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The Checkered Rise of Resilience. Anticipating Risks of Nature in Switzerland and Germany since 1800

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Abstract: *»Der Aufstieg der Resilienz. Die Antizipation von Naturrisiken in der Schweiz und in Deutschland seit 1800«.* Both concepts, prevention and resilience, are ways of thinking and acting that are very similar at first glance. Prevention means optimising the present by anticipating the future. Crucial for the idea and practice of prevention is anticipating a risky future that should never become reality. Resilience describes a less radical manner of behaviour, which does not want to prevent risks per se. It stresses the ability to anticipate danger and to resist damage – if possible without losses. The terms "prevention" and "resilience" are still relatively young and have appeared infrequently in systems ecology, criminology and medicine since the early twentieth century. This article detaches both concepts from these fields and examines their heuristic potential with the example of natural disasters. In order to shed light on the history of prevention and resilience, the essay focuses on various agents with their specific strategies and techniques. So beside the history of hydraulic engineering, it presents other examples from weather control, scenario planning and disaster research to insurance business. It argues that latest in the second half of the twentieth century arguments for prevention lost their credibility as risks during the technological change multiplied constantly. Strategies of resilience, however, seemed far more realistic in a phase of risk pluralization and replaced the paradigm of prevention in many areas. Yet prevention did not fully disappear, but rather became a part of the much wider overall strategy of resilience.

Keywords: Prevention, resilience, natural hazards, hydraulic engineering, weather control, insurance, disaster research.

1. Introduction[1]

In 1825 the hydraulic engineer Johann Gottfried Tulla from Baden published his famous treatise on "the rectification of the Rhine." Had it appeared one-hundred-and-fifty years later, people would have only been surprised at its use of unusual language. Yet its content represents almost entirely the Zeitgeist of the second half of the twentieth century. Without actually using the specific

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terms, Tulla promoted a programme on environmental and security policies. His plan was to straighten the Rhine and thereby defend the region from flooding and epidemic. Scholars have already written extensively on the corrections of the river (Blackbourn 2006; Bernhardt 1998). For this essay Tulla's argumentation to convince the funders of his project is of greater importance. He writes, "especially the personal safety of the people living at the banks of the Rhine and their exemption from the heavy strain of self-defence when the weather is stormy, wet or cold as well as securing their homes and cattle must be considered" (Tulla 1825, 5). In the course of his essay Tulla's rhetoric develops into a dramatic natural apocalyptic:

"If the Rhine is not rectified," Tulla writes,

> the thunder bells will not stop ringing, the dams will continue to burst, and soon this or that village and its council will be flooded; the swamps will not only not disappear but rather expand. The lowlands, which could still be used before, will later enhance the number of swamps because the groundwater will increase and its outflow will be prevented more and more (Tulla 1825, 51).

Time, or to be more precise, future, obviously played a crucial role in Tulla's plans. His strategy was to invent a future full of dangers which mankind could barely manage if it remained inactive. This calculation was typical for hydrology of the early nineteenth century. Since 1800 hydraulic engineering had become professionalized and eventually a part of state administration. A forecast future full of risks for human life and infrastructure opened its way, especially as engineers provided precisely the technologies necessary to prevent these feared risks. At roughly the same time the German states of the Confederation of the Rhine, Prussia and Switzerland were undergoing an intensive phase of reformation in which the referrals of hydraulic engineering seemed to come right on cue. These countries hoped to reduce natural disasters by correcting rivers, making farmland arable as well as optimizing waterways for economic purposes.

The leading Swiss exponent was Hans Konrad Escher, who devised his plans for correcting the Linth during the Helvetic Revolution around 1798 (Speich 2003). He, too, predicted that the newly formed state could gain great security and economic upswing. Escher also drafted a future full of hazards in order to convince political authorities of the necessity of his project: "Order, love of work, diligence and economy will not protect them against shortage and poverty," Escher wrote about the inhabitants of the Linth plain.

> They also cannot find refuge in the sanctity of their homes anymore. […] The floodwaters invade the basements of their houses, and here and there reach the first storeys. […] The population long since lives below its former standards; these weak, pale creatures without energy and spirit seem to be wandering shadows, haggard by the feeling of their own abatement, and even more by looking at their children, who clearly show prevalent degradation of mind and body so that in the end one is not only afraid of the earth's engulfment but also of entire mankind (Escher and Ith 1807, 5 et seq.).

The correction of the Rhine and Linth were mammoth projects and dragged on for decades. And they were merely a part of a fever of straightening rivers which gripped Switzerland and the German states in the nineteenth century. There was hardly a river that hydraulic engineers had not tried to straighten (Vischer 2003, 61-162; Summermatter 2007, 200-14). Although several of these hydro-engineering projects, realised since the nineteenth century by European states and their hydraulic engineers, could indeed reduce the number of floods significantly, times seem to have changed since the second half of the twentieth century. Ecology of renaturation was now opposed to the old hydrology topos of correction. In the 1980s hydraulic engineers considered human intervention in natural landscapes a disruption of the ecosystem. Therefore, they established means to create its original state again. The past seemed to replace the future as an agent for implementing a particular concept of hydrology.

Yet the new field of environmental politics discussed not only Tulla and Escher's methods. They criticized their line of argumentation, their *anticipation of the future*, indeed, their entire concept of prevention. During the nineteenth and twentieth centuries the reception of (natural) disasters had changed considerably. The means for floods that Tulla, Escher and others had conceived of should also apply to further natural hazards, so to landslides, avalanches and even to earthquakes and tornadoes in the respective regions. Natural scientists and disaster researchers suggested to the government to differentiate more precisely between factual risks and purely hypothetical ones. The aim of this differentiation was not only to process the damaging events occurring but also those that were just considered possible. Thus, the disaster developed into a scenario whose occurrence had to be ideally prevented or whose effects had to be calculated and allayed (Hannig 2015, 33-65). Nevertheless, even this model of prevention propagated by Tulla and Escher as the crux for implementing their plans had lost its power of persuasion.

The limits of *prevention* were at the same time also the opportunity for a new, different strategy: of *resilience.* Changes in dealing with floods are just one example of this shift. There are many other fields in which you can follow the footprints of this development, such as weather control, scenario planning, disaster research and insurance business. Although strategies to build up a resilient society can be traced back to earlier centuries, it is noticeable that especially in the field of natural hazards certain economic trends have reappeared since the eighteenth century. Preventive ideas concerning hydrology and, in particular, straightening rivers were the nineteenth century's silver bullet against floods. But latest in the second half of the twentieth century arguments for prevention lost their credibility and acceptance because risks during the technological change were constantly growing. Of course, sciences continued their meticulous research on avoiding natural hazards before they even occurred. Strategies of resilience, however, seemed far more realistic in a phase of risk pluralization and eventually replaced the paradigm of prevention

in many areas (Itzen and Müller 2016, 16-7, in this HSR Special Issue). Yet prevention did not fully disappear, but rather became a part of the much wider overall strategy of resilience (Thoma 2014).

In the 1970s the American disaster researchers Dennis S. Mileti and J. Eugene Haas published a study presenting this change of thought (Haas and Mileti 1976; Geipel 1977, 2-9).[2] They faked a forecast for an earthquake reaching a magnitude of 7.4 on the Richter scale, which would occur in three years' time. Mileti and Haas wanted to offer their experimentees the possibility to avert a disaster before it even arose because evacuations and other safety measures could be organized with enough time given. Subsequently, they spread relevant information to decision-makers in science, politics, media and economy, and then evaluated their reactions. Their results seemed cynical, yet instructive for the booming hazard research, which explicitly dealt with prognoses of disasters. Mileti and Haas found out that the economic consequences would be more fatal for the alleged earthquake region than if there were no warning in advance. In their scenario, firms moved away, investment came to an end, trade tax sank towards zero. In this simulation prevention appeared to lead to a catastrophe before the catastrophe. However, not only the empirical results of this contemporary study are interesting. When they are historicized, you can recognize that common concepts of prevention lost their appeal. To research on prevention thus also meant to reflect on former means of prevention and to therefore hinder even greater damage than caused by the natural hazard itself. In addition, it becomes clear that not only engineers and scientists were involved but also sociology and economic studies. Contemporary surveys like these show that the history of dealing with disasters cannot be considered a success story of prevention.

2. Concepts of Prevention and Resilience in the Field of Natural Hazards

Both concepts, prevention and resilience, are ways of thinking and acting that are very similar at first glance. Prevention means optimizing the present by anticipating the future (cf. Bröckling 2008, 38-48; Billis 1981, 367-79). Crucial for the idea and practice of prevention is anticipating a risky future that should never become reality. The present future, or seen from a historical perspective, the contemporary image of future, is always the starting point. At the same time preventive thought projects a risk-free present as an ideal onto the future,

[2] Haas and Mileti (1976) presented their research at the Australian Academy of Science Symposium on Natural Hazards in Canberra as well as at the annual meeting of the Midwest Sociological Society in St. Louis in 1976. For their reception in Germany, cf., e.g., Geipel (1977).

and therefore attempts more at securing and hindering than creating and improving. Yet prevention is still active in a two-fold sense: first, preventive thought designs precisely those futures that seem threatening. And then preventive action offers help with a promise to avoid those futures. Defined as such, prevention can devise everything as a threat – criminality, disease, social insecurity as well as nature. It usually bases its interferences on scientific knowledge and thereby differs from other individual and spontaneous prevention practice. Modern prevention commonly had its roots in systematic data collection, cause studies or prognostic. The base of preventive action was therefore the conviction of a changeable future (Makropoulos 2000, 79).

Resilience describes a less radical manner of behaviour, which does not want to prevent risks per se. Similar to prevention, the term of resilience derived from systems ecology as well as medical and psychotherapeutic contexts until it appeared more commonly in contexts of disaster research in the 1970s (Walker and Cooper 2011, 143-60; Bonß 2014, 14-31). Resilience stresses the ability to anticipate danger and to resist damage, if possible without losses. This can occur in different ways. Damaged areas can prove to be very robust and therefore not highly vulnerable. Furthermore, resilient systems strive for quick recovery after the event of damage in order to achieve their original state again – in sociology this is called the 'bounce back effect.' After all, resilient societies and their subsections try to acquire the competence to constantly change their structures and thereby react flexibly to potential damage. So it is important to them to achieve a fault-tolerant state of constant adjustability, usually with the help of supportive technologies and target-driven education. Here, states are just as responsible as are private companies (Edwards 2009; Folke 2006, 254-67). The triumphal march of resilience strategies we can observe nowadays is just as much an indication for the assumption that total protection can only be illusionary for a strongly dense infrastructure. Thus, one could add a motto to Ulrich Beck's risk society: resilience seems more realistic than prevention.

Historically, the concepts of prevention and resilience refer to a famous distinction: in the 1920s the economist and founder of the Chicago School, Frank Knight, postulated the differentiation between risk and uncertainty (Knight 1921). His starting point was the assumption that not every risk can be calculated probabilistically; in some cases it can escape this control. Since then political, economic and sociological studies have used this distinction in the hope of separating old and new risk cultures. They seem to be right when considering genetically engineered or atomic risks. Yet risk analysts like to integrate natural disasters sweepingly into this periodization and group them under the 'new risk cultures' without considering that in previous centuries especially natural phenomena like earthquakes or floods could lead to risks whose potential for damage were in no way inferior to the technological risks of the twentieth century. However, in the field of natural disasters a distinction between risk

and uncertainty was applied during the twentieth century that can also be read as an expression of a change from prevention to resilience.

With the increase of tight infrastructural networking the extent of damage also rose in the twentieth century. Large reinsurance companies such as Munich Re registered a nine-fold rise of the insured damaged goods and sixteen-fold the entire economic loss between 1950 and 1995 (Berz 1999, 427-42; 2009, 129-41).[3] Certainly, such rapidly rising figures were the reason for a change of mind and encouraged new forms of protection. To examine and outline the checkered and conflictual paradigm shift from prevention to resilience more precisely, one needs to refer to more sources than just economic loss curves. Therefore, in the following section I would like to examine the three most important agents of prevention and resilience with their specific strategies and techniques. Furthermore, I will take a look at which societal circumstances formed strategies of resilience against natural hazards. In this way precisely those areas can be historicized that up to today still foster enhanced resilience. First and foremost, these are *sciences and social sciences* as well as the *insurance* sector, which have presented themselves as the impulse generators of governmental safety policy since the nineteenth century. But even *politics* triggered several innovations that steered dealings with natural disasters on new courses.

3. Agents of Resilience: Politics, Science and Insurance

3.1 Politics

Let us therefore start with *politics* as the first example of an agent of resilience. During the nineteenth century, protection against natural hazards was gradually nationalized. Around 1800 building authorities of the German states and Swiss cantons began organizing disaster management, thereby slowly taking it away from the responsibility of individual landowners and residents (cf. Summermatter 2005; Speich 2003; Fischer 2003, 272-81). In the twentieth century this tendency towards nationalization expanded to establishing authorities for disaster control and other specialized organizations under national jurisdiction.

In Germany, the *Technische Nothilfe* (technical emergency assistance) as the third institution besides the fire brigade and medical services was responsible for tasks of civil protection, floods and fires. During the Third Reich, the National Socialists tried to release it from their responsibilities and hand disaster management over to the *Sturmabteilung* (SA).[4] Yet there were still several

[3] Nonetheless, the death toll sank slightly.

[4] A letter from SA Gruppenführer Arthur Rakobrandt to the regional administration of Bayerische Ostmark and other offices, 22.1.1936, in: Bayerisches Hauptstaatsarchiv, Bestand Innenministerium, Signatur 71702.

floods where the expertise of the *Technische Nothilfe* was needed (Kunze 1938). In the Federal Republic the organization resumed its work as the *Technisches Hilfswerk* (technical relief organisation). Now civil protection was a matter of the states and, thus, in the hands of the interior ministries. After the war civil defence and disaster protection started to be reformed. The federal ministries also began building up their own departments for disaster protection. These, in turn, set up new federal laws to regulate the areas of authority and worked on concepts on how the government should deal with possible disasters.

Strategies that civil security research later subsumed under the term 'preparedness' were highly sought after by the West German post-war government (Collier and Lakoff 2008). Already since the 1920s there was a trend to rely on less invasive risk management. Therefore, more and more voices drew attention to the dangers created by prevention techniques themselves. Especially the "enforced relocation[s] of river banks" had led to shifting farmland and settlements closer to the water, which, in turn, formed new risks. The government wanted to encounter this threat by building weirs and specialized services for safeguard, which had previously been established only sporadically on local levels. The task of these services was not preventing hazards like floods per se, but rather limiting the inevitable extent of damage and, thus, optimizing the phase of recovery after the shock.[5]

After the Second World War this shift to concepts of resilience continued. Civil servants started to organize simulations in order to guarantee smooth operations during a catastrophe. From a military point of view the roots of this technique go back to the eighteenth and nineteenth century. In the Cold War simulations as well as scenarios had their heyday, especially in the USA, and became well-established as a method of simulation to overcome political and military crises (Collier 2008; Ellebrecht, Jenki and Kaufmann 2013, 240-50). As for the Federal Republic of Germany, first experiments to try out similar methods of simulation were carried out very soon after the Second World War, too. Thus, authorities transferred these military techniques to civilian areas. To my knowledge, the first simulation was run by the Bavarian Ministry of the Interior in 1951. Its typology, aim and procedure are well-documented. The report of the ministry states:

> In a simulation a situation which is made up but close as possible to reality is played through with the help of a plan and maps. The acting participants are selected from the present group of people. The simulation is instructed doctrinally to them by people chosen beforehand. […] Every simulation is based on a supposition, a so-called situation or practice situation that explains briefly

[5] A letter from Ludwig Ritter von Knözinger, district president of Upper Bavaria to all departments of roads and rivers of the district and the section for construction and maintenance of torrents in Rosenheim, 6.4.1927, in: BayHstA, Bestand Innenministerium, Signatur 71702.

> what has happened up to then. This situation is a substitute for reality, the base of all events in the game.[6]

The spectrum of catastrophe scenes drawn up by the Bavarian Ministry of the Interior was wide. As to natural hazards, various types of flooding scenarios dominated due to the state's geography. Yet this first organized simulation dealt with a completely different type of flood:

"Since the early morning of the 11th of June of an unknown year," the preface remarks,

> groups of people are suddenly, constantly and for no apparent reason flocking into the Northeast districts of Bavaria. […] The reports from the border offices state that these are people who are arriving partly without belongings, partly with aimlessly packed inventory on foot, bicycle or agricultural, horse-drawn carriages. They are flooding the border districts and sections are moving southwest towards the county's interior.[7]

The Free State of Bavaria considered military East-West conflicts at its Eastern borders absolutely realistic at the beginning of the 1950s, so the riot police force had to act out several scenarios of the refugee issue.

Simulations like these created a dreadful future that chosen groups of people could experience. These artificially designed experiences were supposed to damp the risks in the present. A later evaluation of the Bavarian Ministry of the Interior states: simulations must "give suggestions on how to fight catastrophes to all of the authorities, offices and organizations involved in disaster control." In addition, these "authorities, offices and organizations" should be inspired to "check their disaster prevention means and – if necessary – improve them."[8] So the work of the governmental offices responsible was directed towards the future in its approach; nevertheless, the character of this bureaucratic way of prevention was rather conservative. The respective departments considered prevention to be first and foremost an optimization of management. In this logic risk seemed acceptable and did not have to be fought as such or even avoided fully.

With this technique of scenarios a new type of data production emerged that was meant to be useful for risk analysis (Parker 2014). Simulations provided the opportunity to measure social behaviour as well as the functionality of organizational procedures empirically. Certainly, the idea was that scientific and technological solutions had their limits and that preventive measures, devised to not let the potential source of danger ever occur, were not feasible. With this new, more or less sociological, data basis authorities wanted to improve their reaction in the case of a disaster. So the government did not in fact

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[6] Erstes Lehrplanspiel Schutz in Katastrophenfällen (Lagen Naila, Hof, Münchberg und Moschendorf), in: BayHStA, Bestand Präsidium der Bereitschaftspolizei, Signatur 31.

[7] Ibid.

[8] A letter from Wilhelm Hoegner, 3.12.1953, in: BayHStA, Bestand Innenministerium, Signatur M 1500.001.

turn its back on general, forward-looking practices of disaster control. Rather, their epistemology changed. Simulations made the future that preventive measures tried to hinder perceptible. So desired reactions towards extreme events were practised (Ellebrecht, Jenki and Kaufmann 2013, 237 et seq.). It was not the first time this technique was applied – especially in the military context manoeuvres were commonly performed. However, transferring them to dealings with natural hazards and other civilian threats in an attempt to compensate the limits of insurability acquired a new quality here.

Generally, this disaster management expresses a fundamental attitude towards natural threats: namely that post-war states did not just fear danger. They partly relied on threats, used them for calculations and often saw hazards as an argument for governmental action. Paradoxically, risks could therefore threaten the state and secure it at the same time. On the federal state level, the ministries tried to closely regulate the areas of responsibility in the event of a disaster, such as high water, floods, bridge collapses, storms, epidemics, etc., to remit "to the administrative body responsible for the specific field of disaster." The rhetoric of the German government was, however, remarkably defensive, for example, when it merely required to keep "damage and loss of the national wealth as slight as possible"[9] Although the departments differentiated distinctly between "preventive" and "protective" disaster control prevention was often perceived as working on and with plans for protection, which – comparable to simulations – should optimize behaviour in the event of a disaster.[10] Hence, the formation and organization of disaster control relied indeed heavily on strategies of resilience. The ministries tried to regulate behaviour *during* the catastrophe and did not address the dangerous event *as such*.

3.2 Science

A second example of a modern prevention and resilience agent is *science*. Concerning its prevention techniques, science operated far more radically than the state's bureaucracy in the nineteenth century although its action cannot, of course, be examined without its close relationship to the government. It was considerably earlier than the so-called "age of scientification," whose beginning is usually set in the 1880s (Szöllösi-Janze 2004), that particularly geology and its related disciplines, such as seismology, volcanology or hydrology,

[9] Letter from Wilhelm Hoegner, 18.4.1951, in: BayHStA, Bestand Innenministerium, Signatur 92158. Cf. also Rechtliche Grundlagen und Organisation des Katastrophenschutzes, *Zivilschutz* 32 (1968): 75-82.

[10] Letter from the undersecretary Herzog to the department IC of the Bavarian Ministry of the Interior, 23.3.1965, in: BayHStA, Bestand Innenministerium, Signatur 92158. Some associations criticised the fuzzy usage of the term "prevention" again and again; cf. the letter from the administrative district association of Bavaria to the Ministry of the Interior, 29.3.1968, in: ibid.

raised society's awareness for natural hazards. They were often the ones who paved the way for prevention. Yet also in the twentieth century you come across some radical techniques of prevention, such as controlling or modifying the weather – a technique that is nowadays examined especially in the contexts of Cold War Science (Achermann 2013; Fleming 2010, 165-88; Harper and Doel 2010; Kwa 2001). But when these attempts of weather control are detached from these contexts, an important trail leading to a dispute over advantages and disadvantages of preventive strategies becomes visible.

In 1948 the agricultural office of the Swiss Department of National Economy organized a concerted action: the battle against hail in the canton of Tessin. The plain of Magadino in Southern Switzerland was impassable moor landscape far into the nineteenth century. Apart from countless germs, the plain inhabited only a few shepherds who could use parts of it for pasture. Yet corrections at the end of the nineteenth century had made this previously wildly meandering river, the Tessin, into an almost straightened canal, and thus also the moor area into an agricultural area, which is still used intensively today. The cultivated fields were fertile and promised good harvests. Nonetheless, the farmers had to deal with large-scale crop failure as the Magadino plain also belongs to one of Switzerland's regions with the most hail. People wanted to prevent this danger – not only with insurances but also with technology (Mauelshagen 2014; Oberholzner 2015). Since the late eighteenth century scholars and nature lovers had discussed the possibility of fending off hail, commonly with the help of canons to disperse the arising clouds (cf., e.g. Heinrich 1789). These techniques were gradually improved; engineers met at International Congresses of Hail Shooting, and insurances benefitted in their tariffs landowners who used hail canons (Fleming 2010, 81-4). Italy, France, Germany, Switzerland and Austria even set up several institutions for shooting clouds (Bouiller 1990). Although its efficiency always remained uncertain its technology was still attractive because it assured true prevention by not even letting the feared hail occur.

Thus, the hopes put into hail shooting are just a part of prevention history as are the constant clean breaks with this practice attempted by science. Even in 1907 the Austrian meteorologist and Privy Councillor Josef Maria Pertner postulated after extensive experiments that the end of war on the clouds had approached. Probably Pertner himself knew that this meteorological clean break was only a half-hearted one, especially when considering that up to date science had not delivered a convincing theory on the formation of hail (Pertner 1907). To end speculations on its usefulness, shortly after the Second World War the Swiss Department of Agriculture started a five-year, large-scale experiment in the Magadino plain in cooperation with the Meteorological Central Department as well as, tellingly, the Swiss Hail Insurance Company. Once and for all it wanted to clarify "whether the hail defence rockets common in Switzerland and that accord to the Swiss standards can prevent the formation of hail

or not." The result was disillusioning to many farmers who were convinced of the efficiency of hail shooting.

"We conclude," the Swiss commission wrote, "that there are no signs pointing to plausible explanations for the hail preventing effect of the rockets used in our large-scale experiment."[11] It is astonishing that despite this expensive and elaborate experiment the practice of hail shooting did not go out of fashion. Quite the contrary, farmers merely ignored these scientific results, relied on their practical experiences and invested independently in new varieties of this technology that had proven to be reliable in their view. In regions of hail, local politicians therefore saw potential to make a mark in these initiatives. The Bavarian district of Rosenheim, for example, also started a large-scale experiment between 1957 and 1967 on behalf of the federal state parliament and supported by state funds – although it had knowledge of the outcome in Switzerland (Achermann 2013, 231-33, 236 et seq.). Silver iodide rockets and propane generators were tested, and since 1975 the citizens of Rosenheim began injecting clouds with these chemicals by aircraft (Gimple 1984; the welcoming speech of the federal state parliament of the district Rosenheim by Dr. Max Gimple in Bayerisches Staatsministerium für Wirtschaft und Verkehr 1985). Amateur researchers worked hard on alternative methods, such as the 'noise canon' whose acoustic waves should mix up the atmospheric layers to produce rain instead of hail. But all of these techniques were marginalized by meteorology or even disclaimed totally in most cases (Bayer. Staatsministerium für Wirtschaft u. Verkehr 1985). In light of this background other researchers, in turn, favoured strategies of resilience and therefore tried to keep the damage slight with the help of nets and other coverings (Weidner 1977). Yet the adherents of hail shootings did not drift off the course of prevention reaching back into the eighteenth century. This example shows that there was not a smooth shift towards strategies of resilience in every field.

However, hydraulic engineering welcomed the renunciation of preventive measures more unanimously. Here you can see a striking turn towards strategies based on resilience. What is remarkable is that hydrology brought together concepts of resilience with ideas of sustainability. Indeed, both concepts were even mutually dependent although recent discussions in German-speaking countries give the impression that resilience theories are a further development of the concept of sustainability (Thoma 2014; Kaltenbrunner 2013, N2). In the twentieth century hydrotechnological interventions were now not only triggered by nature's threat; politics and environmental movements stressed the topic of endangered nature more and more, and not only demanded protection

[11] All quotes are from the final report of Eidg. Kommission zum Studium der Hagelbildung und der Hagelabwehr über den Grossversuch Nr. 1 zur Bekämpfung des Hagels auf der Magadinoebene (Tessin) 1948-1952, in: Bundesarchiv Bern (CH-BAR) E7220A#1970/53#205, Az. 410, Allgemeines, 1955.

from water but also *its* protection (Stern 2006, 17-24). In addition, many previous promises of prevention could not be kept. For example, from the Pyrenees in the eighteenth century to North America in the early twentieth century people commonly assumed that deforestation of mountain areas prevented floods; a view shared by both forestry scientists and politicians, too (Pfister and Brändli 1999; Lübken 2014, 239-47). Yet during the last century this promise of prevention lost its persuasive power.

This is also and especially true of hydrotechnology, which even produced new risks according to its opponents (there were also many other critical voices, for example, André 1828; Schindler 1878). Many correction projects had actually widened and excelled the flow of rivers so that, in part, the middle and lower courses had to transport enormous rates of runoff. Areas that could have served as detention reservoirs had disappeared, thereby shifting the risk of flooding to a local level. Furthermore, river regulations had determined areas for settlement that had been pure swamp or flood regions before the corrections. However, the risk exposure in regions close to water was now enhanced (Götz 2002). Finally, these river engineering projects had generated constant cost responsibility since the nineteenth century, which meant a high maintenance burden for states and cantons. Especially in Switzerland a long period without bigger hazards in the twentieth century had led to neglecting servicing, which had fatal consequences during the floods of the 1970s and 80s. The amount of damage totalled to over 2.5 billion Franks when high water joined the Reuss in the canton Uri in 1987 from the area of the Gotthard to the Lake Urner and damaged dams that were in part one hundred years old (Müller, Zimmermann et al. 1997, 43-84; Bundesamt für Wasserwirtschaft 1991).

Events like these, together with an enhanced environmental agenda, caused a change of hydraulic engineering's objective. Action groups, such as the Schaffhausener Aqua Viva or the Rheinaubund that campaigned in the 1960s and 70s explicitly for the protection and recovery of semi-natural waters, demanded to combine the concepts of flood control more strongly with the ideas of sustainability (Skenderovic 1994). By no means were these demands unchallenged, and particularly not in the early 1960s. Authorities of hydrology by all means questioned whether costly torrent control should be kept up. They thought, for example, that "nature should rather take its course, because in the play of forces […] a calmer and more stable state would be achieved" (Glarus 1963, 10 et seq.) But they mostly decided in favour of hydrotechnological intervention. So the danger by nature still overtrumped the endangerment of nature. In discussions the "danger of substantially serious interferences with economy and traffic" had to "be banned," wrote Swiss hydraulic engineers in 1913. "What has to be checked" was "only the matter to which extent such work should be tackled today" (ibid., 11).

Nevertheless, a change of thought came to the fore. The aims of flood prevention were changing and now relied more and more on resilience strategies.

The first legislative changes and draft papers in the 1970s and 1980s finally announced what hydrology had been implementing latest since the extreme floods of 1987 and 1993, namely abandoning hazard prevention primarily based on technological measures (Bundesamt für Wasserwirtschaft 1992). In fact, authorities saw it as their task to prepare people for a rise of floods, for example, by stopping settlement of and construction in risky areas near rivers (B[eat] Jo[rdi] 2002). These more or less 'passive' protection schemes were to precede invasive measures, such as interventions through water constructions, and to reduce them to a minimum (Bundesamt für Wasser und Geologie 2001).

The blueprint for this change in strategy came from a completely different setting. During the twentieth century even the social sciences rushed into the market of prevention agents. As so-called *Disaster Studies*, originating mainly in the USA, they developed models that offered basic, preventive attempts to regulate human behaviour in the case of a catastrophe (Knowles 2011). While American catastrophe sociologists initiated first field research on "human behaviour in disaster" after the Second World War, Europe needed until the 1970s to find an equivalent group of researchers (Fritz and Marks 1954; Stehrenberger 2014). For example, in Bavaria a new focus on geographical risk research formed around the geographer Robert Geipel at the Technical University of Munich. The main reason for this was the earthquake in Friaul in the Northeast of Italy in 1976, which Geipel analysed according to sociological aspects. Although there had been single trends towards social geography in Frankfurt and Munich since the 1950s, its establishment only occurred roughly twenty years later. Geographers connected descriptions of catastrophes and risk considerations more closely with behavioural research and surveys on development planning in areas of disasters (Geipel 1977, 13-20; Steuer 1979; Geipel, Pohl and Stagl 1988).

It was no coincidence that earthquakes were their focus of research. Unlike meteorological events like floods and hurricanes, earthquakes occur without any warning. So with this background in mind a shift towards more sociological perspectives seems to present a contemporary understanding of the limits of prevention. "Earthquakes present long-term provisional problems for the designing geographer, especially in urban agglomerations," Geipel pointed out himself (Geipel 1977, 21). A way out of this dilemma of prevention was shown in studies examining *behaviour* in the case of a disaster. The geographers accepted so to speak the proper natural phenomenon as well as its unpredictability. In so far they expanded the term of risk of natural hazard in a very substantial manner. They researched in particular the interaction of meteorological, or rather seismic, hazards and social, region-specific vulnerability – a perspective that is currently celebrating its revival in environmental history.

Elsewhere and at the same time another disaster research group was founded which worked exclusively sociologically. "Psychobiology" was the name of this committee the German Federal Republic established in the "Defence Committee

of the Minister of the Interior" in 1970, led by Lars Clausen, a sociologist from Kiel. Yet soon after the psychobiologists had started their work first tensions developed. In the eyes of the Federal Office for Civil Defence, the work of the group seemed too theoretical and too little application-oriented (Dombrowsky 1995). Still, it was the first time that sociological disaster researchers addressed the public. These sociologists focused not only on post-catastrophe, but also on pre-catastrophe research. They propagated the thesis that "natural disasters" did not in fact exist, only "cultural catastrophes." Clausen and his assistant Wieland Jäger therefore decoupled industrial disasters and natural hazards from their contingent character and described them more as a process, a "form of radical and rapid social change" (Clausen and Jäger 1975, 23). So the researchers did not emphasize the spontaneity of a critical situation analytically, but rather presented themselves as agents of resilience who knew how to steer behaviour in the case of a catastrophe so that collateral and property damage could be reduced to a minimum. Disaster research should not merely deal with single events, but also with civilizational chain reactions. In consequence, they conceptualized earthquakes and floods in the context of problematic constructions and embankments, just like the Swiss hydrology did slightly later (Jäger 1977).

Thus, the view of nature by German federal disaster research correlated clearly with that of the environmental movement. By stressing the exploitation of resources and man's lack of adapting to his environment, sociologists made human beings the main culprits for disasters and demanded a more rational handling of natural phenomena. Nonetheless, they did not only use environmental issues as an explanation. Especially in England where a "Disaster Research Unit" had been founded at the University of Bradford researchers noticed that particularly in developing countries the extent of damage after disasters had risen strongly. For them the socio-economic aspects that determine society's vulnerability in the case of a disaster were relevant, and not so much the proper natural phenomenon. In the rhetoric of the researchers the earthquake of Guatemala in 1977 soon became the "classquake" (O'Keefe, Westgate and Wisner 1976, 566 et seq.). At the same time disaster research developed new resilience strategies by reinterpreting natural hazards as cultural hazards, and by offering a view of social and infrastructural resilience. According to this logic, civil protection did not have to mean preventing floods or tornadoes. This would be almost impossible because they are natural occurrences. Rather, it meant avoiding too dense settlement in river areas, relying on safe constructions, and through coordinated crisis management not letting natural occurrences become disasters.

3.3 Insurance

Finally, the third example refers to the player whose mere profession is subscribed to organizing the future: *insurance*. It was also the insurance companies

who coined the term 'risk' as explicitly future-orientated to provide a framework for their field of work. Through calculation and anticipation the insurances' mathematical minds turned dangers into risks, made them seem controllable and capitalized them (Bonß 1995, 147-90). Accordingly, a close connection between insurances and disasters can be traced back into the early modern period when great city fires, the shipping industry and trade with colonial goods encouraged the establishment of a commercial insurance industry (Zwierlein 2011). During the nineteenth century this connection intensified. With this cooperation of politics and economy new debates arose again and again in Switzerland and Germany about how to insure against floods and other natural hazards (Lübken 2008; Wanner 2003). Yet due to lack of statistics as well as the difficulty of predicting natural hazards, the insurance branch was cautious about entering the field of natural disasters. It is thanks to the foundation of reinsurances that an equivalent market could develop and thrive. Reinsurance is a business model that insures insurances. Since the mid-nineteenth century it has brought new dynamics into the market. With the rise of large firms, such as Swiss Re or Munich Re, the insurance branch became more and more international and finally developed global markets of natural hazard insurances at the beginning of the twentieth century (cf. Borscheid 2012; Gugerli 2013). Insurances against different types of natural hazards all over the world soon became branches of the Swiss and Munich Re, although they were not their main sources of income. However, the Great Earthquake of San Francisco in 1906 as well as the following debates led by insurance companies on which damages were in fact caused by the earthquake and which by the subsequent fire linked these firms closely to the sector of natural hazards (Röder 2006).

Subsequently, it was mainly the initiatives of the insurance industry which led to a stronger data collection and prediction of natural risks to render them market-based. In addition, the way politics dealt with natural hazards was also shaped by the insurances' influence. The French sociologist Francois Ewald wrote in the 1980s, "Insurance constitutes the real core of modern societies," and thus alluded to the general change of human security needs (Ewald 1989, 385). Natural hazard prevention was an important part of this change. It became commercial and focused gradually on loss adjustment, on financial prevention schemes, so to speak. Seen from the point of view of the insurances, potential disasters in the future meant first and foremost the financial ruin of residents, firms or states, and this should be prevented by the possibility of providing insurance policies. But at the same time they shifted responsibility: similar to disaster research, the logic of insurances took away the responsibility from nature by making society compensate the consequences with its own means. With this in mind, Ewald points out a change in solidarity because insurance is "an alternative to the cooperative form of protection and to state support" (Ewald 1989, 387). However, dyke associations and other supportive

societies did not become obsolete. From then on provision could be delegated far more easily to professional suppliers who certified contractual rights.

During the twentieth century the insurance market changed significantly again. Declining margins and the intrusion of direct insurers into the business were threatening the reinsurance companies. Thereupon, Swiss Re and Munich Re shifted their business towards supplying expertise. The industry now perceived itself as an interface that not only paved the way for individual financial loss adjustment but also offered specific preventive ideas on how to avoid damage. At Swiss Re as in the industry of direct insurers, you can trace this *shift from risk management to risk engineering* back to the 1930s and 1940s (cf. Gugerli 2013, 147-50).

In 1928 the Swiss Department of the Interior summoned a special commission. It comprised politicians and representatives of the large insurances who should examine ways of insuring the cantons against elemental damage (Report of the Swiss Federal Council to the Federal Assembly 1928). In this newly created "Federal Commission for Examining Aid for Damages by Natural Hazards" the board appointed Hermann Lanz-Stauffer, director of the intercantonal reinsurance association, "expert of the Federal Department of the Interior." He then began collecting information from the cantonal forestry offices on the amount of damage caused by natural hazards.[12] Significantly, there were barely any statistics in this regard. It was only thanks to Lanz-Stauffer's initiative that a systematic collection of data, supported by the federal government, was gradually built up.[13] Already in 1936 Lanz-Stauffer, together with Curt Rommel, was able to publish a 1500-page study that joined scientifically based risk research with insurance maths. With pioneering pragmatics the authors also defined what "natural risks" were. Thus, their study looked only at dangers "where a natural force suddenly and mechanically causes damage." This included high water, floods and storm tides as well as different types of landslides, storms and avalanches. Everything else, such as earthquakes, heat, frost, etc., was excluded (Stauffer and Rommel 1936, V). Demarcations like these had serious consequences because they prioritized specific fields of disaster prevention in an economic way.

At the end of the 1960s a sheer wave of foundations of internal research institutes within the reinsurance companies was triggered, which once again exemplifies the branch's change of thought. On the one hand, engineers were part of this 'scientification' and became more and more important for evaluat-

[12] Letter from Hermann Lanz-Stauffer to Eidgenössisches Oberforstinspektorat Bern, 7.8.1929, in: CH-BAR E3270A#1000/755#233, Az. 1.09, Schätzung der durch Naturgewalten wie Hochwasser, Sturm, Lawinen, Erd- und Felsrutschungen und dergl. an den schweizerischen Waldungen alljährlich im Durschnitt entstehenden Schäden, 1929.

[13] Letter from Stellvertretung des Oberforstinspektors Bern to Lanz-Stauffer, 15.8.1929, in: ibid.

ing large risks of airports, dams and oil rigs (Gugerli 2013, 290-5). On the other hand, the reinsurers specifically recruited geologists and meteorologists because the industry of natural hazards was growing. The market was becoming opaque due to denser infrastructure. At Swiss Re this newly founded research institute was the department of "risk management," at the British Commercial Union Assurance Company the "Commercial Union Risk Management Limited" and at the Munich Re "Geo Risk." This phase of foundation coincided both with the change of strategies in hydraulic engineering as well as the manifestation of academic disaster research. Here, the firms were working in a less technological or sociological manner. Rather, they combined geological and meteorological research with actuarial methods.

Contemporary concept papers show that the insurances' aim was to perceive risks, then analyse and evaluate them as well as prevent and diminish them. Therefore, the work of these firms went farther than pure financial compensation for damage claims. For example, agents of resilience employees made "risk visits" to Singapore, Taiwan or Libya where they offered workshops or initiated publication series, advised new types of earthquake-proof construction or taught successful crisis management. They considered themselves "specialists for risks" and therefore saw it as their duty to participate in discussions on resilience. As the initiator of risk management of Swiss Re claimed at the end of the 1970s, society had developed a "new awareness for risks."[14]

The scientization of the insurance industry, visible since the 1930s and 1940s, was now enriched with a new dimension. Before, the industry relied on external expertise, but now the degree of specialization of the academic disciplines did not suffice anymore. To redefine themselves as risk engineers the reinsurers recruited scientists and specialized them further internally. A new kind of resilience research developed that was both industry specific and firm internal. Its commercial background was certainly visible at times, but public attention was nevertheless huge (Berz 1999; Gleich 1998).[15] Up to today the surveys on damage and long-term data collections of Munich Re and Swiss Re are used both by journalists and scientists for empirical data after severe disasters (cf. the current brochure: Munich Re 2011).

4. Conclusion: From Prevention to Resilience

During the nineteenth century the concept of prevention acquired huge, suggestive power and seemingly privileged prevention over protective, corrective and

[14] All quotes are from „Künftige Tätigkeit der SR in RM", 20.9.1978, in: Unternehmensarchiv der Swiss Re, Sign. 10.166820.00.009.

[15] For example, in 1998 the magazine *Focus* called the founder of the department for geo risk at Munich Re.

curative methods (cf. Bröckling 2008, 40). This inevitably had to lead to an exaggeration of the use of prevention. "He who wants to prevent will never know enough," the sociologist Ulrich Bröckling describes the dilemma of prevention (Bröckling 2008, 43).

Risks may only be identified probabilistically, which is the reason why preventive thought tends to generalize probabilities. Statistics, or to be more precise, set points, gain great importance because deviations from them mean starting points for prevention. So prevention can easily become an obligation. But for precisely this reason the history of prevention also has to check in how far its concepts and techniques can become threats in themselves. Prevention always created new risks, be it through straightening rivers or controlling weather. It often massively endangered on-site lifestyles and altered the landscape's physiognomy.

During the twentieth century prevention lost through these threats its significance as the ideal solution for natural hazards. It was science, namely hydraulic engineering, geology and meteorology, that exposed prevention as utopian, although their own predecessors had implored that general prevention of disasters could be realized. Yet private landowners and single districts still adhered to prevention as shown by the example of hail. The crisis of prevention was simultaneously the chance for a concept that was definitely not new but developed extraordinary radiance: resilience. The term itself, as a defined concept of treating natural hazards, only appeared towards the end of the twentieth century, but what it represented, namely the ability to be prepared, durable and flexible, is a much older idea.

In the insurance industry, politics and science strategies of resilience became en vogue since the mid-twentieth century – not least because they were exposed to failure and partly had fewer requirements than technical or scientific methods. They conceived dangerous natural phenomena as normal and regular events. At the same time, the insurance business became an expert on risk research and advised authorities or single organizations in many parts of the world on how to prepare for great damage. Ministries organized simulations in which they re-enacted major emergencies to train their authorities' reactions. In addition, concepts of resilience paved the way for other disciplines, such as sociology, to contribute to societal and governmental hazard prevention. Therefore, attention shifted away from the menacing natural hazard towards human behaviour, or rather, towards the organization of human behaviour in the event of a disaster.

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Cooperating Associations / Networks / Journals

QUANTUM (Association for Quantification and Methods in Historical and Social Research) http://www.gesis.org/en/hsr/profile/quantum.

INTERQUANT (International Commission of the application of Quantitative Methods in History) http://www.gesis.org/en/hsr/profile/quantum.

H-SOZ-KULT (Communication and Information Services for Historians) http://www.hsozkult.de.

AFC (Association Française de Cliométrie) http://www.cliometrie.org.

AGE (Arbeitsgemeinschaft Geschichte und EDV) http://www.age-net.de.

AHC (International Association for History and Computing) http://odur.let.rug.nl/ahc.

FQS (Forum Qualitative Sozialforschung – Forum Qualitative Social Research) http://www.qualitative-research.net/fqs.

HISTORICUM.NET http://www.historicum.net.

ZOL (Zeitgeschichte-online) http://www.zeitgeschichte-online.de.

PERSPECTIVIA.NET http://www.perspectivia.net.

Archiving by Information Services

JSTOR (ITHAKA) http://www.jstor.org/r/histsocres.

SSOAR (Social Science Open Access Repository) http://www.ssoar.info.

Coverage by Information Services

In recognition of the high quality and relevance to the scientific community our journal *Historical Social Research* has been selected for coverage / archiving in the following databases:

Social Science Citation Index (Thomson Scientific) http://scientific.thomson.com/products/ssci.

SCOPUS (Elsevier) http://www.scopus.com.

SocINDEX with FULL TEXT (EBSCO) https://www.ebscohost.com.

Sociological Abstracts (ProQuest) http://www.csa.com.

Historical Abstracts (ABC-CLIO) https://www.ebscohost.com/academic/historical-abstracts.

International Political Science Abstracts (SAGE) http://www.sagepub.co.uk.

SOLIS (Social Science Literature Information System / GESIS) http://www.gesis.org/en/services/research/solis-social-science-literature-information-system.