1 Can the Mosquito Speak?

In the summer of 1942 two forces invaded Egypt, and each provoked a decisive battle. Only one of the two was human, so only that one is remembered, although the casualties in the other battle were greater. On the northwest coast, Erwin Rommel's Afrika Corps crossed the border from Libya and was halted on its march toward Cairo by the British Eighth Army at al-Alamein. Four months later the British counterattacked. After a two-week tank battle they routed the German and Italian forces, whom they outnumbered in men and tanks by more than two to one. Al-Alamein was the Allies' first decisive land victory in World War II and, along with the Soviet victory a month later at Stalingrad, appeared to turn the tide of the war. No count of the casualties was possible given the scale of violence and the disarray among the defeated forces, but somewhere between fifty and seventy thousand soldiers may have been killed, wounded, or missing.[1] Long after the armies moved on, moreover, the battle continued to claim its victims. Al-Alamein marked the first use of land mines as a major weapon of war. It was responsible for three-quarters of the twenty-three million uncleared mines Egypt accumulated in the twentieth century, the largest number of any country in the world.[2]

Meanwhile, at the other end of the country another invader arrived, descending down the Nile valley from Sudan: the *Anopheles gambiae*, a mosquito native to sub-Saharan Africa but previously unknown in Egypt. The gambiae mosquito carried in its stomach the malignant form of the malaria parasite, *Plasmodium falciparum*.[3] Other species of malarial mosquitoes existed in Egypt, but these carried a more benign form of malaria and were confined to small pockets in the north, where the local population had developed a degree of immunity. There were no local defenses against *Plasmodium falciparum*. The first reports of an outbreak of gambiae malaria came in March 1942 from the villages of Nubia, the country lying across Egypt's southern border with Sudan. The epidemic reached Aswan by July and Luxor by August, then continued north to Asyut, the largest city in the south. As at al-Alamein, the number of victims was unknown and unknowable. It was estimated that three-quarters of a million people may have contracted the disease in the three years of the epidemic, and between one and two hundred thousand died.[4]

I first heard about the 1942 malaria invasion in 1989 from a man named ʿAmm Ibrahim, who lived in a village near Luxor where I was spending time.[5] Then in his eighties, he was the most informed narrator of the history of the village, and the story of the malaria epidemic was always the most vivid part of his narrative. It killed one-third of the village, he used to say, and there were not enough healthy men left alive even to carry the dead. People were hauled to their graves on the back of a camel.

The war and the epidemic interacted with a third threat to the country, a severe wartime shortage of food. The shortage had complex causes of its own. In 1933 the dam across the river Nile at Aswan, built at the turn of the century, had been increased in height, completing a network of dams, barrages, and canals begun in the mid-nineteenth century that converted most of the country's agricultural land to year-round irrigation.[6] Only one-fifth of the Nile valley was now irrigated by the river's annual flood, which in the past had fertilized the soil by depositing a layer of silt and nutrients. The other four-fifths required chemical fertilizers.[7] By the end of the 1930s Egyptian farmers were using 600,000 tons of fertilizer a year—mostly the new artificial nitrates—at the highest rate per cultivated area in the world.[8] An international cartel among chemical manufacturers had assigned 80 percent of the Egyptian market to a consortium led by the German business group I. G. Farben, one of whose companies had invented the process for synthesizing ammonium nitrate.[9] These supplies were cut off by the outbreak of war.

The lack of fertilizer caused the yield of wheat and other crops to drop by as much as a quarter. The government introduced food rationing to supply the cities and the British troops, and introduced fertilizer rationing and acreage controls to force landowners to switch half the country's cotton fields to the cultivation of food.[10] In the far south, however, the main commercial crop was sugarcane rather than cotton, for which no controls were introduced. The owners of the cane plantations extended the crop's acreage by as much as 30 percent during the war, exacerbating the shortage of staple foods in the region hit by gambiae malaria (and increasing the breeding grounds for mosquitoes).[11] In the second year of the malaria epidemic casualties were much higher, since many households had been too sick to harvest the previous year's food crop and were weakened by famine and malnutrition. The highest casualty rates were recorded among the workers on the sugar estates.[12] At one of the largest cane plantations, a few miles south of Luxor, the manager estimated that malaria affected 80 to 90 percent of the people, and the doctor in the nearby town of Armant reported eighty to ninety deaths a day.[13]

The elements combining to cause the disaster of 1942–44 represented some of the most powerful transformations of the twentieth century. First, there was the damming of the river. The building of the original barrage at Aswan in 1898–1902 helped inaugurate around the world an era of engineering on a new scale. Schemes to block the flow of large rivers were to become the century's largest construction projects. Dams were unique in the scope and manner in which they altered the distribution of resources across space and time, among entire communities and ecosystems. They offered more than just a promise of agricultural development or technical progress. For many postcolonial governments, this ability to rearrange the natural and social environment became a means to demonstrate the strength of the modern state as a techno-economic power.[14] Second, there were the synthetic chemicals. The manufacture of artificial nitrates introduced a transformation even greater than the building of dams. From the largely synthetic-free world of 1925, the production of new chemicals, led by nitrates, grew at a phenomenal rate. In the United States output increased tenfold in each decade. By the 1980s there were four million synthetic chemicals in production, sixty thousand of which were in common use. This transformation had an impact at the level of the cell and the organism to rival that of dams at the national level.[15] Third, there was malaria, which took advantage of irrigation schemes, population movements, and changes in agriculture to become the world's most deadly infectious disease. *Plasmodium falciparum* represented only 30 percent of clinical malaria cases but was responsible for up to 90 percent of the deaths. It was so widespread that no one could agree even to the nearest million how many lives it was taking each year.[16] Finally, there was the war. Al-Alamein was remembered as the first great mechanized conflict, in which the German panzers, used in new kinds of tactical combination with antitank guns and aircraft, engaged the larger Grant and Sherman tanks. Yet the battle front was so narrow, and the German and Italian machinery so short of fuel and ammunition, that the two-week battle was fought at close quarters, like a battle of World War I. It epitomized a new and lethal interaction of man and machine.

Dams, blood-borne parasites, synthetic chemicals, mechanized war, and man-made famine coincided and interacted. It is not surprising to find disease brought by environmental transformation, industrial chemistry shaped by military needs, or war accompanied by famine. Nevertheless, their interaction presents a challenge. How exactly did tanks and parasites and synthetic nitrates affect one another? What kind of explanation can bring them together?

The war and the epidemic interacted on several levels. At the outbreak of hostilities Britain had reimposed martial law on Egypt, after the country had enjoyed almost two decades of partial independence from the colonial occupation established in 1882. The authorities censored reporting of the malaria epidemic, hoping to contain it in the south. Already preparing to evacuate Cairo in case Rommel broke through at al-Alamein, the British were unwilling to divert men and resources from the north to meet the invader from the south. This helped the gambiae mosquito advance. The British also faced a shortage of quinine, the only treatment against the infection, for in the same month that gambiae malaria was reported in Nubia the Japanese had occupied Java, cutting off the Dutch cinchona plantations whose trees supplied the drug to Europe.[17] So the Egyptian Ministry of Health was left to launch its own antimalaria campaign. Its eradication teams attacked the disease vector—the mosquito—rather than the parasite itself, spreading Malariol, diesel oil mixed with a spreading agent, on pools of standing water. The oil formed a film on the water surface, which prevented the mosquito larvae from hatching. Malariol tended to go missing, however, since irrigation pumps could use the diesel oil as fuel, which the war had made it difficult to obtain. The eradication teams later replaced it with Paris green, a mixture of arsenic powder and copper acetate used originally as a painters' pigment, which proved a more reliable larvicide, or at least one less liable to be taken over for other purposes.

The war may even have brought the epidemic. The anopheles mosquito has a range of only two miles, so to reach Egypt it needed vectors of its own. One view was that it must have arrived by airplane, a mode of travel not unusual for mosquitoes. German air and submarine attacks had made the Mediterranean unsafe, so the British were flying a new supply route to Cairo via West Africa and Sudan. But the hostilities may also have enabled the mosquito to reach Egypt by boat. The war had increased river traffic with Sudan, and the building and raising of the Aswan Dam had created new breeding places for the insect along the route. Once in Egypt, the mosquito continued to travel north, moving by boat, train, and motorcar. To prevent its movement, these vehicles were treated by a new technique, the pyrethrum spray, developed over the previous decade to combat a major outbreak of malaria in Natal Province on the east coast of South Africa—like Upper Egypt, a region producing sugarcane. Pyrethrum powder, made of the dried flowers of the pyrethrum variety of chrysanthemum and sometimes burned to fumigate houses against insects, was mixed with green soap and glycerine and then forced through the spray nozzle of a stirrup pump, making a fine poisonous mist that killed the adult mosquitoes.[18]

Disease often moves with the changing movements of people, and modern war causes large numbers to find routes outside existing networks of trade and migration. But having taken advantage of new kinds of transport and traffic routes, the insect also needed ways to establish itself by colonizing new territory and populations. The patterns of war and transportation had to intersect with other developments, in particular changing hydraulics. In the same years that the gambiae mosquito began to move north from equatorial Africa along the Upper Nile valley, it also crossed the Atlantic to the coast of Brazil. In both Brazil and the Upper Nile the mosquito took advantage of recent irrigation works and changed patterns of water use. In the case of the Nile, the British had extended the control of the river at Aswan by constructing further storage reservoirs in the Anglo-Egyptian-occupied Sudan. Dams were completed across the Blue Nile at Sennar, two hundred miles south of Khartoum, the Sudanese capital, in 1925, and across the White Nile at Jabal Aulia, thirty miles above Khartoum, in 1937. These projects were followed by reports of new levels of endemic disease, including schistosomiasis (a parasitic worm infection carried by an aquatic snail that would eventually affect all of Egypt, and whose treatment later introduced another endemic infection, hepatitis C, in possibly the world's largest transmission of blood-borne pathogens from medical intervention) as well as malaria.[19] The linking together of the river control projects enabled the mosquito to jump barriers from one region to the next. The accompanying cultivation based on perennial irrigation created many breeding places among a thicker population of human hosts that often lived much closer to the water now that flooding no longer occurred in many areas. The engineers who built the irrigation works had not considered the possibility that snails or mosquitoes would make use of their work to move, or that certain parasites would travel with these hosts, or that devastating consequences would ensue. In a private report in 1942, however, the British acknowledged that the surest way to restore the health of the Egyptian population would be to destroy the dams and return to basin irrigation.[20]

The irrigation works led to other unexpected effects. The damming of the river altered the distribution and timing of its flow, as well as the temperature and chemistry of the water. This affected the riverbed and banks, altering the character of the riverine environment. Microorganisms and plants dependent on the balance of the river's ebb and flood disappeared, while other, more aggressive species took advantage of the change. Curly pondweed, or *Potamogeton crispus,* one of the most invasive aquatic plants, began to form large islands of weed, which the river's current carried in clumps downstream. An Egyptian malaria expert established that the *Anopheles gambiae* in turn made use of the pondweed, which transported the larvae of the mosquito from one breeding area to the next.[21]

If the gambiae mosquito benefited from the changes in the flow and chemistry of the Nile, its parasite, needing human bodies for reproduction, was also able to take advantage. As a spore-forming parasite, the plasmodium did not set out to kill its human victims, but entered their bodies merely to complete its unusual life cycle. Transferred by the bite of the female mosquito, the young spores take up residence for about a week in the cells of the victim's liver. Each spore then bursts apart and releases into the bloodstream up to forty thousand offspring, which feed off the blood's cell hemoglobin and multiply into further offspring, some of which assume separate male and female forms. The explosive reproduction is not intended to kill the victim, but to ensure that with the bite of another mosquito a number of spores are ingested back into the stomach of the insect, where they fertilize and complete the reproductive cycle. However, the malignant form of the parasite brought by the new invader to southern Egypt makes the red blood cells of its victims particularly sticky, clogging the arteries and depriving the body of oxygen. Most victims survive after a severe fever, which ensures that the parasite still has hosts in which to live. But if the brain or another vital organ is deprived of oxygen, the unwilling host can die.

In Upper Egypt the plasmodium found a population with no immune response to interrupt its infection cycle, for it was a new arrival. It also found a population whose bodies had been transformed by the sugar industry. From the 1920s Egypt's newly independent government was for the first time able to protect local manufacturing, in particular sugar production, the country's oldest and largest modern industry. Price protection against the global market in the 1930s and 1940s combined with the irrigation work supported the extension of cultivation. Perennial irrigation and cane cultivation reduced the fertility of the soil and the land available for food production. When the war interrupted the supply of artificial fertilizer, these factors combined to make the people of southern Egypt far more vulnerable to the plasmodium parasite. In contrast to the badly nourished residents of southern Egypt, none of the government officials, medical workers, or eradication teams, nor the wealthy women from Cairo who launched a charity relief operation in the south, lost their lives in the epidemic.[22] Furthermore, reports from Brazil indicate that sugarcane juice, which those working on sugar plantations consumed on site by breaking and chewing the cane, can worsen the effects of malaria.[23] Thus on several levels the parasite found that sugar had left the bodies it encountered less able to resist infection. The chemistry of the epidemic operated at the level of the nation and of the cell.

The fertilizer shortage that contributed to malnutrition also represented the interaction of forces on several levels. After German nitrate supplies were cut off by the war, there was a larger reason why alternative sources of chemical fertilizer could not be found. Natural supplies of ammonium nitrate were available in only one place in the world, the Atacama Desert in Chile, and the U.S. processing companies operating there could supply Egypt with only small amounts. Along with the manufacturers of artificial nitrates, they were using their fertilizer factories for a more urgent purpose. Ammonium nitrate provided the main ingredient for two chemically similar but socially different processes, each concerned with life and death: the fertilizing of crops and the making of high explosives. Europe and America had converted their fertilizer plants to the manufacture of wartime ammunition. The lack of nitrates for Egyptian agriculture, and the consequent food crisis that left much of the population undernourished, was due not only to the loss of a particular source of supplies. The chemical powers of the nitrates contributed to the course of events.

Finally, war provided the method used to defeat the epidemic, for pyrethrum sprays and Paris green were not enough. After the first winter of the epidemic the government declared the gambiae mosquito eradicated, but in 1943–44 there was a second and much more severe outbreak. Part of the problem was that the eradication campaign, influenced by current public health concerns about the unhealthiness of stagnant water, had concentrated on the large standing pools often found on the edges of villages, whereas this particular mosquito was willing to breed in the smallest ditches and irrigation channels and in the borrow pits left by the construction of railway embankments, which were not associated with disease and were often overlooked.[24]

The Egyptian government was able to turn for help to a new form of transnational secular body, the nonprofit corporation. Early in the century, U.S. military expansion in the Caribbean, in particular the building of the Panama Canal, had encouraged extensive efforts to control mosquitoes, which carried both malaria and yellow fever. (Ferdinand de Lesseps, the man who organized the construction of the Suez Canal, had been the first to attempt to dig a canal across the Isthmus of Panama, but in 1889 was forced to abandon the ten-year effort, in part because of deaths from these two diseases.) In 1915, the year after the canal's completion, the newly established Rockefeller Foundation took over the mosquito campaign from the U.S. army and launched a worldwide program to study and control the two mosquito-borne diseases. Thus the global movements of the mosquito gave shape to a transnational corporate philanthropy.

Yellow fever was a more immediate concern than malaria, for it threatened to use the Panama Canal to cross into the Pacific. Rockefeller set up a program in Brazil to eliminate the disease from the coastal areas of South America.[25] The leader of the campaign, Dr. Fred Soper, developed eradication methods based on modern warfare, in which "brigades" of uniformed men armed with spray guns went on search and destroy missions. Disease was to be defeated not by improved social conditions or medical intervention but by the physical elimination of the enemy species. Detailed maps and index cards recorded the location of houses to be searched, the discovery of each mosquito, and the routes and timing of missions to spray or dump the chemicals. With its focus on yellow fever, the Rockefeller Foundation headquarters in New York was not interested in reports that the gambiae mosquito had reached Brazil. However, Soper saw in the arrival of the new and relatively well contained *Anopheles gambiae* an ideal opportunity to demonstrate his technical methods. He organized a campaign in 1938 that eradicated gambiae malaria by the early 1940s. The success made Soper the world's most influential malaria expert, able to reshape tactics and lay down the new methods of total species eradication, methods that were not seriously challenged for another fifty years.[26]

In November 1942, in coordination with the British offensive at al-Alamein, the United States entered the

Mediterranean war, landing troops in French North Africa. Disease was again a concern, but in this case it was typhus, which had killed tens of thousands of soldiers in World War I. To develop ways to protect its forces, Washington set up a Typhus Commission with its headquarters in Cairo. Fred Soper of the Rockefeller Foundation was seconded to the commission and sent to Egypt. As in Brazil, his arrival on an unrelated mission coincided with an outbreak of gambiae malaria.[27] The intersecting networks of U.S. philanthropic and military power had once again brought Soper and the gambiae mosquito together. He drew up a plan for a military-style eradication campaign, but the British authorities, objecting to this introduction of an American influence into Egyptian politics, forced the government to shelve the plan. When the epidemic reemerged in 1943–44, the British began to fear that it threatened the population centers and troop concentrations of the north. They agreed that the Egyptians should appoint “a sort of malaria dictator” to organize a campaign against the disease (the word “dictator” was in vogue in those days).[28] They were forced to drop their earlier objections and allow the Egyptian government to follow the Brazilian model of eradication, advised by Soper.[29] The Egyptian teams finally identified and destroyed the last gambiae larvae in February 1945, a few kilometers to the south of ʿAmm Ibrahim’s village near Luxor.

The chain of events in Egypt seems to create a triangle, formed by the interconnection of war, disease, and agriculture. War in the Mediterranean diverted attention and resources from an epidemic arriving from the south, brought by mosquitoes that took advantage of wartime traffic. The insect also moved with the aid of the prewar irrigation projects and the ecological transformations those brought about. The irrigation works made water available for industrial crops but left agriculture dependent upon artificial fertilizers. The ammonium nitrate used on the soil was the main ingredient in the manufacture of explosives and was diverted for the needs of war. Deprived of fertilizer the fields produced less food, so the parasite carried by the mosquito found its human hosts malnourished and killed them at the rate of hundreds a day.

The chain is in fact more than a triangle. The connections between a war, an epidemic, and a famine depended upon connections between rivers, dams, fertilizers, food webs, and, as we will see, several additional links and interactions. What seems remarkable is the way the properties of these various elements interacted. They were not just separate historical events affecting one another at the social level. The linkages among them were hydraulic, chemical, military, political, etiological, and mechanical. No one writing about Egypt in this period describes this interaction. There are studies of military tactics, irrigation methods, Anglo-Egyptian relations, hydraulic engineering, parasites, the sugar industry, and peasants. But there are no accounts that take seriously how these elements interact. It is as if the elements are somehow incommensurable. They seem to involve very different forces, agents, elements, spatial scales, and temporalities.[30] They shape one another, yet their heterogeneity offers a resistance to explanation.

The resistance may have something to do with the mixing of natural and social worlds. Chemical and biological processes are surely of a different order than military and political forces. Each of these processes and forces has its own science, which identifies the agents, time lines, geo-spatial scales, and modes of interaction appropriate to its analysis. This tends to leave each of them isolated in their separate sciences. The isolation may be appropriate for the task of a particular science or technical expertise, but its limitations are striking as soon as one begins to ask about the kinds of interactions I have described. Since those interactions belong, as I suggested, to some of the most profound transformations of the modern era, this presents a problem for social science. Instead of developing the kinds of analysis that might address these interactions, responding to the techno-scientific transformations of the twentieth century, social theory is still largely trapped in the methods and divisions of labor of the nineteenth century.

There are two characteristics of social explanation relevant to this problem. First, social theory typically operates by relating particular cases to a larger pattern or process. Events in a place like Egypt are explained as the local occurrence of something more general, or an exception to what generally occurs, or a particular variation in the general range of possibilities. In some of the social sciences this aim is quite explicit, expressed in rules of method and styles of writing. In others it is implicit but still at work, for example in historical scholarship, in which the narrative may focus on a specific context but draws its structure and relevance from an implied comparison with other, more general cases. Inevitably the generic case in such accounts is the history of Europe or the West, and the particulars of what happened outside Europe are explained as replicas of Europe's history, or variations from that historical pattern, or alternatives to it.[31] In studies of Egypt, for example, events like those I have been describing fit into a variety of larger narratives: the story of the nation and its development, the growth of new social classes and other national actors, and the rise of the modern state, often placed in the context of the development of capitalism, the expansion of Europe, or the global history of modernity. The story takes it shape from the way it fits into a sovereign narrative told about every place, the story of rationalization, technological and social progress, the growth and transformation of production, and the universalization of the culture and power of the West. This assumption of a universal armature is the foundation that makes social theory possible. The development of forms of explanation placing particular events into a universal framework coincided, of course, with a quite palpable expansion of Western power, wealth, and technical knowledge. The issue is not whether such expansion occurred, but its relationship to the grounds on which social theory is built. The universal to which social theory aspires is a category founded within and expressed by the particular history of the West.

The second feature of social explanation follows from the first: all the actors are human. The protagonists of the history of the nation, of modernity, of capitalism, are people. Human beings are the agents around whose actions and intentions the story is written. This is necessarily the case, for it is the intentionality or rationality of human agents that gives the explanation its logic and enables particular cases to fit as instances of something general. The general or universal aspect of events that social theory attempts to identify occurs precisely as the spread of this human reason, technical knowledge, or collective consciousness. By contrast, although the river Nile is transnational, and anopheles mosquitoes are quite global, their generality is not the same as that of capitalism, the idea of the nation, or modern science. The Nile is not considered an abstraction, nor is the mosquito experienced as an expression of the universal.

The result of these two features of social theory is that in the explanation of events one always knows in advance who the protagonists are. Emile Durkheim once described the resistance that nature offers to understanding compared to the ease with which society is explained. "While the scientist who studies physical nature is very keenly aware of the resistance it offers him, and which he has so much difficulty in overcoming, the sociologist seems to move in a sphere perfectly transparent to his view, so great is the ease with which the most obscure questions are resolved."[32] What is this ease, this transparency? It arises in part from having already decided who counts as an agent. It is not that social analysis necessarily ignores disease, agriculture, chemicals, or technology, but that these are externals—nature, tools, obstacles, resources—whose role is essentially passive. Even on the occasions when they are given a more independent force, there is still a fundamental divide between human agency and the nonhuman elements.

Social science is always founded upon a categorical distinction between the ideality of human intentions and purposes and the object world upon which these work, and which in turn may affect them. There is little room to examine the ways they emerge together in a variety of combinations, or how so-called human agency draws its force by attempting to divert or attach itself to other kinds of energy or logic. No explanation grounded in the universalizing force of human projects and intentions can explore whether the very possibility of the human, of intentionality, of abstraction depends on, at the same time as it overlooks, nonhuman elements. These appear merely physical, secondary, and external.

If the web of events in wartime Egypt offers a certain resistance to explanation, part of the reason may be that it includes a variety of agencies that are not exclusively human: the anopheles mosquito, the falciparum parasite, the chemical properties of ammonium nitrate, the 75mm guns of the Sherman tank, the hydraulic force of the river, and one or two more to be introduced shortly. These do not just interact with the activities of human agents. They make possible a world that somehow seems the outcome of human rationality and programming. They shape a variety of social processes, sometimes according to human plans, but just as often not, or at least not quite. How is it, we need to ask, that forms of rationality, planning, expertise, and profit arise from this effect?

In social theory there is an important exception to the rule that human action is put at the center and the external world is treated as an arena for such action rather than the source of forms of agency and power. It is found in the work of Marx. For Marx, individual capitalists are to be understood not as agents in their own right, but as those who personify the power of capital. The "main-spring" that powers the movement of capitalist history is not human intention but the expansion of value through the exchange of commodities, in particular the exchange of labor power. An individual possessor of money becomes a capitalist, Marx writes, when this expansion of capital through exchange becomes his subjective aim. He then "functions as a capitalist, that is, as capital personified and endowed with consciousness and a will."[33] Thus Marx understands capital as something twofold. It arises from the circulation of money, the development of technical processes, and particular patterns of commodity exchange and power relation. Yet these material processes acquire a quasi-human form. Through exchange, the powers of objects take on a consciousness and a will. Most analyses that draw on Marx move quite quickly over this idea. The ability of certain historical actors to personify the force of capital is easily taken for granted. There might be disagreement over which particular actors achieve this role, and how successfully they accomplish it. But what does it mean for capital to become personified? How exactly do nonhuman things or processes form this hybrid with the consciousness of humans? What does it mean to think of capital as something whose power depends on being simultaneously human and nonhuman? Marx, as Derrida says, was "one of the first thinkers of technics," the first to grapple with the hybrids of man-machine, capital-consciousness, automatism-will.[34] His writing grasped that human consciousness is an artifactual body, even if in the end he always wanted to ground his critique of consciousness in absolute distinctions between real and abstract, presence and representation, object and value, labor and ideas. These are distinctions whose apparent stability we must explore. How is the ambivalent relation between the nonhuman and the human, or the real and the abstract, constituted? How are the irreducible exchanges or tensions between the two resolved in modern politics into so simple an opposition?

To begin this task, we need to find a capitalist, someone who can function in our story as capital personified. Fortunately there is such a capitalist available, and a big one. As it happens he had a large house on the same plantation at Armant mentioned above, where eighty or ninety workers a day were dying of malaria. He was, it will be no surprise to learn, the plantation's owner. Ahmad ʿAbbud also controlled the processing mill five hundred yards down the river, together with the eighteen other large sugar factories in Egypt that made up the country's sugar industry, and he was one of the most powerful figures in Egyptian business and politics.[35] Trained as an engineer at the University of Glasgow, he had worked on irrigation schemes in Ottoman Iraq before World War I and on the railway system in Syria and Palestine during the war. He started business in Egypt in 1924 by obtaining a contract to dredge and maintain the new government-financed irrigation canals, his wealth expanding with the expansion of the public irrigation system.[36] His construction company worked on increasing the height of the Aswan Dam in 1929–33 and other large state projects. Like a handful of other successful entrepreneurs, he used these lucrative government contracts and concessions to move into other business sectors, including shipping, public transport, real estate, trade, and banking. He joined Egypt's new class of big landowners by acquiring the six-thousand-acre sugar plantation at Armant, and in 1939 took control of the Egyptian Sugar Company, the country's oldest and largest industrial venture, which enjoyed a state-protected monopoly over the processing of raw cane and the sale and export of sugar.[37] By the outbreak of World War II, as his business empire moved its headquarters into Cairo's first high-rise structure, the eighteen-story Immobilia Building, ʿAbbud controlled one of just two or three family-based entrepreneurial groups competing to monopolize large sectors of the country's finance, trade, transportation, and industry. Following the war, the international press was to rank him as one of the ten richest men in the world.[38]

The growth of ʿAbbud's empire depended upon his making and remaking circuits of political and social power. In February 1942 the British forced the appointment of an Egyptian government led by the Wafd party, which had earlier negotiated the country's partial independence from Britain and seemed its most reliable wartime ally. Through a business association with the Wakil family, cotton merchants and landowners whose daughter Zaynab was married to the Wafdist prime minister, ʿAbbud reestablished earlier ties with the Wafd, began to finance its activities, and helped put his allies and business associates in control. Three months after the party took power, ʿAbd al-Wahid al-Wakil, a brother of ʿAbbud's business partner, was made minister of health, just as the ministry received the first news of the arrival of gambiae malaria.[39] At the same time ʿAbbud secured the dismissal of the Wafd's new minister of finance, who had tried to introduce sugar rationing (and to prosecute the Wakils for the wartime smuggling of cotton textiles).[40] The minister's removal gave ʿAbbud's sugar monopoly a free hand to negotiate a lucrative deal with the British. As the negotiations neared completion in February 1943, the British ambassador spent six weeks visiting ʿAbbud and his Scottish-born wife Jemima at their spacious red-tiled villa on the sugar estate (a long anticipated trip that became a "nightmare" after the ambassador suffered a dangerous fever and ʿAbbud was twice almost killed, first in a plane crash and then in a driving accident when his horse bolted and threw him against a brick wall).[41] Following the stay ʿAbbud concluded his "thief's bargain," as the disgruntled British called it in private, agreeing to sell the British military authorities his company's "surplus" stock of sugar (at a moment of famine on the sugar estates) for a considerable profit. The deal also gave ʿAbbud scarce supplies of fertilizer, officially earmarked for other crops, to use on the sugar plantations.[42]

Over the following months, as the malaria epidemic took hold again, ʿAbbud embarked on an audacious scheme to use his profits from the sugar deal and the expansion of cane cultivation to make himself into what a British official, invoking once again the nomenclature of the day, called "a kind of commercial dictator."[43] ʿAbbud maneuvered to take over the bank and the affiliated enterprises of the country's other major business conglomerate, the Misr group, which had a dominant position in textile manufacture, the cotton trade, air transport, cinema, insurance, and other fields.[44] At the same time he revived a plan from the 1930s for Egypt's largest industrial scheme, to install hydroelectric turbines in the dam at Aswan that had recently been made higher. He proposed to use the electricity to manufacture and supply the country's entire demand for fertilizer.

The interwar years had seen a growing struggle among the rival business groups for the dominant position in what Robert Vitalis calls the “rent circuits” of Egyptian politics, meaning the profits to be made from privileged control of the economic resources circulating through the country. Controlling the circulation of rents, however, was dependent upon the control of resources that had other, interconnected forms of circulation. These included the complex networks of family power and colonial affiliation whose significance I have already suggested. But at the center of these struggles from the 1920s to the 1950s was an effort to command, or at least turn to profit, one particular kind of circuit, the flow of the waters of the Nile.[45] The Aswan Dam offered the opportunity to reorganize and concentrate into fewer hands a series of further circulations—hydraulic, electrical, political, chemical, and agricultural. ʿAbbud and his rivals competed for the lucrative rights to build a hydroelectric power station at Aswan and convert the force of the river’s flow into the power to drive industry, which in turn would fuel agriculture. Large quantities of electric power would be used to convert nitrogen into artificial fertilizer. Just as alluvial silt had once been carried and deposited by the floodwaters of the Nile, synthetic chemicals would in future be transported in sacks from the nitrate plant at Aswan and deposited across the country’s fields to restore a little of the lost fertility of the soil. The complex flows of the Nile flood, channeled into storage basins, held for several weeks to allow silt and nutrients to settle, and released again into the river, were to be reorganized and transformed into the narrower flows of waters through turbine wheels, high voltages along transmission cables, electrical energy into nitrates, fertilizer sacks across the countryside, and ammonia from the soil into the proteins of cane and cotton plants. The political struggle to control rent circuits was a battle to build and control these interconnected circuits. And it was through these same circuits—dams, irrigation, sugar cultivation—that the mosquito had entered Egypt.

Should we explain ʿAbbud’s power and wealth in terms of his ability to “personify” capital and become the conscious representative of its power to reproduce and expand? This seems preferable to the alternative of saying that ʿAbbud’s success resulted simply from his skill as a calculating agent who was able to out-calculate his rivals and make an ever larger profit. The latter explanation attributes all the success to ʿAbbud himself. It does not even ask what arrangements (of law, property, political economy, engineering, irrigation, and much more) made such calculation possible, or what agencies kept those arrangements in place. The former at least gives some credit to another power, the circulating force of capital. Capital can circulate and, by combining with further forces, go through metamorphoses into other forms—from money into property and labor, property and labor into sugarcane, sugarcane into processed sugar or alcohol, and back again into money—using resources and arrangements that do not come from ʿAbbud alone.[46] Clearly, however, the movements and metamorphoses of capital were not the only circulations at work in ʿAbbud’s success. His struggle to divert rent circuits to his own advantage was at the same time an effort to develop and direct a whole series of interconnected circuits: water, electricity, nitrates, military requisitions, cane, processed sugar, cotton, and several others.

Clearly, too, the idea that these circulations and forces are “personified,” or represented by the actions of particular individuals, is too simple. Individuals may at times secure control of certain elements, and they may even claim to represent those elements in the social world. But no individual masters them, or submits the world to their intentions. More often there occurs a series of claims, affinities, and interactions, all of which exceed the grasp or intention of the human agents involved. Human agency and intention are partial and incomplete products of these interactions. This incompleteness, as we will see, means that no single line divides the human from the nonhuman, or intentions and plans from the object-world to which they refer.

But why insist on all these additional agencies, circulations, and forces? Surely the task of social science, like all science, is to simplify, to identify a limited number of more decisive agents. Why not accept a simpler but more powerful story, one that can depict the big picture and even identify certain patterns or predictions? There is an old answer to this question: that if the world is a complicated and indeterminate place, with many agencies and forces at work, then an accurate picture of that world will be a complex and indeterminate one.[47] But the answer I want to propose here has to do with the role of expertise and reason, explanation and simplification, in the politics of the twentieth century. Politics itself was working to simplify the world, attempting to gain for itself the powers of expertise by resolving it into simple forces and oppositions.

This is not, therefore, a question of introducing a natural or hydraulic determinism to replace the determinism of modern technological innovation or capitalist expansion. If social and economic networks were connected with the changing ecology of one of the world's longest rivers, this does not mean attributing social outcomes to changes in nature. Long before the Aswan Dam, before all the irrigation work of the nineteenth century, the river was already as much a technical and social phenomenon as a natural one. Its waters were channeled, stored, raised, distributed, and drained by the interaction of mechanical, human, animal, and hydraulic power. William Willcocks, the director of reservoirs for the Egyptian government, whose studies of Nile hydraulics were used to determine the engineering of the Aswan Dam, considered the old system of channeling floodwaters in sequence into hundreds of interconnected field basins, holding them for a certain period, and releasing them in sequence again into the river a more complex irrigation mechanism than the enormous but singular barrage and reservoir that replaced it.[48] The old methods had manufactured a geography that was no more natural than it was human, and no less. Rather, it was always both.

Nature was not the cause of the changes taking place. It was the outcome. The very scale of the technical and engineering works of the twentieth century produced a new experience of the river Nile as exclusively a force of nature. A visit to the Aswan Dam inspired a European writer to publish the first popular account of the river, which he called a "biography" of its life. "When, at the end of 1924, I first saw the Great Dam at Aswân," wrote Emil Ludwig, "its symbolic significance burst upon me with such force that I seemed to comprehend the River Nile forwards and backwards from this crucial point in its course. A mighty element had been tamed by human ingenuity so that the desert should bring forth fruit, an achievement which the centenarian Faust had attempted as the highest attainable to man in the service of his fellow-men."[49] The reference to Faust is quite appropriate. Goethe's great novel of the colonizing transformation of nature was inspired by conversations with Saint-Simonians, secular priests of engineering who had traveled to Egypt in the nineteenth century and initiated the irrigation projects completed, and transformed, with the Aswan Dam. The new scale of twentieth-century engineering, of which the Aswan Dam was among the first and most dramatic examples anywhere in the world, turned the bizarre religion of the Saint-Simonians into an everyday belief: that "human ingenuity" could now dominate the "mighty elements" of nature. In manufacturing the dam, the engineers also manufactured nature.

Several features of the new construction helped produce the effect of a world divided into human expertise on one side and nature on the other. First, there was the concentration of the river control mechanisms at one site. The old irrigation mechanisms were distributed along the length of the valley, formed out of hundreds of canals, drains, dikes, basins, sluices, pumps, and water wheels, as well as the channel of the river itself, and drew upon steam, animal, hydraulic, and human power. It would have been difficult in describing these arrangements to say where natural forces ended and technology began, or to draw a line between ingenuity and nature. In contrast, the dam at Aswan gathered all the engineering into one location, providing an observation point where writers like Ludwig could stand and suddenly "comprehend" the river as a force of nature tamed by man. Second, the concentration of engineering required a parallel concentration of capital. Building the original dam cost £2,440,000 sterling, and a further £280,000 was spent to strengthen the base immediately after the reservoir was filled.[50] To organize, and later justify, this expenditure required a series of proposals, plans, financial statements, political memoranda, annual reports, and newspaper accounts, all of which in different ways described, enumerated, calculated, and argued about the building of the dam. The arguments and calculations accompanying the old hydraulic system had been distributed over a much wider territory. Thus a significant reorganization and concentration of accounting, calculation, description, and knowledge accompanied the concentration of hydraulic power in the dam. These and other reorganizations were the kinds of processes through which the world came to be simplified into what seemed nature on one side, and human calculation and expertise on the other.

Life was now to be increasingly resolved into this binary arrangement, rendering up a simple, dualistic world of nature versus science, material reality versus human ingenuity, stonework versus blueprints, objects versus ideas. This dualism, however, as the Aswan example indicates, was an artifact of particular projects and politics. Like all dualisms, and all artifacts, it was neither original nor completely stable. The artifactual is the effect of a process.[51] If one turns back from the effect created by the engineering at Aswan, from the force of the "symbolic" that Ludwig was able to experience when standing before the completed dam, to recover the process itself, then the distinction between nature and science, between masonry and symbol, between the river to be tamed and the expertise that later claimed to have tamed it, one can locate any number of episodes, elements, and forces that disrupt the effect created by the final artifact. Engineering the dam was a messy, uncertain, conflict-ridden, and haphazard project. Public finances were controlled by an International Debt Commission, which forced changes in the alignment of the dam. The original plan had allowed "more play and choice of alignment" to take advantage of the soundest rock for the foundations. Instead, the granite under the foundation was rotten, causing delays to the construction and uncertainty about its future stability. The delays forced the contractors to abandon plans to build the masonry work using mortar manufactured from local lime and to import ready-made, faster-drying Portland cement instead. The cement mortar was less flexible and watertight than lime, leading to problems with leakage through the structure. The water spilling through the dam's sluices began to erode its base. The engineers had neglected to consider thermal stresses. The dam cost twice the original budget.[52] Subsequent problems of silt accumulation, seepage, and evaporation from the reservoir were so great that instead of increasing the water available, the mean annual discharge of water below the dam was almost one-fourth less in the fifty years following the dam's construction than in the thirty years before it was built.[53] None of these problems was foreseen by the experts at work on the dam. So complex were the forms of calculation required by dam construction, it later gave rise to the new field called cost-benefit analysis. But as hundreds and eventually thousands of large dams were built around the world in the course of the century, the accuracy of calculation cannot be said to have improved.[54]

Still, it might be argued, science one by one solved the problems it encountered. Many of them were overcome, it is true, but then one would have to acknowledge that science did not direct the engineer's work as a preformed intelligence. The projects themselves formed the science.[55] Solutions were worked out on the ground. Engineering was an expertise given shape in these and similar undertakings. The British engineers returned to London after each season of construction in Aswan to present papers at meetings of the Institution of Civil Engineers. These were published in the *Proceedings* of the institution, or in professional journals such as *The Engineer*. On a site, engineers could refer to R. B. Buckley's *Irrigation Pocket-Book*, which quoted figures for the adhesion of mortar joints or the expansion of different materials due to the penetration of moisture, based on observations drawn from earlier projects.[56] The expertise was hybrid, not an exterior intelligence applied to the world, but another artifactual body. If one adds to this Willcock's view that the older system of basin irrigation was more sophisticated than the barrage and reservoir that replaced it, the conclusion that follows is that in some ways, rather than applying knowledge to the world, the engineering work took it away. British engineers were taught things by the dam and carried this knowledge into scientific journals and irrigation manuals, but the farmers and local irrigation experts who had managed and maintained the earlier hydraulic system had much of their knowledge taken from them.[57]

The questions and disputes posed by the building of the dam were not restricted to debates within professional journals and discussions among engineers at the site. The problems spilled over and drew in government officials and employees, archaeologists, the national and European press, entrepreneurs and investors, and an increasing number of Egyptian intellectuals and political figures. The reservoir behind the dam inundated the great Temple of Philae and other ancient sites. Archaeologists campaigned against the building of the dam in the European press and at scientific congresses.[58] Cost overruns led to conflicts among financiers, government engineers, contractors, and outsiders, which continued for years and were taken up in national politics. In 1919 Willcocks criticized the postwar plans of the Ministry of Public Works to build two further dams in Sudan, claiming the plans were based on faulty calculations of the Nile flow and pointing out that one of the dams, at Jabal Aulia, would submerge valuable agricultural land and displace and cause suffering to a large population.[59] Science was formed in these wars, and so was the country's new national politics. Willcocks's proposal to increase the height of the Aswan Dam a second time as an alternative to controlling the Nile from Sudan was taken up by the nationalist movement during the 1919 uprising against the British. Willcocks found himself put on trial for sedition and criminal libel.[60] The disputes continued, especially after commissions of inquiry discovered that the ministry's program included further, more serious miscalculations.

The aim of those involved in the disputes, one might say, was to "personify" the forces of nature in politics, that is, to translate their potential into human projects. As with ʿAbbud's later attempt to personify certain circulations of capital, chemical fertilizer, and electricity, the forces put to work, although portrayed as nature or material resources and therefore subject to human expertise and planning, never quite accepted this secondary role. There were always certain effects that went beyond the calculations, certain forces that exceeded human intention. Scientific expertise and national politics were produced out of this tension.

The gambiae mosquito, as we know, figured nowhere in these rival plans and calculations for the dam, or in the technical and political battles that followed. When it took advantage of the new reservoirs and river movements and arrived unexpectedly in Aswan, however, a similar struggle developed to draw the insect into a variety of political alliances. In interwar Cairo the political problems of the countryside, associated with the spread of perennial irrigation, the development of commercial agriculture, the growth of large estates, and increasing poverty, indebtedness, landlessness, hunger, and parasitic infection among the fellahs, or peasants, were translated by those in power into problems of what was called "public health." They were to be solved by government programs of rural social improvement and hygiene. The Wafd government of 1936 created a Ministry of Health, and when the party returned to power with British help in 1942, one of its first acts was to pass the Law for the Improvement of Village Health. "The growth of the democratic and national spirit in Egypt after the war," wrote an Egyptian political economist in 1940, referring to the period since World War I, "has made the nation aware that helping the fellah is not only a duty but also an insurance against social unrest. . . . The creation of a Ministry of Health in 1936 and of an independent Section of the Ministry of the Interior devoted to the planning and execution of rural reforms, is a welcome sign of increased public interest in the fellah."[61] The arrival of gambiae malaria was interpreted by those in power as evidence confirming the need for this program of social and hydraulic engineering. The problems of Egypt were those of limited natural resources and a deficient public health, and were to be overcome by the methods of techno-science. In

December 1942 the new minister of health, ʿAbd al-Wahid al-Wakil, blamed the malaria epidemic on the failure of previous governments to carry through with the hydroelectric scheme promoted by his friend ʿAbbud and with further irrigation projects, arguing that these would have raised the standard of living in the south and made its population healthy enough to resist the epidemic.[62]

Before the war, the program of public health and public works allowed no place for more radical discussions of the question of private property in the countryside. Warning that the rural population, in the language of public health, was "dead as regards healthy nationalistic life," a number of political figures had called for limited measures to alleviate the increasing hardship caused by commercial agriculture and large-scale landownership, and even the government tried to introduce agricultural rent controls. But the issue of property rights was not raised.[63] It was symptomatic of prevailing attitudes toward entitlement that when the wartime fertilizer crisis led to food rationing, supplies were assigned to different groups according to income, with higher income groups getting bigger rations.[64]

But the impact of the mosquito's arrival was not so easily controlled. If ʿAbbud's associates translated the malaria epidemic into renewed arguments for projects of public health and public works, the mosquito could be taken up by rival groups in other directions. A group of women from wealthy families closely associated with the Egyptian royal family, which opposed the Wafd government and the British, organized soup kitchens and other relief projects in the south to aid the malaria victims. By drawing attention to the crisis they provided the royal palace with an opportunity to embarrass the government.[65] But they in turn could be embarrassed by the mosquito. The wealthy women invited a young journalist to visit and describe their relief efforts. The journalist, later to become a leading writer, reported instead that the women themselves were like mosquitoes. They belonged to the class of Egyptians who "suck the people's blood and turn it into cakes, caviar and champagne." The rich were the real epidemic, he wrote, and their opulent palaces were no better than the stagnant pools in which the mosquitoes bred.[66]

The mosquito was put to work by critics of the ruling order to alter the terms of national debate. As the malaria epidemic in the south became public knowledge in Cairo, a number of individual reformers turned the crisis into an argument for more radical change. Rejecting the government view that the high death toll reflected poor sanitary conditions in the countryside and the need for further public works, they linked the crisis to the unequal distribution of land. One deputy in parliament claimed that the standard of living in the Soviet Union, where land was held in common, was much higher, and others drew attention to the successful land reform programs of Eastern Europe. From 1944 to 1947 and again in 1951, bills were introduced into parliament modeled on these reforms, proposing to bar owners of more than fifty acres from acquiring additional land.[67] The measures were blocked in parliament and no party made land reform an issue.[68] Instead, in March 1948 the government launched a program to distribute land reclaimed from the desert in five-acre plots to small farmers, who also received "hygienic houses" grouped in four villages, each equipped with a school, mosque, health unit, and public bath.[69] With such measures, made possible by the raising of the dam at Aswan, there seemed no immediate threat to the power of men like Ahmad ʿAbbud, who were able to consolidate their political and economic position. Yet thanks to the malaria epidemic and to the food shortages and poverty it had made visible, the question of land reform was now in circulation.

ʿAbbud's electricity and fertilizer schemes were interrupted in October 1944, when his political rivals managed to bring down the Wafd government. Five years later, however, he formed an alliance with the rival Misr group, and together in 1950 they helped put the Wafd back in power and secure their monopolistic economic positions. ʿAbbud's empire expanded with acquisitions in tourism and textile manufacturing, and new ventures to manufacture paper and perfumes, both using byproducts of the sugar industry.[70] He abandoned the proposal to build a nitrate plant at Aswan powered by hydroelectricity, which was to become a government project. In its place he took advantage of capital loans and a new nitrogen-fixing technology available from the United States to build a fertilizer factory at Suez, powered not with Nile waters but waste gases from the nearby Shell oil field.

The fertilizer factory was funded by the United States as an emblem of its postwar role in the country, "the most substantial, tangible example of American economic assistance to Egypt," as the U.S. Embassy reminded Washington.[71] The Americans planned to build political influence and at the same time subsidize their own industrial technology through a program of "technical assistance," which would organize postwar international relations around a politics of techno-economic development. Besides the fertilizer factory, in its first years the assistance program also funded a pilot scheme for the introduction of hybrid corn, the supply of six helicopters from United Helicopters of Palo Alto, California, for spraying crops with new chemical pesticides (more on that in a moment), a demonstration project for well drainage to restore land that, thanks to the dam, was "deteriorating from excess irrigation and salinity," and a new technology for building houses of mud brick.[72] People in the Nile valley had been building their houses with mud brick for several millennia, of course, so this last item needs explanation. Arthur D. Little, the Boston-based consulting firm advising the U.S. mission, had determined that an improvement to mud bricks was "an essential part" of Egypt's techno-economic development. The peasant's house "is never clean," the embassy reported to Washington. "The very nature of the mud brick promotes dust rather than cleanliness. Its surface is porous and will not readily take whitewash or paint."[73] The consultants received a contract to build twenty mud brick houses by a new process, using "a special mud brick making machine" instead of the traditional wooden mold, and improving the normal mixture of mud and straw by the addition of oil. From the twenty demonstration houses, it was hoped, "the knowledge of how to build such a house will be spread throughout Egypt."[74]

There were three significant features of this new politics based on technical expertise. First, as with the dam at Aswan, it represented a concentration and reorganization of knowledge rather than an introduction of expertise where none had been in use before. Technical knowledge was to be focused into pilot projects and demonstration sites, from where it would spread throughout the land. Villages in Egypt already had a straightforward method of plastering over mud brick, using particular local clays mixed with straw, employed whenever a house needed smoother or more impressive walls. But existing practice, like the old knowledge of irrigation, involved an expertise that was too widely dispersed to provide a means for building imperial power—or the profits of a Boston consulting firm.

Second, as with the engineering at Aswan, the projects encountered continuous practical difficulties. In fact, every one of them failed. The seedlings of hybrid corn "withered," the oil-stabilized mud brick was a failure, the use of helicopters had "run into various complications" (they broke down), and the new nitrogen-fixing technology for the manufacture of fertilizer did not work as planned. "It will be a long time before the fertilizer plant will produce satisfactorily," the embassy reported to Washington in November 1951. "The basic process is faulty from the design standpoint. Some of the engineering was done in New York and parts in London and it turns out to have been a weak job."[75] As at Aswan, the technical experts tried to learn from these failures. Repairs were improvised, opportunistic alternatives were introduced, and goals were reformulated. But what this means is that technical expertise did not work by bringing science and technology to develop natural resources. It happened just as much the other way around, and in ways that tended to be incomplete or unrealizable. So-called nature formed the expertise, which never completely escaped its compromising origins.

Third, however, it was an important aspect of the politics of technical expertise that these failures and adjustments were overlooked, in fact actively covered up. Techno-science had to conceal its extrascientific origins. Nowhere, first of all, was it mentioned that every one of these technologies—crop spraying, high-yield corn, drainage mechanisms, fertilizer plants, or a mud brick more resistant to disease—were themselves responses (and unsuccessful responses) to problems caused by earlier techno-scientific projects, in particular the Aswan Dam. Beyond this, the fundamental difficulties were presented as minor issues of the improper implementation of the plans, unexpected complications, bureaucratic delays, or the need to follow up. The hybrid corn, it was decided, needed to be recultivated with greater quantities of pesticide. The helicopters needed a larger and more continuous supply of spare parts from California. The new mud brick technology had to overcome political objections from the Ministry of Social Affairs, which believed that modern housing should be built of concrete. The pattern was set from the very start with ʿAbbud's nitrate factory at Suez. Since the factory was built to manufacture not just fertilizer but the political effectiveness of an imperial power, the mistakes in design and engineering could not be made public. No one was to be told that the engineering was a weak job, or that the entire plant was wrong, as the jargon put it, "from the design standpoint." The embassy promised ʿAbbud and his U.S. partners that "we would cooperate fully in keeping the situation quiet. In response to inquiries we would continue to say that operating difficulties in the early phases are to be expected from any new chemical process factory."[76]

Techno-politics is always a technical body, an alloy that must emerge from a process of manufacture whose ingredients are both human and nonhuman, both intentional and not, and in which the intentional or the human is always somewhat overrun by the unintended. But it is a particular form of manufacturing, a certain way of organizing the amalgam of human and nonhuman, things and ideas, so that the human, the intellectual, the realm of intentions and ideas seems to come first and to control and organize the nonhuman.[77]

ʿAbbud's new fortunes were short-lived. Postwar protests against conditions in the countryside intensified, and a popular campaign against the British role in Egypt culminated in the Cairo fire of January 26, 1952, when Shepeard's Hotel, symbol of the British presence, was burned down. A newly appointed government began to move against ʿAbbud's business monopoly. After failing to get him to pay E£5 million in tax arrears, the Ministry of Finance decided to nationalize his sugar company. ʿAbbud in response was reported to have bribed the king, who dismissed the government after four months in office.[78] As the political crisis developed, on July 23, 1952, junior officers in the Egyptian army led by Jamal Abdul Nasser carried out a coup d'état. Within six weeks they passed a land reform law and announced that postwar proposals to build a second and far larger dam at Aswan would go ahead, as the centerpiece of postindependence state building.

These actions, followed by the 1956 nationalization of the Suez Canal and the Suez crisis, brought on by the abrupt U.S. withdrawal of support for the Aswan High Dam, are now remembered as a turning point in Egypt's politics. But Nasser and his fellow officers had not seized power with the aim of carrying out land reform or building a postcolonial state around the Aswan project. Concerned principally with the incompetence and corruption of the army high command, they took control when they suddenly feared their own arrest.[79] They forced the king to abdicate in favor of his infant son and appointed a reformist prime minister with the aim of restoring a less corrupt and oligarchic parliamentary order. Since proposals for land reform were circulating, however, and were even advocated by the U.S. Embassy (as a defense against an imagined communist threat), they offered the means for an insecure new regime to win popular approval and weaken the few dozen oligarchs like ʿAbbud obstructing political reform. The army regime went on to expropriate all the estates of the royal family, but for others set the maximum holding relatively high, at three hundred acres.[80] The high limit and the ease with which it was evaded ensured that relatively little land was redistributed, but the reform did establish rent controls and tenant rights that improved conditions in every village, until their abrogation in October 1997. ʿAbbud lost most of his six-thousand-acre sugar plantation, and subsequently, as the military government moved against "the monopolies" and other rival sources of power, his business empire as well.[81] Hydropolitics had made ʿAbbud rich, but had also set in motion other forces, not least the mosquito, that combined to bring him down.

Similar combinations formed the genealogy of the High Dam, involving exchanges among hydropower, fertilizers, economic collapse, and war. During World War I American fear of Germany's new nitrate technology, and its own dependence on the single natural source of nitrates in Chile, persuaded Congress to include in the National Defense Act of 1916 the funds to build a mammoth nitrogen-fixing plant at Muscle Shoals in northern Alabama. The project included the construction of a large dam nearby, with a hydroelectric power station to supply the great quantities of electricity consumed in nitrogen fixing. At the war's end, after a $100 million federal investment, both the factory and the partially completed dam and power station were uneconomic and useless.[82] This technical failure, however, enabled something much larger to result. In July 1921, Henry Ford proposed a scheme not just for this corner of northern Alabama, but for the entire river basin to which it belonged, linking together industry, hydroelectric power, transmission grids, river navigation, soil improvement through artificial fertilizer, and scientific agriculture. The proposal envisioned an expansion of the industrial coordination schemes that Ford had pioneered, from the scale of car factories and suburban lifestyles, to the transformation of the entire ecology of a geographic region, organized around the technicized space of the damming of a river system and the transforming of its energy into unlimited hydropower. The scale of federal support that Ford demanded for the project ensured the opposition of his business rivals, and the proposal was rejected. But with the economic collapse of the Great Depression the project was revived by the federal government. In 1933 an act of congress put Ford's scheme into effect as the country's largest public works project, the Tennessee Valley Authority.[83]

The TVA, the child of earlier technical and political failures, came to epitomize the new possibilities of development and planning, especially in arid regions such as the Middle East. Large dams offered a way to build not just irrigation and power systems, but nation-states themselves. In 1949 the United Nations sent an economic survey mission to the Middle East. Its head was Gordon Clapp, the chairman of the TVA board. The following year, two World Bank experts writing on development in the Middle East explained how since 1930, "the popular imagination has been captured by the idea of the development of entire river systems."[84] In the following years the old schemes of ʿAbbud and his rivals for a hydroelectric plant and fertilizer factory at Aswan were taken up by the new military government in Egypt. But they now formed part of a TVA-inspired scheme to build the second dam, on a mammoth scale, just above the existing dam at Aswan. Work began in 1964 and was completed in 1971. Ignoring the costs of salinization, waterlogging, declining soil fertility, the displacement of the people of Nubia, the loss of an archaeological heritage, increased disease, coastal erosion, the destruction of a large fishing industry, the loss of water due to evaporation and seepage, and other problems already evident from the first dam, and without even attempting studies of costs and benefits, the Aswan High Dam became the centerpiece of postwar nation making in Egypt.[85]

Marx published some famous lines about an insect—not the mosquito, but the bee. Although it builds itself an elaborate hive, he wrote, the bee is no architect, for the architect "raises his structure in imagination before he erects it in reality."[86] Since Marx wrote those words we have come to believe more and more that this Cartesian notion of the mind-as-architect's-office is what captures the difference between ourselves and nature. The work of imagination puts together plans, images, ideal structures—in fact entire systems of culture and meaning—before they are taken outside and erected in reality. We have made do for too long with this misleadingly simple view of the world that Marx himself placed in question. I have already suggested by describing the work of the engineers at Aswan why this is misleading, and have offered other examples elsewhere.[87] I could make the point again simply by recalling the work an architect actually does: the visits to the site and consultations with the client that precede any attempt at drawing; the long, eye-straining hours with the CAD program; the printing and distribution of drawings; the meetings around a table with the plans spread out to negotiate the rules of building codes and planning regulations; the day-to-day supervision of the building contractor; the arbitrating among electrical, plumbing, and ventilation contractors installing rival networks of cables, pipes, and ducts; the measurements that do not fit; the overlooked details; and the changes of mind as things are taken apart and redone. There is no disputing that all this involves a constant work of imagination, but none of it precedes or stands apart from doing things in reality. There is no other, more real world. Nowhere does one suddenly step from imagination to reality, from plan to real thing, any more than did the engineers at Aswan.

Yet if we return to the case of the anti-malaria campaign in Egypt, it might be said, surely the difference between the mosquito and the human expert is clear. *Anopheles gambiae* may have been clever to make its way across the African continent, but it was no match in the end for the powers of chemical science, human ingenuity, and planning. Perhaps not. Yet here, too, the story of expertise versus nature is too simple. After all, the eradication teams did not kill the mosquitoes barehanded. They needed a lot of nonhuman assistants. Since the end of World War I, the J. R. Geigy company in Switzerland, a manufacturer of dyestuffs for the textile industry (and member of the I. G. Farben chemicals cartel), had been trying to find a safe, effective, and long-lasting substance to use as a mothproofing agent for textiles.[88] In 1941, with Rommel advancing in North Africa and the gambiae mosquito making its way northwards from Sudan, a company chemist named Paul Müller discovered the toxicity of dichloro-diphenyl-trichloroethane. Mixed 5 percent in an inert powder, the chemical was found to kill clothes moths and many other insects yet seemed to have no effect on warm-blooded animals. Since it was a contact rather than an oral poison, it proved to be a potent killer even of bloodsucking insects, which do not ingest poisons, including human lice, the parasite responsible for transmitting typhus.[89] The disease that brought Fred Soper of the Rockefeller Foundation to Cairo the following year, typhus was a major threat to soldiers at war and civilians in war-torn cities. The British Ministry of Supply named the new Swiss chemical after its initials and began manufacturing DDT in April 1943, giving its production the highest wartime priority alongside radar and penicillin.[90] The following year, Soper persuaded the Egyptian government to replace pyrethrum—the powder of chrysanthemum flowers—with DDT in the gambiae eradication campaign in southern Egypt. Houses were treated with the chemical, and the ceilings of trains were spray-painted with a mixture of DDT and kerosene, an innovation later copied around the world.[91]

Neither the companies manufacturing DDT nor the eradication teams using it in Egypt had any idea how the chemical worked. They just admired its potency. In fact, no one knew how it worked, not even the man who introduced its powers. When Müller received the Nobel Prize in Medicine or Physiology in 1948, he won the award for having demonstrated that DDT killed arthropods, not for knowing why.[92] Bringing its powers into action had required several years of methodical work, testing hundreds of synthesized organic substances on flies trapped inside a Peet-Grady chamber. This was an enclosure or room that simulated an insect's environment, such as a desert, a rainforest, or the kitchen of an apartment. The insects and the chemical agent were introduced into the chamber while an observer watched through one-way glass.[93] The discovery that DDT killed the flies was made in the Peet-Grady chamber, not in Müller's head. Techno-science involved not so much planning in advance or raising structures in the imagination; it involved erecting a room inside the research lab, which rearranged so-called nature, much like the dam at Aswan, concentrating its elements in one place, transporting the rainforest onto the premises of a chemical company, and providing a place where it could be continuously observed. The chain of events that took DDT from the Peet-Grady chamber to the field was a process of borrowing, translations, and things invented for one purpose taken over by other forces, all modulated by the politics of U.S.-British rivalry over Egypt, the needs of war, the accidents and ambitions of a Rockefeller career, and the impact of sugarcane production and irrigation works.[94]

What is more important, as we now know, while the malaria campaign used the new power of DDT, the pesticide had purposes of its own, well beyond the intentions of the research chemists and the eradication teams. In 1944 the U.S. Army Public Health Service and the American Entomological Society had already begun to issue warnings: that DDT would kill beneficial as well as harmful insects, was poisonous to fish, and was potentially harmful to all forms of plant and animal life. The warnings were ignored. After the "success" of the new chemical in Egypt, and a more famous success in eliminating head lice under Soper's supervision in Naples (in fact both campaigns mostly employed pyrethrum, with DDT used only at the end, after the epidemics had largely passed), Soper agreed with the advocates of DDT that it was "an almost perfect insecticide."[95]

DDT was not in fact a more lethal insecticide than pyrethrum or other chemicals it replaced. Like pyrethrum, it did not attack the malaria parasite directly. The plasmodium spores were too small and too numerous to reach with poison. The new chemical simply interrupted their breeding cycle by intervening at its most vulnerable point, when millions of spores were concentrated in the bodies of a relatively small number of much larger hosts, the female mosquitoes. DDT's greater effectiveness against mosquitoes was due to its very stable chemical structure. It was practically insoluble in water and resisted degradation by sunlight or soils. So it remained in the environment not for days or weeks, but years and decades. (When it does break down, it was later discovered, the resulting products include DDD, which is also toxic and resists decomposition for up to 190 years.) When sprayed in a house DDT lingered, so it "vaccinated" the place long enough to interrupt the mosquito's breeding cycle, and without the impractical need to seal up the house, as the pyrethrum spray required.

In Egypt, however, DDT (and pyrethrum) also gained their effectiveness from special features of the gambiae mosquito—or rather, of the social relations between the mosquito and its human hosts. As in Brazil, the insect was a new immigrant, so it was not well established in the local community and was comparatively easy to isolate. At the same time, the *Anopheles gambiae* is the most social form of malarial mosquito. It is especially dependent on its human hosts, preferring human blood to animal.[96] Thus it is generally found only around human habitation. This makes it unable to travel long distances, hence the importance of boats, trains, and floating weeds for its travel. But the dependence on humans also made it easier to eradicate, because the spraying of houses and vehicles only was relatively effective. For all these reasons, a methodical and relentless vector eradication campaign, taking on the mosquito pool by pool, house by house, and village by village, was successful.

As a result, the malaria experts drew the wrong lessons from Egypt. Success there suggested, mistakenly, the possibility of a worldwide species eradication using hunt-and-destroy campaigns and the killing power of the pesticide. In 1946 Soper and the Rockefeller Foundation embarked on a malaria campaign in Sardinia, designed to show that DDT could be used not just to control malaria, but to eliminate it. They sprayed the chemical from airplanes and helicopters and employed a total of twenty-four thousand men in ground teams, whose equipment included flame-throwers. Yet despite extending the campaign for five years, they failed to eradicate the mosquito. It was too well entrenched. Hundreds of thousands of pounds of DDT were spread over the Sardinian landscape, but tests showed that the mosquito larvae survived concentrations of the chemical twenty-five times greater than those used in the eradication campaign—for reasons no one could quite explain.[97]

Undeterred by this failure, four years later, in 1955, the World Health Organization (WHO), which had taken over responsibility for the worldwide administration of antimalarial campaigns from the Rockefeller Foundation, adopted a plan for the global eradication of malaria using DDT. Countries where the anopheles mosquito was relatively thinly established reduced or even eliminated the vector, especially in Europe, but in many more places eradication was not effective. Although described as "global," the eradication program ignored Africa, the world's major malarial region, aside from one or two pilot schemes. Elsewhere the parasite gradually developed resistance to quinine and other drugs and returned in large numbers.[98] Meanwhile, DDT produced other, more destructive effects. Only in 1969 did the WHO agree to move toward programs of vector management rather than eradication and begin to warn of the risks of DDT, leading to its banning (but not elimination), at least in agriculture. At the end of the 1990s the United Nations Environment Program sponsored negotiations to end the use of DDT altogether by 2007.[99]

By this time there was a better understanding of DDT's long-term effects. While almost insoluble in water, it dissolves easily in fat, so it accumulates in the fatty tissue of animals, an accumulation that is magnified through the food web. Although no one still quite knew how it worked, it was believed that it acts like a hormone, mimicking or disrupting chemical messengers in the body, affecting the development and functioning of the organism. It weakens the immune system, decreases lactation, causes male animals to develop female reproductive organs, and leads to other disruptions of sexual development.[100]

Since these powers were not limited to killing the lice, clothes moths, and mosquitoes for which DDT had been developed, its use quickly spread to other areas, especially agriculture. Far more of the pesticide was used worldwide in farming, to support the increased use of synthetic fertilizers, than in public health programs. One of the most popular worldwide applications was in the protection of cotton crops.

In Egypt, by 1950 the use of chemical fertilizers had returned to their prewar levels, the highest in the world. The fertilizers were producing "lush vegetation and flowering," it was reported, which encouraged insect pests, in particular the cotton leaf worm.[101] Two local companies began importing DDT to combat the cotton pest. With U.S. help the government acquired the six helicopters from United Helicopters to use for spraying the chemical from the air.[102]

Meanwhile, the country's two dominant business monopolies, the ʿAbbud and Misr groups, whose increasing power I mentioned earlier, consolidated their control by forming a political and economic alliance, which in 1950 helped bring the Wafd party back to power. The two groups prepared the way for this collaboration a year earlier by agreeing to coinvest in a new joint venture with the U.S. chemical company Monsanto—to build a local plant to manufacture DDT.[103] A major ingredient of DDT is ethyl alcohol, which was to be made by Egypt's only commercial distillery, the Société Egyptienne de Distillerie, owned by the sugar baron Ahmad ʿAbbud, using molasses supplied by his sugar monopoly.[104] ʿAbbud had got rich helping to build the Aswan Dam, which enabled the spread of sugar plantations but also required the introduction of fertilizer. The use of fertilizers brought insect pests, which needed treatment with DDT. Now the DDT would be made from ʿAbbud's sugar.

By the time of Nasser's military coup two years later, the government had decided to build the pesticide factory itself using the assistance of international healthcare agencies. One week after the coup, on August 2, 1952, in perhaps its first international act, the new government signed an agreement with WHO and UNICEF to build a factory at Kafr Zayat that would produce two hundred tons a year of finished DDT.[105] With healthcare agencies financing this mass production of the new pesticide, the U.S. Embassy was able to report with optimism that while "Egypt consumes at present less pesticides than would be the case if the average farmer were better educated," as his education progressed, "increased demand for such products should develop."[106] Demand did indeed develop. Standard doses of pesticide were soon found to be ineffective. The DDT had been killing off natural predators, so the pests that survived the chemical were able to reproduce explosively. The quantities used had to be doubled and then trebled. Without the government having to spend a penny on further education for farmers, but through the working of the chemical's own poorly understood powers, the use of pesticides progressed.

Today the *Anopheles gambiae* has disappeared from the story of Egyptian politics. Even the one good account we have of the malaria epidemic, by Nancy Gallagher, does not give the mosquito or its parasite much credit. As in every other explanation of this kind of politics, history has a limited number of actors, and the insect arriving from the south is not one of them. There are the British, manipulating Egyptian politics while resisting the incipient postwar usurpation of their role by Americans; there are the national elites—the monarchy and the small landed aristocracy—losing their power to a more dynamic class of commercial landowners, entrepreneurs, and military officers; and, now and again, there are the subaltern communities—the rural population, the urban working classes, women—making up the rest of the social order. The mosquito, on the other hand, is said to belong to nature. It cannot speak.

As part of nature, the gambiae mosquito became a problem of public health. With the mosquito's help, questions of hygiene, disease, housing, and ignorance emerged as the principal way of addressing the situation of rural Egypt. National politics was organized around programs of health improvement, rural reconstruction, technical development, and above all the engineering of the river Nile and the transformation of its power into electricity, fertilizers, irrigation, and the growth of agriculture and manufacturing. The resources and limits of nature and, by extension, of rural society were to be transformed by the dynamic activity of technical development, which required the application of scientific and social scientific expertise.

These projects began to arrange the world as one in which science was opposed to nature and technical expertise claimed to overcome the obstacles to social improvement. The malaria eradication campaign presented an opportunity to bring the intelligence of medical science, with its resources of chemistry, hygiene, past experience, and worldwide information, to work upon the insect vectors, protozoan parasites, fevers, poverty, and malnutrition that made up the defects of the material world and had to be defeated. In irrigation projects, the power of technical assistance and engineering was to overcome the limits of natural resources. At al-Alamein, the first great battle of technicized warfare, two opposing generals, it is said, combined the mobile powers of mechanized weapons and the new, large-scale deployment of mines to determine the course of history. Such programs and campaigns manufactured a world that appeared as natural resources versus technology, bodies versus hygiene, men versus machines, the river versus human ingenuity.

Yet the projects that produced this binary world could emerge only by engaging a series of other logics, forces, and chemistries: the hydraulic energy of the Nile River, the chemical properties of ammonia, the feeding patterns of the anopheles mosquito, the career making of a Rockefeller epidemiologist, the supply lines sustaining an army at war, the reproductive cycle of the plasmodium parasite, the anticolonial struggle of Egyptian nationalism, the world's increasing chemical addiction to sugar, and DDT's preference for fatty tissue, to name a few. Although technical development portrayed the world as passive, as nature to be overcome or material resources to be developed, the relations of science and development came into being only by working with such forces.

The same was true of what was called the development of capitalism. The circuits that ʿAbbud tried to control and transform into sources of profit involved family networks, the properties of sugar and nitrates, the labor of those harvesting cane, imperial connections, and the shortages brought by war. The production of profit, or surplus value, came about only by working within and transforming such other forces and reserves. Thus a term like "capitalist development" covers a series of agencies, logics, chain reactions, and contingent interactions, among which the specific circuits and relations of capital formed only a part.

Introducing these other forces is not a question of describing the resistance of nature or material conditions. It is not a matter of acknowledging nonhuman forces that worked against human expertise or created obstacles to technical progress and capitalist development. The reports describing the problems of the Aswan Dam, the setbacks in malaria eradication, or the failure of technical assistance programs often used such formulations to express the difficult relationship between human intention and the world of experience. Expertise, however, did not confront such resistance externally, after it was already complete, nor did the power of capital. Plans, intentions, scientific expertise, techno-power, and surplus value were created in combination with these other forces or elements. The technology of dam construction was formed at the construction site in Aswan, and in earlier and subsequent projects. The methods of mosquito eradication developed in Brazil and Egypt were the outcome of working with *Anopheles gambiae* in particular locations, among a new population of human hosts. What is called nature or the material world moves, like the plasmodium, in and out of human forms, or occurs as arrangements, like the river Nile, that are social as well as natural, technical as well as material. The world out of which techno-politics emerged was an unresolved and prior combination of reason, force, imagination, and resources. Ideas and technology did not precede this mixture as pure forms of thought brought to bear upon the messy world of reality. They emerged from the mixture and were manufactured in the processes themselves.

Resolving these processes into reason versus force, intelligence versus nature, or the imagined versus the real misapprehends the complexity. But this misapprehension was necessary, for it was exactly how the production of techno-power proceeded. Overlooking the mixed way things happen, indeed producing the effect of neatly separate realms of reason and the real world, ideas and their objects, the human and the nonhuman, was how power was coming to work in Egypt, and in the twentieth century in general.

Social science, by relating particular events to a universal reason and by treating human agency as given, mimics this form of power. The normal methods of analysis end up reproducing this kind of power, taken in by the effects it generates. In fact, social science helps to format a world resolved into this binary order, and thus to constitute and solidify the experience of agency and expertise. In much of social science this is quite deliberate. It tries to acquire the kind of intellectual mastery of social processes that dams seem to offer over rivers, artificial nitrates over sugarcane production, or DDT over arthropods. It is less important whether one understands how things work, more important how effective are the immediate results. But more careful forms of historical or cultural analysis can do the same thing in less obvious ways, by leaving technics unexamined, or talking about the "social construction" of things that are clearly more than social.

To put in question these distinctions, and the assumptions about agency and history that they make possible, does not mean introducing a limitless number of actors and networks, all of which are somehow of equal significance and power. Rather, it means making this issue of power and agency a question, instead of an answer known in advance. It means acknowledging something of the unresolvable tension, the inseparable mixture, the impossible multiplicity, out of which intention and expertise must emerge. It requires acknowledging that human agency, like capital, is a technical body, is something made. Instead of invoking the force and logic of reason, self-interest, science, or capital and attributing what happens in the world to the working of these enchanted powers and processes, we can open up the question, as I have attempted here, of what kinds of hybrid agencies, connections, interactions, and forms of violence are able to portray their actions as history, as human expertise overcoming nature, as the progress of reason and modernity, or as the expansion and development of capitalism.

2 Principles True in Every Country

In 1863 Ismaʿil Pasha, the Ottoman ruler in Cairo, gave one hundred acres of land to his coffee maker. He gave another hundred to his head barber. He had succeeded his uncle Saʿid as viceroy in January of that year, and within eighteen months he allocated to those around him more than sixty thousand acres of the Nile valley. The recipients were military officers and high officials, family members and household staff. In the same short period he also added more than fifty thousand acres to his own estates.[1]

To Europeans, actions like these expressed everything that was wrong with the East. They exemplified the shortcoming for which colonial officials liked to criticize "native" systems of rule: their arbitrariness. Compared to the universal rules of a modern system of law, native government proceeded by personal decision and the caprice of power. "With respect to general propositions," wrote an English administrator in India, "I have yet seen no reason to admit that principles, unquestionably true in every other country, should not be applicable in Bengal. It is in the nature of justice and good government to deduce its arrangements from undisputed points of original right. It is in the nature of arbitrary power to make exceptions."[2] In non-European government the exceptional was the rule; power gained its strength from its arbitrariness. Modern government, like modern science, the European believed, was based upon principles true in every country. Its strength lay in its universalism.

This language belongs to an earlier century. But the views it expresses remain current. At the end of the twentieth century, the law of property reappeared at the center of Egypt's political and economic life. As chapters 8 and 9 of this book describe, a program of political and economic restructuring reasserted the primacy of property rights as the institutional framework for the introduction of market relations. The universal rules of property were to replace the system of arbitrary political controls, special claims, and institutional exceptions that had restricted their operation. The political economy of Egypt was to be reestablished on the basis of principles true in every country.

THE RULE OF PROPERTY

How is the general character of law produced? How do the rules of property achieve the quality of being universal? There is no straightforward answer to this question. Modern jurisprudence sees law as self-establishing, existing as a system of rules whose validity is established only by other rules.[3] Modern economics sees the existence of property as self-evident, representing an axiomatic set of rules without which the act of exchange could not occur. In the positive accounts of law and economics, the genealogy of what is taken to be a universal system of rules is not open to investigation. This is inevitable, for if the axiomatic had its origins in particular histories and political acts, its claim to universalism would be lost.

In Cairo, the answer to this question about the origin of modern property rights was first formulated in