throughout the 20th century (as the following observations prove and as I will explain in the *Theoretical interpretation* section).

As mentioned, “resilience of the material” maintained a rather dominant application until the mid-20th century, with alternating short periods of higher and lower interest. Since the 1960s, “resilience of the material” appears less and less in publications, which reveals a gradually diminishing interest in this notion. This trend might reflect the fading out of research on the topic.



## Resilience of the rubber & spring

The application of the notion of resilience to the spring and the rubber is closely related to the resilience of the material. Both expressions appear in the fields of physics and mechanics in the late 19th century, likely following the studies on material resilience. It seems plausible that, because of their specificity, neither the resilience of the spring nor of the rubber reached equal popularity to the resilience of the material.

It is interesting to note that the spring and the rubber are not only found in physics and mechanics publications, but they also make appearances in medicine-related journals. The resilience of the rubber, for example, is mentioned in a variety of Dental health manuals.

In the chapter *Elasticity* of Johnston's Dental Miscellany – Volume 4 (1877) the resilience of the rubber refers to elastic bands set up to adjust the dental system.

With rubber being increasingly used in the industry throughout the 20th century, the “resilience of the rubber” grew in mentions between 1920 and 1960. Some publications were as specific as *The Rubber Industry* (1914).

“[...] it has been forgotten that when this operation is carried out in the factories the transformation of latex into rubber has already taken place, while on plantations it follows immediately on the formation of the coagulum, the machines acting on molecules which are not yet completely united or formed, thus breaking down the nerve fibers which supply elasticity and **resilience of the rubber**” (1914).

On the other hand, the “resilience of the rubber” appears in more general publications. An example is the *Official Gazette of the United States Patent Office* (1937), in which a “Rubber grooming device” is presented. Figure 7 is a page extracted from the publication, which gives an impression of the description of new patents in that historical moment.

The “resilience of the spring” is mentioned in many patent publications as well. Around 1960, the “resilience of the spring” appears in physics for explanations within *A History of the Theory of Elasticity and of the Strength of Materials* (Todhunter, 1960).

From the 1960s until today, both the resilience of the spring and of the rubber has been appearing in fewer publications – mainly in scholastic books covering the theory of elasticity and related topics in physics and mechanics.

APRIL 6, 1937

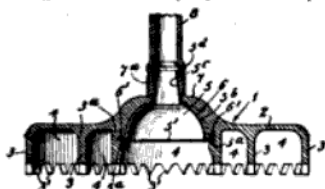
U. S. PATENT OFFICE

93

**2,075,963**  
**METHOD OF OBTAINING HIGHER MOLECULAR ALCOHOLS**  
 Walther Schrauth, Berlin-Dahlem, Germany, assignor, by mesne assignments, to "Unichem" Chemikalien Handels A.-G., Zurich, Switzerland, a corporation of Switzerland  
 No Drawing. Application May 7, 1932, Serial No. 609,991  
 3 Claims. (Cl. 260—156)

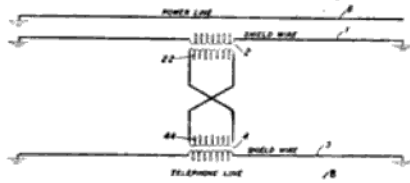
1. The method of producing unsaturated alcohol having an iodine number approximating 85 to 90 which comprises chilling sperm oil to approximately 10° C. to provide solid and liquid fractions, separating the liquid fraction and reducing it with sodium and a low molecular alcohol according to the Bouveault process to produce high molecular unsaturated alcohol.

**2,075,964**  
**RUBBER GROOMING DEVICE**  
 Alfred J. Telgeler, Rutherford, N. J.  
 Application April 27, 1935, Serial No. 18,629  
 2 Claims. (Cl. 15—127)



1. A grooming device embodying, in combination, a back member of resilient rubber, a cylindrical flange member of similar resilient material formed integrally with said back member and having a body portion projecting outwardly from said back at substantially right angles and a free outer edge, said grooming device having a semi-spherical seat portion for a spraying head disposed between the inner end of said resilient rubber flange and the bottom of said resilient back member and provided with an entrance surrounded by said flange and a locking groove positioned between said seat portion and the body portion of said flange, and a semi-spherical metallic spraying head removably seated into said seat portion and having a perimetric flange adapted to snap into said locking groove and to be locked in said seat by the resilience of the rubber, and means for connecting said spraying head with a water supply.

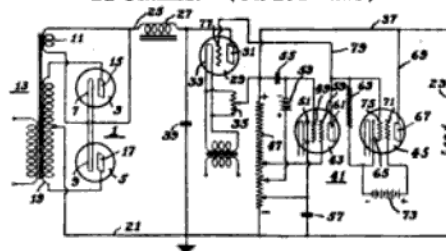
**2,075,965**  
**SHIELDING SYSTEM**  
 John R. Traves, Toronto, Ontario, Canada, assignor to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York  
 Application April 25, 1936, Serial No. 76,402  
 5 Claims. (Cl. 171—316)



5. In combination, a power line subject to a residual current therein, a telephone line subject to induction therefrom, a grounded shield wire adjacent said power line, a grounded shield wire adjacent said telephone line, a pair of trans-

formers each having one winding in series with one of said shield wires, the remaining windings of said transformers being interconnected so that the voltage induced in the telephone line by the current in the shield wire adjacent the telephone line produced by its interconnection with the shield wire adjacent the power line is 180 degrees out of phase with the voltage induced in the telephone line by the power line residual current through the direct coupling between the power and telephone lines.

**2,075,966**  
**REGULATING DEVICE**  
 Arthur W. Vance, Camden, N. J., assignor to Radio Corporation of America, a corporation of Delaware  
 Application October 31, 1933, Serial No. 696,001  
 14 Claims. (Cl. 171—229)



1. In a voltage regulating system for a source of variable voltage, a load, a voltage divider resistor shunted across said load, an electric discharge tube having a control electrode, said tube being connected in the circuit between said source and said voltage divider resistor, and means for controlling the impedance of said tube in accordance with changes in voltage drop across said voltage divider resistor, said means comprising a direct current amplifier having an input circuit connected to said voltage divider resistor and an output circuit connected to said control electrode.

**2,075,967**  
**SHEET MATERIAL**  
 Morgan J. Vittengl, Fairfield, Conn., assignor to E. I. du Pont de Nemours & Company, Wilmington, Del., a corporation of Delaware  
 No Drawing. Application March 1, 1934, Serial No. 713,519  
 6 Claims. (Cl. 91—68)

1. The process of preparing artificial chamois material which comprises impregnating a napped woven cotton fabric base with a rubber dispersion containing in proportion 40 lbs. of raw pale crepe rubber, 10 lbs. of white factice, 10 lbs. of glycerine, 31 lbs. of pigment, and 33 lbs. of filler, said compound being dispersed in 49 gals. of gasoline passing the fabric through squeeze rolls, repeating the impregnating and squeezing until the desired amount of rubber compound has been deposited in the fabric, drying, dusting both sides of the fabric with talc, vulcanizing by means of sulfur chloride and then subjecting the treated fabric to an atmosphere of ammonia.

**2,075,968**  
**HYDRAULIC LOAD PRODUCING MEANS**  
 Gerd S. von Heydekampf, Chester, Pa., assignor to Baldwin-Southwark Corporation, a corporation of Delaware  
 Application April 15, 1933, Serial No. 666,315  
 4 Claims. (Cl. 265—14)

1. A hydraulic materials testing machine comprising, in combination, means for supporting a



## Resilience of the system

Possibly, the most widespread narratives in the context of the resilience discourse are the ones about the “resilience of the system”.

The interesting aspect of this expression is its versatility and its exceptionally wide spectrum of applications due to the comprehensive definition of “system” which encompasses ecological to economic systems, ensuring resilience’s relevance across disciplines and over time.

While “resilience of the system” made shy appearances in 19th-century literature, its use was rather limited and strictly connected to medicine – not surprising after we discovered the huge success of the “resilience of the lungs”. The resilience of the anatomical system was mentioned in medical journals such as *The Medical and Surgical Reporter* (1859), *The Medical Record* (1875) and *New York Medical Journal* (1898).

Throughout the 20th century, the resilience of the system increased in popularity, particularly in the 1960s, thanks to Crawford S. Holling. Around this historical moment, the notion of “system” is strictly connected to the notion of “ecosystem”. I will further elaborate on Holling’s definitions of ecosystem resilience and the present connections to urban and climate resilience in the later section *Resilience of the \* ecosystem at the basis of climate and urban resilience*.

In the book *State of the System Model (SOS): Measuring growth limitations using ecological concepts* (House & Williams, 1974), resilience is described – along with stability – as a key characteristic of ecosystems. Resilience is addressed as the “capability of an ecosystem to ‘bounce back’ or ‘adjust’ after severe shock” (House & Williams, 1974). Moreover, the publication addresses complex systems as more resilient systems.

At the closing of the 20th century, the resilience of the system makes an important appearance in the collective publication *Biodiversity Loss: economic and ecological issues* (Perrings, Maker, Folke, Holling, Jansson, 1997) in which the important connection between the resilience of the system and biodiversity was introduced.

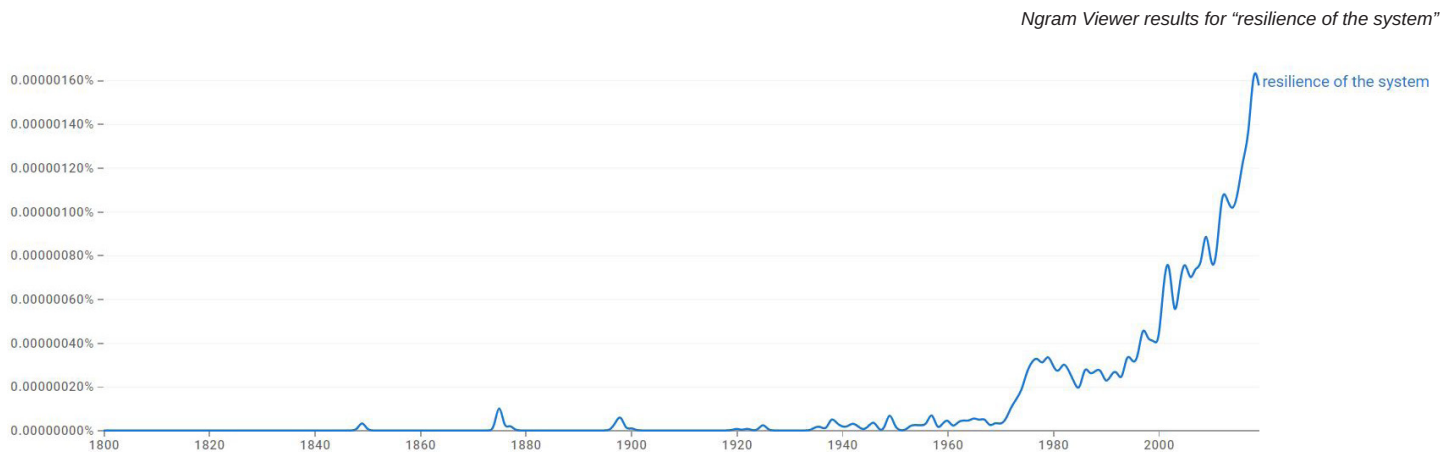
“If wild grasses perform the same ecological functions as domesticated grasses but under a different range of environmental conditions, and if those environmental conditions may occur with some probability greater than zero, the wild grasses have insurance value. They contribute towards the **resilience of the system** before shocks and stresses after those environmental conditions. Indeed, this is the primary motivation for biodiversity conservation in this volume.” (Perrings, Maker, Folke, Holling, Jansson, 1997)

In this and other contemporary publications mentioning the resilience of the system, the preoccupation about climate change is already evident. In these narratives, resilience is continuously associated with systems, and while it has strong environmental connotations, it does not have the same direct relationship with ‘sustainability’ that it does today.

In *Governance Through Social Learning* (Paquet, 1999), energy and envi-

ronmental issues are linked to economic systems. The 21st century brings unprecedented popularity to the resilience of the system with an environmental focus, while the studies become more and more specialized. The so-called “resilience engineering” is introduced (Nemeth & Hollnagel, 2014) along with “the resilience of the electricity system” (2015), and more generally the resilience of complex systems (Deffuant & Gilbert, 2011).

Figure 7



## Resilience of the American

After the term ‘resilience of the human’ re-entered the public discourse, a new expression, ‘resilience of the American,’ emerged. Interestingly, the first recorded mention of this term was found in the *Proceedings of the World’s Dairy Congress* in 1924.

“It is perhaps interesting to note that this organization and its allied organizations exported from the United States, for the use of these children, upward of 500 million pounds of condensed milk during the period of the war and reconstruction. It could be very well said that the saving of these millions of children was accomplished only by strength, the **resilience, of the American dairy industry**”(1924).

If we were not convinced that resilience has been applied to virtually anything, I am sure we are now. But the expression “resilience of the American” was later paired up with many more, possibly more commonplace, terms: resilience of the American economy, soldier, (political) system, people, spirit, and society.

An important mention of “resilience of the American economy” appears in a chapter of the US journal *Monthly Review – Volumes 39-40* (1957). After the 1957 recession, the question about its relatively mild impact on the American economy arises: “In this recession, as in the two preceding ones, the American economy demonstrated a characteristic and powerful resistance to decline” (1957).

Not only was the American economy challenged by recessions but demonstrated its resilience. The resilience of the American people is also highlighted



in many publications. In a speech reflecting on the 2008 crisis and the many jobs created after the Great Depression, Obama states: "No matter how bad the crisis was, one thing did not change, and that is the character of the American people and the resilience of the American people." (Obama, 2012). The resilience of the American people appears frequently in *Public Papers* and *Economic Reports of the Presidents of the United States*.

An interesting field of application is the American education system. *The Rise of American Research University* (Gragam & Diamond, 2004), reflecting on the historical analysis of the half-century following World War II, highlights "the unusual resilience of the American system of higher education. Our post-war history demonstrates the system's capacity to adjust to rapidly changing conditions" (Gragam & Diamond, 2004). Again, we see that many types of "systems" are recurrently characterized by resilience.

Throughout the last century, the various applications of the "resilience of the American" demonstrate the broad spectrum of implementations of the notion of resilience.

## Resilience of the people

American people were not the only ones to be defined as resilient. The two World Wars dissimulated the rather general notion of "resilience of the people".

Often mentioned in proceedings of conferences after World War II, this notion for example appears in the *Record of Proceeding of the Asian Regional Conference of the International Labour Organisation* (1953). A member of the conference states: "I have nothing but praise for the resilience of the people of Japan who, after a disastrous war, have again placed themselves in the vanguard of the economic progress of the region."

In the publications between 1960 and 2010, the "resilience of the people" often refers to epidemics, famines, and conflicts in the global south. A very important topic about which "the resilience of the people" has been mentioned in recent literature is the United States' domination of Native Americans. In the groundbreaking publication, *Culturicide, Resistance, and Survival of the Lakota* (Fenelon, 2014) the concept of cultural domination and genocide is explored. A passage powerfully points out the essence of cultural resilience of people: "In terms of cultural survival, either traditional or adaptive forms, the perpetration by the dominating forces, are analytically and realistically tempered by the types of resistance and the resilience of the people experiencing the domination" (Fenelon, 2014).

While these topics remain popular in the last decade, the resilience of the people to environmental disasters has increased in popularity. An example relates to the impact of Hurricane Katrina on New Orleans: "Buildings can be rebuilt, property lines rediscovered but what is the most important in a city, and this was the case in New Orleans, was the **resilience of the people** – their communal institutions, family and friendship networks, intangible and tangible cultural heritage and so on" (Campanella, 2006).

The notion of “resilience of the people” represents an important intersection between biology, culture, environment, and economy, as individuals are connected to all of these domains. This is evident through the broad spectrum of applications revealed in various publications.

## **Resilience of the economy & financial**

As observed so far, by the middle of the 20th century, the notion of resilience had expanded to various fields. From the physical properties of our lungs, rubbers, springs, and structural beams, the notion of resilience expanded to anthropology; it was increasingly applied to people, populations, and more generally, systems. But while most of these applications remain and grow in popularity throughout the 20th century, the economic rebirth that characterized many countries after World War II allowed for a new application of resilience. Right at the end of the war, “resilience of the economy” was first mentioned in periodic journals and, soon after, in sociology books. After addressing a few mentions of “resilience of the economy”, I present the closely related “resilience of the financial”, a notion that has been growing significantly since its first appearance at the turn of the century.

In his book, *The End of Ideology* (Bell, 1960), the American sociologist Daniel Bell states that the “resilience of the economy to shocks” clearly increased since the end of World War II.

It is interesting to note that the publications mentioning “resilience of the economy” accessed via Google Books come from a great variety of countries: not only countries of the United States and Europe, but also Australia, India, Japan, Pakistan, Myanmar, Tanzania, Mozambique and Ghana among many others. This hints at the global application of the notion of economic resilience. Moreover, with the start of the 21st century, economic resilience is often mentioned in association with climate conditions and urban developments. The last section of this historical narrative focuses precisely on climate resilience and urban resilience, which are closely connected to the resilience of the economy. Severe weather conditions and environmental disasters are among the key challenges for the economy of a country, which shows or develops resilience in such situations. One of the many examples is reported in *The Economic Outlook*, the hearing of the Joint Economic Committee of the US (2006). “The economic challenges posed by hurricanes Katrina and Rita reinforce once again the importance of economic policies that promote growth and increase the resilience of the economy. Energy issues in particular have come to the fore recently” (2006).

Naturally, though, climate-related shocks are not the only ones to challenge the economic resilience of cities and countries. The economic crisis of 2008 plays an important role in the historical narrative of economic and financial resilience. The book *Economic Crisis and the Resilience of Regions* (Bristow & Healy, 2018) analyses the resilience of various regional economies in Europe after the global economic crisis of 2008. Along with presenting a cross-comparative study of how regional economies were affected by the crisis, the



book explores the influence of local and regional policy on the resilience of the economy, which showed to vary throughout areas of Europe. Even though it remains relevant, between 2007 and 2008 the exact expression “resilience of economy” started to decrease in popularity, and was almost replaced by ‘resilience of the financial,’ which continues to grow in popularity until today.”

The expression “resilience of the financial” is completed by a diverse set of words that specify the application of the term. In the first mentions during the 1990s, “resilience of the financial systems” seems to be the most popular. This highlights the broad and faceted use of the general notion of “resilience of the system”. Private and governmental organizations aimed at the resilience of the financial systems (or sectors, or markets). This expression dominates financial reports, business journals and similar publications.

Interestingly, similarities between financial systems and ecosystems (explored in the next section), are made explicit in 21st-century books on resilience. *Resilience: why things bounce back* (Zolli & Healy, 2012) is a good example.

“And his recipe for improving the resilience of the financial network bears striking resemblance to ecologists’ prescriptions for ecosystems. We need more complete, holistic measures of the health of the financial system and the dependencies between various institutions within it; we need to improve communications about it with the public at large in times of impending crisis or system flip, and we need to take steps to improve the financial system’s biodiversity” (Zolli & Healy, 2012).

Recent publications show that the resilience of the financial system is especially relevant to the Great Global Crisis of 2008. In addition to its harsh immediate consequences, such a crisis also sent years-long aftershocks through investment, banking and regulatory cycles worldwide (2019). *Systemic Risk in the Financial Sector – Ten Years after the Great Crash* (2019) provides a guide to understanding the global financial crisis to prevent similar crises in the future.

The data on economic and financial resilience expands our understanding of the concept of resilience and highlights its close connections to various disciplines. While resilience extends into a new sector, the economy, it remains relevant across different fields and demonstrates its general applicability beyond specific contexts.

## Ecosystem resilience

As previously introduced in this thesis, Crawford Stanley Holling played a significant role in introducing the concept of resilience to systems, specifically in the context of ecosystem resilience. This section focuses on ecosystem resilience, which has grown in importance alongside the broader concept of system resilience, as depicted in the Google Books Ngram results for ‘ecosystem resilience’ and ‘system resilience.’ The application of resilience to the field of ecology is central to this dissertation, as it represents a paradigm shift

in the study of resilience.

Figure 9

Ngram Viewer results for "system resilience" and "ecosystem resilience"



Holling took primary elements of ecosystem resilience that were already available, and from 1955 he integrated them to obtain a closed system as well as an integrated strategy for resource management. Holling became one of the conceptual founders of “ecological economics”, which is highly relevant as it influences the socio-ecological and general understanding of resilience up to nowadays (Hellige, 2019).

The early dissemination of Holling's work coincided with the environment and growth criticism of the 1960s. In the first presentation of his theoretical approach, Holling used the term resilience, but only in close interaction with homeostasis, which is “the tendency towards a relatively stable equilibrium between interdependent elements” (2023).

“These mechanisms are homeostatic or feedback processes that tend to resist change and promote stability” (Holling, 1966, p. 196, as cited in Hellige, 2019). He did not question the “resilience of mother nature” as it was the outcome of the evolutionary adaptation of organisms to environmental changes and human interventions. Particularly, the “complex interactions” and the many “interconnections” in the food chains had created the “resilient nature of ecological systems” (Holling, 1966, pp. 196-197, as cited in Hellige, 2019). The shift from predictable to unpredictable system conditions, as well as from common to extremely disruptive events, prompted managers to abandon their previous management objectives of structure stabilization and homogeneity to enhance robustness, self-healing capabilities, and change readiness in ambiguous structures. Instead of avoiding change and disasters, it was now important to intentionally welcome them and use them to strengthen resilience.

Holling conducted a comparison of the system dynamic of fish and insects, from which he concluded that stable “self-contained systems” with low vari-

ability and low disturbances are most likely to collapse with the occurrence of unexpected shocks. While ecosystems that continually deal with unexpected “traumas and shocks” survive thanks to their acquired “internal resilience” (Holling, 1973, as cited in Hellige, 2019).

This instability and heterogeneity arising from permanent competition and pressure of selection are precisely what increases the “capacity to persist”. Holling states “A population responds to any environmental change by the initiation of a series of physiological, behavioural, ecological and genetic changes that restore its ability to respond to subsequent unpredictable environmental changes” (Holling, 1973, as cited in Hellige, 2019).

This gave shape to the rule that the more homogeneous an environment becomes over space and time, the lower the pressure to adapt and consequently the lower the level of resilience (Hellige, 2019). According to Holling, resilience is a product of evolution and social selection. “It is not the strongest of species that survive, nor the most intelligent, but the most responsive to change” (Holling, 2016, as cited in Hellige, 2019).

Holling’s theory became meaningful in various fields. The application of these biological and ecological arguments to economy and society later inspired the “neoliberal concept of insecurity by design” (Evans & Reid, 2014) and the Darwinist re-interpretation of resilience as permanent challenges of adaptability, flexibility and transformability (Zolli & Healy, 2012).

Not only did Holling bring the notion of resilience to a new historical phase and set of applications, but he also distinguished two main approaches to quantify resilience: engineering resilience and ecological resilience (Holling, 1996). Engineering resilience refers to the recovery process of a system after disturbance (Pimm, 1984). Ecological resilience, instead, assumes that a system has multiple alternative states and defines resilience as resistance to change – the quantity of disturbance that a system can absorb before shifting from one state to another (Holling, 1996).

Since Holling first addressed it, the notion of “resilience of ecosystems” has been gaining importance and popularity. “A key challenge in ecology is to predict the resilience of ecological systems to future, and potentially novel, disturbances and environmental conditions” (Sutherland et al., 2013, as cited in, Capdevila et al., 2021b). Global warming (IPCC, 2021) and habitat loss (Newbold et al., 2015) and other global threats will continue to impact ecosystems worldwide, even in the most optimistic scenarios of conservation policy (Leclère et al., 2020). Resilience, however, is an emergent property of complex systems (Scheffer et al., 2018) and thus it is hard to predict. It is therefore essential to develop frameworks to anticipate the potential consequences of the ongoing climate change for the future resilience of ecological systems (Capdevila et al., 2021b).

These considerations lead the historical narrative to the present, and the notions of “climate resilience” and “urban resilience”.



## Climate & Urban resilience

The earth, cities, and buildings we inhabit all function as ecosystems. Although Holling played a key role in shaping our understanding of ecosystem resilience, efforts to recognize, maintain, and improve ecosystem resilience have existed throughout history. There has always been a high value placed on making both natural and human-made systems capable of absorbing disturbances. However, today it is more crucial than ever to preserve existing resilient systems and create new ones, as we face an unprecedented rate of environmental and social change.

Increasingly at a worrying speed, our cities are faced with natural disasters. While we cannot design for all unpredictable events, we can prepare our buildings and cities to better withstand these disruptions and “bounce back afterwards” (Salingaros & Salingaros, 2021).

Smits conveys the situation with a powerful reflection involving, in connection with the environment, the need for “community resilience”:

“Our communities’ exposure to natural hazards will be increasingly frequent in the coming decades. With our human population continuing to rise and increasing numbers congregating along coastlines, fault lines, and river boundaries, a greater number of humans are living in harm’s way. These hazard-prone regions provide bountiful natural environments where we can find food, and shelter and engage in commerce. Yet we need to foster community resilience to address our vulnerability to the threats that are also part of these environments” (Smith, 2011).

This last section of observations focuses on climate resilience and urban resilience, two interrelated notions that exceptionally grew in the public discourse during the last ten to fifteen years.

Figure 10

*Ngram Viewer results for “climate resilience” and “urban resilience” between 1950 and 2020*



According to the Center for Climate and Energy Solutions, “Climate resilience is the ability to anticipate, prepare for, and respond to hazardous events, trends, or disturbances related to climate” (Center for Climate and Energy Solutions, 2021).

In a world with most of the population living in cities, and with these being increasingly affected by climate change, the notion of climate resilience goes hand in hand with “urban resilience”.

The latter can be defined as: “the capacity of individuals, communities, institutions, businesses and systems within a city to survive, adapt and grow no matter what kinds of chronic stresses and acute shocks they experience” (2022). The Resilient Cities Network (2022) explains these “acute shocks” as “sudden, intense events that threaten a community, such as earthquakes, hurricanes, and terrorist attacks. The impact of acute shocks is exacerbated by chronic stresses that weaken the fabric of a community over time, such as recurrent flooding, high unemployment, limited social safety nets, and inequitable public transport systems” (2022). Although urban resilience is not exclusively concerned with climate change, the latter is an important factor, particularly in light of two other global megatrends: urbanization and globalization (2022).

The concepts of climate resilience and urban resilience are often intertwined. For instance, the book *Urban Climate Resilience in Southeast Asia* aims to examine “how climate change impacts interact with poverty and vulnerability to increase the risk for urban residents in Southeast Asia” (Daniere & Garschagen, 2019). To illustrate some key lessons, I focus on Japan, a country with a long history of resilience, as well as New Zealand, which takes a holistic approach to urban resilience in the face of frequent environmental challenges.

The selection of Japan and New Zealand as case studies to explore the concepts of urban and climate resilience is informed by the abundance of literature on the topic, which necessitates a rigorous approach to information selection. Moreover, urban resilience concerning climate change is the primary focus of this thesis, and after examining the historical evolution of resilience across various fields, it is time to delve into the core of resilience as it is commonly applied today. By examining these two countries, which have faced significant environmental challenges and developed innovative solutions, valuable insights can be gleaned for improving resilience in other urban contexts.

**Japan:  
interdisciplinary  
culture of resilience**

Japan is a great example to address climate and urban resilience as an interdisciplinary approach rooted in history. Destructive environmental forces and human-inflicted devastations have forced Japanese inhabitants time and time again to rethink and implement the concept of resilience in their built environment. The Japanese certainly have resisted climate catastrophes through inventive technology, but not only. They also developed flexibility and learned to accommodate recurring earthquakes, typhoons, fires and floods (Genadt, 2019).

In a thought-provoking article titled *Three Lessons from Japan on Architec-*

tural Resilience, the author defines the term “architectural resilience as architecture’s capacity to support a community in regaining equilibrium after a powerful force has disrupted its organization” (Genadt, 2019). According to the author, this concept involves more than just the physical strength or durability of a structure, it also illustrates “the values and the difficulties in the application of resilience as an interplay of rigid and flexible elements” (Genadt, 2019).

The importance of the notion of resilience in Japanese culture can already be imagined by looking at language. In Japanese, there are several words for “resilience”: “hanekaeri 跳返”, “fukugen-ryoku 復元力”, “kaifuku-ryoku 回復力” and “kyōjinka 強靱化”. These terms have been used in different periods with nuanced meanings. “Hanekaeri 跳返” is the Japanese equivalent to resilience in mechanics, closely related to the Latin etymology “resilire”, and it appears in the dictionary in 1874.

The Edo period (1603-1868), during which the modern nation-state was formed, was characterized by recurrent earthquakes, floods and fires that challenged the built environment (Figure 10). The mechanical resilience of the materials was then applied in architecture to achieve urban resilience and prosperity, “by balancing pliability in some buildings with a combination of ductility and rigidity in others” (Genadt, 2019).

Throughout the 20th century, Japan had to deal with the destruction caused by World War II and with the following extreme urban densification. To respond to these events, the group of Metabolist architects took inspiration from resilience in biology to design adaptive buildings and cities.

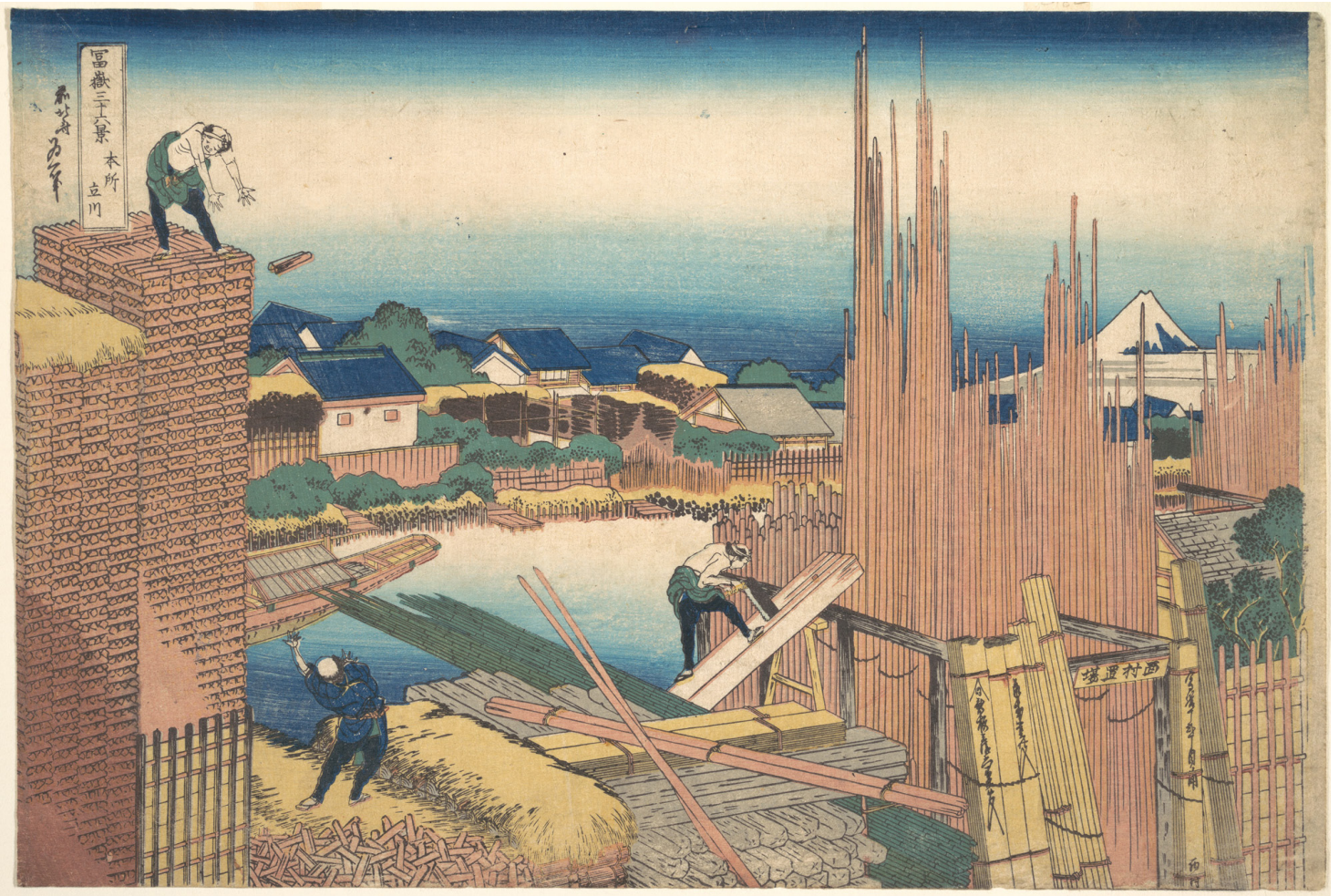
Finally, the “culture of resilience” embraced by Japan comes back in the reconstruction that followed the 2011 Great East Japan Earthquake. Here, architects complemented the engineering-based prescriptions of “toughening” with design approaches that were sensitive to the living preferences of communities. Inhabitants became protagonists of the efforts towards urban resilience by restoring their relationship with the environment (Genadt, 2019). This approach revives the basis of preindustrial resilience (of the Edo period), with the key difference of the engagement of the community.

The concept of resilience and its application in Japanese culture has undergone significant changes over time. It has taught us that traditional knowledge of structural resilience doesn’t necessarily translate to urban areas that can absorb social and climate changes. One of the important lessons from Japan is that technology alone cannot guarantee urban resilience. As a response to climate disasters, resilient architecture must also embrace the constant ebb and flow of nature. In Tohoku, for instance, architectural resilience was achieved by incorporating a reminder of the lost landscape and nature’s cycles (Genadt, 2019). This approach illustrates how architectural resilience is interconnected with social resilience, which is an essential component of climate resilience. Therefore, we cannot discuss climate resilience without also considering the notion of architectural resilience, as Japan has shown us.



Figure 10

Katsushika Hokusai, Honjō Tatekawa. Carpenters in a lumberyard.  
From the series *Thirty-six Views of Mount Fuji* (*Fugaku sanjūrokkei*), ca. 1830–32.  
Stocks of lumber and bamboo ready at hand for quick reconstruction in the Edo period. The Metropolitan Museum of Art <<https://www.metmuseum.org/art/collection/search/56386>>.



**New Zealand:  
a unique case of  
urban resilience**

Another significant case demonstrating urban resilience in practice is one of New Zealand.

Throughout history and more frequently in recent years, New Zealand has been exposed to high risks from environmental hazards. International media often features earthquakes, floods, wildfires, and draughts in New Zealand, and the country has made climate resilience a national goal (2017).

In a report assessing the resilience status and current planning of the seven largest cities of New Zealand, resilience is addressed as “a broad concept, that includes preparations to reduce the impact of a hazard and increase the ability to return to normal economic and social functionality as soon as possible with the minimum disruption and cost” (2017). Going beyond building stronger infrastructure and emergency management, urban resilience involves a holistic approach.

To face the current situation, the Ministry of Business Innovation and Employment founded the so-called Resilience Challenge (RNC) – an ambitious initiative to develop and apply new scientific solutions to transform New Zealand's resilience (2017).

The RNC seeks to implement “tools and strategies for the fast-growing and rapidly changing urban areas to thrive in the face of natural hazards, despite changing needs, populations and urban forms” (2017).

Far from only focusing on technical innovations, the notion of resilience in the “Resilience challenge” has many implications. The introduction of the report Building Urban Resilience in New Zealand (2017) lists: resilient strategy, resilience measurement, community resilience, infrastructure resilience, governance for resilience, and economic resilience. All these “resilience areas” are investigated in each of the seven largest cities of New Zealand. The report composes a look into how these cities “are working towards improved resilience to meet changing demands and thrive in the future” (2017).

One of the cities, Auckland, can be taken as an example to show the broad application of the notion of resilience within the field of urban development and climate change. Framed by the United Nations agreements on sustainable development, climate and disaster management, Auckland developed a whole set of “resilience strategies” and has resilience as the guiding principle of the work conducted by the city council.

The case of New Zealand shows a holistic approach to urban resilience, as well as a strive for self-improvement which is essential in the current climatic perspective.



Figure 11

*The city of Christchurch (NZ) destroyed by an unexpected series of earthquakes in 2010*  
Photo by Mark Longley (Alamy)  
Retrieved by <https://www.munichre.com/topics-online/en/climate-change-and-natural-disasters/natural-disasters/natural-disasters-in-australia-and-new-zealand.html>





The book *Searching for Resilience in Sustainable Development* (Blewitt and Tilbury, 2013) makes an interesting point to reflect on when looking at urban resilience:

“Katrina also demonstrated that the city’s lack of resilience was the product of discriminatory economic, housing, political and social policies that compounded and amplified the impact of the ‘natural disaster’. However, the city survived, as virtually every modern city has done in modern times, whether the havoc has been wrought by natural forces or the atomic bomb. Buildings can be rebuilt, property lines rediscovered but what is the most important in a city, and this was the case in New Orleans, was the resilience of the people – their communal institutions, family and friendship networks, intangible and tangible cultural heritage and so on (Campanella, 2006)” (Blewitt and Tilbury, 2013).

A holistic approach to resilience is essential for cities not only to survive natural disasters but to thrive amidst them. Such an attitude must consider the people who are an integral part of the city’s ecosystem. “Solutions developed through resilience approaches will allow cities to enjoy resilience dividends – helping to prevent and reduce the impact of shocks and stresses on the city’s people, economy, infrastructure and natural environment” (2022).

The historical narrative presented here provides only a glimpse into the multifaceted and constantly evolving concept of resilience, which has countless applications and intertwined meanings. While the observations I reported are by no means exhaustive, they offer a selection that showcases the rich evolution of the term resilience and emphasizes that it goes far beyond urban resilience alone.

In the next part of the thesis, I provide a theoretical interpretation to untangle the tree of “resilience” and describe this term concerning other cultural notions.

## Theoretical interpretation

So far, I have delved deeply into the history of the term ‘resilience,’ which has revealed a fascinating, multifaceted spectrum of meanings. The empirical data on resilience, combined with my scholarly study of primary and secondary sources, has resulted in an elaborate and somewhat chaotic narrative. My ambition is to make sense of this seemingly disordered collection of observations. The following section will explain these observations in a way that simplifies and links the empirical data to seemingly unrelated phenomena.

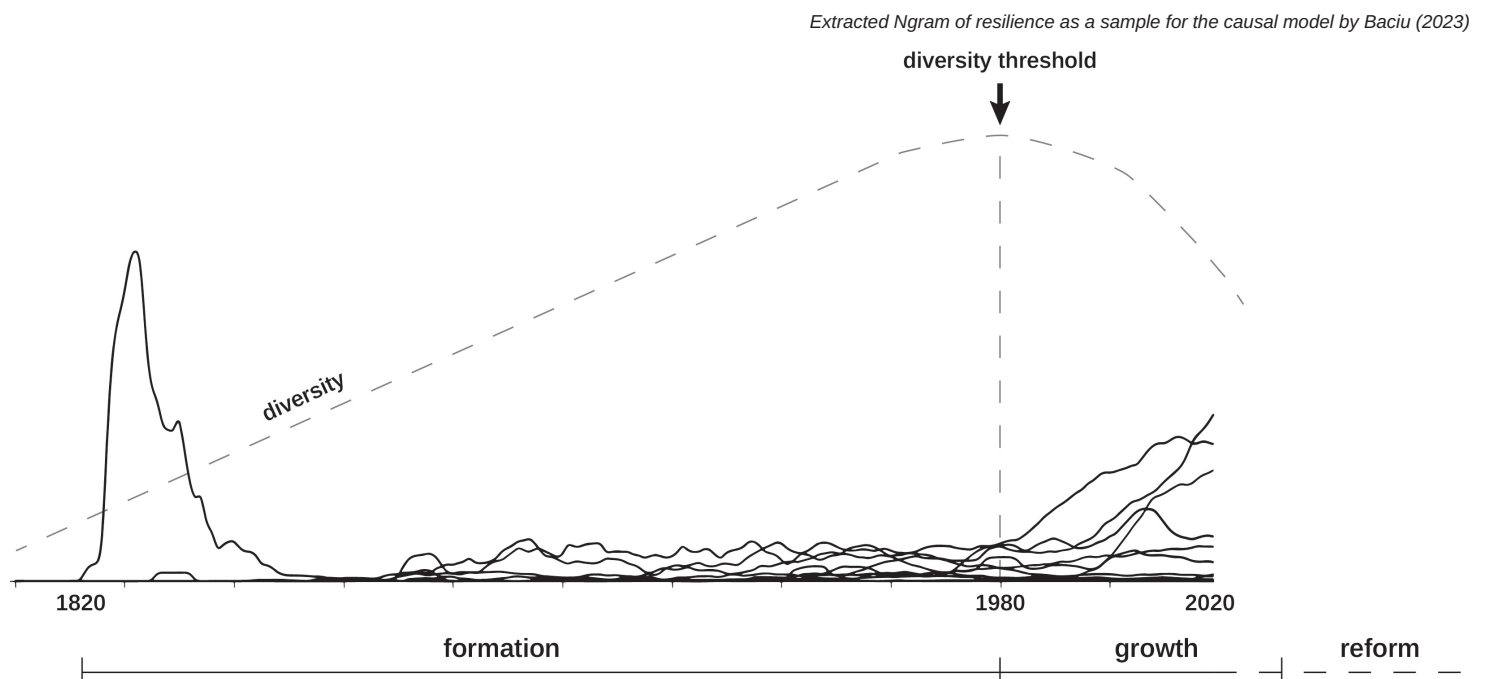
The causal model that Dan Costa Baciú developed, expanding on the theoretical background of the formation and growth behaviours, helps describe the observations on resilience.

In his corpus of publications comprising *Cultural Life: Theoretical and empirical testing* (Baciú, 2020), *The Chicago School: large scale dissemination and perception* (Baciú, 2019) and *Causal models, creativity and diversity* (Baciú, 2023), Baciú expands on the theoretical background about trends of formation and growth to develop a unified framework for causal modelling.

When looking at the empirical data of resilience with this causal model in mind, we can easily recognize a trend of formation and diversification, followed by a period of growth. Between 1820 and 1980, resilience diversified (see sub-section *Period of formation*). Since 1980, resilience has been growing in all disciplines at once – some more – some less, and it is still growing today. If we follow the causal model by Baciú, we can predict a period of habituation, or boredom, followed by a period of reform, which will start a new cycle.

In the following sub-sections, I shortly elaborate on the characteristics of the periods of formation, growth and reform. Moreover, I test these descriptions against the empirical data on resilience, to make sense of it and to compare resilience with other similar terms.

Figure 12



## Period of formation

The period of formation is characterized by an initial peak of interest that defines the first, viral phase of the term's use. After the first peak, smaller follow-up peaks arise with attention given to newer variants of the term in different disciplines. These new narratives show a trend of diversification.

Resilience became extremely popular as a physical property of the lungs. The habituation resulting from this peak of popularity prompted new variations of resilience, in new disciplines. Some first variations expanded to the field of mechanics (resilience of the material, spring and rubber), others to sociology and psychology (resilience of the human, people, American, economy, and financial), and finally to biology and ecology (resilience of the system, ecosystem, city, climate). The historical narrative already suggests this diversification, and it shows that the notion of resilience not only survived steadily but it expanded to many fields of knowledge.

The empirical data on resilience confirms the diversification suggested by the model during the period of formation (as shown in the Google Ngram Viewer graph, diversification between ca. 1870 and 1980).

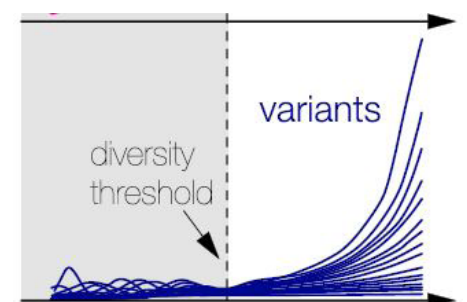
## Period of growth

According to Baciu's model, the formative phase evolves into a period of growth. "The phase of growth sets in when enough diversity is accumulated. [...] The transition from formation to growth occurs after certain diversity threshold conditions are met" (Baciu, 2020).

Figure 13 illustrates a simulation that generalizes the transition between the formative phase and the period of growth and indicates the diversity threshold.

Figure 13

Baciu, D.C. (2020), *Simulation, Cultural life: theory and empirical testing*



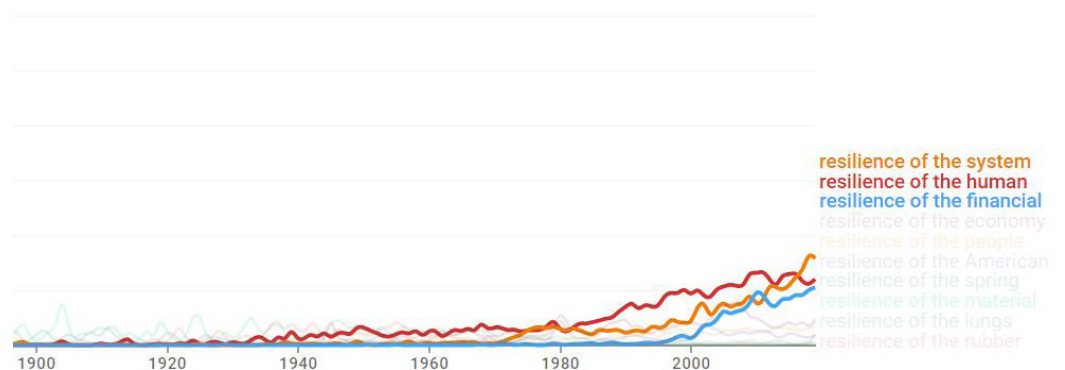
Based on the empirical data, resilience appears to have surpassed the diversity threshold around 1980 and has since been growing rapidly in most fields. Examining publications from the period of 1975 to 1985, around the diversity threshold identified by the model, reveals a significant increase in the diversity of resilience-related references. A multitude of highly diverse mentions of resilience can be found in publications within the Google Books library during this period. (see Appendix B for some examples of publications confirming the diversity threshold).



Despite variations in individual concepts of resilience, the overall period of growth for resilience from 1980 until today fits into a longer cycle in which all variants grow simultaneously. This phase is marked by competitive exclusion, leading to negative diversification (Baciu, 2020). To test the growth trend suggested by the model, I analyzed the empirical data on resilience. The quantitative study confirms the competitive exclusion during the growth period: the graph shows that “resilience of the system,” “resilience of the human,” and “resilience of the financial” outpace other notions of resilience.

Figure 14

Portion of Ngram Viewer result for “resilience of the \*”, highlighting most dominant results



As observed in the last sub-section of the historical narrative, climate and urban resilience are growing even more significantly than the notions I just mentioned. Although the rapid growth of climate resilience and urban resilience is more recent, starting from the early 2000s, it still fits in the period of growth of resilience overall. Despite maintaining a certain level of diversity in literature, the observations confirm the recent loss of diversity in the use of the term “resilience,” which now dominates the field of climate and cities.

## Period of reform

Though in resilience this has not been observed yet, these causal models predict a period of reform that follows the current growth. “Diversity leads to growth. However, growth reduces diversity. In the absence of diversity, growth eventually comes to a halt. At this point, diversification may restart” (Baciu, 2020).

Flash forward to 2040, or perhaps even 2060, where either all the plans to improve the resilience of cities have magnificently succeeded or miserably failed. The buzzword “resilience” has been so frequently used in the context of urban development and climate change that it has lost its meaning. But will it disappear permanently? It’s unlikely. The evolutionary theory and its application to culture suggest that “resilience” will enter a period of reform, where it will diversify and pique people’s interest once again.

This theoretical interpretation of the use of the term “resilience” through history allows us to make sense of the observations and assimilate this notion to other cultural phenomena. According to Baciú (2023), culture experiences cycles of development and improvement that span over several centuries. These cycles can also be viewed as phases of diversification. Specifically, during periods of growth, diversity declines, but during times of reform, it makes a comeback.

In the following discussion, I draw similarities between resilience and other cultural terms, and I highlight the difference from other terms. This reflection will bring us to a conclusion.

## Discussion & Conclusion

The use of the term “resilience” has gained significant momentum in recent years, with ecologists and environmental scholars playing a key role in its widespread adoption. The growing pace of change, be it in the cultural, economic, or environmental domains, has contributed to the rising appeal of the concept, which encapsulates the ability to withstand and recover from disruptive forces. It is worth noting that the popularity of resilience extends beyond academia and has seen a substantial surge since its first application by Carson (“The Resilience of the Resilience Debate,” 2019).

Our chronological collection of observations shows that resilience expanded from its early use in medicine to include physics, engineering, biology, psychology, anthropology, and economics, before dominating the mixed field of climate and cities. Resilience is increasingly pervasive, but its interpretations and influences vary, as can be seen in professional discourse, political actions, economics, public policy, and media discussions (Blewitt and Tilbury, 2013).

After digging into the history of resilience, I have analyzed the empirical data using existing models to make sense of the seemingly complex observations. The notion of resilience emerged in the early 19th century and went through a period of formation, starting with a viral phase in medicine and physics. As the popularity of “resilience of the lungs” decreased, the term diversified and expanded to other disciplines. This process continued for over a century until resilience reached its diversity threshold in 1980, marking the transition from the formative phase to a period of growth that is still ongoing. During this growth phase, certain applications of resilience have out-competed others, leading to the dominance of climate resilience, urban resilience, and economic resilience that we observe today.

Though resilience is a fascinating term with an equally intriguing history, its evolution is not unique. On the contrary, it belongs to a group of cultural terms that go through cycles of growth and reform. “Empirical evidence for such long cycles of growth and reform is found for example in the study of science and science branches” (Baciu, 2023). This interpretation of the observations through a mathematical model allowed me to draw similarities between resilience and other terms, some as broad as “science” and as well as the more specific ones like “Chicago school”.

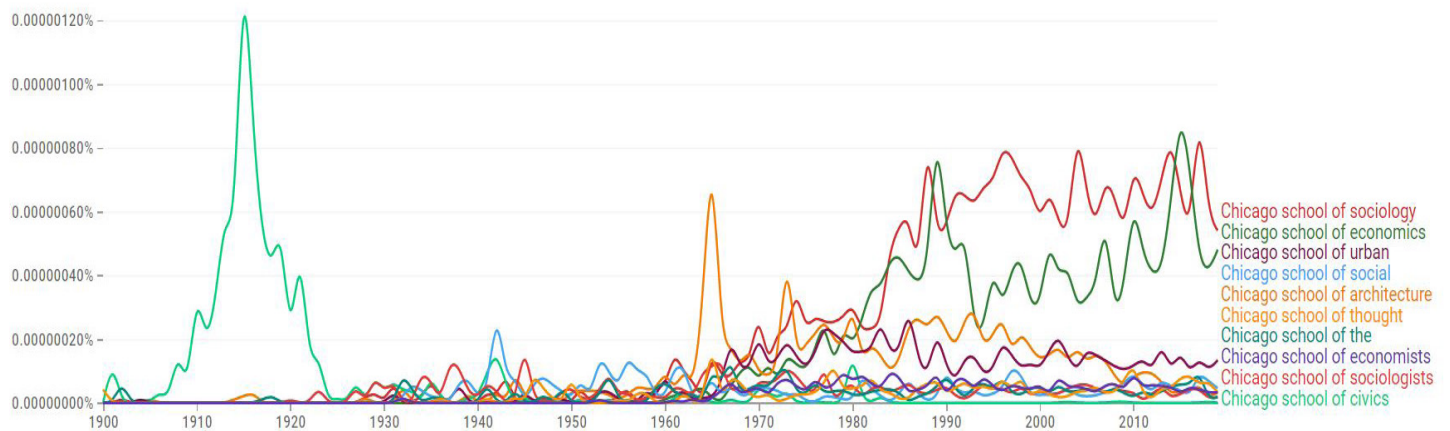
The notion of the “Chicago school” had a long period of formation, during which its collective fame remained moderate until enough schools contributing to the overall notion were accumulated. After reaching this diversity threshold, the Chicago schools went through a period of growth. The graph below manifests the similarity between “resilience” and “Chicago School”.

Empirical data confirms the recent explosion in the popularity of the term resilience, largely driven by ecologists and environmental scholars. However, the accelerating nature of change, whether environmental, cultural, or economic, also contributes to the term’s attractiveness as it captures the ability to respond to buffeting forces (“The Resilience of the Resilience Debate,” 2019b).



Figure 14

Ngram Viewer results for "Chicago school of \*" between 1900 and 2020

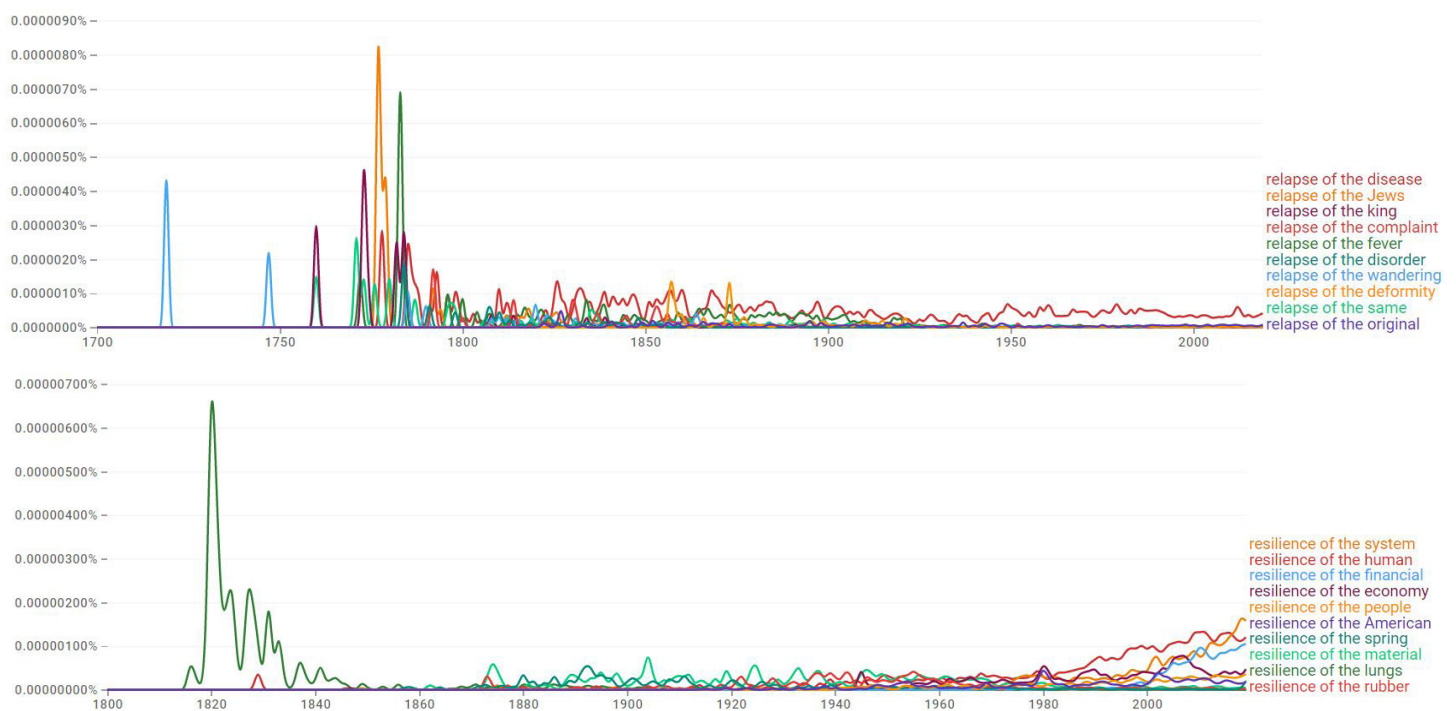


It's important to recognize that not all words are suited to evolve the way resilience did. For example, "relapse" did not experience the same growth or diversification despite its similarity in definition as the return of an illness suffered previously (Relapse, 2023b). After a first viral phase and small follow-up peaks, relapse failed to spread across disciplines, as shown in the Google Ngram Viewer graph.

In conclusion, applying this model to empirical data allows for drawing similarities and differences among notions of culture. These studies confirm the existing intuitions of some scholars.

Figure 15

Comparison between Ngram Viewer results for "relapse of the \*" between 1700 and 2020 (top) and Ngram Viewer results for "resilience of the \*" between 1800 and 2020 (bottom)



While I acknowledge that this thesis may not fully encompass the scope of the resilience debate, I intend to encourage scholars and practitioners to engage in further reflection and contribute to the ongoing historical and theoretical discourse. My hope is that the resilience discourse will remain dynamic and adaptable and that we continue to recognize its potential as an interdisciplinary concept.

Looking beyond the common use of a word can open a fascinating and intricate world of meanings. Through the lens of mathematical models, we can also uncover connections between different fields of culture, science, and biology. The history of the term “resilience” reveals a much broader and more diverse spectrum of meanings than simply the ability of cities to withstand climate change. What’s more, it matches the behaviour of major cultural phenomena.

If we look to the future, we can anticipate that resilience will continue to evolve and diversify, even if the buzzword fades from everyday use. By examining the history of this concept, we can gain a deeper understanding of its role in our cultural and scientific heritage and appreciate its relevance to our current challenges.

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## Appendices

### **Appendix A: Methodology**

This present thesis unites a large-scale quantitative study of published books with a traditional scholarly evaluation of outstanding source material to revisit how the many senses of resilience evolved and diversified.

An empirical study on Google Books Ngram analyses the frequency and diversification of the word's use in various fields and illustrates a tangled tree of resilience. By laying out this tangled tree in the form of a historical narrative on resilience, I categorize the applications of the term and connect them when appropriate.

The historical narrative of the use of resilience is followed by the theoretical interpretation of the empirical data. This part particularly contributes to the research on resilience, as I describe the seemingly chaotic observations through causal models developed by Dan Costa Baciú to explain trends in humanities.

With the help of these causal models, the thesis further substantiates that the history of the term "resilience" reveals the same periods of formation and growth as do "science" and "Chicago school" and many other similar terms describing cultural phenomena. This theoretical interpretation stands by the hypothesis that affirms a "striking equivalence between nature and culture" (Baciú, 2020).



## **Appendix B: Diversity threshold in “resilience”**

To test the diversity threshold indicated by Baciú's causal model, I collected some examples of publications between 1975 and 1980 that show high diversification:

*The Resilience of Ecosystems: an ecological view of environmental restoration* (Dubos, 1978);

*The Resilience of Religious Tradition in the Dramas of Wole Soyinka and James Ene Henshaw* (Edet, 1984);

*Vulnerability, Resilience and the Collapse of Society: A Review of Models and Possible Climatic Applications* (Timmerman, 1981);

*Robustness, Reliability, Resilience and Vulnerability Criteria for Planning Water Resources Systems* (Hashimoto, 1980);

*Rubber: mixes and vulcanized rubber* (1984);

*Regional and national resilience in Asian Survey* - Volume 17 (The University of California, 1977).

This small sample confirms the high diversification of the notion of resilience in the historical moment that we define as the “diversity threshold”.



