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The Great Unwashed

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Many of the great plagues have been associated with dirty and unhygienic conditions, overcrowding, mass migration, war, social disorganisation and the weakness of the state, but none more so than the epidemic I'm going to talk about this evening, typhus, because typhus is spread by the human body louse, which carries on it the *Rickettsia* bacillus – seen here in a stained culture – and transmits it when it bites into the skin. The name given the disease comes from the Ancient Greek *typhos* meaning smoky or hazy, denoting the condition of mind into which the victim soon lapses; it's accompanied by angry red spots that eventually merge into a rash that spreads over the body and erupts into gangrenous sores, by coughing, pains in the joints, severe headaches and muscle pain, a high fever, sensitivity to light, and in up to fifty per cent of those affected, death. But the name given to it doesn't date from the Ancient Greeks; rather, it's the product of the fondness of the medical profession for terms based on Classical languages.

Typhus has often been confused with other, related or indeed sometimes unrelated diseases, notably *murine typhus*, where the symptoms are similar though not identical, and the disease is spread by fleas from rats to humans, rather as in the case of the Black Death. *Typhoid* fever is entirely different, with milder symptoms and a lower death rate, and is spread in contaminated water and foodstuffs, like cholera, though the symptoms were similar enough to those of typhus, as the name suggests, to cause some confusion before modern methods of diagnosis were developed. Indeed until the 1830s both diseases were held to be the same, and it was not until after the middle of the nineteenth century that separate statistics of their incidence began to become available. The first recognisable modern description of the classical typhus occurs in 1489, in an account of the Spanish siege of Moorish Grenada, when 3,000 men were lost to enemy action but more than 17,000 to the new disease known as the spotted fever; then it spread to Cyprus the following year with invading Spanish troops, reappearing in later conflicts in Italy, particularly during the French siege of Naples in 1526, when the army was so badly affected it had to withdraw.

It seemed to be a new disease; but it wasn't part of the Columbian exchange; it was described accurately before Columbus returned from the Americas, and some historians have claimed to recognised the symptoms in the Plague of Athens described in Thucydides's *History of the Peloponnesian War* and depicted in this somewhat over-dramatised painting from the Neapolitan School:

People in good health were all of a sudden attacked by violent heats in the head, and redness and inflammation in the eyes, the inward parts, such as the throat or tongue, becoming bloody and emitting an unnatural and fetid breath. These symptoms were followed by sneezing and hoarseness, after which the pain soon reached the chest, and produced a hard cough. When it fixed in the stomach, it upset it; and discharges of bile of every kind named by physicians ensued, accompanied by very great distress. In most cases also an ineffectual retching followed, producing violent spasms, which in some cases ceased soon after, in others much later. Externally the body was not very hot to the touch, nor pale in its appearance, but reddish, livid, and breaking out into small pustules and ulcers. But internally it burned so that the patient could not bear to have on him clothing or linen even of the very lightest description; or indeed to be otherwise than stark naked. What they would have liked best would have been to throw themselves into cold water; as indeed was done by some of the neglected sick, who plunged into the rain-tanks in their agonies of unquenchable thirst; though it made no difference whether they drank little or much. DNA investigation of skeletons dating from the time of the Plague of Athens in 430 BC has proved ambiguous, suggesting more of a typhoid-like disease, though this never appeared in epidemic form and is never associated with warfare, and of course bacilli mutate over time. According to another claim, a disease that broke out in an Italian monastery in the Middle Ages was also likely to have been typhus, according to the description provided by the medical school at Salerno, the first recorded institution of its kind.

More even than cholera it's associated with war; it spreads when large numbers of people are confined in close proximity to one another, unable to change their clothes or wash themselves regularly. 'Ship fever' was one common name for it in the 18th century. Not surprisingly it's also associated with poverty, which causes overcrowding, and it's sometimes been known as 'hunger typhus'. Like other epidemics it spread rapidly during the Thirty Years' War, where according to one estimate it killed up to ten per cent of the population. It broke out in the Grand Army during Napoleon's retreat from Moscow, during which it's thought to have killed more French soldiers than the Russians did; Minard's classic map illustrates the drastic reduction in Napoleon's forces both during the march on Moscow, shown in pink, and on the retreat, shown in black.

In the nineteenth century typhus was associated above all with poverty and squalor, both urban and rural. McNeill remarks, somewhat heartlessly I think, that the occasional military and political importance of typhus fever was not matched by any notable demographic significance for the peoples of Europe or anywhere else, so far, at least, as the very sketchy indications of population trends allow one to judge. Typhus was, after all, a disease of crowding and poverty. For most of the poor who died of typhus, statistical probability assures us that if infected lice had not assisted their demise, some other disease would soon have carried them off.

And it's certainly true that typhus epidemics did not have the catastrophic effect of, say, the Black Death, or the great cholera epidemics of the nineteenth century. While people took a long time to learn that cholera could be prevented by specific hygienic measures such as washing one's hands, purifying water supplies and so on, the human body louse has always been seen as an enemy, causing discomfort and irritation even where it doesn't spread disease, and so people have always tried to guard against it through basic measures of personal cleanliness. The populations it's affected have always been specific groups of people in specific circumstances.

But that, I want to argue this evening, is what's given typhus its psychological and metaphorical power. It was particularly associated for example with prisoners kept confined in close quarters awaiting trial, often for months on end. Before the prison reforms of the nineteenth century gaols were crowded and confused places, often housing the accused's family and associates mingled chaotically together, as in this eighteenth-century illustration of Newgate Prison, in London; known as gaol fever, typhus could easily escape and infect the court and its personnel, again not surprisingly since here too there was a confused jumble of people sitting together for days or weeks on end. At the Black Assize in Oxford in 1577 more than 300 people died of typhus, including the judge, and there was a similar level of mortality in the Taunton Assize in 1730. Perhaps a quarter of all prisoners died each year from gaol fever, it was estimated, and courts took elaborate but usually futile measures against its spread, notably the nosegay of aromatic flowers customary placed on the judges' bench, supposedly to ward off the noxious and disease-laden miasma emanating from the prisoner in the dock.

Already associated with deviance and criminality, typhus became the vehicle of widespread prejudice in the 19th century as its association with impoverished and desperate Irish migrants came to the fore. During a widespread European famine that immediately followed the end of the Napoleonic Wars, a million and a half people fell ill from typhus in Ireland, of whom some 65,000 died. Famines bring large masses of people from the countryside to the towns in search of food, and typhus broke out again during the potato famine in Ireland in the late 1840s. Half a million poor Irish were evicted from their cottages when they failed to pay the rent, and made for the towns. Rather than be liable for poor relief, many landlords packed their indigent tenants onto ancient and overcrowded ships and sent them to Canada. On board these coffin ships, as they soon became known, typhus raged, and thousands died. By June 1847 ships

containing more than 14,000 Irish migrants were waiting in a line along the St Lawrence river for medical inspection. Thousands died, their bodies simply thrown into the river, while others were dumped onto a quarantine station at Grosse Isle, where still more died and were buried in mass graves. The epidemic spread to Canadian towns and altogether 20,000 are estimated to have died, including a large proportion of the migrants; the epidemic is now commemorated in Canada in a number of memorials, of which this is only one.

The epidemic spread to America and fuelled nativist prejudice against Irish immigrants, who were portrayed by cartoonists such as Thomas Nast as dirty, backward and uncivilised, living in 'shanty' hovels like the 'Ashanti' in Africa, or seen as refractory and undisciplined unlike other kinds of immigrant *en voyage* across the Atlantic, where others like Germans and Russians remained calm, peaceful and co-operative, while the Irish continually picked quarrels and refused to accept the order necessary to preserve life and health on board. The resemblance between the huge, gaunt, blind figure of the Irish immigrant threatening the United States of America, and the conventional images of cholera stalking Europe or invading it from the East that I showed in my last lecture, was too close to ignore. Anti-Irish sentiment in the USA, fuelled by the arrival of huge numbers of immigrants after the famine of the late 1840s, reached its height in racist cartoons that depicted the Irish as savages, barely human, the northern equivalent of the 'negro' in the South, on a lower stage of civilization than the rest of society.

In England typhus arrived with Irish immigrants and quickly became known as the Irish fever; the recorded death rate from typhus and typhoid in Dublin from 1864 to 1873 was 130 per 100,000 and Belfast 123 per 100,000, compared to 89 in London, though in the cramped towns of the industrial North like Salford and Sheffield it was even higher; most likely the majority of deaths in Dublin were from typhus and those in the English towns from typhoid, for while the death rate fell by 97 per cent in Salford and 88 per cent in Sheffield by 1880, it only dropped by 26 per cent in Belfast and Dublin and declined much less rapidly in seaports in the north east and north west of England like Liverpool and Sunderland that had strong trading links with Ireland. By analogy, Irish Fenianism, the violent campaign for land rights and later for home rule, was seen by cartoonists such as Sir John Tenniel in terms of a disease carried by the Irish and to be combated in the same way as a contagious disease. With the arrival of Darwinian ideas of evolution, indeed, Tenniel even portrayed the Irish as gorillas - 'Mr G O'Rilla', signatory of a nationalist manifesto in this cartoon - lower down the scale of humanity than the civilised English. Such views were underlined by repeated outbreaks of typhus in the very poorest parts of London, where Irish emigrants, unable to afford decent accommodation, flocked in the wake of the great famine: the notoriously tumbledown slums or 'rookeries' of St Giles in London was one area particularly favoured by the Irish, whose numbers in the capital city doubled from 300,000 in 1841 to 600,000 by 1861.

For radical liberals such as the German pathologist Rudolf Virchow, typhus was not so much a sign of ignorance and slovenliness born of a backward state of civilization, as the result of oppression and the deprivation of basic human rights. Commissioned by the Prussian government to investigate an outbreak of the disease in Upper Silesia, a province inhabited almost entirely by Poles, Virchow condemned the filth, squalor, idleness and drunkenness of the people but rejected any idea that these habits had racial origins. The people, he declared, were depressed because they had lost their right to participate in cultural and political life following the conquest of their country in the late eighteenth century. If they were allowed their rights once again, they would learn the benefits of hard work and start to improve themselves. Virchow's report earned him dismissal from his post, but in retrospect it can be regarded as one of the first great classics of social medicine. It is not surprising that its author subsequently became a leading liberal and opponent of Bismarck, who was so angered by his criticisms that he challenged Virchow to a duel. As the person challenged, Virchow had the right to choose the weapons to be used, and famously he chose two sausages, one thoroughly cooked, for himself, and one raw, and stuffed with lethal trichinae larvae, for Bismarck. Sensibly on all counts, Bismarck then withdrew his challenge. Had the duel taken place it might have resembled this one which is supposed to have taken place in the 1874 in the Bois de Boulogne.

Virchow was a convinced supporter of the miasmatic theory of disease which we've already encountered earlier in this series, and he ascribed typhus to pollution of the air as well as other diseases. The association of typhus with dirt and poor hygiene was well established, and as towns and cities became cleaner, and people developed a more hygienic way of life, the incidence of the disease fell dramatically. The actual discovery of the cause and mode of transmission of typhus came fairly late on in the great age of bacteriology dominated by Koch and Pasteur. It did not in fact happen until 1909, when the French bacteriologist Charles Nicolle, director of the Pasteur Institute in Tunis, noticed that epidemic typhus patients only infected others inside the hospital and outside if they had not changed their clothes. He investigated the dirty clothes and established that they carried body lice. He then placed some of these on a healthy chimpanzee, which duly caught the disease. Nicolle was duly awarded the Nobel Prize for medicine for his discovery. He spent the rest of his life working unsuccessfully on trying to develop a means of inoculation, helped by the discovery in 1916 of the bacterial causative agent of the disease by the Brazilian pathologist Henrique da Rocha Lima, who was working at the Institute for Tropical Medicine in Hamburg. Together with his Czech colleague Stanislas von Prowazek, Lima became infected with typhus while studying the disease at a prisoner-of-war camp hospital; Lima not only discovered the bacterium but also recovered from his infection, while Prowazek died: Lima called the organism *Rickettsia Prowazeki* in his memory and that of the American medical researcher Howard Taylor Ricketts, discoverer shortly before the war of the causative agent of a variety of typhus known as Rocky Mountain spotted fever; here's Lima on the left and Prowazek on the right.

An effective means of inoculation was eventually developed in the early 1940s and treatment with antibiotics was introduced soon afterwards. The fact that these discoveries occurred in wartime was no coincidence; war in the twentieth century boosted not only disease but also military medicine: Lima and Prowazek's researches were indeed commissioned specifically in order to try and find the cause of typhus and were initially sent to Turkey to conduct their investigations. Governments had realised that in the vast majority of wars throughout history more soldiers had died of sickness than from enemy action, and the First World War saw an immense effort on all sides to minimize illness and keep the troops healthy. Since it had become clear just before the war that typhus was transmitted through body lice, the obvious way to stop the disease from spreading was to stop soldiers becoming infested with lice. But in the chaotic conditions of the Eastern Front this was scarcely possible. Following the Austrian invasion and occupation of Serbia a massive typhus epidemic broke out, particularly among Serbian refugees fleeing the conflict, and Serbian troops retreating through Albania; over half a million were infected - the population of Serbia at the beginning of the war was only 3 million - and some 200,000 died. The country's rudimentary medical facilities were overwhelmed. Almost all the 400 doctors in Serbia caught the disease, and 126 are known to have died from it. Half the 60,000 Austrian prisoners of war in Serbia died of typhus. The Austrians held back from occupying the country until the epidemic war over.

Confrontation with lice-ridden billets in conquered areas of Eastern Europe confirmed German troops in their belief that Russia - which at this time included Poland and the Ukraine - was fundamentally backward and uncivilized. In this postcard approved and released by the censor, a German soldier ironically describes 'Russian culture' in the billet he shares with a local family and its animals, all living in the same room: 'Father's delousing, the child kills his louse; the master's delousing, and the servants of the house; I'm billeted here and sit amidst it all, I observe it to start with then delouse as well.' The situation threatened Germany itself when thousands of lice-infested Russian prisoners of war were crowded into prisoner-of-war camps, with an epidemic breaking out in one camp only 100 kilometres from Berlin and increasingly Russian prisoners were put to work to relieve the labour shortage on German farms. In early 1915 the Reich Health Office organised a conference on typhus and ordered delousing stations to be set up using bathing and showering in summer and fumigation with a variety of chemical disinfectants in winter; clothes and bandages were particularly targeted, since it had been discovered that lice tended to congregate there. Quarantines were set up around the camps, parcels to the home front from soldiers in the east were isolated for a fortnight, public baths were turned into delousing stations, research into the reproductive habits of lice commissioned. Soldiers had to show delousing certificates when they went on leave.

Typhus was endemic in Russia with some 82,000 cases a year recorded before 1914, but with the collapse of the Eastern Front, the

Bolshevik Revolution and the Civil War that raged until 1921, waves of refugees overwhelmed Russia's towns and cities while Red and White armies swept across the countryside. When typhus broke out on the Romanian Front, the Volga and in Petrograd some 20 million people were affected, two and a half million of whom are estimated to have died. 'Either socialism will defeat the louse', Lenin observed, 'or the louse will defeat socialism'; so, he commanded, 'All attention to this problem comrades!' Posters were issued by the Bolsheviks, delousing stations set up, and the Red Cross and international medical aid brought in. Here too however as in the case of the Irish in the nineteenth century, though now informed with the language of bacteriology, typhus and its vectors became a political metaphor: as one poster declared: 'The Red Army has Crushed the White Guard Parasites: Ludenich, Denikmin, Kolchak. Comrades! Fight Now Against Infection! Annihilate the Typhus-Bearing Louse!'

For the Western Allies, the massive epidemic in Serbia was a wake-up call, the more so since every Allied nation sent medical missions there to help combat the disease. Delousing stations were set up by all combatant armies on the Western Front, though the British placed more emphasis on maintaining personal hygiene, whereas the Germans preferred mass compulsory delousing and the fumigation of clothes with poison gas and other disinfectants, to which chemists devoted considerable time and effort to developing and applying; their major new development was the invention of a new cyanide compound known as *Zyklon*, which had limited use because it was fatal to humans; other forms of hydrocyanic acid however were widely used. The more static nature of the western front meant that there was no real parallel to the mass movements of troops and refugees that carried typhus everywhere in the east, though lice were still far from uncommon, and were the major vector of the milder infection known as 'trench fever'. Typhus was more or less absent from the trenches of Flanders.

After the disastrous epidemics of the war and immediate postwar years in Eastern Europe, Germany and other countries undertook serious measures to try and prevent the spread of typhus to the west. Poverty, inflation, and economic crisis and upheaval were all felt to threaten the spread of disease, underlined by the catastrophic influenza epidemic that caused such devastation at the end of the war, notably in India. In the early 1920s international relief efforts in the Soviet Union included medical assistance as well as food aid, and the Germans instituted limited medical collaboration with the Soviets in tandem with clandestine military co-operation in the development and testing of new weapons. Germany in particular tried to establish a kind of *cordon sanitaire* on the new Polish border to prevent typhus spreading. East-Central Europe was inhabited by around 5 million mostly extremely impoverished Jews who suffered along with other inhabitants of the region from the ravages of typhus. Self-help measures were already inaugurated before the First World War by a Society for the Preservation of Jewish Health set up in St Petersburg in 1912. It set up clinics, hospitals and ambulatory stations and raised funds, a quarter of which came from the USA, for a programme of Jewish health education. Though its status inevitably changed after the Bolshevik Revolution it was still able to carry on working in the Soviet Union in the 1920s. Both these posters are in fact directed against typhus and remind Jews of their duty to keep clean, observe the commandments and avoid a repetition of the plagues that they know about in general terms from Biblical times.

Jewish self-help contrasted sharply with the policies adopted by the Nazis following the invasion of Poland in September 1939 and then of the Soviet Union in June 1941. From the beginning they had used the language of bacteriology to dehumanise the Jews; here in this propagandist poster the bacteria under the microscope are all shown as little stars of David. Now, occupying an area inhabited by millions of mostly impoverished Jews, the German authorities pushed this conflation on to a new level as they justified forcing Jews into ghettos as a 'sanitary measure' then created the unhygienic, insanitary and overcrowded conditions in the ghettos that provided the ideal breeding-grounds for the typhus bacillus. Soon typhus epidemics were raging in the cordoned-off areas of Waraws, Lodz and other major cities into which hundreds of thousands of Jews were penned. By the autumn of 1941, the hospitals in the Warsaw ghetto were treating around 900 typhus cases a day. Notices were posted around the perimeter warning non-Jews that the ghetto was 'prohibited infectious area' because of typhus. Visiting the Warsaw ghetto, the Nazi Propaganda Minister Joseph Goebbels declared: 'These are no longer people...The task is not humanitarian but surgical. Steps have to be taken here, and really radical ones too. Otherwise Europe will perish from the Jewish disease.' Typhus became the justification, both metaphorical and propagandistic, not for medical intervention but for genocide.

The rare sympathetic non-Jewish doctor such as Zygmunt Klukowski, whose diary is a major source for the Nazi occupation of Poland, defied German orders not to treat Jews, admitted Jewish patients under pseudonyms to his hospital, set up warning signs outside announcing the presence of typhus to keep the Germans away, and when he was arrested used the possibility that he himself was infected to secure his release: 'Glory be to the louse!' he wrote in his diary. Inside the ghettos, Jewish doctors did what they could to set up delousing facilities and combat the epidemic but they were starved of medical supplies and disinfectants and were fighting a losing battle. Meanwhile the disinfectant Zyklon-B, developed for delousing clothes, was adapted at the Auschwitz-Birkenau extermination camp to murder hundreds of thousands of Jews in specially constructed gassing facilities; the killing of Jews was presented as in Goebbels's diary as a kind of disinfection of human society. Outside the camps and ghettos, Poles were told that it was the Jews who were spreading typhus in posters that suggested they were doing this deliberately, a warning to the many Poles who were secretly harbouring Jews to give them up to the Germans.

If the ghettos became breeding-ground for typhus then the situation in the concentration camps was far worse. Here too the SS failed to provide proper sanitation and withheld vital medical supplies. Delousing, such as it was, functioned not as a prophylactic against disease but as a brutal, humiliating and dehumanising ritual to which all prisoners were subjected on arrival at a camp, but seldom if ever afterwards, especially since once in prison the inmates were handed back their old clothes to wear after the procedure was over. Prisoners were stripped, doused with foul-smelling disinfectant, their heads shaven, their civilian clothes burned. When conducted in the freezing cold of winter, delousing could be a death sentence in itself. Not surprisingly, mass outbreaks of typhus were common in the camps, with hundreds dying every day at times in Auschwitz in 1942 and again in 1943, even if the Germans did inflate the numbers to try and conceal from the Allies the extent of their mass murder of Jews by gassing. Typhus became another way of warning outsiders from concerning themselves with what went on in the camps. It also served as a euphemistic warning to the prisoners of the fate that awaited them, above all if they were Jewish: 'one louse your death' in a situation where most prisoners were covered in thousands of lice and completely unable to get rid of them, was a grim reminder of the fate that awaited them in the end. In the chaotic circumstances of the end of the war, when prisoners were evacuated in what became known as the 'death marches' from camps in the east, pouring into camps like Belsen in completely unmanageable numbers, typhus raged unchecked, killing the weakened and starving prisoners in huge numbers. Entering the camps, the Allies themselves put into force a large-scale programme of testing the prisoners for typhus, cleaning up the barracks, and disinfecting the inmates. At the end of the war, with millions of refugees, displaced persons, former camp prisoners, returned soldiers and others milling around in Europe, the danger of infection was particularly acute, and American troops had to be warned of the threat posed by lack of cleanliness and caution, while disinfection and delousing facilities were set up in all occupied zones on a large scale.

Despite their boast that they had been able to keep typhus at bay in the First World War, the German armed forces suffered heavily from the disease on the Eastern Front in the Second. Delousing and disinfection was compulsory for German troops, but supplies became increasingly short, both mobile and stationary delousing facilities slow to come into operation and often overused and liable to disruption when power supplies failed; and in combat situations, which sometimes lasted for weeks on end, soldiers had to stay in their uniforms, which became breeding-grounds for lice. 'Everyone is swarming with lice, and is constantly itching and scratching', wrote one German general of his troops in the harsh Russian winter of 1941-2. 'Your red pullover', one soldier wrote to his wife from the Battle of Stalingrad, 'is a proper louse-trap'. 40,000 German soldiers who died from typhus were buried in mass graves in the city; many more died in prisoner-of-war camps after the surrender to the Russians, like the officer whose death notice recorded the disease as the cause of this young officer taken prisoner at the end of the battle. Altogether between 70,000 and 180,000 German soldiers are thought to have been infected across the Eastern Front and in North Africa. Typhus spread to the civilian population in Pomerania, where the German authorities made things worse by trying to conceal the epidemic. By contrast, typhus infection among the western Allies was kept to manageable

dimensions.

To some German medical scientists, typhus represented not only a threat but also an opportunity. Research, drawing on work in occupied countries such as France, focused in particular on developing a cheap and safe means of inoculating soldiers against infection and treating them once they had caught the disease, but though it met with some success, it was bedeviled by competition between different institutes and their various patrons, in a way typical of the dysfunctionality of the Nazi regime. SS doctors sought to steal a march on their rivals by using concentration camp inmates as involuntary subjects for experimentation, infecting them with typhus by injecting blood taken from victims then testing out various putative remedies on them, generally to no effect. A special institute was set up at Buchenwald, where up to 600 prisoners were infected, the overwhelming majority of them fatally. The published results of some of these experiments attracted international condemnation from doctors who guessed at their involuntary nature. Further trials of a vaccine were undertaken in the Natzweiler camp, while various useless therapies were applied at Mauthausen and Ravensbrück. Meanwhile the Americans developed a successful vaccine, used to good effect in the treatment of liberated camp prisoners at the end of the war.

The Allies were ahead in the battle against lice as well as in the struggle to control and prevent the diseases they carried. Dichloro-diphenyl-trichloroethane was synthesised in 1874 but its properties as an insecticide only became clear with the work of the Swiss scientist Paul Hermann Müller in 1939. It soon began to be manufactured by American chemical companies on a vast scale and applied to control the insect vectors not just of typhus, the initial object, but then of malaria and other diseases, and proved effective both during and after the war against lice, mosquitoes and other parasites of men and animals. Soon it was being used for a wide variety of purposes, including as a household insecticide spray and even impregnated in the wallpaper of children's bedrooms to destroy any insect life that should try to come in. But it was in agriculture that it found its widest application, with manufacturers and chemical companies eagerly advertising its benefits for livestock and crops to rid them of parasites, improve animal health and boost cereal and vegetable production. In the mid-1950s the World Health Organization launched a campaign to eradicate malaria using DDT sprays of mosquito-infested areas but after some initial successes the mosquitoes began to develop resistance and the campaign failed to achieve results in sub-Saharan Africa where conditions were not favourable to spraying. Already by this time, critics were pointing to the fact that in killing insect life DDT was depriving many birds and animals of the food they needed to survive, and research began to suggest it had carcinogenic effects in humans (so even if Cary Grant escaped the machine-gunning from the crop-spraying plane in Hitchcock's 1959 movie *North by Northwest* he might have died from the effects of the crop spray later on). The campaign against DDT led to Rachel Carson's famous book *Silent Spring* in 1962, the beginnings of the environmentalist movement in the USA, and the banning of the insecticide worldwide in the 1970s with a very few and limited exceptions.

Meanwhile, typhus had become the subject of another, if possible even more sinister set of experiments by Nazi scientists searching for effective ways of waging biological warfare against the Allies. Canisters carrying the typhus germ were tested on the Eastern Front, sparking fantastic fears on the Allied side that the Germans were planning to parachute over a quarter of a million plague-and typhus-infected rats onto their territory. The problem was that, as with gas warfare after 1939, if one side tried it, then the other side might do so too, and Allied air superiority almost from the outset was so great that the Germans, who lacked an effective strategic bomber force, would be at a disadvantage. So Hitler put the brakes on the research. The Japanese had no such inhibitions, and Unit 731 of the Japanese Army conducted many experiments on prisoners in the effort to develop a means of using disease as a weapon. Typhus was far from ideal for this purpose, however; releasing anthrax spores proved the most promising, and was tested by the British as well as the Americans and the Japanese; releasing cholera into water supplies has also come under consideration. . But how to stop the infection bouncing back on your own side has always been an insurmountable problem, and the length of time it would take for such weapons to have an effect is another disincentive, so except in the occasional unsuccessful terrorist attack they haven't been used, and the international community has agreed a series of treaties effectively outlawing their deployment – though this hasn't stopped them researching means of defending themselves against bioterrorism or biological warfare should it occur – here's an American protective suit aimed at stopping poison or nerve gases or biological agents from attacking the wearer.

Since the end of the Second World War and the eradication campaigns of the 1950s, typhus has all but vanished from the world. Improvements in hygiene and personal cleanliness, better education, the spread of medical knowledge and the increasing effectiveness of medical treatment, have all eliminated the human body louse from human society. As with so many other diseases, it's above all in weak or disorganised states, or in times of civil conflict or warfare, that typhus becomes a threat. It can spread in areas of high altitude in Africa where people tend not to change their clothes during the winter. In Africa it's been particularly common in Rwanda and Burundi, where there were large numbers of cases in the mid-1970s, with 9,000 reported in Burundi alone, and in January to March 1997 some 20,000 cases were registered there; in both cases the epidemic followed genocidal civil conflict with large numbers of people fleeing to makeshift refugee camps where hygiene and sanitation took a long time to establish. In Ethiopia epidemics followed war with Somalia, famine and civil dislocation above all at the end of the 1970s.

These are undoubtedly exceptional circumstances and by and large typhus or at least its epidemic form belongs to the large category of diseases which we can say have effectively been eliminated or at least reduced to minute proportions compared to their incidence in the past. By the mid twentieth century, medical science was beginning to believe that epidemic diseases had been vanquished. This was not of course the case, and since then new diseases have appeared and still more threaten humankind. In my next and concluding lecture in this series, I'll look at this new situation in particular with the example of HIV/AIDS, yet another disease which is closely bound up with the complexities of human politics and society.