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Salt, fire, cress and fennel – how to create pollution

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Introduction

The English word pollution, derived from Latin *perluere*, is connected to Latin *lutum*, mud, and Greek *lyma*, dirt, and corresponds closely to the English verb “to soil”. Both are thus connected to the soil (Webster’s Third New International Dictionary 1976, lemma pollution). The dictionary provides the following definitions (Webster’s Third New International Dictionary 1976):

- "1. to render ceremonially or morally impure; impair the purity of; destroy or violate the sanctity of: corrupt, defile, profane <a temple, a person's honor>;
2. to make physically impure or unclean: befoul, dirty, taint <a water-supply by the introduction of sewage>."

Here the figurative use comes before the physical one. The entry on “pollution” is even more telling. It is defined as:

- "1. emission of semen at other times than in coition;
2. the action of polluting or the state of being polluted: defilement, desecration, impurity, uncleanness <streams subject to _ by mill wastes - C. R. Cox> <the dilution of atmospheric _ - K. H. Jehm> <cleanse the king and the people from the _ of any offenses - J. G. Frazer>
3. crossbreeding when regarded as the source of degeneration of a stock."

The focus is thus very much on the purity of the human body, under threat from uncontrolled emissions that nevertheless cause moral opprobrium. The antique concept of crime as a pollutant has an equal place with the release of wastes (a word not used in the definitions or examples) into watercourses or the air, and the idea of “racial purity”.

Wikipedia [accessed 11/08/2014], a handy gauge on contemporary perception if not always a reliable source of information, has, in contrast, a definition that is wholly restricted to the physical pollution of the environment:

“Pollution is the introduction of contaminants into the natural environment that causes adverse change. Pollution can take the form of chemical substances or energy, such as noise, heat or light.

Pollutants, the components of pollution, can be either foreign substances/energies or naturally occurring contaminants. Pollution is often classed as point source or nonpoint source pollution”.

Not even the disambiguation page mentions any of the other kinds of pollution listed by the Webster’s dictionary entry; any moral or ritual aspect of pollution is conspicuous by its absence. The meaning of the word has thus radically changed in the last 50 years (see Nagle 2009, 7–16 on the history of the term). As the following text will show, it is difficult, however, to disentangle the ritual and the physical aspects of pollution.

The History of Pollution

Pollution is seen as uniquely human, connected to culture, not nature. Arguably, many animal species also alter and degrade their environment, for example, cormorants (Hebert et al. 2005), elephants (Ben Shahar 1993) and hippopotami (Kilham 1982), to name but a few. However, this is not normally classified as pollution. Human pollution of the environment starts with the first fire, that is, anytime between 1.5 myr at Swartkrans and 0.8 myr at Gesher Benot Ya’aqov (James 1989; James 1996; Goren-Inbar et al. 2004) (Fig. 1). The idea of environmental modification by fisher-hunter-gatherers in general (e.g. Beaton 1982; Simmons/Innes 1988; Bos/Urz 2003; Rick/Erlandson 2009; Ryan/Blackford 2010) was accepted only very reluctantly, which can probably be best understood by taking a post-colonial perspective on the concept of “nature” in general (cf. Ginn 2008).

Not all types of environmental change would generally be classified as pollution, but many have polluting by-products or results that can negatively influence human health. Not all of these results are obvious in the short term. Human actions leading to anthropogenic environmental change in prehistory include:

- fire
- clearing vegetation for hunting, the creation of settlement spaces and the extraction of raw materials, including wood
- selective use/over-use of plants and animals
- mining
- the use of poisons for fishing
- the creation of waste accumulations
- the introduction of new species/pests

The possible results are:

- extinctions (megafauna etc.)
- hillwash caused by the creation of clearings
- eutrophication of water bodies
- smoke, causing pulmonary diseases and affecting the environment
- the acquisition of new types of parasites

Of the processes listed above, a number would negatively affect human health.

Fire

The smoke of wood fires can cause severe pulmonary diseases. Presumably, this only becomes an issue with the introduction of closed dwelling structures ('hut lung', cf. Gold et al. 2000; Godson et al. 2013, Oluwole et al. 2013 etc.), for which evidence is rare and disputed before the Upper Palaeolithic, but it is also connected to industrial activities like charcoal burning (Diaz et al. 2006). Dung fires causing the same problem (Özbay et al. 2001) will have only become feasible with the massive presence of domestic ruminants.

Agriculture and Sedentism.

A changed diet caused by the introduction or domestication of new species and a radically narrowed range of food sources can lead to malnutrition and deficiency syndromes such as scurvy, rickets and anaemia (cf. Nissen 2011, 25; Bach/Bach 1987; Carli-Thiele/Schulz 2001, etc.), and periodic starvation, which are indeed attested to an increasing degree from the Neolithic onwards.

The formation of hill wash can lead to erosion, a decreased river flow, the formation of swamps and back swamps and the spread of malaria. Increased methane production with the onset of cattle pastoralism and wet rice cultivation may have influenced the climate from the Neolithic onwards (Fuller et al. 2011), as did forest clearance.

Long-term settlements with closely spaced habitations will have led to increased waste accumulations, also attracting pests and the eutrophication of adjacent water bodies, especially if these were used for the disposal of waste, but also simply by run-off.

Human and animal waste is an important source of fertilizer and fuel, but also a source of pollution. Contact with faeces (smear infection) can transmit diseases, such as food poisoning, typhus, cholera, amoebiasis and hepatitis A, among others, and also parasitic flatworms, roundworms, hookworms and pinworms. Parasite infections were already present in the Palaeolithic, but presumably on a small scale. According to genetic studies, parasites, such as *Trichinella*, tapeworms and lice, were 'acquired' by hominins long before the onset of the Neolithic (Zarlenga et al. 2006, 58; Reed et al. 2004; Light et al. 2008). There is some archaeological evidence to support this, for example, the Mesolithic whipworm Goldcliff in Wales (Dark 2004; Fig. 2). Closer contact with other humans can also promote the transmission of diseases, such as pulmonary tuberculosis (Bickle/Whittle 2013, 372). In Central Europe, as opposed to, for example, Greece (Rykwert 2001, 36), Egypt or the Indus Valley (Jansen 1989, 189), there is no evidence for water closets and latrines before the Roman era (for the latter, see Jansen et al. 2011; Neudecker 1994), and for latrines before the later Medieval epoch, so presumably fields, adjacent woodlands and maybe derelict buildings were used for defecation throughout prehistory. In rural areas, dung heaps were used for this purpose well into the 20th century (cf. Krämer 1999, 139; Schrader 2006, 21; Stiewe 2016, 30), despite the work of hygiene-commissions concerned with eradicating infectious diseases. Studies of the distribution

of soil-phosphate (Stäuble/Lüning 1999) around LBK-houses show a concentration of phosphate near the presumed doors in the middle of the long-axis of the buildings and in the long pits alongside the houses (*Längsgruben*), but allow no unambiguous interpretation, as the phosphates can also derive from ash and other kinds of organic waste.

Closer contact with animals can lead to interspecies transmission of viruses and the emergence of novel viruses (Chan et al. 2013, 544). New diseases could also have been introduced by contact with animals (zoonosis, Krauss et al. 1986), which became much closer and more constant from the Neolithic onwards, and also by the consumption of animal products like milk (e.g. tuberculosis and brucellosis). There is also faster spread of diseases due to bigger communities and closer contact between larger groups of people. In addition to domestic animals, pests can also transmit diseases, with the most prominent examples of fleas and black rat as vectors of the plague (McCormick 2003). Increased mobility connected with new modes of transport, such as wagons, the domestication of beasts of burden, like cattle, and later horses, donkeys and camels, as well as improved ships led to the spread of new pests which potentially changed local ecosystems and also hosted vectors of diseases. The spread of the black rat *Rattus rattus* (Armitage 1994) and the Polynesian rat *Rattus exulans* (Matisoo-Smith 1994) are examples for the former. Animals, for example, domestic mice (Vigne/Guilaine 2004; Cucchi et al. 2012) and voles (Orkney, Barnett 2014; Cucchi et al. 2008), were introduced with the earliest Neolithic colonisers of island habitats in Northwest Europe. There is archaeological evidence for shipboard presence of domestic mice from the Late Bronze Age shipwreck of Ulu Burun (Cucchi 2008).

In the case of the Polynesian rat, it is not entirely clear if the introduction was unintended, and indeed there are examples for the deliberate introduction of wild animals from the Neolithic onwards, which is most easily observable on islands, but presumably happened in other types of habitats as well. On Cyprus, in addition to the house mouse, wild animals including fallow deer, fox and cat (Vigne/ Guilaine 2004; Vigne et al. 2004) were introduced. The latter received special treatment (burial) but was morphologically wild (Rothwell et al. 2004). A similar introduction of fox is attested for the *Urocyon littoralis* of the Californian Channel Islands (Levy 2010). On Orkney and Ireland (Woodman et al. 1997; Carden et al. 2012), red deer were introduced during the Neolithic. Fallow deer and rabbits came to the British Isles in Roman and Norman times.

In early villages, noise, smell and nasty neighbours will have created social stress and health hazards. Sedentism necessitated changed mechanisms of living together (Hodder 1990) and a different attitude to pollution in general, as it could no longer be avoided by simply moving away. Stress will also have been caused by changed social relations and increasing inequality. There is evidence that hunter-gatherers actually enjoy crowding in the base-camp (Draper 1973), but this may change when this is no longer offset by long periods away from the group while foraging. With the advent of plough agriculture in the Late Neolithic, mobility in general may have decreased, either because of the ownership of land or the labour investment into clearing and building activities. This can lead to the build-up of refuse and concomitant diseases.

Warfare, caused by inequality and private ownership of land, can lead to the destruction of resources and deliberate pollution. The poisoning of wells and water supplies is well attested in written sources as a part of warfare, even if the accusation was also levelled at minority groups like the Jews in Medieval Europe (Lotter 1995). Human bodies have been found in wells by archaeologists in some number (Martin-Kilcher 2007; Hampel 2001; Schröter 1985; Müller/Lange 1975), but often deliberate pollution is difficult to distinguish from normal refuse disposal or a regular form of burial (Martin-Kilcher 2007, 54).

Mining and Industry.

With the Bronze and the Iron Age, and the onset of large-scale mining and smelting, especially the use of sulphurous copper ores, industrial pollution sets in. Indeed, in Wales heavy metals indicating smelting appear earlier than the earliest archaeologically known copper mines (Mighall et al. 2002; cf. Monna et al. 2004a, b; Martínez-Cortizas et al. 1997; Breitenlechner et al. 2014). Signatures of lead smelting in the Mediterranean are visible in the Greenland ice-cores (Hong et al. 1994; Rosman et al. 1997), cores from the Canadian Arctic (Krachler et al. 2009), and bogs worldwide (cf. Shotyk et al. 1998; Alfonso et al. 2001, etc.), and are probably the first instance of environmental pollution visible on a worldwide scale.

Analyses of human bone reveal heavy pollution of mining areas like Wadi Feynan (Grattan et al. 2003; Pyatt et al. 2005). Ancient mines continue to contaminate the environment and human populations even today (Camizuli et al. 2014; Varrica et al. 2014). In intensively mined areas, extensive spoil (Mitterberg in Austria, cf. Hanning et al. 2013) and slag heaps (Rio Tinto in Spain, Rothenberg/Palomero 1986) marred the landscape. The need for fuel and pit props fundamentally transformed the vegetation (cf. Breitenlechner et al. 2010; Breitenlechner et al. 2013), and slag heaps polluted by heavy metals developed special plant associations, for example, in the Harz Mountains (Dierschke/Becker 2008). The highly visible pollution of the Odiel, Rio Tinto and its tributaries in Southern Spain by metal salts (Fig. 3) may well date back to prehistoric times (Davis et al. 2000).

It has been claimed that copper smelting and working arsenical copper (Oakberg et al. 2000) can leave traces in human bone. The use of mercury compounds will also have posed a health hazard to the workers and users. Cinnabar was mined and used at least from the Vinca period onwards; mercury was utilized for gilding in classical Antiquity (Harper 1987, 655) and later times. Pollution with heavy metals was observed in modern scrap-metal workshops (Crippa et al. 1991) and small scale foundries (d'Andrea et al. 1981, cited after Lilis et al. 1985; cf. Lilis et al. 1985; Benin et al. 1999) and metal foundries spread heavy metals into the environment (Parker/Hamr 2001). This would also have been the case in prehistory. Smelting and working of arsenical bronzes can also have detrimental effects on health, causing dermatitis, hyperkeratosis, arsenical melanosis skin cancer (Harper 1987; Nriagu et al. 2007) and lung cancer (Oakberg et al. 2000, 895; Arriaza et al. 2010, 1274), among others. Arsenic in long bones has been interpreted as evidence for the participation in or exposure to copper smelting (Oakberg et al. 2000) in the Chalcolithic cemetery of Shiqmim in Southern Israel. Limping Gods of metalworking, like Vulcanus/Hephaistos and their offspring

(Palaimonius, the Kabeiroi) have been interpreted as victims of arsenic poisoning, which can cause peripheral toxic neuritis (Nriagu 1983, 316–317, 379–380).

Unfortunately, it is difficult to differentiate between *in vitro* and diagenetic uptake of heavy metals into bone (Özdemir et al. 2009, 1033–1034; Rasmussen et al. 2009), and the study of Shiqmim has been criticised for not taking this sufficiently into account (Pike/Richards 2002). Arsenic can also be taken up *in vivo* via the groundwater (Yousuf et al. 2011; Arriaza et al. 2010). As the number of studies is quite limited so far, the pollution caused by prehistoric metalworking as opposed to mining is difficult to assess. The recognition of the side-products of metalworking would, among other things, depend on the life expectancy of the population in question (Harper 1987, 652), as some of the effects, like a paresis, are slow onset.

What is pollution?

Terms like pollution and dirt have several dimensions of meaning. Not only are they used to characterise specific substances, the selection of which is largely or wholly socially determined, but they also carry a religious and a moral significance. In the context of medieval miracles, the expulsion of bodily fluids – blood, vomit or excrements – could mark the cure of a sickness, which is visually disgorged in the presence of the Saint’s relics (Nugent 2001). A dirty body can signal low status (Corbin 1988, 189–212), sin and moral corruption (Pisani 2011), but also meekness and saintliness, the open disdain of social conventions and of personal comfort. St. Hilarion of Gaza, one of the desert fathers, never washed his clothes and only cut his hair at Easter (Fremantle et al. 1893). Unsurprisingly, he managed to scare off the robbers that haunted his part of Palestine. In the 14th century, St. Catherine of Siena would suck stinking pus from a cancerous breast in her pursuit of holiness (Miller 1997, 158–161), even if the patient herself found her behaviour highly suspicious.

Ritual

According to Emile Durkheim (1912), the principle of the sacred is based on creating and maintaining a separation between the sacred and the profane. Thus, ascetics try to renounce any connection to the profane world, to anything human at all (Durkheim 1994 [1912], 66). Neglecting the care of the body or overcoming the socially accepted triggers of disgust is a component of many varieties of asceticism and a way of getting nearer to the sacred. Durkheim divided rites, the most basic constituent of religious activities, into negative and positive rites (Durkheim 1994 [1912], 405). Negative rites consist of interdictions (ibid., 406) or prohibitions, while positive rites serve to get into contact with the sacred, to enter some kind of interaction with it (ibid., 441). These consist of sacrifices, sharing food with divinities (ibid., 445), mimetic and memorial rites and expiatory sacrifices. All of them serve to create and renew group cohesion (ibid. 520). While the former are conducted in a spirit of joyfulness, trust and enthusiasm (ibid., 522), expiatory sacrifices, like those accompanying the death of a community member, are connected to emotions of loss,

fear, pain and disorientation. These rites incorporate self-mutilation and self-pollution. Soil, ashes and excrements are smeared on the body as a sign of mourning (ibid., 526).

In rites of passages, especially during initiation, contact with polluting substances is used to emphasize the liminal position of the person to be initiated. The candidate is often denied his or her most normal needs. He or she may have to fast, refrain from sleep, talking and washing, or is fed disgusting food. Durkheim stresses the similarity of initiation to death and rebirth (Durkheim 1994 [1912], 421). Modern torture uses very similar mechanisms, however. At the same time, the initiand is seen as potentially polluting (cf. also Douglas 1974, 198) and is normally isolated from society. They can take part in antisocial behaviour as part of the initiation rite, but will not be blamed for their acts, as they are outside society at that time (Douglas 1966, 117).

Society

Durkheim does not discuss why a certain substance is seen as polluting, he actually seems to accept, for example, the disgusting quality of menstrual blood at face value and as self-evident. It was Mary Douglas who raised the question of what was defined as dirty and polluting, and why. Her book on *Purity and Danger* (1966) was probably the most influential publication on pollution in the last century. Famously, she denoted dirt as “matter out of place” (Douglas 1966, 48: not her definition). Douglas uses the concept of pollution to understand social structure in general and is particularly interested in the supposed differences in the religious beliefs between “primitive” and modern societies. According to Douglas, substances that defy classification are classified as dirt. Dirt is thus not something that fulfils any objective criteria, but something that threatens social order.

Disgust

In contrast, authors influenced by sociobiology argue that “hygiene behaviour and disgust predate culture” (Curtis 2007, 660) and that hygiene, defined as “the set of behaviours that animals, including humans, use to avoid infection” (ibid., 660) is common to all animals as the product of biological evolution, favouring behaviours that keep away parasites of any kind (ibid., 661). Disgust is interpreted as an automatic reaction to all unhygienic substances and organisms (Curtis/Biran 2001, 18; Haidt et al. 1997). Virginia Smith (2011, 13) claims that there are universal, biologically prompted reactions to certain kinds of dirt triggered by smell, the “disgust response”. This allegedly genetically triggered disgust is used to explain everything from the “instinctive” avoidance of contagion (Pinker 1998) to the choice of mates (Prokop et al. 2013) or the preference of certain sexual mores (Ellis 2011).

For Sigmund Freud (1896), nausea and vomiting were a phylogenetically predetermined reaction to rotting matter. Other authors link the origin of disgust to spoilt food (Olatunji et al. 2008, 1243); the later transference of this emotion to other substances like effluvia of any kind and specific types of behaviour is

then caused by enculturation/education (Kluitmann 1999, 269–270). Small children, who should show the most immediate reaction to hereditary behavioural clues, are in Freud's anal stage actually intensely interested in faeces and not at all averse to handling them (Miller 1997, 12), a behaviour actively discouraged by Western parents in the later course of potty training, supposedly leading to any range of neuroses. Young children seem to judge the suitability of food mainly by taste and seem to have no concept of contamination (Fallon et al. 1984) either. Food preferences, a source of intense intercultural disgust, seem to be acquired mainly by the imitation of the mother, even in animals (Wyrwicka 1978), and are fixed only quite late in life, with an increased breadth of diet in the early teens (Cashdan 1994, 286; Dovey et al. 2008, 183–184). Children below the age of four (Cashdan 1994) are most willing to try out new food, and also most frequently eat poisonous substances. Disgust of specific food items seems to develop between two and four years of age (Cashdan 1994, 284), but corresponding research is made difficult by the low development of linguistic competence at that age (Fallon et al. 1984). Both facts make the straightforward genetic origin of disgust rather improbable, and several attempts to establish a "disgust scale" have revealed wide cultural differences.

Personal pollution.

Reversibility.

Up to now, I have mainly concentrated on pollution caused by the deposition of substances, either in the landscape or on the human body. But in many religions, pollution can arise from "natural" processes inside the human body as well. According to Mosaic Law, a woman is "unclean" both after her menses and after childbirth, and needs purification in order to enter the normal, i.e. male, world again (see Feder 2013 for Biblical conceptions of purity). In Islam, after a "serious pollution", caused by bleeding wounds, menstruation, sexual intercourse, male and female ejaculation or death (Reinhart 1990, 10–11; <http://islam.de/41.php>), the whole body has to be thoroughly bathed (*ghusl*) before prayer or other religious acts, such as reading from the Quran (Bousquet 2012), are permitted. Even touching a member of the opposite sex or sexual desire can make the normal washing before prayer (*wudū*) void according to some schools of Islam (Chaumont 2012). In Orthodox and Catholic Christianity, women are considered unclean during the postpartum period (*Wochenbett*) as well and are received back into the community by a special ritual, traditionally after 40 days or six weeks.

Pollution can also be caused by death. Ethnographically, there are numerous examples of houses or settlements abandoned upon the deaths of their occupiers (for an example, see Shephardson 1978 for the Navaho).

Personal pollution or uncleanliness is usually reversible, and indeed one could argue that the reversion of pollution, that is, cleansing rites, form the mainstay of many religions and tend to support numerous ritual specialists.

There is a constant cycle of clean and unclean for any Muslim (Safran 2003, 198), but pollution can be shed by the simple expedient of different types of ritual washing. The personal state of purity does not influence daily life but only the ability to take part in the prescribed religious rites (Reinhart 1990, 21). No ritual specialist and no guilt are involved, even if the acts that cause pollution are indicative of man's fallen nature (Wheeler 2004, 100–104). Reinhart has commented on this rather unique take on the problem of purity, and links it to the fast genesis of Islam (Reinhart 1990, 23) and presumably its fast scripturalisation that did not leave time for the accumulation of ritual systems. Maybe this needs explanation for Christians especially, who tend to equate pollution with sin, even if it can be shed by repentance and confession. Actually, this "natural" cycle is found in much older religions as well, for example, in Hinduism (Milner 1987, 68). Jacob Neusner (1978) points out that in Judaism, the states of clean and polluted also follow a natural rhythm, with purity as the natural state of humankind and nature providing the means of its purification. Only traumatic historical events give these stages a new or additional meaning and take them out of the constant cycle of change.

"Only when the symbolic perfection of the cult's perpetuity is shattered by events will a place have to be made for history. But at that point the cultic system, including uncleanness, is made subordinate to some other system and no longer serves as the principal focus and pivot of system. Then uncleanness and all that goes with it become conditions for the expression of some further, now deeper, ontology, rather than the a priori ontological and mythopoeic reality" (Neusner 1978:3).

All in all, there seem to be different types of pollution. They can be linked to persons, things or places, and they can be contagious or not, and be linked to sin/transgression or not, as shown in Table 1.

Table 1. Types of pollution.

	contagious	not contagious	sinful	not sinful ¹¹
sacred	x	—	—	x
magic	x	—	x	—
pure	—	x	—	x
polluted	x	x	x	x

Contagion

The term contagion is very important for Durkheim, maybe no accident in the context of the "Pasteurisation of France" (Latour 1988) or indeed the Western World after the role of bacteria in the transmission of diseases was accepted from the late 1870s onwards and replaced miasma (Corbin 1988; Le Guérer 1994, 51–106; Robins 1995; Cole 2010) and microzymes as principal pathogens (Thomes/Warner 1997; George 2011). According to Durkheim, the sacred is always contagious and magic works by contagion.

¹¹ I do not use the word innocence here, as innocence, once lost, cannot be re-gained, while many religions possess mechanisms to get rid of guilt.

As Table 1 shows, the sacred, magic and purity are characterised by specific moral states and modes of transfer, only the polluted crosscuts all categories. As Douglas has emphasised, it is exactly this transgressive state, the impossibility of classification, which makes a person or a thing dirty.

The contagious power of pollution makes all the difference between a *personal* religious “problem” and a social one. If pollution can spread by contact like a microbe, and the expected divine retribution will hit the innocent together with the guilty, as in Ancient Greece (Visser 1984; Parker 1983) or the Old Testament, the community in question will have to develop mechanisms to identify pollution and then either to cleanse or to expel the “infected” person. In the Ancient Near East as well as in the Middle Ages, the headdress of a woman would indicate her social status and state of purity; in the Middle Ages, “unclean” lepers and Jews were forced to wear special clothing to mark them out.

The idea of contagious personal pollution can be a powerful method of social control. It can be used to enforce correct behaviour, specific types of worship and also to define the position of the sexes (Carson 1990; Cuffel 2007; Das 2008), religious (Arabestani 2012; Safran 2003) and especially social groups. In traditional India, the five main castes and the numerous subcastes are kept apart by a hierarchy of purity that descends from the Brahmins to the Pariahs (nowadays “scheduled castes”). Any direct contact with a member of a lower caste is seen as polluting. The marriage of a Brahmin to a member of a lower caste is more polluting than falling into a cesspool (Milner 1987, 62). Dirt in “traditional India” is thus “primarily social rather than physical” (Milner 1987, 60). The caste-system creates a hierarchy of purity rather than a simple dichotomy, which allows for purity-concerns even in those castes that are perceived as unclean, and for purification rites using substances that would be considered unclean in other contexts. I am going to return to the question of classification below.

Contagious pollution can be spread by objects as well as by people. Certain substances are inherently unclean, and this taint can spread to other objects and to other people. In Islam, contagion can be transmitted by impure substances, such as wine, faeces, urine, blood, semen, pus, vomit, corpses, pigs and dogs, as well as by food and especially by water left over by an unclean animal (Safran 2003, 201), but not from person to person (Wheeler 2004, 31; Maghen 1999).

The concept of unclean food is a powerful way of preventing closer contact between members of different religions (Safran 2003; Houston 1993, 13) and also between different ethnic groups.

In ancient Greece, corpses were seen as polluting (Parker 1983, 33–49). Many societies believe that a menstruating woman not only polluted herself but spreads this pollution to anything she touches (Das 2008). In the late medieval and early modern Holy Roman Empire, gallows, the wagons used to transport the condemned, implements of torture and animal carcasses did not only dishonour their wielders, but also everybody who touched them or torturers, executioners and other members of “dishonourable trades” (Stuart 1999). Their status was inherited.

This indirect contagion is especially dangerous because the taint is often invisible and hence can be contracted unknowingly. It is also a long-time danger: the contagious person may be gone, but has left traces

that are still polluting and dangerous to others. Therefore, it becomes essential to deal with these “carriers of pollution” in a systematic way: to keep them confined in specific rooms (menstruating women), keep them apart at all times, or at least keep them away from the core areas of the house or settlement, and especially vulnerable places and substances.

Thus, there are several different avenues to approach the issue of pollution. Taking the emotion of disgust or modern ideas of hygiene as the starting point, “medical materialism” in Douglas’ words (1966, 41), the belief that most rituals actually minimise exposure to pathogens, it would be logical to start any analysis of pollution with the things, or rather substances, that can cause or transmit pollution, like dead bodies, faeces or certain types of food. In a second step, this emotion might then be transferred to persons habitually in contact with these substances. But the Indian example above illustrates that, whatever the original triggers of disgust are, it develops a dynamic of its own. Kathy Stuart (1999) has traced the labyrinthine way in which dishonour was transmitted in early Modern Augsburg: contact with a torturer or executioner would dishonour a person (even if proved innocent of any crime). This dishonour spread to the cart used to transport the condemned to the gallows. The furriers used such carts, which was advanced as the reason for their own dishonourable status. In contrast, the contact with an executioner acting in a medical capacity was not considered polluting. It is obvious how the concept was part of a power-play between the different guilds and trades. It was used in a highly instrumental and political fashion, and special pleading comes in whenever it is convenient to those who can get away with it. The example also serves as a reminder that concepts of pollution are not given and static, but can change radically through time (cf. Khan 1994), and can be used to justify a wide range of different behaviours. Among others, Stephen Tyler stresses that they “have always been a matter for negotiation and variable interpretation” (Tyler 1973, 170). The rules can change or allow exceptions while the general system remains (ibid. 1973, 151). The outcome is ultimately decided by changing power-relations between different social groups, but, as with many superstructure-phenomena, superstructure changes much slower than the economic base; they are also often over-determined.

In a moral perspective, falling into a cesspit is accidental, but marriage is by choice, or at least a positive action. The same principle seems at work with some takes on pollution in Islam (Wheeler 2004). In contrast, under a functionalist paradigm, the concept of pollution helps to maintain a certain social hierarchy, the division of labour between the castes (Dumont 1970; Milner 1987, 64) and prevents any mixing of castes or other social groups.

It is easy to get lost in the discussion of disgust and the role it plays both in society and the formation of the individual (Kristeva 1980; Krebs 2010), but it seems obvious to me that a purely biological interpretation of pollution and disgust is overly simplistic. I would maintain that attempts at a genetic explanation of the rules of purity and pollution in any given society will not work, partly because of a lack of sources, but mainly because of the constant and evolving dialectic between society and superstructure. It is more fruitful to look at these examples from several different perspectives:

- personal action

- maintenance or justification of social structure
- the theory of contagion/purity etc.
- hygiene and public health
- site maintenance

The latter is, of course, the place where archaeology comes in useful and where archaeologists can suitably start from.

Archaeologists and Mary Douglas

To avoid confusion, in the following I shall use the term *refuse* for substances and items that have fallen out of use or are useless, regardless of an indifferent or negative reaction to their nature. *Dirt* describes waste-products that are seen as worthless and unpleasant/ repulsive, whereas I reserve the term *pollution* for the effects of acts and substances, which are perceived to be not necessarily unpleasant, but repugnant and morally, ritually or medically dangerous. This classification is more or less arbitrary and runs counter to some modern usages as outlined above, but should serve to clarify the following discussion.

Archaeologists have used Douglas' systemic understanding of dirt in order to interpret archaeological features and finds and to understand rubbish disposal practices and site maintenance. Often, it was used as part of a cautionary tale to emphasize that ideas about pollution are culture-specific and that archaeologists cannot identify polluting substances in a prehistoric context (Moore 1982; Sommer 1991; Sommer 1998).

In contrast to anthropologists or historians, archaeologists do not start with an observed set of behaviours or beliefs, but with different types of find distributions and use these to reconstruct an archaeological biocoenosis, that is, a set of artefacts and structures in use together (Sommer 1991). Processual archaeologists will then go on to draw conclusions on social structure from this inferred process, while postprocessual archaeologists try to elucidate the attitudes that went with it.

If we start with the problem of site maintenance instead of the idea of pollution, how is this going to influence the interpretation of the different ways to deal with refuse? All human activity creates refuse, either through bodily processes (metabolism) or through artefact production. These can be dealt with by avoidance – change of settlement site – or by site maintenance, where specific types of refuse are only produced or deposited in certain areas, or are periodically removed.

The treatment of refuse is always dependent on its classification. There are four main criteria used in classifying refuse:

- 1) the type of refuse
- 2) the person producing refuse
- 3) the area refuse originates in or is found in at any point in time
- 4) the person dealing with the refuse

1) I have tried to work out some general criteria for how refuse is dealt with, based on its type, that is, the categories of size/amount, dangerousness, dirtiness and value (Sommer 1991, 69–100). Obviously, the

categorisation of individual items or substances is dependent on the cultural context in general and the social position of the persons involved as well. The danger a piece of refuse represents, for example, can be a physical property, like the sharpness of cutting edges (for example glass-shards or obsidian flakes), perceived as a health hazard or, in contrast, the danger of pollution that may cause social ostracism or divine retribution. Douglas (1966, 8) pointed out the lower cleanliness threshold of her husband, and many females in the West would agree there is a general difference between the genders in this regard – although systematic studies seem to be lacking. There may also be differences between classes, age-groups and between different countries, as well as changes through time (Barnes 2006; Sommer 1991, 67–70; Corbin 1988).

2) The same substance can be more or less dirty or polluting depending on who produced it. Blood is generally seen as polluting in Islam, except for the blood of martyrs (Reinhart 1990, 17, footnote 16). The used washing water of a Muslim is acceptable for ritual cleansing, whereas, in contrast, the washing water of Jews and Christians is of doubtful status (Safran 2003). Hesiod warns of dire if unspecified consequences if a male were to use the washing water of females (Carson 1990, 135). In Kottar in southern India, the faeces of lower class people are more polluting than those of one's own caste (Lüthi 2004, 233), and children's faeces (presumably of the children of the family) are acceptable even inside the living areas of a house and are often left lying around for some time (*ibid.*, 247). Even modern British health-workers, who are systematically trained in hygienic procedures, admit to finding children's faeces less disgusting than those of adults, and the bodily expectorations of relatives less noxious than those of strangers (Jackson/Griffiths 2014, 73), sentiments strangely echoed in the assessment of ritual pollution in the Caribbean (Khan 1994). Any type of refuse produced by one's own child seems to be generally perceived as less disgusting than that of others (Case et al. 2006).

3) The type of area that refuse originates in will also influence its treatment. There are a number of relevant spatial categories, from nature/culture (Lüthi 2004), “civilised world/barbarians/savages” (Müller 1972, 119), and/or monsters (Scafi 2006), West/Orient (Argyrou 1997) down to us/foreign parts, settled land/outside area (wildwood, steppe etc.) and settlement proper/fields, house/outside. This can be part of a system of binary oppositions, or of concentric circles, ranging from the familiar to the strange and finally the monstrous (Friedman 1981). There are few systematic studies of refuse disposal, but generally, despite the country code, items and substances tend to be deposited “outside” that would not be acceptable “inside” (cf. Wilk/Schiffer 1979; Rathje 1981, 650 as classic examples). Normally, the outside is designated as the proper place to deposit refuse and pollutants. Defecation happens in the bush or the fields, and the scapegoat is driven off into the desert or the wilderness both in Israel (*Leviticus 16:21*) and Ancient Greece (Bremmer 1983), which may be the abode of evil and unclean spirits anyway. A clear division between inside and outside means that outside dirt can be safely ignored, as it does not matter in terms of personal and family purity (cf. Lüthi 2004; Hodder 1982, 192). It also means that the whole concept of environment (“Umwelt”) as a place to be protected (cf. Kraemer 2008, 149–174) does not exist.

Inside the settlement, the treatment of refuse will depend on how busy and accessible an area is (Sommer 1991, 94–96), but also on the social status of the area. Often, there is a spatial hierarchy of purity. There can be transitional zones, like the entrance, the pantry or the hallway, unclean places, like the latrine, and clean core zones like the parlour, bedrooms or rooms used for prayer/sacrifice. No general rules on the classification of space have been identified: kitchens can be perceived as warm and cosy (England), relatively pure but in need of protection (India, Lüthi 2004, 248) or extremely unclean (Indonesia). Potentially polluting activities, such as cooking, eating, defecating, sex, childbirth, and death, can either be conducted in protected and pure zones, or kept at the periphery of a compound. A latrine/ WC can either be physically dirty because it is conceptually dirty (Lüthi 2004, 249) or be kept very clean for the very same reason, as in Western Europe. Rooms where strangers are received (parlour, kitchen, veranda) can either be relatively impure or extremely pure, even if normally kept very clean. With a strong inside/outside dichotomy, rooms that are “deep” in the building in terms of spatial syntax (Hillier/Hanson 1984) tend to be purer – though not necessarily cleaner – than rooms on the outside, even if they are used for potentially polluting activities like sex, childbirth or death (bedroom, harem).

4) If certain types of refuse are classified as polluting, this restricts the range of persons having to deal with them. As Durkheim has pointed out, the sacred is always endangered by pollution. Thus, priests may be banned from handling a range of objects or substances. In ancient Rome, the *Flamen dialis* could not even set his eyes on a dead body. In contrast, people who habitually handle polluting substances could be perceived to be permanently polluted, and thus themselves polluting, like Roman funerary workers (Bodel 2000). In the Holy Roman Empire, certain trades were considered dishonourable. This included artists, but also people handling dead bodies, like executioners, tanners und furriers (Stuart 1999). In traditional India, the lower castes are forced to deal with the disposal of rubbish and other substances that are deemed unclean, like blood, dead animals, leather, and cut-off hair (Milner 1987, 64). Even in developed countries, handling refuse can have a social stigma attached (Whitson 2011). Pollution is not always related to refuse-handling, however, as the social exclusion of “polluted” blacksmiths in East-Africa demonstrates (cf. Galaty 1979 for the Massai).

In dealing with refuse, the effective and rational behaviour would be to remove it either immediately or whenever there is a sufficient build-up (or, in a hunter-gatherer context, to remove the settlement). As we all know, this rarely happens. It takes long-term systematic habituation to ensure cleanliness and orderliness (Elias 1978 [1939]; Sommer 1991, 67–73). Defining items or substances as dirty or polluting may increase the efficiency of refuse-disposal, while a perception as clean removes or at least lessens the impetus for removal.

Getting another person to remove refuse is an option wherever inequality is present. Cleaning can be forced upon a gender, an age-group, persons of a specific family status, or people lower down in the social hierarchy. A conceptual association between dirt and pollution will reinforce and naturalise this division of work.

Alternatively, persons and places can be purified symbolically, as Ian Hodder (1982, 154–163) has described for the Sudanese Mesakin and for Victorian chamber-pots. The actual and moral purity of either the self and/or the family (especially females) can also be a safeguard against both pollution and actual dirt both in the house and the settlement and the wider environment as well.

As a practical consequence of these varying coping-strategies, the archaeologist has to look for refuse-disposal practices at several levels: the level of the house, the settlement and the landscape.

Purification rituals themselves are probably difficult to trace archaeologically. In historical and ethnographic cases, some substances are used which modern Westerners would consider quite unclean, for example, animal waste and blood. In South-India, *pañcagavya* – a mixture of cow-urine, milk, yoghurt, butter and cow dung (Fig. 4) – is used to purify people and polluted rooms (Lüthi 2004, 239, 250). After a birth or a death, the whole house is cleaned with this mixture, which may well leave misleading phosphate-values for the archaeologist to find. Some Greek temples would regularly be cleaned with pig's blood (Parker 1983, 27, 30). Confusingly, a temple would be polluted by human bloodshed, but could be purified by animal blood. Substances like faeces (von Staden 1992, 9), menstrual blood or the blood of dead gladiators could also be used for medical purposes (Moog/Karenberg 2003).

Pollution of the City

Greek temples and public places were in periodic need of cleansing, often in preparation for feast days. Much as with humans, there was a circle of cleansing and pollution that were as much part of the ritual yearly cycle as personal pollution and cleansing. Armies were cleansed before a campaign and after some types of transgression (Parker 1983, 22); Roman armies before and after a campaign (*ibid.*, 24).

Important public places needed cleansing before entering; lustration bowls were placed at the entrances to the Athenian agora, an area that foreigners and polluted persons were not allowed to enter (Parker 1983, 19). The meeting place itself was purified by killing a piglet and carrying it around the areas (*ibid.*, 22). The Roman *pomerium* was not only a legal boundary between civil and military spheres (Drogula 2007, 453) but was also defined as an inner pure area where burials, certain types of executions (Rüpke 1992, 63–66) and the worship of foreign gods, such as Isis, were not permitted.

After civil strife or defeat, entire cities (which, presumably, included the *chora*) could be in need of cleansing. Thus, Athens was cleansed in 480 BC and Rome after the expulsion of the Etruscan kings and after the conquest by Brennus (Parker 1983, 24–25). Parker (1983, 24) sees these purifications as rituals of transition “which removes dirt from the past and so makes ready for the future”. Contrary to the literal meaning, they assure renewal, rather than removing a taint that is still active.

While there have been numerous studies of the pollution of settlements (Addyman 1998; King/Henderson 2014; Hardy-Smith/Edwards 2004; Scobie 1986; Hope/Marshall 2004, to randomly pick out just a few), in addition to studies about the development of modern urban sanitation and cities of the 18th and 19th centuries

(cf. Barnes 2006; Halliday 1999; Jackson 2014), the pollution of landscapes in antiquity and prehistory has been of less interest so far. Large-scale pollution was mainly linked to industrial processes like mining and overcrowded habitats. “Development always produces dir t” as Murray Milner (1987, 59) puts it.

Some substances and objects are deemed immune to pollution. Water and soil are perceived as unchangingly pure in Hinduism (Milner 1987; Lüthi 2004, 256), for example, and a bath on the Ganges is purifying even if the river is heavily polluted from a hygienic perspective (Batabyal et al. 2014). In Ancient Greece, pollution could be thrown into the ocean (Parker 1983, 210; Lindenlauf 2003). Salty sea water was commonly used for purification rituals (*ibid.*, 226). Polluted items could also be buried, left outside the city territory (Lindenlauf 2003, 423), or carried off into the mountains, “where nobody can see or tread at them” (Hippocrates, on sacred disease, Parker 1983, 229; Lindenlauf 2003, 423). In this case, it is not clear if the wilderness was seen as safe from pollution or simply as empty and “in between”, as polluted items would also be discarded at crossroads (*ibid.*), the ambiguous no-man’s land *per se*.

Water, in contrast, could be used to wash away pollution, but would then be polluted itself (Parker 1983, 229); therefore, for example, a river should not be crossed with unwashed hands (Parker 1983, 293). Fire could also be polluted (Parker 1983, 293); a new fire was fetched to a house after the end of mourning (*ibid.*, 35) and after the purification of Athens following the Persian conquest, new fire was fetched from Delphi (Parker 1983, 23). Zoroastrians also believe that the pure elements, water, soil and fire, can be polluted (Herodotus, Histories 1.138; 3.16). In Judaism, natural substances, such as water, can be used for purification, but great care has to be taken to make sure they are not contaminated. Thus, only spring water can be used for ritual ablutions (Lev. 11, 36). The same was the case in Ancient Greece (Parker 1983, 207).

Pollution by sin

In contrast to everyday rites of purification, which also served to organise the passing of time (Parker 1983, 31), there were pollutants that could actually threaten the whole community and, by implication, its territory.

For the ancient Athenians, sacrilege as well as the shedding of human blood was polluting, and this pollution was contagious. Divine retribution would eventually hit a murderer and potentially everybody in his company (Parker 1983, 9). In Athens, a murderer would be formally banned from “lustral water, libations, shrines, mixing bowls, agora” by the *archon basileus* (Parker 1983, 125), that is, from places and items vulnerable to pollution because of their sacred and pure status. According to the Tetralogies, attributed to the 5th century orator Antiphon of Rhamnus, an unavenged murder could endanger a whole city. The culprit would pollute the temples, making sacrifices invalid, and in eating together with other citizens he would pollute them as well. Crops would fail, cattle and women turn infertile and “affairs in general go wrong” (Parker 1983, 105). Around 600 BC, Athens was cleansed by Epimonides to counter the effects of the slaying of the supplicant followers of Kylon in the temple of Athene (Hoessly 2001, 175–178).

In Greek mythology, an unavenged murder or other transgressions could result in a plague. The power of that belief is attested by the Athenian purification of Melos after the plague of 430 BC. The whole island was cleared of burials which were deemed defiling (Thukydides 5, XV): Birth, death and sexual intercourse, all reminders of human mortality, were generally banned from the temple-precincts of the immortal gods and thus also from the sacred birthplace of Apollo and Artemis.

Perjury and blasphemy could also attract indiscriminate and potentially contagious divine retribution. Banishment seems to have been a common solution to this perceived danger, but the death penalty could also be used. Hospitality and supplicants were under the special protection of Zeus and any transgression could have repercussions for the whole community and any innocent bystander. Aischylos (*Suppliants*) strikingly describes the enraged Zeus Hikesios, the “all-destructive God”, perched on a rooftop, spreading havoc and pollution on the house and all of its inhabitants (Parker 1983, 10). The trials at the Athenian Areopagus were held in open air to avoid sharing the same roof with persons accused of murder, who were polluted and liable to persecution by angry spirits (âlitteroi, Connor 1985, 92). In all of ancient Greece, the houses of perpetrators could be pulled down in order to deter divine retribution on the whole community (Connor 1985). Suspected murderers could even be tried while standing in a boat to prevent them from polluting the surrounding countryside (Parker 1983, 119).

All in all, however, in the Greek view, pollution seems to have been restricted to individual persons (including their descendants and even ancestors, as in the case of the Alkmaeonids) and communities rather than to a specific landscape or territory, even if divine retribution could take the form of crop-failures. There are only a few examples of a more territorial nature. The land the Persians had allotted to the Chians as a reward for turning over a supplicant was considered defiled (Parker 1983, 185), for example, but it is unclear what the exact consequences were.

According to Jewish and Christian traditions, the whole earth is cursed for the sin of Adam: “for God said to Adam after he had sinned, cursed is the ground for thy sake, in sorrow shall thou eat of it all the days of thy life” (Genesis 3:17). This view may have influenced the way the respective religions may have viewed environmental pollution, but this topic is way beyond the scope of the present article.

Naturally unwholesome landscapes

In ancient Greece, entire landscapes could be unwholesome because of their airs, waters and general location. The term “miasma” describes both common dirt and “contagious religious danger” (Parker 1983, 5). Later on, the term came to be used for unhealthy vapours that spread diseases.

The Hippocratic author of “Airs, Waters and Places”, probably from the late 5th (Ducatillon 1977) or the 4th century BC (McKeown 2002, 53), discusses the influence of the environment on the human body and its health. He believes that both bodily traits, like skin-colour (Lloyd 1983, 162), constitution and bodily strength, as well as character traits (Lloyd 1983, 160) are caused by the environment, especially by the type of water and the prevailing wind. When arriving at a new city, a doctor should therefore assess the location

(exposed or sheltered), the exposure to winds, the type of water supply as well as the soil and vegetation (Lloyd 1983, 148), which will help him to understand which diseases are prevalent in the area.

Stagnant water from the marshes will cause dysentery, diarrhoea and oedema in summer, pneumonia, madness and a fever called *causus* in men, tumours and leucorrhoea (*Fluor genitalis*) in women. The author then describes the Phasis (Rion in Georgia) as an archetypical unhealthy landscape, a land covered in water and mist, with houses built on water and the inhabitants having to use dug out boats to go to market. As a result, they have a yellow skin, stout and big bodies, and deep voices. They also have little stamina (Lloyd 1983, 162). The description of diseases in the “Epidemics” (Lloyd 1983, 87–138), another Hippocratic text, is thus always preceded by the name of the town and a description of its environs together with the season and the prevailing weather at the time.

Generally, a temperate climate, “centrally placed between hot and cold” and a changeable weather was seen as most conducive to good health and good character. The air in towns could be stagnant and thus unwholesome because it was hemmed in by the town-walls, but it was mainly the environment of towns that determined whether they were healthy or not.

The Roman poet and philosopher Lucretius took up Hippocratic and Aristotelian ideas and described how epidemics had their origin in “earth rotted by drenching rain”, and how the plague in Athens was caused by contaminated air coming from Egypt inhaled by men (Glacken 1967, 101). A landscape could thus be contaminated for a short time period or constantly, depending on geography. In contrast, authors, such as Strabo or Vitruvius, emphasized how landscapes and their wholesomeness or otherwise could be changed by human labour (ibid., 103–110).

Greek ideas about the salubrity of specific environments were taken up and enlarged by medieval Arab authors, who complemented them by their own observations. The pollution of soil and air was identified as the cause of diseases. In the 9th century, Al-Rāzi recommended settlements to be located uphill and upwind from infected areas (Gari 2002, 476). As he was criticised by later authors for his bad knowledge of Greek, it seems this advice was based on personal observations. In the 10th–11th century AD, Qustā ibn Lūqā ascribed diseases to vapours from forests and swamps and other “ground humidities”, such as smoke rising from mountains and furnaces. Smoke also rose from burning corpses and other decaying objects “which emit bad fumes and stinky odours when heated by the sun and nature”. These factors could be acerbated by extreme temperatures, but it is “air spoilage”, resulting from the above sources, that is seen as the cause of the majority of illnesses (Gari 2002, 476). Ibn Sina (Avicenna) was the author best known in Christianity. He believed diseases to be transmitted not only by air spoilage but also by mouldiness, impure food and animals. Nevertheless, he advised how to place houses in order to avoid putrid air (Gari 2002, 481).

This idea of naturally polluted landscapes, especially swampy, low-lying areas, points to a specific “hygienic geography” that produced several works on the theme.

When Hippocratic medicine was rediscovered during the Age of Enlightenment, the Greek term “miasma”, pollution, was resurrected to designate dangerous odours emitted by the soil, stagnant water and man-made holes (Dobson 1997, 9–37; Corbin 1988, 21–34). “Pestiferous airs” (Dobson 1997, 24) came to be seen as the main cause of diseases (Fig. 5). Both stagnant water and stagnant air were deemed unwholesome, following the Hippocratic teachings. Swamps were especially polluted and unwholesome (Wear 2008), causing malaria (bad air) and other afflictions, a theory that could be supported by empirical observations (Dobson 1997, 81–187). In France of the Ancient Regime, the whole countryside was perceived as polluted, connected, as it was, to “unclean” soil and manure used as fertiliser. The Soil itself was supposed to produce an effluvium harmful to health, for which the experiences of miners were cited as proof (Corbin 1988, 35).

Pollution could lead to the abandonment of areas, that is, by those who could afford it. The stately home of Trentham in Staffordshire, seat of the Dukes of Sutherland, was abandoned by the family because of the smell of the River Trent, the water of which fed the ornamental Italianate fountains, and it was pulled down in 1911 (Richardson 2013, 171). The river carried the sewage of the swelling industrial towns of the potteries district, one of the core-areas of early industrialisation in Britain (<http://www.trentham.co.uk/media/141001/history-timeline.pdf>).

In urban contexts, the solution was often to get rid of polluting substances, like dead bodies (Foisil 1974) and crowded housing, preventing a sufficient flow of air, in favour of well ventilated, centrally planned apartment blocks (Wise 2009, 265–271). The “sanitation” of the European cities is linked to the ideas of Pasteur and the ascendancy of water based sewage systems after the cholera epidemics in Vienna 1831, London 1849 and Hamburg 1892, among others.

This was still based on the idea of separation: dirt is transported to a place outside the settlement, where its effects are ignored. The alternative solution, advocated by as diverse people as Justus von Liebig, Georg Varrentrapp and Karl Marx, of using the night soil from latrines as fertiliser, relied on a re-classification of dirt as a useful substance inside a closed system. As Dominique Laporte (1991) has outlined, this contrast can be connected to specific views on economic development. Here is no place to go into detail, but it should be obvious that the different ways of dealing with pollution by classification are not limited to prehistory or the developing world.

Postmodern landscapes of pollution can be found in the ship breaking yards of Alang on the coast of Gujarat and in Chittagong in Bangladesh, the trash vortex in the Sargasso Sea, Wen'an in China, where plastic refuse from Europe is recycled (Minter 2014), or on the Gramacho dump in Rio de Janeiro (Nidecker 2015) (Fig. 6). They define internal social divisions and cement subordination (Whitson 2011), but above all, they map class divisions that have been transferred from the first world core into what was once the periphery, stabilising the capitalist system not only by the economic exploitation of the “Third World” in terms of raw material (Luxemburg 1913) and cheap labour (Meillassoux 1978) but also by exporting the polluting residues in the opposite direction.

Intentional pollution

Divine retribution can render places unfit for settlement forever. Well-known examples are Sodom and Gomorrha in the Bible (Genesis 19:1–29).

Some places devastated by human conquerors were also declared off-limits for habitation. This type of ban could take the form of a curse on anybody rebuilding the settlement and his descendants, or a ritual pollution to make the site unfit for any future settlement.

Examples for actions of this kind are restricted to written sources. It is doubtful if such measures could be identified archaeologically. If a major settlement is destroyed and not re-settled for some time, ritual pollution or a curse, in other words, political force strengthened by ritual means may have been the reason. Interestingly enough, none of the sites we know of remained empty for long.

When the Hittite King Anitta von Kuššara conquered the city of Hattuša in the 17th century BC, he sowed the ruins with weeds and cursed any king who would try to settle Hattuša again.

“(45)... And h[unger(?)] opp]ressed the city Hattuša, and I let it continue (in this way). When at last it (46) became terribly afflicted with hunger, then Siusmi surrendered it [to(?)] the deity, Halmas[uitta], and in the night (48) I took it by storm. On its site I so[wed] cress. (49) Whoever shall become king after me (50) and shall settle Hat tuša again, [may] the Storm-god of heaven strike him!”

(BoTU, I, No. 7, KUB, XXXVI, 98–98c, after Gevirtz 1963, 53). In a similar vein, the city of Timmhuala was destroyed by Muršili II. (14th century BC) and consecrated to the weather god. “No man will inhabit it” (annals of Mursili, Goetze 1933, after Gevirtz 1963, 59), but no weeds are mentioned.

The Hittite name of the weed is unknown, as it is written with the Sumerogram [ZÁ.AH.LI](#). The Ortaköy fragment 95/3 gives the syllabic reading of marashanha (mara-aš-ha-an-ha-<aš>-pát) which, as S.P.B. Durnford and J.R. Akeroyd (2005) claim, denotes a member of the fennel family, most probably fennel, *Foeniculum vulgare*, a female contraceptive and abortative (*ibid.* 8) or the giant fennel *Ferula communis* (Fig. 7). The latter plant commonly grows in Western Anatolia, and is frequent in overgrazed areas. It also grows in disturbed ground and on ruins. Durnford and Akeroyd (2005, 8) state that it does not grow over 400 m and thus on the Anatolian plateau, but *Ferula assa foetida* and *F. orientalis* (Davis 1972) would present other candidates. Peter Davis (1972) also lists a number of badly known species like *F. hausnachtii*, *F. hubermorathii*, *F. longipedunculata*, *F. rigida* and *F. szowitziana*, the low-growing *F. caspica* and *F. szowitziana*, as well as *F. halophilia*, restricted to salty areas around Tuz Gölü (Vanderplank et al. 2014, 252) as species to be found on the Anatolian plateau and the mountains to the east.

A ritual similar to the above is described in a number of Assyrian sources. Adad-Nirari I. conquered and burned Taidu, one of the Mitanni-capitals, and sprinkled it with *kudimu* (Weidner 1928/29, 91). Shalmanasser III. destroyed Arina in the Zagros Mountains and strewed *kudime* over it (KAH I, 13 col. ii. 3), Tiglat-Pileser III. captured Hunusa, the capital of Kumana, carried off their gods and goods, burnt the city – “to mounds and ruin I turned it” – devastated the city’s environs and strewed it with *sipa*. He also left an

inscription banning the rebuilding of the city and a “clay house” with a bronze thunderbolt, dedicated to Aššur or Adad. Aššurbanipal claims to have conquered the whole of Elam and to have lain 60 double hours of land to waste. “Salt (and) cress I scattered over them” (Gevirtz 1963).

Sipa is translated as “a type of salt”. Salt, in general, played an important part in Assyrian ritual. It was used to ward off evil and also to provide meals for the gods (Potts 1984, 230–232). The use of salt as a means of pollution is rather singular, even if the negative results of the salinization of soils was well known. Maybe *sipa* was not intended to pollute the site, but rather to consecrate it. The translation of *kudimu* is given as “Alkalosalz” by Donald John Wiseman (1952, 38), which, confusingly, can also be an abbreviated form of *kudimeru*, *kudimeranu*, either salicornia or cress (*ibid.*). The latter was a common constituent of Mesopotamian diet, either as a salad (Ellisson 1984, 89, 95) or as ground seeds (Dalley 1980). The translation probably needs to be studied afresh by an Assyriologist.

Sites that were destroyed and subsequently cursed and/or sanctified are also known from the Levant. Jericho, after being conquered by the Israelites (Joshua 6), was burnt to the ground and consecrated to God. “And Joshua adjured them at that time, saying, Cursed be the man before the LORD, that riseth up and buildeth this city Jericho: he shall lay the foundation thereof in his firstborn, and in his youngest son shall he set up the gates of it” (Joshua 6, 26). Around 840 BC, King Meša of Moab conquered the Israelite city of Nebo, killed all inhabitants and consecrated it to Kemoš (Gevirtz 1963, 52; Müller 1985).

In only one case, the conquered territory was ritually polluted. When King Abimelech destroyed his rebellious home-city of Shechem, he sowed it with salt (Judges 9, 45). No cursing is mentioned. Alexander M. Honeyman (1953) surmises that the salt was meant to pacify the spirits of his half-brothers, the 90 sons of Jerubbaal, whom he had slain in Oprah, not to render the site infertile (Fensham 1962). As the narrative line of the account is the working of the curse of Jotham against Shechem and Abimelech, the salting of Shechem is only mentioned in an aside, so it is difficult to judge its ritual importance.

In a Greek context, Strabo mentions that Agamemnon cursed Ilion (Troy) “in accordance with an ancient custom” (Geographica Strab. 13.1.42), and therefore nobody dared to rebuild it. Sidene in Mysia is mentioned in the same section as an example of a cursed site. It had been destroyed by Kroesus, King of Lycia, for supporting a certain Glaukias, and the former had put a curse on anybody who would re-fortify the site.

After the conquest and destruction of the Phoecean city of Krissa by troops from Athens, Thessaly and Sikyon in the First Sacred War, the *chora* of the town was consecrated to Apollo, with the promise never to plough it again. Any transgressor, be it a city, individual or nation, was threatened with the curse that: “neither land may bear fruits, nor their wives bring forth children like their parents, but monsters; that their herds may not bring forth a natural offspring; may they meet disasters in war, in trials and in the forum, and may both themselves and their families and their whole race be utterly destroyed, and may they never [...] offer acceptable sacrifices to Apollo, nor to Artemis, nor to Leto, nor to the provident Athena, and may these divinities not receive their sacrifices” (Aeschines, Against Ctesiphon 107–112, after Gevirtz 1963, 54–55).

In all these cases, the transgressor/rebuilder and not the ground itself was cursed, and no substances of any kind were put on the site itself as far as we know.

The biblical story about the ritual pollution of Sichem was later transferred to the Roman destruction of Carthage. After Scipio Africanus had the city razed to the ground in 146 BC, according to Appian, ten members of the Roman senate sent out to Africa who “[...] decreed that if anything was still left of Carthage, Scipio should obliterate it and that nobody should be allowed to live there. Direful threats were levelled against any who should disobey and chiefly against the rebuilding of the Byrsa or the Megara, but it was not forbidden to go upon the ground” (Appian, *Roman History* VIII, §135). Macrobius describes a specific rite that was used to consecrate Carthage to the Infernal Gods (Ridley 1986, 141) and the city may have been re-consecrated in 81 BC (Stevens 1988, 39). According to the Roman jurist Modestinus Herennius, the site was ploughed over as well (Stevens 1988, 141).

The curse was certainly perceived to work. Appian (*Roman History* VIII, §136) relates how, when 6000 settlers were sent out to Africa under the Gracii in 122 BC, the boundaries of the plots they had set up on the territory of Carthage “were torn down and obliterated by wolves”, and how the senate then decided to abandon any idea of establishing a colony there. Julius Caesar, who planned to resettle the area, was murdered before he could realize his plans, and it was only in 29 BC that Augustus finally rebuilt the city (Appian, *Roman History* VIII §136, for details see Stevens 1988).

The account of the destruction and cursing of Carthage was very powerful in attracting older stories. Appian describes how Scipio cited Homer’s verse on the description of Troy while sitting in the ruins. During the 19th century, the salting of the *ager Carthaginensis*, modelled on the biblical destruction of Sichem, but not attested in any classical sources (Ridley 1986) was added (Stevens 1988; Visonà 1988).

Several cities that were destroyed and sown with salt are mentioned in medieval sources, for example, Padua by Attila and Milan by Friedrich Barbarossa (Stevens 1988, 41). This is presumably based on the same biblical template as Carthage.

The most striking commonality of all these accounts of cursed and deliberately polluted ground is that it did not work. All settlements were settled again, either because the pollution wore off through time, or because the locations were just too good to lose, which was probably why a curse was thought to be necessary in the first place.

Juthā

Pollution by contact with bodily discharges, which are seen as extremely impure, is perceived as a constant danger by Hindus or Sikhs. Even one’s own spittle is impure, therefore the mouth is cleaned first thing in the morning (Lüthi 2004, 238) and water is poured into the mouth in order to avoiding contact with the beaker or bottle. These bodily substances are contagious and, in the case of spittle, more or less invisible and difficult to detect. Cooking exposes food to pollution by spittle, which can be contracted by eating

leftovers, which have touched the lips of another (*juthā*, see Kahn 1996, 246 for further definitions of the term). All boiled food is thus potentially polluted to varying degrees (Babb 1970, 295), while uncooked food and especially fruits are safer. The process of eating pollutes all the food in a dish and the utensils used for eating; washing up is therefore often relegated to the lower castes (Sharma 1969, 211). Guests may wash their own plates to save their hostess from performing the demeaning task (Lüthi 2004, 238).

Eating *juthā* can establish a relation of subordination. The Gods leave the leftovers of sacrifices to man (*prasād*), and the members of lower castes eat the leftovers from the feasts of Brahmans (Selwyn 1979, 694; Babb 1970, 295). In the course of the marriage ceremony, the wife cooks for her husband, who eats and then passes on the leftovers to her (*Muhajayan*; Selwyn 1979, 688). Accepting pollution this way is the highest sign of respect (Babb 1970, 269), similar to touching the (polluted) feet of a highly esteemed person.

This concept of “spittle pollution” can be transferred to other substances and contexts. It is used for animals like pigs, which eat faeces, leather, the leftover of a dead animal, and even the game of football, as it is played with an unclean leather ball (Mangan 2000, 46). All castes that are in constant contact with bodily effluents, such as sweepers, washers and barbers, are considered polluted (Lüthi 2004, 237), as well as anybody who eats polluted food like pork (Khan 1994, 238). Women can become *juthā* by sexual activity (Khan 1994, 246).

In the Indian context, *juthā* can only contaminate persons and objects, not the soil, as soil cannot be polluted. However, the concept of *juthā* points to the role of human presence as such in perceived pollution. While authors like John Barrett (1993) have looked at the process of domestication of a landscape in terms of making a home, this may mask a low tolerance of traces of human presence by prehistoric populations. Garbage and faeces, the infestation of gardens and fields by weeds and pests, an increase of transferable diseases and visible environmental change as well as memory-traces manifested in monuments and ruins may have polluted entire landscapes in the perception of prehistoric populations.

When I was taking part in a field-project in Kerinci, Central Sumatra in 2003 (cf. Bonatz 2003), the team’s ethnographer, Wolfgang Marschall, went out to collect origin tales from the various villages in the surrounding area. Almost invariably, the story, as I recall it from his reports in the evening was as follows:

“We lived in village A. We had been the first to settle there, we had always lived there. Then people came and founded village B upriver from us. They polluted the river, they polluted our drinking water. In the end, we left A and went upriver into a new area on a tributary. We founded a new village, where we have been living since. We called it A”. Sometimes an elephant or a tiger (cf. Bakels 2000; 2009) was thrown in; otherwise the stories remained boringly unchanged.

The settlement-structure in this area is indeed oriented string-like along the rivers, or, in rare cases, along footpaths (Znoj 2009, 353) with the settlement by agriculturalists starting at the coast (Watson 2009, 262) and then spreading further and further into the highlands (Fig. 8).

Crowding is generally accepted to have negative consequences for human health and social structure, and is seen as a prime motor for demic diffusion. It is, however, a preponderantly subjective phenomenon. The

unexpectedly high mobility of European Neolithic populations indicated by some recent studies (Bickle/Whittle 2013; Hoffmann 2016) of stable isotopes and population densities may well be related to the perceived pollution of local environments. Thus, one wonders if the reason for the spread of, for example, the LBK through Europe may have been the story of annoying neighbours who polluted rivers and creeks.

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Fig. 1. The classic image of industrial pollution: The Madeley Wood Furnaces in the Ironbridge Gorge in Shropshire in 1801 (Painting "Coalbrookdale by Night" by Philipp Jakob Loutherbourg the younger).

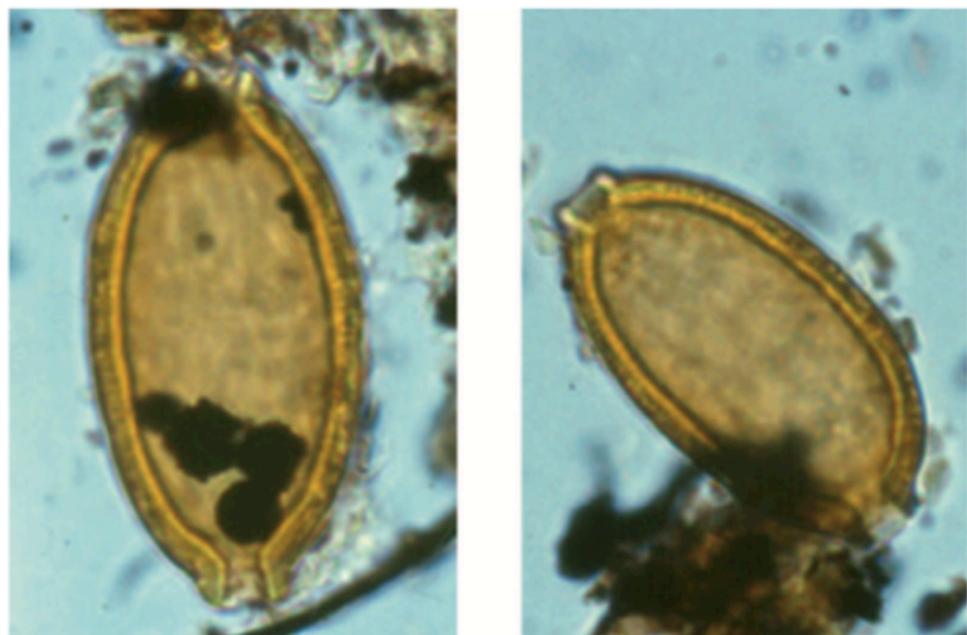


Fig. 2. Late Mesolithic whipworm eggs, Goldcliff, Newport, Gwent (Dark 2004, fig. 1)



Fig. 3. Pollution of the Rio Tinto in southern Spain by metal salts (<https://pixabay.com/de/rio-tinto-2-huelva-spanien-2701960/>)

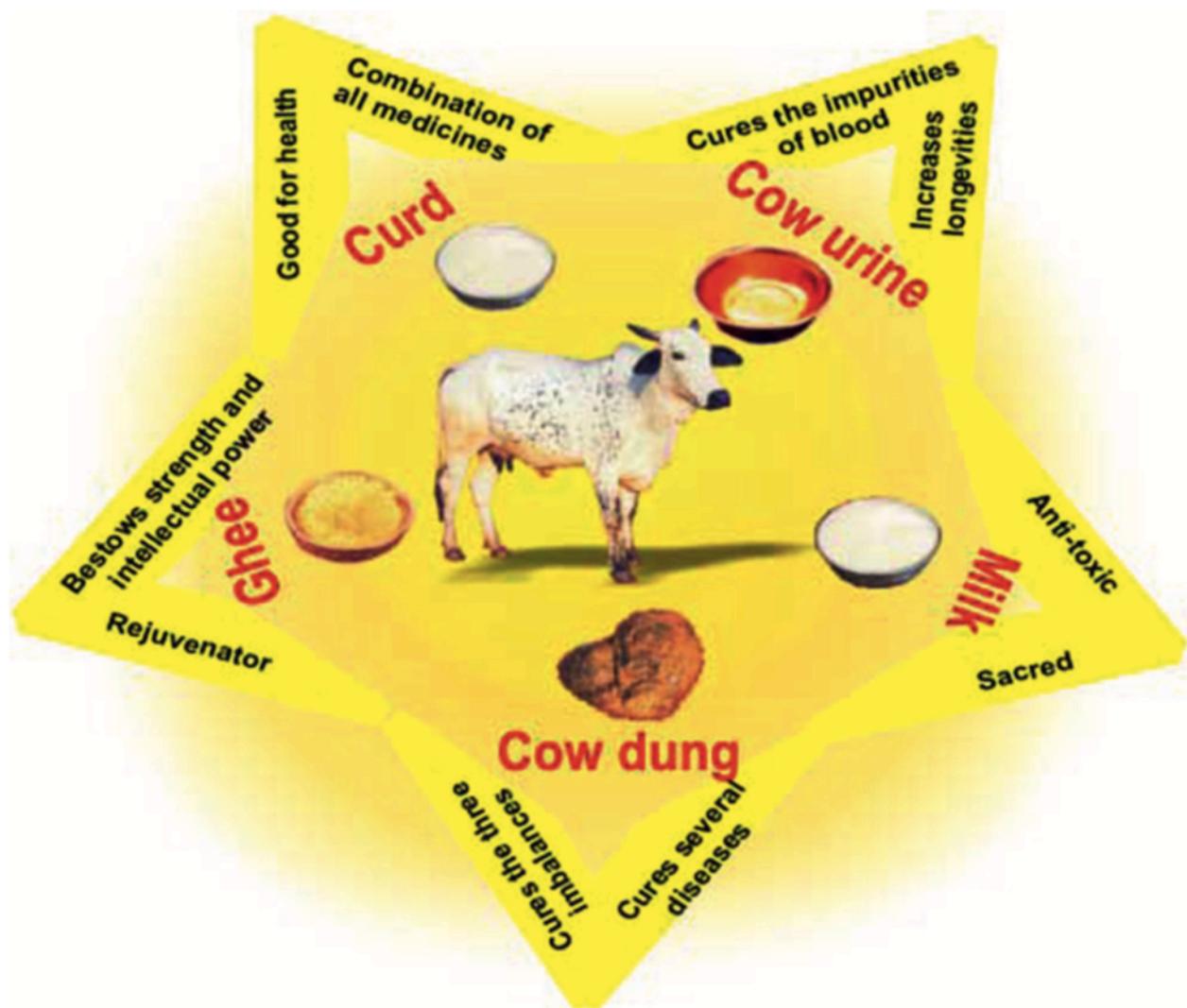


Fig. 4. Advertisement for Pancagavya, a medicine made of cow-urine, milk, yoghurt, butter and cowdung. (http://govi-gyan.com/Pages_ayurved/centres.aspx, accessed April 2013)



Fig. 5. Bubonic Plague in San Francisco, 1900. (Edwards 2014, <http://jezebel.com/ from-miasma-to-ebola-the-history-of-racist-moral-panic-1645711030>)



Fig. 6. Gramacho dump in Rio de Janeiro (https://en.wikipedia.org/wiki/Jardim_Gramacho#/media/File:Jardim_Grama-cho.jpg)



Fig. 7. *Ferula communis*, Sicily.



Fig. 8. Floating toilet in the Batang Hari near Murajambi, Sumatra.