Asbestos: Socio-legal and Scientific Controversies and Unsound Science in the Context of the Worldwide Asbestos Tragedy – Lessons to be Learned*

Sozialjuristische und wissenschaftliche Kontroversen sowie Fehlinterpretationen im Kontext mit der weltweiten Asbest-Tragödie – Was ist daraus zu lernen?

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Abstract

Eight to fifteen per cent of lung cancer cases and nearly all mesothelioma cases are caused by asbestos. Problems in compensation issues ensue from strict legal requirements for eligibility and regulations of the statutory accident insurance institution pertaining to eligibility for occupational disease benefits. The latter include the unscientific requirement for set numbers of asbestos bodies or fibers to be found in lung tissue in order to "prove" disease causation if lung specimen are available. Although the validity of such evidence has been discredited by independent scientists, it is still used as evidence by an influential US pathology department. Frequently, epidemiological evidence regarding causal relationships and exposure histories is also often being ignored by insurance-affiliated medical experts.

Similar misleading arguments are currently being used in newly industrialized countries where white asbestos – which is carcinogenic and fibrogenic like other asbestos types – is efficiently promoted as being less harmful. As a result, asbestos use is increasing in some of these countries. Behind the worldwide asbestos tragedy, a well-designed strategy orchestrated by certain transnational or multinational industrial interest groups can be perceived.

Beyond the asbestos tragedy their covert plan is motivated by economic interests and discounts the ensuing damage to health and the impact of the diseases they create on public health systems.

Zusammenfassung

8 – 15 % aller Lungenkrebsfälle und nahezu alle Mesotheliome sind asbestbedingt.

Probleme der Berufskrankheiten-Entschädigung ergeben sich aufgrund der teils vom Verordnungsgeber, teils von der Arbeitgeber-Haftversicherung, d. h. den Berufsgenossenschaften, vorgegebenen hohen Hürden der Beweisanforderung. Von letzteren ist besonders die wissenschaftlich widerlegte Forderung des Nachweises einer bestimmten Zahl von Asbestkörpern bzw. -fasern im Lungengewebe relevant. Sie hat sich auch bei einem einflussreichen Pathologieinstitut in den USA etabliert. Dabei wird den sich aus epidemiologischen Studien ergebenden Wahrscheinlichkeiten für den Ursachenzusammenhang jegliche Bedeutung abgesprochen.

Entsprechend negierende Argumentationen finden sich aktuell in Schwellenländern. Dort wird Weißasbest, der wie andere Asbestarten kanzerogen und fibrogen ist, derart effizient propagiert, dass die Verbrauchsmengen z. T. wieder ansteigen.

Über die weltweite Asbest-Tragödie hinaus ist von Bedeutung, dass, zumeist geschickt verdeckt, letztendlich in vergleichbarer Weise bestimmte transnational oder global agierende industrielle Interessengruppen ihre wirtschaftlichen Interessen ähnlich rigoros auf Kosten des Gesundheitsrisikos der Allgemeinheit verfolgen.

Introduction

Currently in Germany, there are annually more than 9,000 new suspected cases of occupational disease caused by asbestos. Annually, approximately 3,700 cases are recognized as occupational disease and about 2200 patients receive a pension. Fifteen hundred patients die from their asbestos-related occupational diseases each year. According to official occupational disease statistics, 8 – 15 % of all lung cancer cases and approximately 60 % of all mesothelioma cases are caused by occupational asbestos exposure. For the re-

* Dedicated to Univ.-Prof. em. Dr. med. Hans-Joachim Woitowitz on the occasion of his 80th birthday.

maining 40 %, apparently the causal exposure cannot be established (cp. the difference between the numbers communicated by the Robert Koch-Institut (RKI) [2010 n = 1670] [1] and the cases recognized by the compensation insurance companies [2] [937 – 988 each in the years 2010 – 2013]). In 2004 the WHO registered 59,000 deaths caused by mesothelioma and 41,000 caused by asbestos-induced lung cancer worldwide [3].

A relevant publication [4] presents the occupational safety measures that were initiated in Germany against considerable opposition. These measures eventually led to the 1993 ban on using and producing asbestos-containing material and to the implementation of subsequent preventive screening of people previously exposed to asbestos. In addition, problems of compensation are discussed. They are particularly associated with the German mesothelioma register of the Hauptverband der gewerblichen Berufsgenossenschaften (HVBG, [statutory accident insurances association]) respectively the subsequent Deutsche Gesetzliche Unfallversicherung e. V. (DGUV, [German statutory accident insurance]).

The present paper deals with frequently encountered positions extending beyond this and running counter to medical and scientific knowledge which lead to denying the recognition of occupational disease and compensation. At the same time, the similar developments in other countries and comparable strategies of other trade associations must be pointed out.

The scientifically unsubstantiated hypotheses on the significance of asbestos bodies and asbestos fiber concentration in lung tissue as presented in [4], established in the local practice of assessment as well as being argued by the „Deutsches Mesotheliomregister“ [“German mesothelioma register”], have been adopted into social legal publications that are highly regarded even by the social jurisdiction. Thus, in the 8th edition of the commentary [5] written for the most part by the employer liability insurance’s social jurists it says, „Am besten standardisierbar erweist sich die Asbestkörperchenzählung in einem Milliporefilter des Lysats eines Lungenwürfels von 1 cm Kantenlänge. Bei röntgenologisch typisch erkennbaren Asbestosen sind in 1 cm³ Lungengewebe mehr als 10.000 Asbestkörperchen auffindbar. Nach der Rechtsprechung ist die Diagnose einer Minimalasbestose an den staubanalytischen Nachweis von ca. 1.000 eiweißumhüllten Asbestkörperchen pro cm³ fibrösem Lungengewebe gebunden.“ [“The asbestos body count in a millipore filter of the lysate of a lung cube with an edge length of 1 cm proves to be best standard. In radiographically typically recognizable asbestosis more than 1,000 protein-coated asbestos bodies can be found in 1 cm³ of lung tissue. According to judicature the diagnosis of minimal asbestosis is tied to the detection of approx. 1,000 protein-coated asbestos bodies per cubic centimeter of fibrinous lung tissue in dust analysis.“]

Four LSG-(Landessozialgericht [higher social court]) verdicts [4] to the contrary are thereby being ignored.

From the 6th edition (1998) of the book „Arbeitsunfall und Berufskrankheiten“ [“Accidents at Work and Occupational Diseases”, [6] which in many cases is seen as a definitive work, one could, for example, gather the following, „Techniken der präparativen Gewinnung und Anreicherung von Asbestkörperchen aus Lungengewebe erschließen den Nachweis beruflich bedingter Faserbelastungen des Lungengewebes auch bei negativem Röntgenbefund.“ [“Techniques of preparative extraction and enrichment of asbestos bodies from lung tissue yield the confirmation of the occupation-induced fiber burden of lung tissue even in negative X-ray findings“].

„Faserzahlen zwischen 100 und 1000/cm³ Lungengewebe können als Indiz für eine erhöhte berufliche Exposition, Faserzahlen von mehr als 1000/cm³ Lungengewebe als beweisend für eine stärkere berufliche Belastung gelten, auch wenn röntgenologisch keine Fibrose erkennbar ist. Im letzteren Fall wird aufgrund einer Konvention der Begriff der ‘Minimalasbestose’ verwendet“. [“Fiber counts between 100 and 1,000 per cubic centimeter of lung tissue can be counted as an indication of increased occupational exposure, fiber counts of more than 1,000 per cubic centimeter as proof of higher occupational burden, even if no fibrosis can be detected radiographically. Based on a convention, the term ‘minimal asbestosis’ is used in the latter case.”]

Phrasings reaching even further are contained in the employer liability insurance’s (DGUV e. V.) Falkenstein recommendation, „Im Deutschen Mesotheliomregister wurden bei Patienten mit histologisch verifizierten Minimalasbestosen (Grad I) und Asbestosen (Grad II – IV) Amphibolasbest- bzw. Chrysothilasbestfaser-Konzentrationen in einer Größenordnung von mindestens 10^6 – 10^8 pro Gramm Lungenfeuchtgewebe nachgewiesen“ [“In the German mesothelioma register, amphibole asbestos respective to chrysotile asbestos fiber concentrations were demonstrated on a scale of at least 10^6 – 10^8 per gram of wet lung tissue in patients with histologically verified minimal asbestosis (grade 1) and asbestoses (grade 2 – 4)”, [7]. Beyond that, one finds the following section both there and in the S2k-guideline „Diagnostik und Begutachtung asbestbedingter Berufskrankheiten“ [“Diagnostics and assessment of asbestos-caused occupational diseases”, [8], „In den sog. Helsinki-Kriterien werden, entsprechend den internationalen und nationalen Kriterien, für die histologische Diagnose einer Asbestose der Nachweis einer interstitiellen Fibrosierung in gut entfaltetem Lungenparenchym, entfernt von Tumorgewebe oder sonstigen sekundären Lungenveränderungen in Verbindung[1] mit dem Nachweis von entweder 2 oder mehr Asbestkörpern auf einer Schnittfläche einer Probe von einem 1 cm² Größe oder der Nachweis einer Anzahl von nicht umhüllten Asbestfasern, die im Bereich von Asbestosen liegen, die im gleichen Labor nachgewiesen wurden, gefordert.“ [“To histologically diagnose asbestosis, corresponding with international and national criteria, the so-called Helsinki criteria require the identification of interstitial fibrosis in well inflated lung tissue remote from a lung cancer or other mass lesion, plus the presence of 2 or more asbestos bodies in tissue with a section area of 1 cm² or a higher count of uncoated asbestos fibers that falls into the range recorded for asbestosis by the same laboratory.”]

Parallel developments in professor Roggli’s private institute at Duke University Medical Center, NC, USA ▼

In the USA extremely noteworthy parallel practices of assessment took place. They are evocative of the practices of professor Otto from Germany [4]. In the USA the high compensations based on fatal mesothelioma disease in car mechanics working on brakes are in legal dispute with regards to liability. This latter fact also affects establishments of the German automotive industry. In this area Victor L. Roggli, professor of the Institute at Pathology

[1] Take note of the more precise wording in the original text of the criteria in the 2014 Helsinki consensus report; here the word “Verbindung” [“conjunction”] is replaced with “plus” [“plus”] which expresses that the detection of asbestos bodies is indeed required but not in the areas of fibrosis. See below for further explanation.

at Duke University Medical Center, is regarded as one of the most influential pathologists not only in the USA but also internationally. Additionally, he successfully works in an institute in the private sector. He prominently defends the position that Canadian chrysotile used in brake linings does not cause mesothelioma. His assumption in numerous trials is comparable to the views defended by Otto. It is always based on the missing or allegedly insufficient evidence of asbestos fibers in the lungs of the diseased. Scientifically one can on no account follow such an absolute condition as favored by Otto and Roggli as a criterion for a legal decision. First of all, this is because of the fact that it is the short and very thin fibers traveling from the lung into the pleura that determine the mesothelioma causing effect of white asbestos fibers. They are not visible through a light microscope but are absorbed endocytotically by pleural surface cells. Interaction with cellular components ensues, resulting in the stimulation of fibroblasts and frequently in the development of pleural plaques (BK Nummer 4103 Anl. BKV [occupational disease no. 4103 appendix Occupational Disease Act]). By the formation of reactive oxygen and nitrogen species (ROS, RNS) the multistage process of carcinogenesis can lead to the development of tumors. The reactivity of the fibers' surface is of particular significance in this process.

It became known that Roggli has received fees in the millions of dollars for his expert opinions from the chrysotile asbestos processing industry, which is facing numerous law suits [9]. In return for suitably high dollar payments, he not only trained industry lawyers, he even gave them the opportunity to influence his pathological expert reports prior to their release – without, however, disclosing their involvement.

Roggli also received international significance, particularly in Germany, as chairman of the task force "Pathology and Biomarkers" on the occasion of the 1997 Helsinki conference. Thus even back then he was able to significantly influence the content of the pathology section of the subsequent Helsinki declaration. Additionally, Roggli was substantially involved in the revision of the evaluation of asbestos-caused bronchiolar changes in the so-called Roggli-Pratt-modification by the committee of the College of American Pathologists and Pulmonary Pathology Society [10] [11]. This revision was likewise adopted into the Helsinki criteria under the chair of the area Pathology and Biomarkers, Dr. Roggli. In the Roggli-Pratt-modification, notable US-American pathologists see a shift of the demarcation towards the pathological and also a cut-off criterion in regard to compensation. In their view, the older CAP-NIOSH-definition [12] should continue to take precedence [13, 14]. In contrast to the Roggli-Pratt-modification, the CAP-NIOSH-definition underwent a thorough and transparent review procedure and was finally commented on and recommended by the National Institute of Occupational Safety and Health (NIOSH). It differs particularly in its clear delineation of normal findings. In the area of early-involved peribronchial tissues (grade 0) the definition there differentiates the grade 1 fibrosis in at least one respiratory bronchiole that has to be considered. When additionally including the alveolar sacks or at least two layers of adjacent alveoli, one gets grade 2. The further differentiation is grade A (extent 1; sporadic fibrosis in respiratory bronchioli) and grade B (extent 2; fibrosis in less than half the respiratory bronchioli).

In contrast, the Roggli-Pratt-modification encompasses distinctly pathological changes in the lowest (and still seen as normal) grade 0. The same holds for a lack of definition in the demarcation, "no appreciable peribronchial interstitial fibrosis, or less than half of bronchioles involved" [11].

Asbestosis with few or even missing asbestos bodies and asbestos fibers in lung tissue and the chrysotile "hit-and-run phenomenon"

▼

Inhaled chrysotile fibers are not persistent in lung tissue over decades (less persistent than they are in the pleura). This is not in conflict with their having acute or sub-acute pathogenous importance in both locations when they are present, as do the microfibrils arising from fanned-out fibers. To improve social and legal appreciation H.-J. Woitowitz coined the term "hit-and-run phenomenon" for this situation decades after exposure [15] [16]. The term matches the results of other notable working groups [8, 13, 14, 17 – 26]. Internationally leading pathologists and scientists who, however, are not associated with the asbestos industry or insurance companies, have repeatedly pointed out that the counting of asbestos bodies and asbestos fibers does not represent diagnostic methods that will stand up in court and that can be recommended [14, 17, 27 – 29].

The evidence of chrysotile asbestos fibers in lung tissue – not even in pleural tissue – as favored by the pathologists Otto and Roggli as legal determining criterion towards occupational disease cannot be ascribed any evidentiary value.

Arising from the aforementioned facts, one needs to differentiate between previous occupations with exposure to amphibole asbestos (with a decade or lifelong half-life [30, 31]) or to white asbestos (chrysotile) in the interpretation of asbestos body numbers and asbestos fiber numbers in the human lung. The half-life of chrysotile fibers ranges between approximately 2 weeks and a few months, depending on the analytical method. The half-life of amphibole asbestos, as previously stated, amounts to decades.

Corresponding to the hit-and-run phenomenon, the S2k-guideline states (cp. chapter 4.5 of the guideline [8]),

„In den Helsinki-Kriterien wird darauf hingewiesen, dass in seltenen Fällen der Nachweis von Asbestkörpern negativ ausfallen kann. Zur differenzialdiagnostischen Abgrenzung der idiopathischen Lungenfibrose wird in diesen Fällen die Analyse der Faserlast gefordert. Da sich Chrysotilfasern bedingt durch die z. T. lange Latenzzeit der Faserdiagnostik entziehen können, werden in diesen Fällen relevante klinische oder radiologische Daten gefordert, in Kombination mit Daten zur (Asbest-) Exposition." ["In the Helsinki criteria it is pointed out that rare cases of asbestosis occur without detection of asbestos bodies. The analysis of fiber load is required in these cases to allow the differential diagnostical discrimination of idiopathic pulmonary fibrosis. Chrysotile fibers can sometimes elude fiber detection due to the long periods of latency. Therefore relevant clinical and radiological data are required in these cases, in combination with data on (asbestos) exposure."]

The absence of asbestos bodies and asbestos fibers in lung tissue therefore does not preclude asbestosis. This notably applies for the stage of honeycomb lung caused by white asbestos (grade-4-asbestosis) (S2k guideline chapter 4.4.1.1, [8]).

Many times, however, this fact is ignored in expert's opinions. Some medical experts and consulting doctors also arbitrarily evaluate the fundamentally possible absence of asbestos bodies in asbestosis as indication that no such disease is present, if no scanning electron micrograph analysis of the uncovered fibers is performed. There is no medico-scientific basis of data supporting this condition and requirement. Instead there merely is a recommendation in the diagnostic decision tree in the S2k-guideline [8]. Contrary to the repeatedly encountered basis of decision-making, the non-availability of an analysis of uncovered fibers

can therefore in no way be used as an argument against the presence of asbestosis.

In the diagnosis of asbestos-induced diseases, recognizing from the aforementioned facts that no minimum concentration of asbestos bodies and asbestos fibers can be defined, it is therefore incorrect to require a dust analytical threshold value on a specific area. Please refer to the corresponding conclusions both in the S2k-guideline (chapters 4.4.1.1 and 4.5) and the statement of the German Society of Pathology [32]. This is also documented in the detailed study by the pathologists Warnock and Isenberg. They examined 75 men with lung cancer, 68 of whom had been exposed to asbestos [19]. Of the 7 afflicted men with moderate asbestos exposure (3 of whom had asbestosis) not a single one presented the above-mentioned concentration of a minimum of two asbestos bodies in tissue with a section area of 1 cm^2.

Inadmissible equation of the pathological-histological findings of UIP (usual interstitial pneumonia) with IPF (idiopathic pulmonary fibrosis)

Contrary to arguments that are repeatedly put forward, the pathological and histological (and equally the radiological) findings of UIP do not allow for the etiological classification crucial in assessment. Instead it is a pathological-histological and radiomorphological pattern that typically can be detected both in advanced asbestosis and pulmonary fibrosis of different etiology. (ch. 4.1 and 4.4 of the S2k-guideline [8], as well as [18]).

Asbestosis versus IPF: Inadmissible elimination diagnostics exclusively on the basis of collected pathological-histological findings and fiber analyses

Despite the aforementioned limited informational value of pathological-anatomical findings with regard to etiology, the claim that a diagnosis of asbestosis can be pathologically-anatomically excluded without question not infrequently stands at the center of expert opinions and reports by pathologists associated with the statutory accident insurance institutions. It is claimed that the "typical findings" or respectively the "clearly defined picture of asbestosis" are not present. This is being based on unsubstantiated definitions of asbestosis. In practice, diagnostically appropriate fiber analytics, e. g. by ARTEM-analysis, is not applied for the partially possible documentation of asbestos bodies or asbestos fibers in the lung of the patient previously exposed to asbestos. Instead, even after previous chrysotile exposure, both a combination of interstitial fibrosis with asbestos bodies per square centimeter section area and detection of asbestos bodies in areas of fibrosis are being demanded (see also the more detailed explanation at the end of this chapter). Both demands are being ultimately ascribed a decisive relevance.

On the one hand the statement holds [8], "Asbestosis is pathologically-anatomically assured if asbestos bodies can be detected in areas of fibrosis via light microscopy." As a converse argument, it is wrongly assumed that an inability to detect asbestos bodies in areas of fibrosis via light microscopy pathologically-anatomically excludes asbestosis (see **table 3a** for examples). This conclusion is inadmissible as long as it has not been proven and verified in at least one original scientific article in a peer-reviewed journal. A claim like this can be deduced neither from the criteria of the 2014 Helsinki consensus report nor from the S2k-guideline „Diagnostik und Begutachtung asbestbedingter Berufskrankheiten" ["Diagnostics and expert opinion in asbestos-caused occupational diseases"] nor from any scientifically reasoned article. The same holds true for the cut-off-criterion of a certain density, amount or concentration of asbestos bodies or fibers (see above). Lastly the recommendations in the criteria of the 2014 Helsinki consensus report [33] are to a large part also cited incompletely and interpreted incorrectly in this context (see p. 4 in the Helsinki report). Please refer in particular to the asbestosis-definition as it is phrased in the Falkenstein declaration [7] and in the S2k-guideline [8], „… der Nachweis einer interstitiellen Fibrosierung in gut entfaltetem Lungenparenchym entfernt von Tumorgewebe oder sonstigen sekundären Lungenveränderungen in Verbindung mit dem Nachweis von entweder zwei oder mehr Asbestkörpern in einer Schnittfläche von einer Probe von 1 cm^2 Größe oder der Nachweis von nicht umhüllten Asbestfasern, die in einem Bereich liegen von Asbestosen, die im gleichen Labor nachgewiesen wurden." ["…require confirmation of interstitial fibrosis in well inflated lung parenchyma, separate from tumorous tissue or other secondary lung alterations, in conjunction with the evidence of either two or more asbestos bodies on the section area of a one-square-centimeter-sample, or the evidence of a number of uncovered asbestos fibers located in the range of asbestosis cases as detected in the same laboratory."] (see comments in introduction). The requirement of such a link between interstitial fibrosis and asbestos bodies on a cut-surface-sample of one square centimeter respectively in areas of fibrosis to diagnose asbestosis is not supported by scientific research. This holds particularly true when chrysotile exposure is present. Such an arbitrary definition is explicitly not shared by the notable pathologists who authored the following standard works [18, 34 – 36], as again confirmed by them following the author's personal question.

Incidentally, as mentioned, this statement's explicit limitation to amphibole asbestos (**table 3b** [37]) is frequently ignored or overlooked. This results in a misinterpretation of the collected pathological-anatomical findings and the fiber analysis. According to occupational medical knowledge it has to be assumed that nearly all asbestos-exposed persons primarily and mostly came into

Table 3a

Examples of faulty transfer of asbestos body findings in practice in a patient with pulmonary fibrosis (with at least 8.8 fiber years) and in a patient with lung cancer and acknowledged asbestosis who have received 30 % compensation (quotations from current expert opinions from insurance-affiliated physicians):

„Bei mangelndem Nachweis von Asbestkörpern in Fibrosierungsarealen oder einer elektronenmikroskopisch ermittelten Asbestfaserkonzentration kann die Diagnose einer Lungenasbestose nicht als gesichert angesehen werden." ["Due to lack of proof of asbestos bodies in areas of fibrosis or of a concentration of asbestos fibers determined via electron microscopy, the diagnosis of lung asbestosis cannot be seen as certain."]

„Unter Anwendung der 1.000 Asbestkörperchen-Hypothese muss eine Minimalasbestose ausgeschlossen werden." ["When applying the 1,000 asbestos bodies hypothesis, minimal asbestosis is to be excluded."].

Table 3b

Wording in the long version of the 2014 Helsinki-criteria [37] (p. 50): "It should be noted that recommendations for fiber analyses apply only to amphibole fibers, since chrysotile fibers are cleared more quickly from lung tissue."

contact with chrysotile asbestos, as it is the predominantly used type of asbestos in this country (approx. 94%).

Further aspects of the findings in the lungs of asbestos-exposed persons and of the limitations of the pathological-histological diagnostics

Today there is agreement that asbestos bodies hold no pathogenic significance. They do not cause asbestosis. In the case of amphibole asbestoses, asbestos bodies represent a marker of exposure; but this is not true for the predominantly used chrysotile asbestos.

The following has to be noted on the fiber analysis by means of electron microscope recommended by the statutory accident insurance institutions (Berufsgenossenschaften) and practiced nationwide in the statutory accident insurance association's pathology institute and in the German mesothelioma register, respectively, that has been supported and financed by the DGUV e.V. [German statutory accident insurance association] for many years: a PubMed-search for literature performed in collaboration with Dr. Jerrold Abraham, a US-American pathologist internationally established in this area, yielded not a single scientific publication in a peer-reviewed journal that contained verified data on the relevant reference values used by the above-mentioned institutions. Scientific publications that prove the following, frequently repeated statement were equally impossible to find, „Im Deutschen Mesotheliomregister wurden bei Patienten mit histologisch verifizierten Minimalasbestosen (Grad I) und Asbestosen (Grad II-IV) Amphibolasbest- bzw. Chrysotilasbest-Faserkonzentrationen in einer Größenordnung von mindestens 10^6 bis 10^8 Fasern (Länge ≥5µm) pro Gramm Feuchtgewebe nachgewiesen." ["In the German mesothelioma register, fiber concentrations of amphibole asbestos and chrysotile asbestos respectively (≥5 µm length) were demonstrated on a scale of at least 10^6 – 10^8 per gram of wet lung tissue in patients with histologically qualified minimal asbestosis (grade 1) and asbestoses (grade 2 – 4)"] (quotation from [7]).

Furthermore, it has to be considered that idiopathic pulmonary fibrosis represents an exclusion diagnosis, as illustrated above [38]. That is to say, this diagnosis can only be made once all other etiologies including asbestos-induced pulmonary fibrosis have been excluded.

Occasionally, the so-called chrysotile-overload-hypothesis, that has not been substantiated in any studies, is advocated. The hypothesis states that only particularly high chrysotile loads exceeding the clearance rate of the bronchial system and of the macrophages carry pathogenic significance. In this way the asbestos industry and its associated scientists convey, contrary to all experience, that one can safely use chrysotile when applying simple safety measures (http://www.rightoncanada.ca/, http://www.chrysotileassociation.com/en/).

Epidemiological-statistical associations

A number of epidemiological studies demonstrate the relationship between exposure to asbestos and both non-malignant lung diseases and malignant diseases as defined in our occupational disease legislation [39]. Beyond this, current investigations are examining the causality of gastro-intestinal tumors. Those are slightly more frequent in asbestos-exposed populations [40]. Further correlations exist for ovarian cancer [41] and COPD [42, 43]. Both diagnoses have been observed at almost double the expected frequency in persons exposed to asbestos.

In this context, newer review articles that for the most part are based on selected data and that negate the adverse effects of chrysotile have to be pointed out: LaVecchia and Boffetta [44] came to the false conclusion that further exposure successively following previous exposure to asbestos does not additionally increase the risk of mesothelioma. Particularly in Italy, this assumption has lead to the tangible consequence that many mesothelioma cases have not been recognized as occupational diseases and are not being compensated. This is being justified with the rationale that the original employer has ceased to exist. Statements of this nature have been repeatedly disproved, however [45, 46]. In the meantime it has become known that the co-author (Bofetta) received extensive industry funding, including from asbestos interests. The industry ties had not been declared openly but rather had been concealed. Public protests, started in particular by French organizations of asbestos-victims, by unions as well as scientists, averted his appointment as director of the renowned and influential Centre International de Recherche en Épidemiologie et Santé des Populations (CESP) at Inserm-Université Paris-Sud.

Currently, in this and in other countries [47], epidemiological-statistical associations are also being misinterpreted or ignored in experts' opinion with regard to the identification of the likelihood of the disease cause. To quote from a more recent expert opinion, „So können wir eine exakte pathologisch-anatomische Diagnose stellen, ohne auf statistische Wahrscheinlichkeiten zurückgreifen zu müssen" ["Thus we can provide an exact pathological-anatomical diagnosis without having to resort to statistical probabilities "], or „… , dass bei einem asbestexponierten Patienten mit größerer Häufigkeit eine interstitielle Lungenfibrose auch durch das schädigende Agens bedingt ist, ist im konkreten Fall nicht von Bedeutung, da im Umkehrschluss die dezidierte erweitert zur Verfügung stehende Diagnostik in der individuellen Begutachtung die Diagnose einer Asbestose nicht ermöglichte" ["…in the current case, it is of no importance that in a patient exposed to asbestos, interstitial pulmonary fibrosis is more likely caused by asbestos, because the decidedly extended available diagnostics (within the individual expert opinion) did not allow a diagnosis of asbestosis "].

As a matter of course, epidemiologically-statistically gained probabilities have to be considered in individual assessment, especially as the "decidedly extended" pathological diagnostics do not allow for the alleged elimination diagnostics. Here the rarity of the frequently assumed, yet ultimately neither pathologically nor radiologically delimitable, idiopathic pulmonary fibrosis, IPF, has to be pointed out. The incidence of IPF is about 20 cases per 10,000 residents. In contrast, in substantially asbestos-exposed populations, there are single- to double-digit percentages of asbestosis-cases [8]. The repeatedly assumed combination of IPF with asbestosis, that can neither be proven nor excluded, represents an extremely rare occurrence. In the identification of occu-

pational diseases, as is well known, the likelihood of a connection between the affecting event (exposure to asbestos) and the disease suffices.

Dose-response-relation in asbestos-caused lung cancer

A number of publications consistently document a linear dose-effect-relationship between exposure to asbestos and risk of lung cancer [48 – 51]. However, in doing so a considerable variance is revealed. Drawing upon this, the 1997 Helsinki report states, "The relative risk of lung cancer is estimated to increase 0.5 – 4.0 % for each fiber per cubic centimeter per year (fiber-years) of cumulative exposure." In contrast the corresponding passage in the 2014 Helsinki consensus statement and the identical phrase in current publications guided by certain interests reads, "Using an estimate of 4 % increase of risk for each fiber per cubic centimeter per year (fiber year) of cumulative exposure: 'A cumulative exposure of 25 fiber-years is estimated to increase the risk of lung cancer 2-fold, clinical cases of asbestosis may occur at comparable cumulative exposures." Thereby arbitrarily only the upper end of the range of dispersion continues being referred to. The statistical uncertainty as well as the well-documented dose-response-relation is disregarded. This amplifies the misinterpretation and replaces the dose-effect-relationship with an evaluation of limit value. This error is not eliminated by the following statement, that a medical occupational history probably is a better indicator than fiber analytics.

Significance of the medical occupational history and technical inspectorate (occupational hygienist) evaluations of exposure frequently not performed or not considered

Beyond dispute the best possible evaluation of exposure is represented by the detailed qualified medical occupational history gathered by a medical specialist combined with the technical inspectorate exposure assessment [29]. This does not hold true for the sole pathological-histological and/or fiber analytical analyses, see also the further remarks in the previous chapters.

According to [52] the following applies, "The role of the pathologists and molecular toxicologists still remains at the secondary level".

Contrary to the phrasing in the pathology section of the 2014 Helsinki consensus report [33], the evaluation of pathological-histological findings (see their limitations with regards to etiology) is not central to determining the causality of exposure in asbestos-induced occupational diseases. The same applies to the error-prone analysis of asbestos-bodies and asbestos-fibers (see the quoted expression of the chrysotile "hit-and-run phenomenon" [15, 53]).

The S2k-guideline states on the subject, „Staubanalytische Untersuchungen (Lungengewebe/BAL) können die Feststellungen aus der Arbeitsanamnese und aus den Ermittlungen der TAD nicht ersetzen und nicht Anlass sein, die ermittelte kumulative Exposition nach unten zu korrigieren". ["Dust analyses in lung tissue/BAL cannot replace the conclusions drawn from the medical occupational history and the evaluation by TAD (the technical inspectorate of the statutory accident insurance). They cannot justify changing the determined cumulative exposure downwards."]

Discussion and conclusions

For over one hundred years the serious health hazards asbestos poses have been known. As early as in 1918 the US-American insurance giant MetLife noted higher rates of mortality in employees exposed to asbestos [54]. Under an arrangement with the company, this fact was not made public. Regulations to protect health had to later be pushed through against great resistance. In this country, it was not possible to achieve a ban on production and application of asbestos before 1993. With regard to this delay, scientists well-disposed towards the asbestos industry and also physicians played a helpful role for the asbestos trade associations [55, 56]. Strategies of defense have been and are being applied, adopted from the tobacco industry where they have been perfected and well tried. This includes the misinterpretation of scientific findings, the dissemination of non-substantiated doubt towards positive studies, having persons with industry ties infiltrate socio-political committees that provide political advice and are authorized to set policy, including scientists funded by the asbestos industry, who do not disclose their conflicts of interest.

Such activities currently continue to be practiced in newly industrialized countries, where the usage rate of chrysotile is rising, though without doubt it is carcinogenic and fibrogenic like all types of asbestos (http://ibasecretariat.org/graphics_page.php#row_1). Currently these politics of the still economically strong and today primarily Russian chrysotile industry are particularly concentrated against the IARC-categorizing of chrysotile as carcinogenic in humans [57] and against the WHO-recommendations to ban asbestos worldwide (http://www.rightoncanada.ca/?p=2953, www.wecf.eu/english/chemicals-%C2%AD%E2%80%90%E2%80%91health/topics/asbestos.php, http://www.euro.who.int/__data/assets/pdf_file/0005/276206/Towards-elimination-asbestos-related-diseases-EURO-2014-en.pdf, http://www.rightoncanada.ca/, http://rocalliance.blogspot.de/, http://monographs.iarc.fr/ENG/Monographs/vol100C/mono100C.pdf [58]). The renewed veto of Russia, Kazakhstan, Kyrgyzstan and Zimbabwe in May 2015 resulted in chrysotile – unlike other types of asbestos and 3 dozen chemical compounds dangerous to health – still not being included in the Rotterdam-convention. For this reason the otherwise binding requirements for obligatory labeling (including the utilization of warning notices) according to international law and also the prior consent of the importing country required for import (Prior Informed Consent, PIC-convention) are not in force for chrysotile.

The worldwide pandemic and tragedy of the frequently fatal asbestos diseases represent a disaster, not only with regards to ethical and socio-political aspects, but also with respect to short-sighted economic aspects. Recent projections calculate annual costs of 1.7 billion euros for treatments, pensions etc. in 15 European countries for mesothelioma alone [39]. The overall costs of diseases caused by asbestos likely amount to a multiple of this sum, the costs of the building restorations that are ongoing and pending in the upcoming decades probably add up to far more. In spite of these obvious economic aspects, further considerable efforts of persuasion are required to comply with the demands of the WHO, ILO, IARC and other independent non-profit organizations, and to achieve a worldwide ban of asbestos – in order to prevent diseases caused by asbestos in the future. One upcoming particularly crucial step in newly industrialized and developing countries is replacing asbestos, the cost-efficient and technically well-suited building material, with nonhazardous

materials or at least with material considerably less harmful to health.

Alongside the above mentioned faulty and restrictive practice in diagnostics and compensation issues, the professional restoration (combined with the adherence to health and safety measures) of contaminated buildings (90% of asbestos used in buildings is still in these buildings) is the focus of the socio-political dispute in Germany.

The monopoly-like diagnostics used in the institute of the defendants (statutory accident insurances association) respectively in the so-called German mesothelioma register, now transferred to a foundation of the statutory accident insurance body, should no longer be accepted. Expert opinions in occupational disease actions, based on grave misinterpretations and in part adopted by high judicial authority, urgently require review and amendment, if necessary. This particularly applies to the large number of rejections of occupational disease status based on asbestos-bodies-counts (according to the 2012 German mesothelioma register annual report the number of so-called fiber analyses in the meantime had risen to over 2200 per year). On account of the limited informative value and therefore lacking evidentiary value when results are negative, one should generally refrain from fiber analyses of the lung. Surgical interventions (biopsies) for the purpose of assessment are also obsolete when the asbestos-induced changes in the lung and pleura are obviously benign [29].

In closing, there remains the sobering conclusion: the story of the asbestos-tragedy is a blueprint – for certain transnational companies of the pharmaceutical and chemical industry, the automotive industry and the social insurance companies, who rigorously pursue their economic interests at the expense of the general public's health risk [56, 59]. Examples are faulty pharmaceutical tests, the negation of adverse effects to health, particularly carcinogenity. In most recent times, one can add to this list the adverse endocrine toxic effects of certain pesticides, chemicals such as PCBs, POPs, exhaust emissions and pollution.

"Wir kennen die Geringschätzung und Marginalisierung von Menschenrechten, wenn es darum geht, wirtschaftliche Interessen durchzusetzen" ["We know of the disregard and marginalization of human rights when the point is to assert economic interests"] (Federal President Joachim Gauck on the occasion of the 65th anniversary of the Universal Declaration of Human Rights, December 6, 2013).

Conflict of interest

The author declares that there are no conflicts of interest.

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