The Kishon Affair: Science, Law, and the Politics of Causation in the Israeli context

Abstract:

This article describes how science and law were called upon to resolve a toxic exposure controversy that created a deep and painful rift between the Israeli state and some of its most revered citizens. The controversy, which came to be known as the *Kishon Affair*, began in 2000 when veterans of an elite and secretive unit in the Israeli military claimed that a polluted river they had trained in during their service has caused them a rash of cancers. The veterans demanded that the Ministry of Defense take responsibility for their illnesses, finance their medical treatments, and support their families if they die. The military denied the causal connection between the polluted river and the veterans' cancers and rejected their demands. The dispute quickly escalated into a bitter public controversy and a high-ranked committee made of Israel's top jurist and two prominent scientists was called upon to study the disputed causal relation and reveal its true nature. Alas, after nearly three years of intense inquiry the jurist and scientists reached opposite conclusion: the jurist found a causal connection while the scientists rejected it.

Using the Kishon Affair as a case study, this article discusses the scientific and legal responses to the growing concerns in late-modernity with toxic exposures. It follows the committee's scientists and the jurist in their separate inquiries and analyzes some of the difficulties that prevented them from coming to terms in addressing the perennial concern with toxic exposures. These difficulties, the article argues, owe less to partisanship or

special interests and more to deep-seated differences between the legal and scientific expectations of truth and practices of proof.

The Demise of the Kishon

On May 25, 2000, Professor Avital Gasith, an aquatic ecologist from Tel Aviv University, took his students up north to conduct a field study along the lower part of the Kishon, the largest and most polluted waterway in northern Israel.[1] Rising in the northern end of the Samaria mountain ridge, the Kishon flows northwesterly for about 70 km on its way to the Mediterranean Sea. It first runs through the agricultural Valley of Jezareel, draining the runoff water heavy with fertilizers and pesticides from the intensely-cultivated fields. It then cuts through the Haifa metropolitan area where it once more serves as a receptacle, this time to the ever-growing urban load generated by the burgeoning population. Finally, on the last leg of its journey, the Kishon rubs backs with Israel's largest industrial port, at the Haifa bay, where it is greeted by a dense cluster of heavy industries– shipyard, refineries, petrochemical plants, etc. – all discharging their toxic wastes directly into its watercourse.[2]

[1] Protocols of the Kishon Committee, Jan 10, 2001.

[2] For information (in Hebrew) about the Kishon, see The Kishon River Authority website http://www.kishon.org.il/.

Running strong for centuries the Kishon might have been able handle its share of this modern abundance and carry it to the open sea.[3] But in 1953, the young state of Israel, desperate to quench the thirst of its quickly growing population and its agricultural-based economy, dammed the Kishon's upper watershed in the Jezareel Valley and redirected its flow into an artificial lake, to be stored for irrigation during the long and dry summer seasons.[4] The capturing of the water at their head transformed the lower Kishon into an ephemeral stream with little capacity to carry the heavy agricultural, municipal and industrial deposits into the sea. Hereinafter, the river quickly deteriorated. By the 1960s, the mounting discharges have already surpassed the entire natural flow of the river, converting it into an outright sewage conduit, especially in the summer months when natural flow was minimal.[5] By the 1970s, worried public health officials reported that the Kishon was "so heavily contaminated with industrial wastes that it wiped out any sign of biological life;"[6] and strongly warned against any direct human contact with its water.[7]

---

[3] On the viability of the Kishon prior to the 20th century see John Macgregor, The Rob Roy on the Jordan, Nile, Red Sea & Gennesareth: A Canoe Cruise in Palestine and Egypt, and the Waters of Damascus (London, John Murray, 1870).

[4] Hillel Shuval, Water quality management under conditions of scarcity : Israel as a case study (New York : Academic Press, 1980), p. ??

[5] In 1970, for example, the lower part of the Kishon saw 33 million cubic meter of water: 14 millions came from drainage and run-off water, another 14 millions from the Haifa Sewage Treatment Plant, and another 5 million from industrial effluents. See Avital et. all, *Public Health Survey of The Kishon and its Brooks*, 1972, 1.

[6] Id.

[7] Balasha-Jalon Infrastructure Systems, "Prevention of the Kishon's Pollution by Industrial Wastes: A preliminary Report." September 1975.

By the 1980s, scientists from the national Oceanographic and Limnological Research institute who monitored the river warned the authorities that the extensive toxic sedimentation was accumulating at the Kishon's bottom, slowly chocking it up and diminishing its capacity to channel large flows to the sea.[8] By the early 1990s, these warnings materialized. In the stormy winter of 1992 the lower Kishon overflew, covering extensive residential and industrial areas with thick toxic sludge and transporting massive quantities of it into the bay.[9]

The flooding and its tremendous cleaning costs put new pressures on the political system to find a solution to the Kishon problems.[10] Consequently, in 1994, a new statutory entity, the Kishon Authority, was created to administer the political, legal, scientific, and administrative efforts needed for the rehabilitation of the Kishon.[11] The new authority quickly found itself walking a fine line. The largely privatized industrial cluster at the Kishon's estuary played a central role in Israel economy and could offer tremendous political resistance. The refineries, for example, provided crucial energy to Israel rapidly growing modern economy; and the petrochemical industries were among Israel major exporters, turning local minerals into a much needed foreign currency. Any attempt to

---

[8] H. Hornung, N. Kres, and M. Krumgalz, "The Presence of Heavy Metals in Sediments taken from the Kishon's Bed and the Docks," IOLR Reports (October 1990);

[9] Kishon Authority Annual Report, 2000, p. 90. In Hebrew.

[10] See for example the protracted litigation between insurance companies and the various local authorities regarding liability, in Haifa District Court, cases 404/93 and 307/99. The litigation later reached the Israeli Supreme Court. See cases 2906/ 01, 3049/01, and 3139/01

[11] For information on the Kishon River Authority, see their website http://www.kishon.org.il/.

enforce regulative measures that will add to the cost of production in these plants was conceivably a threat not only to the viability of the plants but also to that of the region or even the nation at large. The plants provided livelihood to thousands in the Haifa area, and were thus also backed by the *Histadrut*, Israel's powerful umbrella labor union, which controlled much of local politics. Facing resistance high and law, the Kishon Authority chose wisely. Its officers avoided confrontation, abstained from taking punitive actions against any of the big polluting plants, and sought instead to cultivate cooperation by ongoing negotiation.

A proper solution, all parties agreed from all sides of their mouths, must be found. Unfortunately, such a solution necessitated great expenditure and the plants were reluctant to bear the financial burden alone, without significant help from the government, which was not forthcoming. The plants responded with delay and evasion, doing just enough to avoid sanction but never enough to fully comply. The stage was set therefore for a long and intricate choreography of administrative courting and industrial procrastination that lasted throughout the 1990s.[12]

Scandal in the making

[12] For analyses of the conflict, see Erika Weinthal and Yael Parag, "Two Steps Forward, One Step Backward: Societal Capacity and Israel's Implementation of the Barcelona Convention and the Mediterranean Action Plan," *Global Environmental Politics* (February 2003) 3(1):51-71; Deborah Shmueli and Michal Ben Gal, "Stakeholder Frames in the Mapping of the Lower Kishon River Basin Conflict," *Conflict Resolution Quarterly* (2003) 21(2):210-238

How do you measure the health of a river? For decades, concerned Israeli scientists have taken the Kishon to be checked at the laboratory. They sampled its gloomy water, conducted physical and bacteriological analyses, calculated chemical and pathogenic concentrations, and reported their findings in scientific publications and administrative reports. Professor Gasith' 2000 field study along the lower part of the Kishon was certainly part of this on-going scientific concern with the Kishon. Still, Gasith belonged to a new generation of scientists who considered the traditional laboratory tests to tell only part of the story. Physical samples, he noted, have no memory. The samples reflect the situation at the time of the sampling and one could not determine from them what the conditions were a week or a month earlier. A toxic spill could had occurred earlier and not be detected, although it may had severely affected aquatic life for a long time to come. Furthermore, although the rich cocktail of pathogens, carcinogens and other toxins in the Kishon was well documented, their concentrations varied widely and many of them often stayed within the limits dictated by the relevant standards.[13] Hence, officially, the water may pose no probable danger. But Gasith suspected that even if each concentration by itself was below the regulatory threshold, the synergic impact of so many put together could be extremely dangerous.[14] Environmental scientists have long acknowledged the possibility of such synergism, but have not been able to reduce it to practical laboratory measurements. Consequently, a growing number of scientists, Gasith among them, began to substitute biological for physical monitoring -- that is, they analyzed biological species

[13] Israel used American standards, set by the EPA and modified to fit Israeli conditions.

[14] Avital Gasith, Protocols of the Shamgar Committee, Jan 10, 2001, pp. 27-29.

and their abundance instead of chemicals species and their concentrations. The results, Gasith maintained, may be less quantifiable but more truthful.[15]

Gasith set his 2000 field study of the Kishon for late spring, when biological activity was at its peek. Unfortunately, the surveying students failed to find any sign of life higher than microbes in the water of the lower Kishon.[16] That might have shocked some of them but not their professor. At the request of the Kishon Authority, Gasith has being monitoring the Kishon annually since 1996 and has grown accustomed to these unprecedented results. He had surveyed many Mediterranean coastal streams during his career, and no matter how heavily polluted they were he always managed to find some forms of life above the unicellular level. Not in the Kishon, though. The lower Kishon, as he succinctly put it two years earlier, in 1998, was, "for all intents and purposes 'sterile'."[17]

Gasith was soon proved wrong. On the morning of May 26, 2000, just a few hours after he and his students completed their fruitless search for life in the lower Kishon, he learned that there was one species that was tough enough and resourceful enough to

---

[15] S. Gafny, M. Goren, and A. Gasith, "Habitat condition and fish assemblage structure in a coastal Mediterranean stream (Yargon, Israel) receiving domestic effluent," *Hydrobiologia* (2000) 422/423: 319– 30.

[16] Avital Gasith, Protocols of the Shamgar Committee, Jan 10, 2001.

[17] Gasith, A. And D. Pargament, Practical obstacles to effective implementation of environmental enforcement : the case of the coastal streams of Israel. In A.Shapira, ed., The Tel-Aviv University studies in law. pp. 117-134, on 128. See also Avital Gasith, Protocols of the Shamgar Committee, Jan 10, 2001.

withstand even the horrors of the Kishon – the Israeli Naval Commando. Gasith, together with the entire stunned nation, learned of this in a special investigative report that appeared in the weekend edition of *Yediot Aharonoth*, Israel's most popular daily newspaper.[18] The Naval Commando, the headlines screamed, an elite and highly secretive unit in the Israeli military, has been training in the Kishon unbeknownst to the civil authorities since the 1940s. For decades the navy had ignored all existing warnings and sent its young soldiers to train in the water of the Kishon. Consequently, many of these soldiers died or were still fighting various forms of cancer caused by the heavily polluted water, while the navy, the military, and the government continue to look the other way, denying responsibility and ignoring the plight of the sick soldiers and the families of those who had already died.[19]

Asked later how he could have let his soldiers train in this nasty water, General Ami Ayalon, the highly decorated ex-commander of the Naval Commando, pointed out that even pollution may have its attractions. "The filthy water did not bother us," he explained. "On the contrary, the filthier it was the better the preparation for the real thing."[20] Others answered in the same vain. The polluted Kishon presented a formidable challenge that separated the men from the boys. It made every little thing that much more difficult. But then, the slogan written large on the commando's dining-room wall was "difficult in training, easy in war". Hence, all these long years, despite the filth and the

---

[18] Anat Tal-Shir and Tsadok Yechezkely, Cancerous Diving, Investigative Report, *Yediot Aharonoth*, May 26, 2000.

[19] Id.

[20] Ami Ayalon, Protocols of the Shamgar Committee, Nov 26, 2000, p. 4.

stench and despite all the warning signs erected along the shores, the Naval Commando continued to train and dive in the Kishon's basin. Going under, the young trainees did not smell the stench. Coming up, their officers sometimes made them fill up their fins and drink the filth as a disciplinary measure. Getting out of the water, they took long showers, trying to scrub the putrid grime from their skin. They were young and unshakable. Other dangers occupied their minds and none of them dedicated much thought to the potential risks lurking in this dark body of water.[21]

It was only years later, when some of the divers began to contract various illnesses, that they started to suspect that their problems were related to their training in the Kishon. The first to make the connection was Yuval Tamir, who retired from the navy as Lieutenant General, after a twenty-three year career during which he logged more than thousand hours of diving in the Kishon estuary. In 1998, shortly after his retirement, Tamir was diagnosed with skin and colon cancers. Suspecting that his cancers were related to his diving in the Kishon, Tamir turned to his commanders and requested that the navy finance his medical treatment.[22] His suspicion brushed aside and request ignored, Tamir began to discuss his concerns with his fellow commandos only to discover that quite of few of them have also been dealing with various cancers, and that close to ten of them had already died. Outraged, Tamir and his friends decided to get organized and take action. They wanted the military to acknowledge the link between their diving and their health problems and to terminate all activities in the Kishon. They also demanded from the defense ministry to take responsibility, finance their expensive medical treatments

[21] See various testimonies, Protocols of the Shamgar Committee, Dec 29, 2000.

[22] Yuval Tamir, interview with Tal Golan, April 7, 2004.

and support the families of those who died. When the military and the defense ministry continued to respond with delay and evasion, they decided to make their plea public.[23]

Speaking out, in public, against their unit, was not an easy decision for the naval commandos. Over the years their unit had become an integral part of their identity. They gave it their very best and cherished it dearly. In many ways their unit functioned as their extended family, but in return it demanded unconditional loyalty and absolute commitment to secrecy. Still, as it became apparent to the commandos that the military was refusing to acknowledge its responsibilities, and that their unit continues to train in the Kishon, some of them felt free to break the code of silence and to take their story to the media.[24]

Military service constitutes a central unifying narrative within the otherwise highly-fractured Israeli society. All young Jewish (except ultra-orthodox) citizens are required to serve in the military, during which they must follow orders, sometimes to the extent of risking their life. In return, the state, by means of the Ministry of Defence, guarantees full care of them and their families in case of injury or death in the line of duty. Trust in the state and the military is at the core of this vital pact between the state, the soldiers, and their families, and the elite military units, the Naval Commando prime among them, embodied the very essence of this pact as their soldiers took the greatest risks and in return received society's highest regards. The notion therefore that this trust had been

[23] Id.

[24] Id.

compromised and in non other than in the Naval Commando, mesmerized the media and they played it for all its worth.[25]

A huge scandal erupted literally overnight and the gloomy Kishon finally emerged from the obscurity of scientific journals and political backrooms into the frontal lobes of Israeli society. Newspapers, radio stations, and TV channels alike dug out the long history of disregard and neglect in the Kishon, raced for the personal stories of the distressed soldiers and their families, and highlighted the military's staunch refusal to take responsibility for the welfare of the country's most beloved soldiers. The politicians did not lag far behind. The scandal became the hottest topic in Israeli politics, and Yuval Tamir and his fellow commandos became *personae gratae* in the various meetings of parliamentary committees eager to share the spotlights.[26]

Yielding to the swell of public outcry and political pressure, the navy declared its intention to appoint a commission of inquiry to investigate the alleged connection between the polluted river and the high incidence of cancer among the soldiers who dived in it.[27] A broken trust however is hard to mend and the renegade commandos, emboldened by the public and political support they were receiving, refused to cooperate

---

[25] Smadar Ben Asher, "Hegemonic, Emancipated and Polemic Social. Representations: Parental Dialogue Regarding Israeli. Naval Commandos Training in Polluted Water," *Papers on Social Representation* (2003) 12, 6.1-6.12

[26] See for example, Protocols of the meetings of the Parliamentary Committee on Internal Affairs, June 7 and 20, 2000; Protocols of the Parliamentary Committee n the Military Budget, June 13, 2000, pp. 13-22

[27] Yuval Tamir, Interview with Tal Golan, April 7, 2004.

with the suggested committee. The navy proposed two emeriti chief-officers of the Military Health Corps to head the committee. Tamir and his comrades argued that the military could not and should not investigate itself and threatened to appeal to the Israeli Supreme Court if it did. The ensuing period saw feverish negotiations among all parties. The military authorities wanted to maintain close control over the inquiry, which could determine, inter alia, their liability for a potentially large number of soldiers exposed to a yet-to-be-defined spectrum of similar risks. On the other hand, the commandos had lost faith in the military and insisted on the appointment of an external committee stuffed with independent experts.[28]

The solution was finally found in the shape of a person everyone respected and trusted -- Meir Shamgar, the retired president of the Israeli Supreme Court and a towering moral and legal authority. Shamgar maintained long and close connections with the Army. During the 1960s, he served as Military Advocate General and was a key participant in the formulation of Israeli military law.[29] Shamgar was also a revered civic icon. His public career was launched in 1968, when he was nominated Attorney-General of Israel, a role he gave meaning to by declaring war on corruption and inculcating awareness for the rule of law at all levels of government. In 1975 he was appointed Justice of the Supreme Court, and in 1983 became its president; a position he relinquished only upon retirement in 1995. During his long career at the Supreme Court, Shamgar was celebrated

---

[28] Id.

[29] See Meir Shamgar, *Military Government in the Territories administrated by Israel, 1967-1980: The legal Aspects* (Jerusalem: The Faculty of Law, The Harry Sacher Institute for Legislative Research and Comparative Law, The Hebrew University, 1982).

as a defender of the ordinary citizen in the face of bureaucracy and governmental obtuseness. In a series of high-profile decisions, he buttressed the democratic norms in Israeli society – from the freedom of speech and press, to the rights of suspects and the accused. He also opened up the Supreme Court to the public by expanding the right of appeal, and became a model for all justices for his respect and patience with the citizen standing before the bench. In short, he was loved and trusted by all - a tall order in the highly fractious Israeli society.[30]

Even after his retirement, Shamgar retained his status as the supreme mediator in Israeli society. He was called upon by the private sector to arbitrate their thorniest financial disputes, and by the political sector to sort out the most notorious public crises. For example, when Prime Minster Rabin was assassinated in 1995, Shamgar was the only candidate trusted by all to chair the commission of inquiry into the assassination.[31] One can imagine then the collective sigh of relief heard when Shamgar agreed to chair the committee that would look into what came to be known as the Kishon Affair. Exercising his moral authority, Shamgar was quickly able to broker an agreement among the parties on two scientific figures that would serve with him on the committee: Professors Meir Wilchek, a highly regarded biochemist from the Weizmann Institute of Science, and Gad Rennert, a senior epidemiologist and expert on public health, from the Carmel Hospital in

[30] Shamgar was a laureate of numerous prizes, including the 1996 Israel Prize for his special contribution to society and the State. For an English source, see Daniel Mandel, "And Justice for all: Voice of sweet reason," The Australia/Israel Review Jul 29, 1998.
[31] See Shamgar Commission: Report on the Assassination of Prime Minister Yitzhak Rabin (1996).

Haifa.[32] Thus, with law and science secured at the helm, the door was now open for a legitimate resolution to this most agonizing conflict between the state and some of its most revered citizens.

The Committee at work

On July 24, 2000, the IDF Chief of Stuff, General Shaul Mofaz, convened a press conference to announce the terms of the agreement reached. The Israeli Defense Authorities will appoint a military investigation committee. Chaired by law and guided by science the committee was authorized to investigate the following issues:[33]

1. Has the water of the lower Kishon contained hazardous materials?
2. What are the potential medical risks for anyone trained there?
3. What is the causal connection between the water and various cancers discovered among the soldiers who trained in them?
4. What is the responsibility of the various military authorities?

---

[32] Letter of Nomination, Chief of Stuff Office, July 24, 2000. Choosing the scientific experts was also a difficult process. It was hard to find leading experts that did not have ties with the military or the relevant Industrial corporations. Various names were suggested only to be strike down by one of the parties. The negotiations ended only when Shamgar chose the experts and forced them upon the parties. Yuval Tamir, interview with Tal Golan, Sept 2006.

[33] Letter of Nomination, Chief of Stuff Office, July 24, 2000. See also Shamgar Committee, Interim Report (June 2001), 13.

The committee quickly set itself to work. Military commissions usually run their business behind closed doors but recognizing the public sensibilities involved, the Shamgar committee decided to open its meetings to the public, except when national security or personal privacy dictated otherwise.[34] Starting on August 1st, the committee held within the next three months twenty-seven meetings, nineteen of them open to the public. During this period the committee also toured the Kishon area, both by foot and by boat; heard testimony from 103 witnesses; and reviewed more than 600 records that included scientific and technical reports, military orders and protocols, and minutes, reports and other papers generated by various professional and political bodies that were involved with the Kishon since the 1950s.[35]

It did not take long for the committee to realize the scale of calamity they were dealing with. The evidence mounted on their tables left no doubt that the lower Kishon had been heavily polluted for many years and that the culprits included almost everyone involved: the industrial plants that took the river hostage and pumped their toxic wastes into it; the municipal authorities that did the same with their domestic sewage; the administrators and politicians who knew about the pollution but looked the other way; the arrogant naval commanders, who ignored all warnings and failed to guard the safety of their soldiers. It was therefore rather easy for the committee to quickly answer two of the four queries it was charged with: Did the lower Kishon contained hazardous materials? Plenty. Who could be held responsible? Plenty, again. Nothing, however, was easy about the two other tasks before the committee: to estimate the medical risks emanating from the Kishon and

[34] Shamgar Committee, Protocol of the first meeting, Aug 1, 2000.

[35] Shamgar Committee, Interim Report (June 2001) 14-15.

to negotiate from these a verdict regarding the causal connection between the water and the cancer. These were notoriously slippery problems that mixed a fragile science with anxious politics; a volatile mixture that ignited many legal and policy debate throughout the second half of the twentieth century.[36]

The committee decided to launch a comprehensive scientific study of the risks involved in diving in the Kishon. Such an endeavour necessitated massive administrative and medical efforts. All soldiers who had ever served in the relevant military units needed to be identified and summoned for an extensive series of questionnaires, interviews, and medical tests. Initial estimates talked about more than 5000 such soldiers and it was clear that it would require considerable time for all of them to be properly tested. The committee decided therefore not to wait for the completion of the entire study and to go ahead and publish an interim report that would address the urgent needs off the sick soldiers and their families, as well as the immanent dangers of the Kishon that required immediate attention. [37]

The preliminary report was released in July 2001, a year after the committee started its work. Recounting the long history of the river's pollution, the report spared no element involved: The polluting plants and municipalities; the inattentive regulators and licensing authorities; the careless politicians; the arrogant militant commanders and their medical

---

[36] Cf. Sylvia Tesh, *Uncertain Hazards* (Cornell UP: 2000); Fischer, Frank, *Citizens, Experts, and the Environment: The Politics of Local Knowledge* (Duke University Press, 2000).

[37] Shamgar Committee, Interim Report (June 2001) 15.

officers – all were privy to this scandalous affair. All of them knew or should have known what was going on, and each of them could and should have taken action to stop it. The committee found the neglect to be so wide-spread and systematic that it saw no purpose in pointing fingers:[38]

"The spectrum of the factors related in one way or another to the state of the Kishon is so wide, and the number of years during which the events took place is so long," the committee interim report grimly noted, "that passing judgment on the personal responsibility of this person or another has become impractical and irrelevant. We are facing a general phenomenon of a mental barrier that has prevented the understanding of the situation and the proper evaluation of the emerging risks, which required active intervention, in contrast to business as usual. Under these circumstances, we see no point in parting responsibility to this period or other in a vain attempt to translate it to specific-personal dimensions."

The preliminary report concluded with a set of recommendations, most of them directed at the military. These addressed three major issues. First, the sick soldiers and the families of those already deceased should receive interim medical and financial help pending the committee's final resolution. Second, all military activities involving physical contact with its water must be suspended until the Kishon was rehabilitated. Third, the army should develop the capacity to test the environmental safety of all military training sites before soldiers be allowed to train there. Although not included in

[38] Id. 219.

its mandate, the committee members found themselves obliged to comment also on the disturbing state of public affairs they encountered during their investigation. The culture of disregard towards the environment must not be tolerated anymore. The civil authorities must use the plenty of legal and technical means available to them to prevent the pollution of the Kishon with dangerous materials.[39]

The Shamgar committee, we should keep in mind, was a military jurisdiction. Its recommendations carried therefore much weight with the military and served to reshape the military policy regarding environmental risks. Professional teams were appointed to conduct scientific studies of the extensive military training sites.[40] Never before had Israeli environmental research access to such political and financial resources needed for such a task and the result was an unprecedented database that mapped in details the environmental risks over much of Israel. Eager for a taste of it, environmental groups campaigned hard to make this knowledge public.[41] The defense ministry refused, however. Clearly, it felt less obliged to the part of the committee's recommendations directed at the public sphere. Meanwhile, all were waiting for the publication of the committee's final report, and with it the resolution of the main bone of contention – what is the causal connection between the commando's cancers and the water they dived in?

---

[39] Id. 235-242.

[40] E.g. , S. Almog and Y. Amitai, *Diving in Polluted Water: Proposed Guidelines Report of the Israeli Expert Committee, Conference on Diving in Polluted/Contaminated Water* Washington DC, July 25-26, 2006.

[41] Alona Karo, Head of Life and Environment, Israel's environmental umbrella organization. Interview with Tal Golan, April 2004.

Constructing causality

Science offered the committee two distinct modes of calculating risks and constructing causality, and Meir Shamgar made sure to have an expert in each seating by his side. Meir Wilchek, biochemist, represented the first modality – an experimental, reductionist science, built on the strength of the laboratory. Gad Rennert, epidemiologist, represented the second – an observational, statistical science built on the power of big numbers.

Earlier in the twentieth century it was the experimentalists who dominated the field and provided the kind of answers sought by the committee. The toxicity of things was checked in the laboratory. One strategy, called *in vitro* studies, examined the effects of chemical agents on materials ranging from molecules such as DNA and proteins, to cells, bacteria and even embryos, in order to better understand the biochemical mechanisms involved. Molecular structural analysis could also be called upon, to gain clues from structural resemblance to other, better known, chemicals. It is a long way, however, from molecules to humans, and other researchers had taken a shortcut by performing *in vivo* studies. This reduced some of the difficulties but introduced new ones. Unable to experiment directly with humans, the toxicologists run their studies on other mammals. But although much is common across mammalian species, much is also different, and scientists are not always sure which is which. In addition, *in vivo* studies typically involve larger-than-life doses, to shorten the experiment and augment the effects. Toxicologists turn then to mathematical models, known as dose-response curves, to extrapolate from the short and intense exposure of the tested mammals to a chronic low-level exposure of

humans. The model serves for the calculation of the risks per any given dose and any given period, and for the setting of exposure standards, with appropriate safety factors to protect the more susceptible subpopulations.[42]

During the 1970s, as environmental regulation took central stage in western polity, the power of this experimental science to provide answers good enough to legitimize administrative and legal action was closely scrutinized. As the young regulatory agencies began to churn out their safety standards, both industry and civil action groups challenged the science behind the standards-- industry in attempt to moderate the standards; activists, to step them up.[43] The ensuing legal battles revealed to all the fragility of the science involved. What had thrived in the temperate climate of the laboratory did not survive the adversarial heat of the courtroom. The notorious non-linearity of physiological systems was mobilized to undermine the extrapolations from high to low doses and from short to long exposures; and the poorly understood interspecies and intrahuman variations were called upon to show that the justification of the standards went beyond scientific and technical competence.[44] Eager to protect the regulatory regime, the legal system responded by adopting the powerful precautionary doctrine, which admitted the fragility of the science involved but nevertheless justified the right of the authorities to act upon it, based on the ever-pressing need to regulate potential risks before they turn into actual

---

[42] Roger O, McClellan, "Human health risk assessment: a historical overview and alternative paths forward," *Inhalation Toxicology*. (1999) 11:477-518.

[43] Sheila Jasanoff, Science at the Bar: Law, Science, and Technology in America (Cambridge, Mass: Harvard University Press, 1995), 69-92.

[44] See *Reserve Mining Co. v*. Environmental Protection Agency (1975) 514 F.2d 492, and *Ethyl Corporation v. Environmental Protection Agency* (1976) 541 F.2d 1.,

harms. The legitimacy of such a regulatory regime, the courts prescribed, resided in its deployment of the best scientific tools available. These tools, they also increasingly suggested, may no longer be found in the laboratory but in the arsenal of epidemiology.[45]

Earlier in the 20th century, epidemiology served public policy merely as a form of surveillance technology. Medical attention was focused on infectious diseases -- each caused, as it was generally held, by a specific microbiological agent. Fighting infectious diseases was a job for the laboratory - to isolate the specific causal organism, study it and devise the best means to fight back.[46] Epidemiology served in this campaign merely by informing scientists of geographical and social patterns of the disease. But by the middle of the twentieth century the balance had begun to shift. At least in the developed world the battle against infectious diseases seemed to have been won and public and medical attention increasingly turned to a new and rising pattern of disease - non-infectious, chronic, with long latency and with poorly understood etiology; diseases such as cancer or heart diseases that began to top the medical charts. Experimental science, with its reductionist logic and specific causality model, made little headway with this new kind of health problems. These problems seemed to have multiply, and often quite different,

---

[45] David Rosenberg, "The Causal Connection in Mass Exposure Cases: A "Public Law" Vision of the Tort System," *Harvard Law Review* (1984) 97: 856-57 (1984) 851-929. Jack Weinstein, "In re: Agent Orange Product Liability Litigation," 597 F. Sup. 749 (1984).

[46] Koch Robert, "Über den augenblicklichen Stand der bakteriologischen Choleradiagnose," *Zeitschrift für Hygiene und Infectionskrankheiten* ((1893) 14: 319–333; Evans AS "Causation and disease: the Henle-Koch postulates revisited". *Yale Journal of Biology and Medicine* ((1976) 49 (2): 175–195.

causes; their long latency made experimentation difficult, if not impossible, and their mechanisms kept eluding the researchers. Epidemiology, on the other hand, proved much more flexible. A post-facto observational science that relates exposure to outcome, it did not have to ponder too much over the illusive biological mechanisms involved. Instead, epidemiologists adapted their computational strategies to a distributed, multivariate model of causation that seemed to better fit the nature of these new diseases, where a cause could have many effects and an effect many causes.[47]

The power of epidemiology to make causal claims in this new web-like universe of irreducible, chronic health problems was demonstrated during the late 1950s and early 1960s, when a cluster of British and American epidemiological studies first implicated cholesterol and smoking as significant causal factors for heart disease, and in the case of smoking, also for lung cancer.[48] Running ahead of experimental research, these studies

---

[47] Bert Black B, David E. Lilienfeld, "Epidemiologic proof in toxic tort litigation," *Fordham Law Review* (1984) 52:732-85; Vincent M. Brannigan, Vicki M. Bier, Christine Berg, Risk, "Statistical Inference, and the Law of Evidence: The Use of Epidemiological Data in Toxic Tort Cases," *Risk Analysis*, (1992)12 (3): 343-351.

[48] Thomas R. Dawber, Gilcin F. Meadors, and Felix E. Moore, Jr., "Epidemiological Approaches to Heart Disease: The Framingham Study," Am J Public Health Nations Health (1951) 41(3): 279–286; Doll R, Hill AB. "Smoking and carcinoma of the lung," British Medical Journal (1950) 2:740-8. Idem, "A Study of the Aetiology of Carcinoma of the Lung," *British Medical Journal* (13 December 1952) 2:1271-86; idem, "The Mortality of Doctors in Relation to their Smoking Habits: A Preliminary Report," *British Medical Journal* 1 (26 June 1954): 1451-55; idem, "Lung Cancer and other Causes of Death in Relation to Smoking: A Second Report on the Mortality of British Doctors," *British Medical Journal* (November 1, 1956) 2: 1071-81.

made no appeal to concrete biological mechanisms.[49] Instead, they introduced a new lexicon that appealed only to what came to be known as 'risk factors' – environmental, social and other patterns that are statistically correlated with higher incidence of disease; the higher the correlation the more certain the association. Nevertheless, or precisely because of it, many medical scientists went up in arm. At stake, they cautioned, was no less than the scientific essence of modern medicine, which was very much rooted in the laboratory. Epidemiology, they pointed out, was not an experimental science. It could neither sufficiently control its data nor test the veracity of its conclusions. Thus, while epidemiology remained useful in generating causal hypotheses, only experimental science could reliably validate them.[50]

---

[49] See for example the language of the landmark 1964 Surgeon General's Advisory Committee report on smoking: "It should be said at once, however, that no member of this committee used the word 'cause' in an absolute sense in the area of this study. Although various disciplines and fields of scientific knowledge were represented among the membership, all members shared a common conception of the multiple etiology of biological processes. No member was so naive as to insist upon mono-etiology in pathological processes or in vital phenomena. All were thoroughly aware of the fact that there are series of events and developments in these fields and that the end results are the net effects of many actions and counteractions." Smoking and Health: The Report of the Advisory Committee to the Surgeon General of the Public Health Service, (U.S. DHEW, Washington, D.C., 1964), p. 23.

[50] R. A. Fisher, "Alleged Dangers of Cigarette-Smoking," *British Medical Journal* (1957): 43(2) 297-98 ; Alvan R. Feinstein, Clinical Judgment (Baltimore: Williams and Wilkins, 1967); Idem, "The epidemiologic trohoc, the ablative risk ratio, and `retrospective' research," *Clinical Pharmacology and Therapeutics* (1973)14: 291-307; Idem, "Methodological problems and standards in case-control research," *Journal of Chronic Diseases* (1979) 32: 3541; idem, "Scientific standards in epidemiologic studies of the menace of daily life," *Science* (1988) 242: 1257-1263.

Criticism of the newly-fangled epidemiology was by no means limited to die-hard experimentalists. Scientists committed to genetic views of disease faulted epidemiology for focusing attention on environmental effects, while those committed to social explanations of disease faulted it for focusing attention on individual factors abstracted of social context. Perhaps the most sophisticated critiques came from bio-statisticians anxious to protect the integrity of their science from political pressures, and from epidemiologists who were concerned that too much would be claimed for their fledgling science, which was just starting to make inroads into medicine. These critics were able to point out various methodological difficulties inherent to epidemiological research, from sampling and selection biases to confounding variables, which further undermined epidemiology's capacity to establish authoritative causal claims.[51]

The proponents of the new risk-factors epidemiology responded by appealing to concrete usefulness rather than abstract truthfulness. They conceded that experimental demonstration of concrete causality constitutes a higher form of scientific proof, but pointed out that such a proof was hard to come by in this new era of chronic diseases. In the absence of such strong proof, they prescribed a diet of epistemological modesty and methodological flexibility. The distributed nature of the problem should be met with an equally distributed scientific effort. The epidemiologist's search for health risks was still to be based on the strength of carefully-constructed statistical studies, but epidemiologists

[51] Allen Brandt, "The cigarette, risk, and American culture," *Daedalus* (Fall 1990):155–76; Cf. Harry M. Marks, Charles Rosenberg and Colin Jones, *The progress of experiment: Science and therapeutic reform in the United States, 1900–1990* (Cambridge: Cambridge Univ. Press, 1997);

should remain mindful of the limitations of their method and careful to support it with other types of evidence. In the absence of a concrete demonstrable mechanism, the epidemiologists should nevertheless look for a plausible biological explanation. In the absence of direct experimental control, the epidemiologists should support their causal hypothesis by plausible temporal and dose-response curves, and indeed by any other coherent source of evidence. None of these explanatory factors was sufficient or necessary, nor could any of them bring forward indisputable evidence for or against the causal hypothesis researched. Epidemiologists should therefore qualify their confidence with appropriate confidence margins, and single studies should be treated skeptically until their results are verified by other studies, conducted by different persons, in various places, circumstances and times. The combined weight of these studies, the epidemiologists maintained, was in a growing number of cases the best science could offer public health decision-makers in this new era of latent and irreducible causes and chronic disease.[52]

Disdained by scientific purists, this pragmatic program of epidemiology was warmly embraced by the expanding regulatory regimes of the late twentieth century. Practical by nature, legislators, administrators, and public health officers were less concerned with the rigorous pursuit of experimental design and more with the pressing businesses of public

[52] Bradford Hill, "The environment and disease: association or causation?" *Proceedings of the Royal Society of Medicine* (1965) 58:295–300; Leon Gordis, "Challenges to epidemiology in the next decade", *American Journal of Epidemiology* (1988)128:1-9.

policy, which often necessitated judgment made with less than perfect information.[53] They found epidemiology with its quantified logic and its focus on the population as the unit of investigation perfectly placed to provide them with potent tools to estimate the prevalence of otherwise irreducible health problems, investigate their probable sources, identify those groups with elevated risks, and target them with preventive measures.[54]

The later part of the twentieth century saw therefore the flourishing of the so-called "black-box epidemiology" - a technical, policy-driven epidemiology that shunned biological hypotheses and concentrated on computing the risks facing taxpayers from a myriad of modern conditions.[55] The parallel growth of medical registries and computer technology allowed for the deployment of increasingly complex statistical techniques in the search for increasingly smaller risks in increasingly larger populations. The epidemiologists traded up their mechanical rulers first for punch cards and then for software programs, and got comfortable with the new tools of multivariate correlation and regression, and exotic tests of statistical significance. By the end of the 20th century, the reduction of causes to a distributed network of risk factors had become prevalent and

---

[53] Advisory Committee to the Surgeon General of the Public Health Service, *Smoking and health*, (Washington, DC: Department of Health, Education, and Welfare, PHS Publication No. 1103. 1964.)

[54] Milton Terris, "Epidemiology and the Public Health Movement," *Journal of Public Health Policy* (1987) 8 (3) 315-329; Stephen Thacker and Ruth Berkelman, "Public health surveillance in the United States," Epidemiological Reviews (1988) 10: 164-190; Hertz-Picciotto, "Epidemiology and quantitative risk assessment: a bridge from science to policy," *American Journal of Public Health* (1995)85:484-491.

[55] Neil Pearce, "Traditional Epidemiology, Modern Epidemiology, and Public Health," *American Journal of Public Health* (1996) 86(5): 678-683;

increasingly informed medical research, as well as regulatory and legal action. In theory, some continued to insist, this was not a science of causation. In practice, however, it was exactly this - a hunt for causes; if not for science then certainly for administrative and legal action.[56]

Causality – scientific side up

Professor Wilchek belonged to the top tier of Israeli science. His contributions in the field of molecular recognition and their applications to biological systems have earned him wide international fame, and his expert advice was much sought after by a wide spectrum of clients, from regulative agencies to start-up biotech companies.[57] Yet, Wilchek's experimental expertise was not well suited to deal with the kind of problem posed before the committee. Too many chemicals were out there in the Kishon, and too little was known about most of them, not to mention of their synergic affect. They came in different forms - soluble in the water and combined in the sediments; in suspended particles and in interstitial water; each form governed by many interlinked factors, such

[56] Susser M., "Epidemiology in the United States after World War II: the evolution of technique," *Epidemiological Reviews* (1985) 7:147-177; Idem, "Choosing a future for epidemiology: I. Eras and paradigms," *American Journal of Public Health* (1996) 86(5):668-73.

[57] In 1987 Wilchek received the Wolf Foundation Prize in medicine for the development of affinity chromatography and its applications to biomedical sciences; In 1990 he received the Israel Prize in the Life Science.

as acidity and temperature.[58] Even if an adequate model could be constructed for this complex environment, Wilchek would still need to feed it with reliable input. Unfortunately, the commandos' exposure to the Kishon was intermittent, and spanned four decades during which the conditions at the Kishon varied widely. Thus, it was unlikely accurate exposure information could be obtained. The ultimate dose intake further depended on the absorption rates of the various chemicals through the divers' skin, lungs, and digestive tracts. Some of these rates have been studied but not all, and little was known about their behavior under diving conditions.[59] Did wet-suits protect the divers or enhance their risks? Did water pressure affected absorption rates? Add these uncertainties and others to the methodological problems facing experimental toxicologist discussed above, and we can see why Wilchek's contribution to the committee's scientific enquiry into the causal relations between the water of the Kishon and the cancer contracted by the naval commandos was secondary at best. Instead, it was Dr. Gad Rennert, the epidemiologist, who took over the inquiry.

---

[58] Cf. Wayne G. Landis, W. H. Van der Schalie,eds., Aquatic toxicology and risk assessment (Baltimore: ASTM Committee E-47 on Biological Effects and Environmental Fate, 1990); Lenore S. Clescerl, Arnold E. Greenberg, Andrew D. Eaton, Standard Methods for Examination of Water and Wastewater (Baltimore, United Book Press, 1998)

[59] See the following correspondence: Elihu D. Richter et. al., "Cancer Risks in Naval Divers with Multiple Exposures to Carcinogens," *Environmental Health Perspectives* (2003) 111(4): 609-617; Yona Amitai et. al., "Cancer risk to naval divers questioned," id., 111(12), 630; Elihu D. Richter et. al., "Cancer risk to naval divers: response," id. See also, S. Almog and Y. Amitai, Diving in Polluted Water: Proposed Guidelines Report of the Israeli Expert Committee, Conference on Diving in Polluted/Contaminated Water Washington DC, July 25-26, 2006

Epidemiology's principle strategy for studying causation in toxic cases is the so-called *cohort study*. In this study design the researcher first identifies the exposed individuals and then compares their incidence of disease with that of another cohort, of unexposed people. The result is an attractive decision mechanism in the shape of simple index of relative risk, defined by the ratio of the disease incidences of the exposed (nominator) and unexposed (denominator) cohorts. The higher the index, the stronger the confidence that the computed association represents a causal relation. A relative risk of one signifies that the incidence rate is the same among the exposed and non-exposed cohorts and thus indicates a lack of association between the suspected exposure and the alleged disease. Relative risk greater then one suggests that exposed people are in higher risk of disease than a non-exposed. A relative risk greater than two indicates that the exposed more than doubled their chance to contract the disease. From a population perspective, this means that more than half of the exposed owed their disease to the exposure. From the individual's perspective, it means that the exposure was more likely than not responsible for his or her disease.[60]

The logic of the cohort study is sound. The devil is in the details. The compared cohorts need to be cut as similar as possible, except for the specific risk under study. The more similar the cohorts are, the more epidemiologists can be certain that the correlations they compute could be assigned to the risk under study and not to other, unaccounted for,

---

[60] Kenneth J. Rothman, Sander Greenland, eds., Modern Epidemiology (Lippincott, 1998) 79-93; Paula A Rochon et. al., "Readers guide to critical appraisal of cohort Studies: Role and design," *British Medical Journal* (Apr 2005) 330; Meirik , Cohort and Case control studies, (Genève: Unit for Epidemiological Research).

confounding factors. The golden standard is the so-called *clinical trial* – which compares incidence rates of health complications in various cohorts, each assigned with a different medical treatment. The comparability of the clinical trial's cohorts is assured by randomization, i.e. by assigning individuals to large cohorts via a random process. However, in toxic exposure cases such as in the Kishon, the cohorts of exposed and non-exposed had already been set by the events of the exposure. In such cases the epidemiologist's first challenge is to accurately reconstruct these cohorts from personal and institutional memory– a task easier said then done.[61]

Rennert lunched his inquiry by a massive administrative effort to identify all those individuals whose records indicate that they may have been exposed to the water of the Kishon during their military services. All together, over 10,000 people were identified (4145 from the Naval Commando) and summoned for a comprehensive set of interviews and medical tests. A little over 3,000 have showed up (1911 from the Naval Commando) and were carefully evaluated according to their degree of exposure and types of medical problems. Estimating the degree of exposure was by far the hardest part. The military records were incomplete, especially during the early decades of the state, and uncertainty could not be avoided. The whole process took a year and half to complete, during which 107 cases of cancer were identified, 19 of which previously unknown. The extensive testing was required to ensure that all medical problems are discovered and treated.

---

[61] Michael d. Green, Michal Freedman, and Leon ordis , Reference Guide on Epidemiology, in *Reference manual on Scientific Evidence* (Federal Judicial center, 1994), pp. 121-180; Dave Smith & S. Ebrahim, "Data dredging, bias, or confounding," *British Medical Journal* (2002) 325: 1437-1438.

Rennert, also, needed the database for his investigation, but he had to use it carefully. For example, he could not include in his study the new cases discovered by the committee's medical tests, since this would bias the comparison against any control group that was not equally tested.[62] To preserve the comparability of his cohorts, Rennert was therefore forced to use only those cases recorded by the National Cancer Registry, and since this registry had a three years' lag, Rennert was forced to ignore not only the new cases discovered by the committee's inquiry but all cases diagnosed after 2000. All together, about a quarter of the cancer cases known to the committee had to be excluded, leaving Rennert with 81 cases to work with.[63]

Rennert's initial plan was to compare cancer rates between the naval commandos who dived in the Kishon [hereinafter - the *Divers*] and a control cohort made of soldiers from other elite units [hereinafter - the *Elites*]. Such a control cohort, Rennert assumed, would be the most similar to the naval commandos in age, physical condition, social variables, etc. However, during the long process of data collection Dr. Rennert realized that he has access to an even better control cohort. The Naval Commando's training course is long and extremely hard, and Rennert found out that a significant percentage from those who started the course dropped out before reaching the stage that involved diving in the Kishon. He decided to use these dropouts as his optimal control cohort [hereinafter - the *Dropouts*]. Finally, Dr. Rennert also used data from the national cancer registry to define

---

[62] Epidemiologists call this *recall bias* – the access of disease rate created by unequal testing procedures, or even just by heightened awareness of the disease among of the target group.

[63] Shamgar Committee, Final Report (Apr 2003), Chapter 17, 469-481.

a third control cohort - the general Israeli male population, which he used as a base reference for all his other comparative analyses.[64]

Equipped with his four cohorts -- the *Divers*, *Elites*, *Dropouts*, and *General Population* - Rennert was finally ready to launch his analysis. First, he tested whether the rate of cancer among the *Divers* was indeed higher than in the three control cohorts. He found the results equivocal. The rate of cancer among the *Divers* was higher than the average recorded in the *General Population* by a factor of 1.21, and higher still when compared to the *Elites*, whose rate, as expected from their top physical shape, was significantly lower than that of the G*eneral Population*. However, the most important comparison -- between the *Divers* and its closest control cohort, the *Dropouts* -- found no difference in rate of disease.[65]

To explain this curious result, Rennert looked for confounding factors, i.e. other risk factors that could have confounded his analysis. He noticed that those who volunteered to the Naval Commando (i.e. both the *Divers* and the *Dropouts*) showed higher rates of skin cancer of the type generally associated with exposure to the sun. Rennert assumed therefore that those who volunteered to the Naval Commandos tended to spend more time at the beach or at sea, even before their recruitment, and were more exposed to the sun than the other two control cohorts. To test his hyspothesis, Rennert omitted all skin cancer cases from his calculations. The result: all significant differences disappeared. Without the melanomas, no causal pattern could be found in the data. The rates of cancer

[64] Id.

[65] Id. 485-492..

between the *Divers* and all three control cohorts were more or less the same. If there were any cancer risks in the Kishon, the analysis failed so far to find them. [66]

Sensitivity is of constant concern in cohort studies. The design requires a large number of exposed individuals, since only a small fraction of them will contract the disease. The rarer the disease, the larger the cohort needs to be in order to discern its risk factors. The problem is further exacerbated in a case like the Kishon, where the exposure varied greatly over time in both content and intensity. In such cases, one could expect that any risk factor, if it exists, would affect only part of the cohort, during only parts of the exposure period, and be responsible to only part of all possible cancers. To look for such finer distinctions, the epidemiologist must further cut his cohorts in various ways. Like an anatomist, a good epidemiologist is judged not only by the soundness of his method but also by the quality of his cuts.

Such cuts carry their own risks, though. The more one cuts, the smaller the cohorts get; too small perhaps to reveal risk clusters in a statistically meaningful way. Moreover, the more one cuts and compares the higher the probability one will find spurious differences, created by chance alone. This could lead to two types of error: either a false association could be found (false positive) or a true association could be overlooked (false negative). Epidemiologists have always been more vigilant about the first type of error. To guard against the possibility of claiming associations that do not exist, they adopted a two-tier defence strategy termed the *null hypotheses*. This strategy operates under the presumption

[66] Id..

that no causal connection exists between the exposure and disease under study, and demands a strong proof to reverse this presumption. Such proof requires not only of the measurement of a high enough risk-ratio, but also the statistical assurance that it is not a false association, created by chance alone. Statistical theory can provide this assurance by calculating the probability of such false positives, and the epidemiological dogma demands it to be smaller than 5% (i.e., less than 1 in 20) for the association to be considered statistically significant. This self-imposed standard reflects the cautious attitude of scientists who wish to be 95% certain that their measurements are not spurious. But this caution comes with a price. The rates of false positives and negatives are inversely related. The less you allow for the first the more you are forced to accept of the second. In other wards, the more you guard against false risks the more you are bound to miss true ones.[67]

The evidence gathered by the committee in 2000 made clear that the Kishon has steadily deteriorated since the 1950s. Still, until the early 1970s there was relatively little evidence of acute pollution, while reports from the mid-1970s forward started to specify significantly higher levels of pollutants in the water. This could have been an effect of a better detection or documentation rather than reflecting the state of the water. Still, looking for a dose-response relation is a basic epidemiological strategy and Rennert decided to use 1975 as a cut-off dat. He divided each of his cohorts to two: those

[67] The relation between false positive and negatives is non-linear and can be computed from the sample. See J. Neyman & E.S. Pearson, "The testing of statistical hypotheses in relation to probabilities a priori," reprinted in J. Neyman & E.S. Pearson, *Joint Statistical Papers*, Cambridge University Press, (Cambridge), 1967 (originally published in 1933), pp.186–202.

recruited before and after 1975. The finer grid provided a sharper picture. The cancer rate among the post-1975 *Divers* was now twice that of the post-1975 *Dropouts*, and 2.28 higher than that of the post-1975 *Elites*. And when Rennert eliminated the skin-cancer cases, the differences grew even stronger. Without the melanomas, the rate of cancer in the post 1975 *Divers* was 2.8 times higher than that measured in the *General Population*, and 2.4 higher than the *Elites*. [68]

Rennert's higher resolution seemed to reveal some evidence that could support a causal relation between diving in the Kishon and contracting cancer. But the higher resolution came with a stiff price. The cohorts Rennert worked with were not large to begin with. Initially, 107 cases of cancers had been identified among the commandos. Of these, 31 were eliminated due to bias considerations. The remaining 76 cases were first divided to a *Divers* cohort of 39 and a *Dropouts* cohort of 37, and then again to *Pre-1975* and *Post-1975* sub-cohorts, the latter merely 12 cases strong. Add to this the relatively young age of the soldiers, and we can see how weak the statistical traction was. These were small cohorts, too small perhaps to provide the required level of statistical significance for anything less than really high risks. Altogether, Dr. Rennert performed 73 comparisons and only seven of them proved statistically significant, and among these only one pointed towards a clear risk -- among the professional divers, a sub-cohort of the *Divers*, who spent significantly more time in the Kishon than anybody else.[69] All other correlations failed to rise to the level of statistical significance required by science and thus could not

---

[68] Shamgar Committee, Final Report (Apr 2003), 485-494.

[69] Id. The cancer rate measured in this group was 5.45 higher than in the general population.

be formally interpreted as supporting evidence for the existence of a causal connection between diving in the Kishon and contracting cancer. Consequently, unable to discern clear pattern of causation, Rennert felt obliged to stick with the null hypothesis. Science, he and Prof. Wilchek concluded, found no reason to reverse their initial working assumption that there is no causal connection between diving in the Kishon and contracting cancer. [70]

Causality – legal side up

While the scientists on the committee collected data and compared cohorts, their Chair, Chief-justice emeritus of the Israeli Supreme Court Meir Shamgar, was making his way through the law books, collecting precedents and comparing legal opinion. The committee's mandate was carefully limited to a factual determination of the causal connection between the Kishon's water and the commandos' cancer. Yet, Shamgar had made clear already in the preliminary report that his inquiry into this connection could not be reduced to the scientific evidence, for it would be based on a more flexible and inclusive conception of causation. To explain, Shamgar differentiated three legal kinds of proof: direct and evident, statistical, and what he called "high probability." Direct and evident proof, of the kind attainable by an eyewitness or experimental demonstration of cause and effect, was rarely available in toxic cases. In its absence the law had increasingly turned to the second statistical kind of proof, of the kind attainable by

[70] Id. 495-502.

epidemiology. However, Shamgar emphasized, the third mode of proof, the so-called high probability, was also in play; all the more so when science was uncertain. Wider in scope and more flexible in application, it could resolve problems outside the reach of science. Made of multiple, often partial, pieces of evidence drawn from various sources and integrated by common sense, it was a dynamic mode of proof that could be reduced neither to science nor indeed to any single system of uniform proof. It was a mode of proof unique to the legal culture, central to its identity and authority and Shamgar busied himself considering its principles and their application to the problem before the committee.[71]

Shamgar could not have found much in his legal library by way of direct local precedents. Israeli courts had considered the determination of toxic causation in individual tort cases but they never ruled before on a case like the Kishon, which crowded together multitude of plaintiffs with various case histories, all claiming to be harmed by the same toxic exposure.[72] This however was hardly the case in other countries, where fears of toxic exposures that might endanger a large number of people

[71] Shamgar Committee, Interim Report (Jun 2001), 225-230.

[72] The few cases that did exist were settled before the courts had the opportunity to express its opinion. In 1994, for example, fishermen that work in the Kishon, joined by the Israeli Union of Environmental Defense, sued the managements of the two biggest polluting plants: Haifa Chemicals, inc. and Deshanim Inc., for polluting the Kishon. The suit ended two-years later with an out-of-court compromise. See Haifa Peace Court records, criminal complaint # 5790/94.

had become a trademark of late modernity.[73] One obvious place to look for guidance and relevant precedents was in US courts, whose opinions and rulings have been frequently considered by Israeli courts.[74]

The shifting notions of causation in mass toxic tort action in the US

By 2003, US courts have been struggling with the proof of toxic causation for at least four decades. The problem emerged in earnest in the 1970s in two main contexts: judicial review of regulatory action and private tort litigation, and the courts have responded differently in each. The judges put forward the precautionary doctrine to legitimize regulatory action in the absence of unequivocal science, but they were reluctant to extend the same leniency to the private sphere of litigation.[75] Claims of potential risk belonged to the public sphere and required a relatively low level of proof to justify regulative action. Anything more, the judges recognized, would leave but few environmental regulations standing. Claims of actual harm were treated differently, however. These belonged to the private sphere where, the courts insisted, the traditional requirements of tort law still held: the plaintiff must offer a persuasive proof of a concrete and actual harm caused by the defendant. Anything less, the judges held, would be unfair to the defendant, who should not be forced to pay for injuries it did not cause.

---

[73] Ulrich Beck, *Risk Society: Towards a New Modernity* (London ; Newbury Park, CA : Sage Publications, c1992)

[74] For example, see the 2004 influential analysis of scientific evidence by Judge Yehudit Naor in the appellate case of *Kibuts Maaian Zvi v. Krishnov* 1639/01. Naor refers in her analysis to more than 20 US cases .

[75] Sheila Jasanoff, *Science at the Bar: Law, Science, and Technology in America* (Cambridge, Mass.: Harvard University Press, 1995), 114-137.

The courts' insistence on a concrete proof and the difficulties of science to deliver it turned causation into a central problem for the thriving late-modern genus of toxic tort litigation.[76] Tort, the branch of private law that deals with injury claims, had traditionally prided itself on its individualized case-by-case approach. Its subject-matter was willful human beings whose causal agency, the judges insisted, could not be subsumed mechanically, without the careful exercise of human judgment on a case-by-case basis.[77] Ironically, this humanistic approach was coupled with a model of causality as reductive as that of the science of infectious disease. To exists, a legal cause had to be reduced to a causal agent. To be sure, this causal agent was a human being, not a microbe, a fact that added a moral dimension and much complexity to the process of proof. Nevertheless, the plaintiff's burden of proof, like that of the medical experimentalist, was to single out this agent and demonstrate the causal chain of events that linked the agent's actions to the plaintiff's injury. If a specific causal agent could not be uniquely determined - that is if the plaintiff could show only that the defendant's action might have caused the harm or if another indistinguishable potential cause existed – the courts usually dismissed the claim for the failure to prove 'specific causation.'[78]

---

[76] Steve Gold, **"**Causation in Toxic Torts: Burdens of Proof, Standards of Persuasion, and Statistical Evidence," *Yale Law Journal* (1986) 96:376-402.

[77] Morton J. Horwitz, The doctrine of objective causation**,** In D. Kairys ed. *The Politics of La*w (New York: Pantheon Books, 1992) 201-213.

[78] Wright, R.W., "Causation in Tort law", *California Law Review*, 73 (1985): 1737-1828. For a classic legal discussion of this approach, see O.W. Holmes, The Common Law (1881), 88-90.

This reductionist model of specific causation has worked quite well in traditional tort cases such as accidents or assaults. The defendant's identity and conduct were usually verifiable by direct evidence such as eyewitness testimonies, and the causes for a black eye or a flooded house were understood well enough to allow the courts to decide liability based on whether those causes were controlled by the defendant. That was not the case, however, in a growing range of environmental, work-safety, and product liability cases that came to be known by the end of the 1970s as 'toxic tort' cases. [79] These cases involved injuries of the kind that has frustrated experimental science - chronic, with long latency and poorly understood etiology; injuries that could not be comfortably reduced to a single cause. In the absence of direct proof of cause and effect the courts increasingly turned to epidemiological evidence for resolution. That was particularly true for the new and emerging phenomenon of mass toxic tort litigation that clustered together large crowds with various case histories, all claiming to be harmed by the same exposure or by the same standardized, mass-marketed product. Here, lawyers and judges, just like legislators, administrators and public health officers, found epidemiology's quantified logic and population-based analysis particularly conducive to their needs.[80]

The power of epidemiology to provide persuasive proof of causation in mass tort litigation was first demonstrated in two of the largest and most publicized litigations of

---

[79] The first cases to be termed toxic tort was an early Agent Orange case from 1979. See Robert F. Blomquist, "American Toxic Tort Law: An Historical Background," 1979-87, *Pace Environmental Law Review* (1992) 10: 85-173, on 86.

[80] Peter Schuck, *Agent Orange on Trial: mass toxic disasters in the courts* (Cambridge, Mass. : Belknap Press of Harvard University Press, 1986) 26-28.

the 1970s, involving asbestos and the first synthetic hormone, diethylstilbestrol (DES), a drug widely given to pregnant women in the 1950s and 60s to prevent miscarriage.[81] In both litigations the epidemiological evidence took central stage by demonstrating a strong association between the exposure and a unique 'signature' disease among the exposed. Adenocarcinomas of the vagina and uterus were almost unknown among women whose mothers had not taken DES, and Mesothelioma was a rare from of cancer that was alleged also to be uniquely associated with asbestos exposure.[82] These exclusive relations allowed the plaintiffs to successfully argue that the litigated exposure was responsible for their specific ailment and win decisive legal victories against the manufacturers.

The early successes of the asbestos and DES litigations brought in a tide of toxic tort actions to the courts. However, many of these new actions lacked the signature disease central to the earlier cases. Instead, the plaintiffs often suffered from various illnesses that could be found also in the general population and could have resulted from causes other than the exposure at issue. Should the court rely on epidemiology for the determination of causation even in the absence of a signature disease, or in the presence of alternative causes? And what is the court to do if the epidemiologists fail to find it? Could the court

---

[81] For an updated account of Asbestos litigation, see Stephen Carroll et. al., *Asbestos Litigation* (Santa Monica, Ca: Rand corporation, 2005); For the DES litigation, see *Sindell v. Abbott Laboratories*, 26 Cal. 3d 588 (1980)

[82] Selikoff IJ, Churg J, Hammond EC, " The occurrence of asbestosis among insulation workers in the United States. Annals of the *New York* Academy of Sciences. (1965) 132:139-155; Herbst AL, Ulfelder H, Poskanzer DC "Adenocarcinoma of the vagina. Association of maternal stilbestrol therapy with tumor appearance in young women". *New England Journal of Medicine(*1971) 284(15): 878–81

still find a causal relation where science saw none? These questions stood at the center of the largest and most publicized mass toxic tort litigation of the 1980s – the Agent Orange case.

Agent Orange

The Agent Orange action was brought in the early 1980s by many thousands of Vietnam veterans who believed they had suffered or might suffer a variety of diseases due to their war-time exposure to Agent Orange – an herbicide widely sprayed in Vietnam by the U.S. military in order to destroy the jungle and the advantages it afforded to the enemy. Agent Orange contained dioxins, a family of highly toxic man-made organic compounds that the veterans believed were responsible for their health problems, including cancers, heart attacks, a suppressed immune system, hormonal imbalance, diabetes, menstrual problems, increased hair growth, and weight loss.[83]

The similarities between the *Kishon Affair* and *Agent Orange* are striking. Both cases involved veteran soldiers and both became national affairs and rallying points for public protest against what was perceived as official indifference to those who had faithfully served their country. In both cases the problem of causation stood front and center, and in both cases the decision makers were willing to rely on epidemiological studies alone to solve the problem. "We are in a different world of proof than that of the archetypical smoking gun," commented Judge Weinstein, the federal judge who managed the Agent

[83] In re: Agent Orange Product Liability Litigation, 597 F. Sup. 749 (1984).

Orange case. “We must make the best estimates of probability that we can, using the help of experts such as statisticians and our own common sense and experience with the real universe.” [84]

The epidemiological inquiries in both cases met with similar difficulties. The Israeli and the American veterans suffered from a variety of ailments that could be found also in the general population and could not be easily reduced to the exposure at issue. In both cases little doubt existed about the severity of the exposure at high doses but the impact at lower doses was far less clear. In both cases also, the specific levels of individual exposure were not clear and had to be reconstructed largely from personal memory, many years after the fact. Perhaps one should not be surprised then that in both cases the best estimates of probability left much in doubt. The epidemiological studies of Vietnam veterans undertaken by various federal and state authorities failed to demonstrate statistically significant differences between the incidence of relevant ailments among the exposed veterans and other groups in the population. The only alleged injury that was demonstrably correlated with exposure to Agent Orange was chloracne, a disturbing but far from fatal skin disorder.[85]

Lacking positive epidemiological findings, the veterans’ lawyers based their proof of factual causation on laboratory animal studies and occupational studies of industrial accidents that demonstrated that dioxins can cause many ailments, including nerve damage, birth defects, increased rates of miscarriages and changes to the immune system.

[84] Id.

[85] Id.

But Judge Weinstein discounted this type of scientific evidence. The differences in species and in the levels of exposure examined, he maintained, undermined the significance of these studies, and without the support of epidemiology they did not suffice to prove causation.[86] Still, despite the lack of an adequate scientific proof of causation, Weinstein refused to dismiss the case. Unable to satisfy the standard of proof required in tort, he chose to question the applicability of this standard, and by implication, the applicability of the entire traditional tort edifice to the late-modern phenomenon of mass toxic tort litigation.

The long-established standard of proof required in tort cases is known as the "preponderance of the evidence,' or 'more likely than not' standard.[87] Under its traditional interpretation in tort, statistical correlations alone indicating that the probability of causation exceeds fifty percent were insufficient to satisfy this standard. Some concrete proof that can provide direct and actual knowledge of the causal relationship between the defendant's tortuous conduct and the plaintiff's specific injury was required.[88] But in mass exposure cases such as Agent Orange, Weinstein argued, where the chance for particularistic evidence is small, the consequence of retaining this

---

[86] In re: Agent Orange Product Liability Litigation, 597 F. Sup. 749 (1984).

[87] David Kaye, "The Limits of the Preponderance of the Evidence Standard: Justifiably Naked Statistical Evidence and Multiple Causation," *American Bar Foundation Research Journal* (1982) 7(2): 487-516

[88] For example, the testimony of medical expert that a given disease is uniquely associated with the exposure at issue.

requirement "might be to allow defendants whom, it is virtually certain, have injured thousands of people and caused billions of dollars in damage," to be free of liability."[89]

Weinstein sided therefore with what he called a 'weaker' interpretation of the preponderance standard – one that allowed a verdict chiefly on statistical evidence in mass tort cases. [90] But he warned that the successful adoption of this weaker standard required further procedural adjustments. As practiced, its application on a case-by-case basis in a mass tort action will not only be an administrative nightmare but will almost always result in either under or overcompensation. If probability be a hair less than %50, each and all plaintiffs will lose and an obviously tortuous defendant will walk away. If probability be a little over %50, each and all plaintiffs will win, including those uninjured by the defendant. This made no sense to Judge Weinstein. Given the unprecedented scale of mass tort, he was worried of the potentially devastating economic implications, which could lead to the financial ruin of entire industries or the deprivation of a large number of injured people from proper compensation.[91]

Weinstein's solution was as straightforward as it was radical. Given the necessarily heavy reliance on statistical evidence in mass exposure cases, the preponderance standard of proof, the winner-takes-it-all approach, and the case-by-case and plaintiff-by-plaintiff

---

[89] In re: Agent Orange Product Liability Litigation, 597 F. Sup. 749 (1984).

[90] This weak interpretation was also adopted by another federal judge, who saw over another early-1980s leading mass toxic tort litigation. See *Allen v. United States*, 588 F. Supp. 247 (D. Utah 1984). 415.

[91] In re: Agent Orange Product Liability Litigation, 597 F. Sup. 749 (1984).

method of adjudication will all have to go. “Even if the statistical increase attributed to the substance in question is just a few percentage points, if statistical theory supports a finding of correlation there is no reason why the industry as a whole should not pay for the damages it probably caused.” [92] Equipped with more flexible metrics, Weinstein suggested, mass toxic tort cases should “try all plaintiffs' claims together in a class action thereby arriving at a single, class-wide determination of the total harm to the community of plaintiffs. . . The defendant would then be liable to each exposed plaintiff for a pro rate share of that plaintiff's injuries.”[93] In short, if the courts should allow for verdicts based on statistical evidence in mass toxic torts cases, they need to match it with the equally aggregative and innovative mechanisms (at least in tort) of class action and proportional liability.

Judge Weinstein was well aware that his cutting of the Gordian knot of mass toxic tort ran against the legal grain and that if the Agent Orange action would go to trial, his wholesale modification of tort would quite possibly be reversed on appeal. He therefore pushed the parties to sign an out-of-court agreement engineered by him. He cajoled the industry to put together a $180 millions fund and ordered its distribution among the 250,000 Vietnam veterans on the degree of disability alone, regardless of cause. True to his analysis, Weinstein later summarily dismissed without a trial the individual claims of those veterans who chose to opt out of the agreement, on the ground that under traditional

[92] Id.

[93] Id.

tort rules, it was unfeasible to connect their individual ailments to Agent Orange exposure.[94]

Agent Orange constituted a key chapter in the adaptation of late 20th century American tort law to the challenges of mass toxic tort litigation. It put on display the inadequacies of the traditional tort doctrine of specific causation in dealing with mass toxic tort cases and the centrality of epidemiological evidence for their resolution. More pertinent for us here, it also put on display Judge Weinstein's reluctance to allow the narrow tort doctrine of causation prevent the injured veterans from recovering and his willingness to modify this strict doctrine to allow the veterans to recover. Weinstein' wholesale fusion in *Agent Orange* of probabilistic causation with class action and proportional liability may have been too radical for the everyday business of tort courts but his endorsement of epidemiology as "the best (if not the sole) available evidence in mass exposure cases," and his dismissal of animal studies as "so potentially misleading as to be inadmissible," remained influential.[95]

During the 1990s, as the American legal system continued to struggle with the complexities of toxic tort litigation, epidemiology has moved from being a useful adjunct

---

[94] Peter Schuck, Agent Orange on Trial: mass toxic disasters in the courts (Cambridge, Mass. : Belknap Press of Harvard University Press, 1986) 188-89.

[95] Michael Green, "Expert witnesses and sufficiency of evidence in toxic substances litigation: The legacy of Agent Orange and Bendectin litigation," *Northwestern Law Review* (1992) 86: 643

to an almost necessary element in the proof of causation.[96] But it has not been given free reign. To fit epidemiology into the particularistic ideology of tort, American courts split the proof of causation in toxic tort cases to general and specific. General causation refers the potential of a given exposure to cause injury; specific causation, to the actual harm claimed by the plaintiff.[97] The partition was very much rooted in the politics of the jury system and the perennial concern with the ability of the lay jury to handle the complexities of the scientific evidence. The proof of general causation, increasingly provided by epidemiology, was checked by the judge before the trial, during the admissibility stage.[98] Only upon the satisfaction of the judge that the potential for harm was proven, could the legal action move forward to the trial stage, where the issue of specific causation could be examined by a jury.[99] Here, in this diminished realm of specific causation, lay the irreducible domain of the 'high probability' mode of proof Shamgar referred to, where the contingencies of the parties and the singularities of the

---

[96] By the early 1990s U.S. courts were regularly dismissing, without a trial toxic, suits that could not support their claims with solid epidemiological studies. See Joseph Sanders, Bendectin on Trial: A Study of Mass Tort Litigation (The University of Michigan Press, 1998).

[97] Dillingham, William O; Hagan, Patrick J; Salas, Rodrigo, *Blueprint for General Causation Analysis in Toxic Tort Litigation*, FDCC Quarterly **(**Oct 1, 2003)

[98] *Daubert vs. Merrell Dow Pharmaceuticals*, 509 U.S. 579 (1993); Margaret Berger, "What Has a Decade of Daubert Wrought?" *American Journal of Public Health* (2005) 95: 59-65.

[99] Dillingham, William O; Hagan, Patrick J; Salas, Rodrigo, Blueprint for General Causation Analysis in Toxic Tort Litigation, FDCC Quarterly **(**Oct 1, 2003).

case escaped the bounds of science, and proof was provided by the wisdom and common sense of judge and jury.

Shamgar's decision

Like his American colleague Jack Weinstein in Agent Orange, Chief-Justice Meir Shamgar also seemed determined to prevent the clearly negligent military and government from escaping its responsibility over the difficulties of proving causation in toxic exposure cases. However, Shamgar was chairing a military investigation committee, not a tort action, and thus was not obliged to reckon with tort's restrictive doctrine of causation. Instead, he chose to tackle the problem of causation from a different legal angle which provided a better rationale for allowing the ailing soldiers and their families to receive compensation and due recognition despite the lack of an adequate scientific proof.

Since its establishment in 1948 Israel developed an extensive body of law that deals with the rights of soldiers injured over the course of their military service. If recognized as IDF Disabled Veterans, such soldiers and their families are entitled to generous compensation from the state by means of an extensive array of pensions, tax breaks, and other compensatory measurements. In order to be recognized as an IDF Disabled Veteran, an injured soldier must prove that his or her injury was caused or aggravated by his or her military service. Families of soldiers who died while serving in the military are exempted from this requirement. In these cases, the courts have presumed a causal

connection between the death and the military service and shifted the burden of proof to the military in the event that it wished to claim otherwise.[100] It was not enough for the military to show that the scientific evidence does not support causation. It had to provide a specific proof that the soldier's death was not caused by his or her military service. The Israeli Supreme Court provided two primary reasons for this shift of the burden of proof. First was the legislators' desire to compensate the families of deceased soldiers, even when the cause of death could not be clearly established. Second, while injured soldiers could provide direct details about the events leading to their injuries, the families of dead soldiers were at a distinct disadvantage vis-à-vis the military authorities regarding the collection of evidence.[101]

The legal presumption of a causal connection applied only to those soldiers who died during their military service. Those merely injured, and the families of those who died after their military service, had to prove the causal connection between their injury and their military service, and their proof was measured by the same preponderance-of-the-evidence standard used in tort. Still, Shamgar was able to assemble a body of precedents to show that in such cases too, when the soldier's proof of causation was frustrated by inconclusive medical opinion, Israeli courts had found various ways to ease the soldier's burden of proof. [102] Typically, the courts did not require the soldier to exclude all possible causal explanations for the injury but his or hers. Instead, it was sufficient for the soldier to show only a probable possibility of a causal connection between the injury at

---

[100] The Soldiers' Families Law, 1988.

[101] *Military Payment Officer vs. Hecht*, 192/85.

[102] Shamgar Committee, Final Report (April 2003) 507-528..

issue and the military service. Once the soldier had done so, the court shifted the burden of proof to the military to prove otherwise. If the military failed to do so, the court felt free to adopt the soldier's version over all other possible explanation. Shamgar quoted the following Israeli Supreme Court justification for this leniency:[103]

> The subordination of the soldier to the circumstances of military life is inescapable and he cannot by his free will change it and live in other circumstances. Hence, the comparison with the dangers he might have been exposed to in other 'civil' circumstances, must be more liberal and the state must bear the responsibility for every injury or disease that bears a concrete causal relation with the military service.

Next, Shamgar moved to examine the judicial treatment of causation also in civil toxic tort cases. This, he emphasized, was done only for comparative purposes. The authoritative body of law remains that which dealt with the rights of soldiers injured during or because of their military service. Still, Shamgar was able to presented a coherent body of precedents to show that in civil tort too, in cases in which the defendant's conduct was manifestly tortuous but the plaintiff had no means of identifying the specific cause of injury, Israeli courts had taken steps to ease the plaintiff's burden of proof by shifting some of it to the defendant.[104]

---

[103] Weinstein 137/64, Quoted in Shamgar Committee, Final Report (April 2003) 512-13.

[104] E.g. Krishov v. Kibuts Maaian Zvi 95/382; Michaelli v. Tadiran 10/94; Toister v. Technion 4248/98 and 4022/98. See Shamgar Committee, Final Report (April 2003) 530-575.

Having clarified the legal principles and their application by Israeli courts to the problem of toxic causation, Shamgar finally turned to examine the actual question before the committee -- the determination of the causal connection between the water of the Kishon and the divers' cancers. He first addressed the water. The evidence left no doubt, he concluded, that the water had been heavily polluted for decades by all kinds of carcinogenic materials. Next, he turned to examine the question of exposure. Here too, he concluded that the evidence made clear that the divers spent long hours in the water, coping with insufficient equipment, accidents, and disciplinary measures that increased their exposure to the dangerous water. Was that enough to deduce a causal connection? Shamgar did not ignore the negative conclusion of his scientific colleagues on the committee. Instead, in an impressive display of rhetoric he presented Dr. Rennert's epidemiological study as an excellent but isolated scientific effort that was frustrated by unreliable exposure data and limited-size cohorts; all of which prevented it from providing an authoritative answer to the problem before the committee.[105]

Having established the lack of a clear scientific verdict on causation, Shamgar referred back to the precedents collected: in similar instances Israeli courts tended to side with the injured soldiers' causal version, if probable enough. Was that the case also with the Kishon? Shamgar reviewed the testimonies of the epidemiological and medical experts

[105] Id. 599-603.

who argued favorably before the committee for such a causal connection.[106] These testimonies may have carried less weight than the opinion of committee's own scientific experts, which was based on a direct study of the divers. Still, Shamgar argued, these testimonies, together with the evidence of the military's negligent conduct and the divers' exposure to the clearly proven dangerous waters of the Kishon, were enough to make the divers' causal version possible, if not probable. Consequently, Shamgar concluded, the evidence collected by the committee justified the legal determination of a causal connection between diving in the Kishon and contracting cancer. [107] In so deciding, it was important for Shamgar to clarify that he was not trying to second guess his scientific colleagues in their own expertise. Instead, he was motivated by legal considerations – namely, to protect the crucial social contract between the state, its soldiers and their families, and to abide by the legislator's explicit purpose to help those who took special risks for their country.[108]

The Final Report

The committee presented its final report and recommendations to the Ministry of Defense in April 22, 2003, nearly three years in the making. The report was comprised of three parts that reflected the sharp divide among the members of the committee. The first part

---

[106] Id. 593-597. These included experts such as Dr. *Eliahu Richter* of the Hebrew University-Hadassah School of Public Health; Prof. Tamar Peretz , Head of the Institute of Oncology, Hadassah-Hebrew University Medical Center, and Dr. Benjamin Malenky, Chairman of the Israeli Occupational Hygiene Society.

[107] Id. 605-606.

[108] Id.519-20.

of the report belonged to science. In it Gad Rennert described the principles and methods that directed his study; reviewed the data his team collected; tabulated the numbers computed; and explained the considerations that led him and Professor Wilchek to finally reject the hypothesis supporting a causal connection.[109] The second part of the report belonged to law. Shamgar explained the legal principles that directed his analysis; reviewed the evidence regarding the long neglect in the Kishon; presented the precedents collected, and explained the considerations that led him to accept the causal hypothesis rejected by science.[110] By themselves, each of these two parts contained a masterful exposition of scientific and legal expertise. Together, bounded in an official pale-blue cover that displayed the Menora, the ancient symbol of the modern state of Israel, they embodied the failure of science and law to come to terms in addressing the growing late-modern concerns with toxic exposures.

The third and final part of the report, which contained the committee's final conclusions and recommendations, failed to bridge the divide among the members of the committee With agreement beyond their reach, the scientists and the jurist chose to present their opposing conclusions in two separate sections. Rennert's and Wilchek's joint conclusion reflected the conflicts inherent in their position as scientists appointed to resolve an intense public controversy. Science, they reiterated, "did not prove that the pollution in the Kishon caused a statistically-significant increased of cancer among the divers."[111] Still, Rennert and Wilchek acknowledged the limitation of their epidemiological study

[109] Id. 469-502.

[110] Id. 503-606..

[111] Id. 608.

and the well-documented presence of carcinogens in the Kishon, and qualified their final conclusion. They noted that a statistically significant increase of cancer was found among the sub-cohort of the post-1975 professional divers, who spent more time in the Kishon than anybody else, and recommended that the military recognize those "heavy divers" (as they called them) who contracted cancer as IDF disabled veteran, making them eligible for compensation. Finally, and most unscientifically, they recommended that the military make an exception and accept responsibility, although perhaps on a lower level, for all other "lighter" divers who trained in the Kishon and contracted cancer, because science "could not exclude the possibility of a causal connection between their exposure and disease."[112]

Shamgar's conclusion was more clear-cut and authoritative. "In light of the concrete facts of the cases before us and the questions associated with the epidemiological study," he wrote, "the Committee Chair sees no reason to join the committee's majority opinion, which rejects causal, legal and logical connection." He recommended that each and every soldier exposed during their service to the Kishon and who contracted cancer should be duly recognized as a IDF disabled veteran and receive all compensation and support to which they were entitled by law.[113]

The publication of the committee's ambiguous report generated a renewed swell of public outcry. The divers organized a press conference in which they and their experts angrily rejected the scientific findings of the committee, criticized the slippery distinction

[112] Id.

[113] Id. 607-608..

between 'heavy' to 'light' divers, and demanded that the Ministry of Defense choose people and numbers.[114] The newspapers headlines cried "Humiliation to the Divers," and prominent public figures, generals, and members from all sides of the Israel parliament joined the clamor and urged the government to adopt Shamgar's minority opinion and recognize each and every sick diver as a disabled veteran. "There is only one decision that the defense minister, Shaul Mofaz, can and ought to make in order to bring this tragic affair to conclusion," wrote *Yediot Aharonoth*, Israel's largest circulating newspaper, whose investigative report had started the whole affair three years before, "and that is to recognize all sick divers as disabled veterans. It is the only moral and just resolution that he can take. There is no other. Not for the person who heads the organization that send these men to the water."[115]

The heated rhetoric left little room for any serious analysis of the intricate report. The scientific view of the committee was portrayed as petty, mean and narrow, and was contrasted with Shamgar's "courageous decision that preferred the moral over the scientific, people over statistics; common sense over numerical hodgepodge." [116] All this left the politicians with little choice. Five days after the publication of the report, the minister of defense Mofaz declared that the government reviewed the committee's report and decided to embrace Shamgar's minority opinion. All the sick divers and their families, he promised the agitated public, will be taken care of.[117]

---

[114] Maariv, April 22, 2003, 1.

[115] Id., 1; *Yediot Aharonoth*, April 22, 2003

[116] *Yediot Aharonoth*, April 22, 2003

[117] Protocol of the government meeting, Apr 27, 2003

This, everyone seemed to agree, was the only sensible resolution to the scandal. In the absence of an agreement between science and law, the politicians stepped in and exercised their legitimate power to restore justice, if not truth. But the sticky differences between judicial prudence and scientific certainty refused to go away. At the time of the ministerial promise, the number of soldiers seeking compensation was just several dozens. Since then, in compliance with recommendations of the Shamgar Committee, the naval commandos have been regularly monitored and more and more of them were diagnosed with cancer. By 2008, the attorneys representing the veterans and their families reported that the number of soldiers who are attributing their cancer to their training in the Kishon grew to 500.[118]

As the numbers continued to grow, the Defense Ministry tried to scale down its original commitments and set new parameters that limited the range of future suits. The ministry announced it will not recognize claims from anyone who trained in the Kishon prior to 1975 and also refused to accept claims from veterans who served in other units, including Naval Engineers, who were also exposed to the water of the Kishon during their training. By 2008, the Defense Ministry had acknowledged the claims of only 250 out of the 500.[119] Thus, the Kishon Affair continues to smolder, and the long latency of cancer and the relatively young age of the soldiers virtually guaranty that it will not go away anytime soon. Like the toxic sludge that still lies under the lazy façade of the River, the Kishon

---

[118] See, Yechiel Spira, Nachal Kishon and the IDF Naval Commandos - Special Report, Yeshiva Work News, *May 11, 2008.*

[119] Id.

Affair had erupted violently unto the surface only to sink back to the privacy of the dark bottom where it still lies until stirred again.