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Architectures of Pestilence:
Smallpox, Tuberculosis, and the Spatial Control of Epidemic Disease

by

Diana K. Davis

A THESIS SUBMITTED
IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE

Master of Architecture

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ABSTRACT

Architectures of Pestilence:
Smallpox, Tuberculosis, and the Spatial Control of Epidemic Disease

by

Diana K. Davis

By examining the spatial dialogue that arose to reconcile the opposing figures of smallpox and tuberculosis, it has been possible to trace a spatial or architectural transformation in which methods for protecting the body from disease have evolved into methods for protecting disease from the body. However, given that the threat of pestilence has always inspired defensive strategies based on redundancy, this transformation may be traced not only as it has unfolded at the scale of the individual body, but at the scale of the building, the city, the international network, and the natural order, as well. In separating out the products of these various scales of defense and allowing them to read independently, it has been possible to show how solutions follow from the representation of the threat: the problem of pestilence having always been, however, that there was, at any time, more than one representation.
ARCHITECTURES

of

PESTILENCE

smallpox

tuberculosis

and

the spatial control of epidemic disease

DIANA K. DAVIS
I thank
the boundless grace, patience, and support of

the candor and sympathy of

the wisdom, insight, and generosity of

and the wit and comradeship of

for making this project possible.

Jeff Mathews,

my parents,

Farès el-Dahdah
Michael Bell
Albert Pope
and
Sanford Kwinter,

my dear friends
at Rice,
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Hidden within a substantial body of literature dealing with epidemic disease is an implied space in which occurrence and response are indelibly tied and the admission that it is within the material substance of society that a “plague” is ultimately shaped, located, and created. Falling outside the mandates of the medico-historical or literary discourse, the “space” of epidemic disease cannot be analyzed by tracing trajectories or capitalizing on contexts. Whether reactionary or prophylactic, pharmaceutical or architectural, the space established by pestilence is at the same time both evolutionarily volatile and morphologically stable. The etymological implication of “plague” privileges the effect over the cause, the lasting imprint over the event. As derived from the Latin plaga, meaning a blow or wound, or a mark left by an object striking the body, the importance of the “imprint” transcends its historical specificity. History only serves to reinforce the impression, or reshape it by successive events. An analysis of epidemic architectures, then, can treat history as a folly, as narrative frame or didactic crutch, upon which to hang a spatial story.
To serve as a narrative structure, then, smallpox and tuberculosis have here been chosen. They have been selected not for their historical tenacity, not for their visual histrionics, not even for their prophylactic technologies, though they possess all such characteristics in abundance, but because they have made nice foils in the literary sense: one viral, the other bacterial; one repetitious, the other durational; one eruptive, the other consumptive; one eradicated, the other only thought to have been. As Hans Zinsser has observed: “In following infectious diseases about the world, one ends by regarding them as biological individuals which have lived through centuries, spanning many generations of man and having existences which, in their developments and wanderings, can be treated biographically.”

As individuals, any two diseases can be seen to have been engaged in a kind of extended dialogue, whether concerning control measures and the scale of the city or the sharing of genetic material between microorganisms. By examining the spatial dialogue between smallpox and tuberculosis, it has been possible to trace a spatial or architectural transformation in which methods for protecting the body from disease, have been transformed into methods for protecting the disease from the body. However, given that the threat of pestilence has always, in accordance with its characteristic capacity for being both intensively localized and threateningly universalized, inspired defensive strategies based on redundancy, it is possible to examine this spatial transformation not only as it has unfolded at the scale of the individual body, but at the scale of the building, the city, the international network, and the natural order, as well. The solutions that have arisen in the attempt to control pestilential diseases have not been the pure products of a single, historical and socio-medical dialogue, but have rather represented a series of fragmented defenses at different scales of operation bound together by little more than an era’s self-perceived pattern of susceptibility. In separating out the products of these various scales of defense and allowing them to read independently, it is possible to show how the solution has always followed from the representation of the threat: the problem of pestilence having been, however, that there was always, at any time, more than one representation.

The problem of representation is illustrated in the question that asks whether the social body, like the individual body, is similarly sickened by an outbreak of epidemic disease, or, likewise, whether the presence of an epidemic of sickened individuals is enough to render a society pathological. The normal condition, as defined by Georges Canguilhem in his Essay on Some Problems Concerning the Normal and the Pathological, is the functional solution found by life as a response to the demands of the environment. Any manifestation of disease is itself, therefore, one of many possible norms of life, but an inferior one, in that it tolerates no deviation from the conditions in which it is valid—diseased life has lost the capacity, known as health, to establish other norms in other conditions. The patient is sick because he can admit of only one norm. Canguilhem admits that this concept of the biological norm begs the anticipation of a possible flexibility, easily transmuted to society as a normative institution, as a kind of homeostatic device. The difference, however, between the sickening of the social machinery and the individual living organism grows out of the different structures of the normative devices they employ, this difference being nothing more than a function of an evolutionary process that has proceeded through inverse modes. The biological evolution of organisms, Canguilhem explains, has
proceeded through a more thorough integration of organs and functions and an autonomous internalization of the conditions of existence—that is, the establishment of an “internal environment.” Human societies, however, have spread their means of action and regulation in spatial externality. In society, the solution to problems of information and regulation are sought, if not obtained, by the creation of institutions “parallel” to those whose inadequacy becomes evident at a given moment. While the diseased body undertakes a physiological realignment that renders the needs of the internal environment paramount over those of the external environment, the diseased society creates a series of encapsulated redundancies that force its internal structure into stasis in order to give priority to the external threat to health.

In exploring the social ramifications of disease, Michel Foucault, in the essay on “Panopticism” published as a part of his 1975 work *Discipline and Punish*, takes as a starting point two of Canguilhem's propositions: first, that the condition of disease is distinct in terms of value from the normative results it engenders; and second, that the new norms established by disease are irreversible, i.e. health is not a return to a previous norm. Foucault is thus able to assert that the city which most closely resembles the utopian ideal, that city in which the governmental bureaucracy exercises a direct and measurable power over all individual bodies, is that which recalls the sickened city, or more precisely, the city as it exists beset by plague. Foucault insists that all disciplinary technologies are the legacy of measures taken against plague, as plague represented the ultimate threat of social disorder and thus gave birth to the ultimate in social control mechanisms. Foucault’s project in *Discipline and Punish* is to trace the development of the modern “soul”, redefined as the product not of religious ideology, but as the individualized receptacle of a surplus of disciplinary power, a kind of non-corporeal organ which serves as the referent of a machinery of disciplinary knowledge, itself the heritage of plague.

In plotting his ideo-archaeological trajectories along a longitudinal plane, Foucault often invites, when he does not provide, innumerable lateral excursions, and it is at one of these cross-hairs that
this study finds itself: for if we were to take another historical trajectory and rather than follow the influence of the plague across a disciplinary lineage that traverses prisons, reformatories, and asylums, we followed from the plague an epidemiological lineage that navigates quarantine stations, pest houses, and sanatoria, would we not be faced with another kind of surplus—a surplus of pathology—that equally needs directing? By examining the threat of epidemic disease as the absolute sickening of the social fabric—though this is not to imply that there are not other ways the social body manifests disease—we can examine, to borrow Canguilhem’s terminology, the way the accumulated irreversible parallels of response have accrued, and we may suggest the guise that Foucault’s “soul,” here a receptacle for a surplus of pathological power, has taken. Thus, are not hospitals and public health infrastructures, rather than the Benthamite panopticon, the evidence of a surplus of an epidemiological evolution, beginning with measures against plague and culminating today with the Centers for Disease Control, whose disciplinary arm they constitute?

Pestilence has always been associated in the collective consciousness with retribution—the “Wrath of God” being the oldest theory of disease causation—and responses to epidemics have thus become a direct indicator of points of social unease and collective tension. Their architectural manifestation has developed as a natural sampling device, a mirror held up to society in which a foreign attack on the body public finds correlation with a socially held point of susceptibility. The response is, ironically, aimed both against the perceived source of the problem as well as against the site of attack. Defining the cause of epidemic disease has always been a way to protect existing social categories or power relationships, to define the boundaries of “normal” behavior, or to reinforce norms that seem to be threatened by marginal groups. The lazarettis which arose in fifteenth-century Italy were attempts to prevent the transport of contagious diseases directly associated with shipping and trade, but owe their resulting form more to the stress on the social body that resulted from the radical economic restructuring following the depopulation of the countryside after the Black Plague. Cholera epidemics in the mid-nineteenth century led to the establishment of epidemiology as an organized discipline and to the consequent practice of “mapping” incidents of occurrence in an afflicted area in order to diagnose and treat not bodily, but urban ills. The tuberculosis, or consumption, epidemic at the turn of the century initiated a response to the unmitigated capitalist development and the stratification of wealth taking place in cities by creating a backlash of Jeffersonian classicism and reestablishing a communal model of health. Currently, AIDS has demonstrated that advances in medical research have not eradicated epidemic disease; the shrinking space of international travel and the increasing expansion of development into tropical regions has created a situation in which contagion can again out-race control. The consequent unease which has resulted may be equally attributable to the ascendance of epidemiology and surveillance over physical quarantine measures and to the fact that the only physical structures to which society may now look are megaliths like the Centers for Disease Control in Atlanta, which operate seemingly invisibly, only occupying the space of popular and sensationalized literature and film.
The current virus panic in evidence in popular literature and film is the direct result of the fact that our favorite vices for explaining away epidemic occurrences have, with AIDS, been proven unreliable: the vice of rationalism allowed us to celebrate linear progress and reassuringly demonstrate how evil is overwhelmed by the good of scientific progress; and the vice of relativism permitted us to separate the event from its context in order to believe that nothing had really changed. Examining the encapsulated structures that have historically following from major epidemic outbreaks provides a context within which to analyze response without resorting to either of these often held vices: by priviliegding the scale of the response and its operational strategy over its historical or sociological pedigree, the lineage of epidemic disease management may be studied much like a sophisticated architectural program. Such analysis has shown that these physical structures and the spaces they create have been established within a reflexive geometry in which both disease and the measures established against it have been complicit. With new infectious diseases emerging at rates never before seen and old ones returning with renewed vigor, what Foucault called the “millennial gaze” has again paused over men’s sufferings and made it necessary to speculate upon the space that the next response will fashion.


ARCHITECTURES of the BODY
It is perhaps the overt utilization of brash, destructive protagonists and grotesque descriptive prose that causes Edgar Allan Poe’s allegorical tale “King Pest” to be tagged as one of his least valuable works. Being, however, more concerned with the complex interaction of body and environment than with any elaborate motivational study, the story proves interesting. Set at some point in the years 1327–1377, in the reign of Edward III—a time when England is repeatedly ravaged by outbreaks of the Black Death—Poe’s tale provides an opportunity to venture into the heart of the plague-stricken city, without thought for personal safety, in the guise of two drunken and plundering naval seamen. Halted in their carousing neither by monarchical mandate, which has, under pain of death, placed the “horrible regions, in the vicinity of the Thames” under ban; nor by the prospect of the “loathsome death” which will certainly overwhelm any “wretch whom no peril could deter from the adventure”; nor even by “the whole mass of forbidden buildings” in whose windowless habitations can be seen “the carcass of many a nocturnal plunderer arrested by the hand of the plague in the very perpetration of his robbery,” the two fearless drunks make their way toward the center of the stricken city. Having picked their way through such horrific obstacles, they are neither to be dissuaded by the fiendish shrieks emanating from beneath an undertaker’s door, nor by the residents they find therein. For inhabiting the undertaker’s quarters are a small group of less than hearty survivors, holding court as regal grotesques, each possessing a “monopoly of some particular portion of physiognomy.” One member of the party evidences her physiognomic excess in the mouth, which commencing “at the right ear...swept with a terrific chasm to the left.” Evidently in the last stage of a “dropsy,” a disease known for causing terrible thirst, she, like the others, is transformed into the very caricature of the disease with which she is stricken: it is less likely that the disease has created a gaping thirst where there was none before than that some unquenchable aspect of her personality has called the disease forth in its exaggerated form. The plague as it is represented by Poe is not a single affliction, but somehow takes its form based on the physicalterrain over which it treads. The body is here a truly contextual construct, shaping the pestilence rather than merely carrying it.

Poe’s anti-heroes, after leading the reader through paragraph after paragraph in which the effects of the plague are shown manifest upon the crumbling architectures of the city, are finally presented with the disease’s ravages on the bodily frame. Would it not be easier, asks the contemporary reader, to describe the character of the plague through a uniform image of suffering, an inevitable and identifiable pestilence through which the surrogate viewpoint moves, ever aware of its eventual similar fate? Were the story being told today, in an era in which pharmaceuticals and prophylaxis create a “clean” conception of disease as a single pathogenic invasion, when disease is held up to a symptomatic and micro-biological datum, the witless protagonists would move through a sea of bodies stripped of their individuality by a uniform affliction. At the time Poe’s allegory is written, however, what is seen in an epidemic assault was less a single disease as identified by a set of shared symptoms than a varied collection of maladies—the primary disease along with its opportunistic minions. When AIDS, that contemporary epidemic similarly characterized by a host of secondary afflictions, today becomes identified by pneumonia or tuberculosis it is only to protect the individual from the shame of a disease
The heedlessly courageous anti-hero is often called upon as a support for literary indulgence in macabre descriptive prose. Whether venturing headlong through blind alleyways or recklessly opening doors better left untouched, the dauntless protagonist of the horror genre exists to allow a reader those experiences that any inherent instinct toward self-preservation would warn against. This figure, usually less deserving of empathy than condescension, is created to serve as little more than a surrogate body, a fictional corpus which, though possessing all associated sensory capacities, is without advantage of reason and accountability. Early appropriated to the cinematic medium, the surrogate body, with its modicum of motivational supports, ventures into those situations and circumstances so horrific as to only be imagined. It is here that the mind/body split most literally locates itself in narrative form: the fictional body inhabits the descriptive context of the story, while reason and survival instinct find their frustrated expression in the mind of the reader or viewer who is unable to effect change in the “bodily” narrative.
that society would see as, itself, an allegorical figure. The opportunist is called in to serve euphemistically as an identifying facade when the epidemic malady under which it falls might provide too much information about the personal circumstances or life choices of the afflicted. While Poe's opportunistic diseases provide a physical commentary on their sufferers, the diseases associated with AIDS serve to cloak the true identity of the afflicted.

Carried along with Poe's anti-heroes into a confrontation with a bizarre court of pestilential caricatures, the reader embarks upon far more uncertain territory than if the disease had been painted as a uni-faceted scourge; it is territory the more fearsome because the outcome is uncertain. Poe's horrific tale becomes allegory when, at this confrontation, the reader is no longer allowed to remain the omniscient observer, but is forced into the position of subject, encouraged to speculate as to what form the plague would take were it to tread upon his own personal ground. And after the ill-mannered behavior of the carousers leads them fleeing hastily to the dock, carrying in tow not just the lady with the dyspeptic heart, but her companion at court, the Arch Duchess Ana-Pest, the reader's viewpoint quickly shifts again. As the plague, in the form of the captured female courtiers, is carried back to the ship, the reader must finally dispense with the luxury of both the surrogate body and the omniscient viewpoint: as the surrogate body, in the form of the protagonists, is threatened, so, figuratively, is the reader's. All bodies, in all ports of call, suddenly become the tale's new setting, "outside" soon becomes inside, and any concern for bodily harm that follows from being carried along on the fantastic narrational journey soon locates itself in the potential outcome of the journey's destination. The disease will again find the context that exaggerates its internal architecture: it will find in the cities it hits the place most like "the vicinity of the Thames"; in these cities, new buildings will decay in the order of their proximity to the pestilence--the degree of abuse they sustain in direct proportion to the riches they contain; and fresh bodies will sicken at their personal points of greatest concentration.


Ibid., 246.

Ibid.
Leprosy was the patriarch of a family of diseases—including smallpox, measles, and syphilis—which were known by their particular capacity to mark and disfigure the flesh, and which consequently inspired the earliest tactics for the bodily quarantine of the diseased. It was in these horrific dermatological pestilences that contamination was most easily imagined and observed, and they provided a model for defilement that went beyond their corporeal origin. The medieval mind could not but overlay the judgment of the Almighty upon a disease such as leprosy, which felled the unclean in slow progression. Though the methods employed by medieval Europeans for dealing with the affliction were based on history’s first definitive implication of contagion, the written recognition of the potential of an epidemic to spread by direct contact between the sick and the well that was described in Old Testament writings, they added to the ancient Hebrew’s clear strategic program of diagnosis, isolation, quarantine, and disinfection the elaborate ceremony of the living funeral. The leper was hereby induced into a community of the living dead with whom he resided outside the city walls in the monastically-fash-
ioned leprosarium. He could enter the city, but only in proscribed
dress, sounding his approach with a wooden clapper. Though he
was allowed the bodily freedom to move through many of the
spaces he once frequented, he did so surrounded by a contractual
bubble, a socially-determined space beyond which the contagion
could not pass, a space constructed by the practice of costume.
Akin to the personal space of contagion established around the
leper was the space of health fashioned by those whose work
brought them in contact with the defiled community: personal
protection was maintained by carrying a long rod demarcating the
perimeter around the healthy body within which the sick could not pass.

In the eighteenth century, the creeping rash of smallpox supplanted leprosy as the prime source of
external disfigurement. Leprosy, the disease that from antiquity down through the middle ages had
symbolized impurity, sin and defilement no longer held sway over the enlightenment mind, nor did it
present a real threat to the enlightenment body. Smallpox, first differentiated in the sixteenth century
from the huge pustules of syphilis—the great pox—was what literally transfigured and transfixed the
eighteenth century. Removed from any venereal kinship, its evil was without moral association, exist-
ing in its ability to permanently mar, when it didn’t destroy, the body as an integral whole, its ability to
deface classical beauty. Leprosy’s slow progress through a relatively isolated, medieval community
made it a relatively simple matter to single out those with the affliction and separate them from the
general populace. Equally feared for the brutality of its disfiguring, if not lethal, outcome, smallpox
came in widespread, sudden, and unpredictable attacks, and, as
such, was unique in the terror it inspired. If leprosy had appeared
as the slow, premeditated judgment of God, smallpox was akin to a
natural disaster, a great pestilence that scarred indelibly the bodily
landscape. With its recurring waves which increasingly focused its
ferocity on children, it did, in fact, seem to have more relation to
the whims of the natural environment than to any providential
prognostications.

Medical thought in the ancient tradition of Hippocrates associated
disease with a natural cause, this cause being but an imbalance of
the material constituents of the body provoked by atmospheric and
climatic conditions. Rhazes, the tenth century Persian diagnostician
and clinician, sought to explain the ubiquity of smallpox by
describing it as the natural by-product of an atmospheric interfer-
ence in the normal physiological change from the hot, moist blood
of children to the cold, dry blood of adult life. Smallpox occurred,
Rhazes believed, when this normal fermentive change was delayed by an undue proportion of heat and moisture in the air. The disease would, accordingly, only erupt in adulthood when similar “pestilential, putrid, and malignant constitutions of the air” caused the blood to become overheated in certain predisposed cases. Just as it was logical to assume the epidemic constitution of the atmosphere to explain mass epidemics, so was it necessary to invoke individual predisposition to account for the fact the even mass epidemics were not universal in their incidence. Eighteenth century medicine, following in the tradition of Rhazes and Hippocrates, was *humoral* medicine, meaning that both individual bodies and places could be characterized in terms of an inherent opposition of primary qualities—hot and cold, wet and dry—and any malady, or constitutional disturbance, could be rectified by balancing the prevailing inequality by changes in regimen or place, by medicines which would raise or depress, by bleeding, by applying warmth or cold, by over-feeding or starving, by vomiting or purging.

Of all the various remedies that would be employed through the ages to treat smallpox, however, the most curious and persistent were based on widely held beliefs in the therapeutic efficacy of red objects. As humoral medicine in its most ancient guise, the conviction that the color red could help cure smallpox was at least as old as tenth century Japan, when the *I Shinho* first advised the hanging of red cloth in the sickrooms of persons with smallpox. Though the “red treatment” took many forms in the many cultures in which it was practiced, it existed with some similarity within ancient China, India, Turkey, Asian Georgia, Africa, and in western countries after the dissemination of the twelfth century writings of the Moslem physician Averroes. Gilbertus Anglicus in his *Compendium Medicinae* (c. 1240) not only included a long description of the causes and varieties of smallpox, along with its first attribution as a contagious condition, but also advised the use of red-colored items to treat patients with the disease, making him the first known European author to do so. Only two generations later, another Englishman, John of Gaddesden, boasted of curing King Edward II’s son of the disease by surrounding the young prince John with red blankets and red curtains, and by giving him red liquids to drink.

**FIGURE 1:**
A leper with clapper and bowl as illustrated in the thirteenth-century "Mirror History" of Vincent de Beauvais.

**FIGURE 2:**

**FIGURE 3:**
Red images such as this nineteenth-century print of legendary Japanese archer, Ch. Hachiro Tamesato, were often hung in Japanese homes in the belief that they could prevent or cure smallpox.
and when France's King Charles V caught smallpox, he was dressed in red shirt, red stockings, and red veils to aid his recovery. The king's body, without recourse to the reasoning capacity of his mind, was responding directly to its environment, and more specifically to the color in which it was wrapped. The color red, it was assumed, was drawing his blood to the surface and provoking a more intense exanthem. The treatment was balancing the tendency of the diseased blood to fester under the skin and produce multiple, disfiguring eruptions. It called forth the hot blood and allowed it to cool.
Medieval leprosy was not the same condition known today as Hansen's Disease but would have been identified by similar symptomatology.


Ibid., 28.
In the conceptual transition represented by the opposing figures of the defiled medieval leper, from whose body emanated a cloud of pestilential punishment, and the scarred enlightenment royal, upon whose person was placed the ultimate sign of his environmental sensitivity, was a fundamental shift in the location of the material origin of disease with respect to the body. Though the doctrine of epidemic constitutions competed with several other beliefs in eighteenth century medical thought—some practitioners attributed smallpox to an environmentally-induced change in the innate “seeds” present in every human being at birth; some held with the corpuscular theory, which likened contagion to tiny particles that affected the body in a manner analogous to a poison; and still others held with the less popular animacular theory, according to which smallpox was caused by tiny, living, “animated atoms”—the various prevailing models of the pathological world all placed the toxic influence external to the afflicted body.

Medical circles in enlightenment Europe sought new methods for controlling epidemic attacks that relied less on a traditional
solution of isolation and quarantine which evolved in an era of
defiled and contaminated bodies, and they eagerly received reports
of a new, more effective way to prevent the dreaded pox. Joseph
Lister, a trader for the East India Company writing from Amoy,
China, in a letter dated 5 January 1700, described to Dr. Martin
Lister the ancient Chinese practice of inoculating persons with
infectious material from mild smallpox cases by inserting dust from
powdered scabs beneath the skin. This practice, which gained
receptivity in Europe and the American colonies along with many
Eastern ideas at the time, allowed the inocullee to obtain immunity
at less risk of death than if he had acquired the disease naturally.
Though the newfound ability to “buy” one’s protection from the
disease definitively argued for a specific material cause, it was not
sufficient to eradicate the perceived role of personal predisposition.
Unlike cholera epidemics which were known to take their victims
predominantly from among poor, urban populations, smallpox had
irreparably scarred enough promising careers at court to have
been presumed to gain severity from luxurious living. Once weeks
of elaborate, supervised medical care and diet before and after the
procedure had been deemed integral to its success, smallpox inocu-
lation became an expensive operation available only to the
privileged classes.

The “red treatment” for smallpox, in seeking to balance the de-
structive tendencies of the disease through the manipulation of the
body's environment, hinted at the possibility of externally accelerat-
ing the course of the disease by drawing the infected blood
quickly to the surface and encouraging early in the course of the
sickness its dermatological eruptions. With the development of
inoculation, a true strategy of acceleration was realized. Immunity
could be rendered by deliberate infection with a pox that would
progress so quickly as to leave very little trace of its presence on
the body. Smallpox in its inoculated form, however, still proved
risky to the individual and his or her contacts as it retained,
however reduced, its lethal and contagious potential. When Edward
Jenner (1749-1823) demonstrated that the passage of the smallpox
virus through cattle so altered its plasticity that it could then cause
no more than a negligible local reaction in man, while nevertheless
retaining the fundamental biological properties by which it immu-
nized him, it suddenly became conceivable that smallpox in its epidemic form, smallpox as it affected en masse entire populations, could be so accelerated that the course of the attack could be moved ahead on its inevitable natural timeline to the point at which it would have exhausted its supply of non-immunes within the population. Jenner himself predicted only a few years after the discovery of vaccination that "the annihilation of smallpox—the most dreadful scourge of the human race—will be the final result of this practice."12

The cowpox vaccine, obtained through a natural, zoological source, could nonetheless be propagated from arm to arm, body to body. Rather than confirming the conviction that the disease's source was located external to the body, vaccination had, in fact, made it increasingly unclear whether the predispositions of the body were more sensitive to the effects of a hostile natural environment or to the productions of other sickened individuals. By the turn of the nineteenth century, smallpox had contributed to the distinction that was being made between those toxic agents which resided in the atmosphere and thus entered the body internally and

FIGURE 1:
Vaccinating by the puncture method: the needle tip is passed through a drop of the virus before entering the skin.

FIGURE 2:
Chinese inoculator and patient. Immune smallpox was induced by blowing powder smallpox scabs up the patient's nose.

FIGURE 3:
Instrument for making the inoculation incision.

FIGURE 4:
James Gillray's 1802 etching, The Cow-Po, illustrated the concern that Edward Jenner's vaccine might threaten the purity of the race by producing bulbous hybrids and animal-shaped eruptions.
those which were associated with the body and entered via the skin. If the agent resided in the atmosphere, anyone who lived in an affected area could become ill: this was infection. If the agent was, on the other hand, associated with individuals, then the disease must attack each person in succession: this was contagion.

Smallpox, having been associated with the skin, became the model contagious disease by which all others were judged, the epistemological model of contagion having included a mode of contamination coupled with a technique of prevention. Sir John Simon, in his 1878 article “Contagion” prepared for Quain’s Dictionary of Medicine described these particular pathogens when he wrote:

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\text{The true or metabolic contagion in their respective and specific ways, operate transformingly on the live bodily material which they affect...the identity of each separate true contagion is settled in experimental and clinical observation by the uniformity of the operation of each on any given animal body which it affects. Each of the diseases propagates itself in its own form in as exact identity, as if it were a species in zoology or botany; and in each such repetition of the disease there is a multiplication always a large, and sometimes an inconceivably immense multiplication, of material which has the same infective property...however minute may have been the quantity of contagium by which the disease was started, the patients’ diseased body (part or whole) yeilds for the time an indefinitely large supply of the specific agent.}^4
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The contagious diseases then, like smallpox, were those which had found in the body the raw materials necessary for their continuous propagation. The body, as the soil in which the disease took root, could not help but to accelerate the production of the disease in infinite multiplicity, the contagious element having become identified as a “germ,” akin to a seed that had been passed from body to body. This doctrine of morbid specificity, in emphasizing the action of a specific pathological agent, had relegated the influence of atmospheric conditions with relation to smallpox to second rank and had been a step in the medical unification of cause and effect. With such a conception of disease, avoiding the cause had meant preventing the effect, or with vaccination, neutralizing the cause by accelerating the effect. It had become natural, therefore, to think in terms of tactics of avoidance—the legacy of segregationist practices—in order to confine individuals within isolated and supervised areas until the germs had been liberated or neutralized. Adherents to the contagionist model of the pathological world as it had been illuminated by techniques of vaccination and inoculation had unwittingly re-embraced the ancient belief in the absolute connection of body and disease and the ancient practices associated with their therapeutic disconnection.

Though they admitted smallpox to be the contagious exception, by the early nineteenth century, contagionism as a conceptual model lost its persuasive power within the established medical discourse. It involved a notion of disease that seemed fantastic and old fashioned: namely, that disease operated as
a kind of demon which took control of the body. More so even than its antiquated associations, a certain logical weakness argued against the widespread embrace of contagion theory: it presupposed the existence of a external cause or source of infection which, upon entering the body, produced a particular illness. In addition, failure in the early nineteenth century to demonstrate that other diseases were propagated like smallpox led to the assumption that smallpox was but the exception to the pathological rule and that new diseases must follow from environmental sources. The anomalous character of smallpox actually encouraged the Hippocratic tradition: it followed that diseases like cholera, for which there was no acquired immunity and no ability to inoculate, were the result of widespread exposure to an infected atmosphere, the body having become impregnated by the deleterious “miasmata” present in its surroundings. Thus was explained cholera’s tendency to single out certain of the urban poor, such as the disproportionately infected gut-dressers and cesspool-drainers who became the Parisian physician Francois-Joseph-Victor Broussais’s (1772-1838) classic examples of lives spent in the midst of putrid emanations. Disease was, for the infectionists, determined not by the amount of such emanations absorbed by the body—as the contagionists were likewise unconcerned with the original quantity of contagious material consumed—but by the degree of physiological irritation, the amount of inflammation sustained. Just as it was necessary to extinguish the inflammation within the body, so too was it urgent to eliminate the sources of infection in the environment, to disinfect or neutralize the noxious emanations, to drain the swamps, and to prevent the accumulation of waste. The cure existed outside the body, in the removal of the irritant. In Broussais’s view, man existed through the excitation exercised on his organs by the environment in which he was compelled to live, and treatment, consequently, lay in adjusting the amount of excitation. For Broussais and his colleagues then, the distinction between health and disease was soon to become a simple quantitative one limited to the terms of environmental deficiency and excess.\footnote{\textit{ibid.}, 55.}
The program of medically-supervised self-denial embarked upon in preparation for smallpox inoculation was product of an era in which personal predisposition was perceived not as an inherent personal trait, but as a constructed condition. Predisposition, as it was defined in the pre-inoculation era, referred to the body's innate capacity to absorb or to be effected by environmental fluctuation. The proponents of infection theory, however, began in the early nineteenth century to collapse the distinction between the properties of the body and the properties of the environment which, though long held to be mutually affecting, previously maintained their own, unique, behavioral logic. As Michel Foucault described in The Birth of the Clinic, medical prescriptions and interventions were beginning at the time to be formed relative to a new standard of functioning based on the growing prestige of the life sciences, whose role as model was “linked originally not with the comprehensive, transferable character of biological concepts, but, rather, with the fact that these concepts were arranged in a space whose profound structure responded to the healthy/morbid opposition.” To organic space was being attributed a certain
plasticity, responsive to the salubrity or toxicity of the conditions in which it was maintained. The tools of the diagnostician, schooled in the tenets of infectionism, were required to ascertain both the relative health of the body and of its surroundings, and the resulting diagnosis was nothing less than a denunciation of society as it was then constituted.

Though the elaborate preparations for smallpox inoculation had implied a connection between lifestyle and disease, it was the affliction known variously as consumption, tuberculosis, or phthisis, which, beginning in the nineteenth century, made corrupting civilization key to its etiology. While the great epidemics of the past had struck each person as a member of an afflicted community, tuberculosis isolated its victims by singling them out, one by one, in slow progression. Like leprosy, the affliction produced an overt and highly contagious illness only after months or years of infection. While the bubonic plague killed in a matter of hours, and smallpox in a matter of days, few were felled by tuberculosis without years of debilitating illness. While the prevailing infection theory, in its concern with cholera, reduced the complex self to a sick environment, it was necessary to the profile of consumption to place the individual in relief against his or her environment. Society’s attempt to reconcile consumption’s individual assaults with an historical response evolved to cope with epidemics of rapid and accelerated virulence thus produced a pathological profile complex and often paradoxical. Predisposition and environment were conflated in the causal picture, in a relationship not dissimilar to the physical/spiritual dualism constituting the prevailing vitalistic cosmology. Punitive ideologies involving the belief that disease fit the sufferer’s character like a punishment fit a crime evolved at this time into a notion that disease expressed character as a product of the will, as another form of self-expression. As the victim was “consumed” and reduced by the disease, his or her existence became spiritualized. As the body dematerialized into liquid, the “encumbering accretions of the victims personality melted away, revealing the spiritual matrices out of which the transitory and illusory accidents of his character had been formed.”

The publicity given to the deaths of celebrated consumptives in the early nineteenth century created the impression that the affliction was unusually partial to the sensitive, passionate and exceptionally creative. For parvenus and social climbers, consumption was quickly appropriated as an indisputable physical index of gentility, modeled after the fashionable phthisic beauty portrayed by the Pre-Raphaelite and Symbolist painters and popular consumptive authors such as Percy Shelley, Ralph Waldo Emerson, and Henry David Thoreau. The penchant for genius shown by the disease was important enough to its profile to warrant medical explanation as late as 1922, when Dr. Maurice Fishberg explained in his treatise
Pulmonary Tuberculosis:

The intellectual powers of the genius are quickened by reason of the general psychic excitation resulting from the action of the tuberculous by-products. It appears that as a result of a prolonged state of the poisons resulting from the metabolism of the tubercle bacilli, as well as of the products of decomposition of the affected lung tissue, the consumptive is in about the same mental state as those who are under the influence of mild alcoholic intoxication.³

Illness was as much physical as behavioral dissolution: the consumptive disposition was as impressionable physically and constitutionally—whether to internal or external influence—as it was mentally and spiritually. Within the cultural heritage bequeathed by the tuberculosis epidemic was the startling and decisive realization, as expressed by Foucault, that our culture’s “first scientific discourse concerning the individual had to pass through this stage of death.”⁴

The romanticization of consumption was an inseparable part of that distinctively modern activity, promoting the self as an image. After social and geographical mobility made worth and station no longer pre-determined, Romantics embraced the project of assertion, and reinterpreted illness as a pretext for leisure and for dismissing bourgeois obligations in the name of artistic and spiritual edification. Consumption, demanding rest and flight from unhealthy surroundings, was the ideal affliction with which to retire without personal responsibility. It supplied a ready made model of the bohemian life, lived with or without the vocation of the artist. The consumptive was the consummate dropout, the wanderer in endless search of the salubrious landscape.⁵ By the early nineteenth century, consumption was the new justification for self-imposed exile.

As the preeminent literary embodiment of the phthisic disposition, Hans Castorp, was “true to type.” Product of a dank and humid port city, he bore the additional disadvantage of having “liked good living, and notwithstanding his thin-bloodedness and look of overrefinement, [he] clung to the grosser pleasures of life as a greedy

FIGURE 1:
Wispv. elongated physiques signified it in the 1920s and 1930s. The “pigeon breast” was a visual marker of an individual’s propensity for weakness and disease.

FIGURE 2:
Illustration accompanying a short story which appeared in McClure’s Magazine. Such images of consumptives were meant to convey the presence of a powerful and consuming force within their earthly b
suckling to its mother’s breast.”* Product of Thomas Mann’s brief bout with tuberculosis, Hans Castorp, the legendary protagonist of The Magic Mountain, was the very realization and expression of the consumptive personality, and, in the fashion of his creator, sustained in disproportionate abundance the cognitive influence of his “simple but tedious case.”* Tuberculosis produced, in all respects, the very denial of any conceptualization of a linear formula—-it always produced in paucity or excess of the conditions of its instigation. The retreat from “the flatland” to the clean air of the sanitarium environment, located high in a mountainous landscape, was not simply a retreat from the conditions of malignancy to health: the symptoms of the disease did not merely drop away the further one got from corrupting civilization. The cure was as fickle as the disease itself.

Though Hans Castorp ventured to the Sanitarium Berghof merely to visit his ailing cousin, Joachim, his stay extended long past Joachim’s ultimate demise. Castorp’s degree of health at the time of his arrival, however, was ultimately inconsequential. Placed before the untainted sanitarium environment, what product of modern progress could appear unailing? Hans was given to the realization that “an unfavorable influence exerted upon a man’s personal life by the times in which he lives may even extend to his physical organism.”† Doctor Krokowski, the sanitarium’s resident psycho-analyst, in corroborating that never in his life had he “come across a perfectly healthy human being,”‖ also implied that it was society itself which, in creating desire and passion, engendered disease. Society, as an imperfect construct, was a sickened state, unable either to recognize the signs of health or to support them. Hans’s mentor Settembrini, rationalist disbeliever in the sanitarium cure, argued that it was nothing more than an error in thinking that “the well man attributed to the sick his own emotional equipment, and imagined that the sick man was, as it were, a well man who had to bear the agonies of a sick one...For the sick man was—precisely that, a sick man: with the nature and modified reaction of his state.”‖ The sanitarium itself, that supposed cathedral to the cure, is nonetheless populated by “all this tuberculous crew...with their reckless folly, light heartedness and loose morals, and their total lack of desire for health.”‖ Hans Castorp’s person, seeking to cure itself of the malignant influence of the modern world, unwittingly adapted to another norm of unhealth, a society constructed literally in accordance with disease.

With the increasing progress of the tuberculosis epidemic, the being of disease, as a biologically or zoologically determined entity, disappeared as a dominating structure. By the first quarter of the nineteenth century, when Poe described in “King Pest” a band of grotesques variously and uniquely disfigured by a single pestilential attack, the pathological phenomenon no longer existed in conformity with any dominant type that preceded it. Disease, reconfigured as the complex movement of tissues in relation to an irritating cause was, in the words of Foucault, caught in an “organic web in which the structures are spatial, the determinations causal, the phenomena anatomical and physiological”.‡

Disease is no longer a bundle of characters disseminated here and there over the surface of the body and linked together by statistically observable concomitances and successions; it is a set of forms and
deformations, figures, and accidents and of displaced, destroyed or modified elements bound together in sequence according to a geography that can be followed step by step. It is no longer a pathological species inserting itself into the body wherever possible; it is the body itself that has become ill.\textsuperscript{15}

The idea of disease attacking life was replaced by the notion of pathological life. "Living consists in dying," was the realization expressed by Hofrat Behrens, resident physician of the Sanatorium Berghof. Life was but that which remained consistent through the pathological translation of the bodily form, which was, for Poe, evidenced by that aspect of personal character which gave its shape to the ravages of disease. For Behrens: "Life is life which keeps the form through change of substance."\textsuperscript{16}

In the x-ray room of the sanitarium, Hofrat Behrens permitted his patient, at his request, "to look at his own hand through the screen. And Hans Castorp saw precisely what he must have expected, but what is hardly permitted man to see, and what he had never thought it would be vouchsafed him to his vision: he looked into his own grave...and for the first time in his life he understood that he would die."\textsuperscript{17} Modern technology, in the hand of the medical practitioner, had provided a mechanism that, by allowing the imagination an accelerated viewpoint with respect to the "change of substance" that the body was undergoing, created a space that collapsed the living figure onto the death of disease. The x-ray, scale, and thermometer, diagnostic trinity of the sanitarium cure, were not just tools of measurement but technologies of prediction: they produced a objective, calibrated record of the course of bodily deterioration which had before only been felt subjectively by the patient.

\textbf{FIGURE 3:}

Portraits of new medical technologies featured a male physician/technician administering to a partially-clad female. Such representations suggested that sex and power were embedded in touching looking at the human body, as in this illustration of Victor Rohntgen Radiography Stand, an apparatus for x-ray examination.
With the increasing popularity of microscopy, physiologists succeeded in replacing vitalistic doctrines with a mechanistic theory of biology, positing a material rather than a spiritual basis for life. The human body was better characterized as an organism than a being, and its mechanical functioning could be better served by the physician with the most sophisticated tools: “We now use as many instruments as a mechanic,” explained S. Weir Mitchell to the Congress of American Physicians and Surgeons. Though such technological breakthroughs had provided physicians with an accurate understanding of the cause and progress of the disease, their knowledge of the disease’s specific mechanisms had failed to keep pace with their grasp of its etiology. Physicians were placed in the uncertain position, described by Caldwell, in which:

To maintain their authority as practitioners, as healers, rather than as mere theoreticians or pathologists, they needed to be as specific and methodological in their cures as they were in their diagnoses, and this proved elusive... So the physician always hungered after more method than science had so far afforded him: it had uncovered so much that it came, perhaps, to seem that method itself, in any form, was salubrious.

2The disease known as “consumption” had been on record since the fourteenth century, but the epidemic with which we are here concerned achieves its characteristic profile with the advent of individualism.


4Ibid., 17.


6Foucault, 197.

7Sontag, 33.


9Ibid., 447.

10Ibid., 314.

11Ibid., 16.

12Ibid., 467.

13Ibid.

14Foucault, 189.

15Ibid., 136.

16Mann, 266.

17Ibid., 218.


It had become difficult after years spent at the sanatarium Berghof to explain the presence of Hans Castorp’s fever, which had persisted for years accompanied by little other sign of the debilitating illness. Having had every other aspect of his existence irrevocably altered by his sojourn, Behrens’s conclusion, “that a man can even have tubercular bacilli in his blood without being any the worse for it,” was severely anti-climatic. It was nothing less than a cruel trick of the body, to have forced the adaptation of the spirit to the life of disease without providing for its physical justification. Behrens, himself, as overseer of a cure founded upon the conviction of the body’s responsivity to improved conditions of life, was being forced to admit to the insignificance of his efforts: “We aren’t more than three steps away from the conception that tuberculosis is a disease of the blood.”

Responsible for having brought the contagionist/infectionist controversy to a temporary draw, tuberculosis had, however, caused notions of disease causation to undergo a geographical translation: the complex of personal predisposition, in conflating
physiological history with environment, had made it possible to profile disease through the investigation of anatomical pathology. Disease pathology, understood in the grand tradition of clinical anatomy, had been thought to follow from the derangement of the normal relations between the body's differentiated colonies of cells. The most promising avenue of investigation into the cause of a disease such as pulmonary tuberculosis had been, then, the postmortem examination of diseased lungs and a comparison of these to their healthy counterparts. Careful correlation of this data would, the theory ran, gradually coalesce in an accurate and detailed picture of the course of the disease. Pathologists, committed to the understanding of disease as a modification of internal geography, conflated in a paradoxical mix infectionist tenets and convictions in internal causation. Likewise, infectionist support of external causation had, with the discovery of the bacterial cause of tuberculosis, been wedded with the contagionist belief in a "germ" or "seed" that could be transferred from body to body, and the term etiology had been coined to describe disease as a penetration of bodily defenses by a pathological invasion.

The legacy of infection theory was at first strengthened by microscopy's discovery that microorganisms, as a group, were "extra-corporeal" and most easily observed in dead animal and vegetable matter. Robert Koch's 1882 discovery of the microbial cause of tuberculosis proposed not only a specific organismic mechanism for disease transmission, but gave credibility to a research methodology as delaminated from the body of the afflicted individual as the "miasmic" model which preceded it. Through the iteration of his "postulates," Koch developed a methodology which removed pathological investigation from the body of the infected and transferred it from the clinical autopsy table to the laboratory. Tuberculosis was no longer to be identified by its symptomatic profile, but by its ability to first be isolated from the body in the form of a recognized and universally present bacterial organism; secondly, to spawn a pure culture of identical microorganisms in a laboratory environment; and, lastly, to infect a sacrificial laboratory specimen.

With the ascent of the practice of bacteriology, the person of the sick, as an individual manifestation of symptomatic events, became irrelevant to the profile of tuberculosis. As photomicrographs or drawings of bacilli increasingly became the common illustration accompanying articles on tuberculosis in the popular and scientific press, the image of the bacillus began to substitute for the identity of the consumptive. The microscope had, for the first time, supplied a counter, trace, and definitive to the historical notion of contagion. Once the progress of an epidemic could be tracked by a
simple sputum test as it spread from victim to victim, the resulting increase in social control could be easily justified: the individual was a mere site or “case” in a statistical profile, and in the words of Milton Rosenau, “a case isolated is a case neutralized.” It took the bacteriological era for tuberculosis to assume the mantle of a great pestilence, with all associated concern for contagion and quarantine, for by the last decade of the nineteenth century another Koch discovery had made it possible to definitively assert the origin of disease within the body.

It was in connection with the study of the cholera epidemic of 1892-93 that Koch and his fellow investigators found that among a number of persons who had been exposed to the cholera-causing bacteria, there was evidenced a range of severity of reaction. From the most severe and rapidly fatal cases down to the mildest imaginable, each maintained the presence of the microorganism. The only conclusion that could, therefore, be drawn was that any attempt to diagnose disease from symptomatology alone was seeing only half the picture, and that the potential for epidemic severity lay in the presence of transmissible bacteria rather than the degree of sickness it caused in any individual case. In attempting to create a practical, laboratory method for the detection of human sources of infection, Koch had succeeded in focusing attention on the individual infected human being, sick or well, and in giving rise to the medico-philosophical concept of the “carrier.” The remarkable explanation proposed by Koch for the symptomless carrier was that bacteria were actually parasitic and that the presence of disease was nothing more than evidence of a poorly adapted symbiotic relationship between a bacteria and its human host. It had previously been thought that a disease took root in some persons rather than other because a virus or germ was like a seed: it sought the human “soil” most like that from whence it naturally arose. Following the realization that bacteria were actually parasitic, that is, that their existence outside the human body was the exception rather than the rule, it became apparent that the disease had actually found the “best soil,” so to speak, when it created a symptomless illness. The disease was more likely to survive in the body when it presented no challenge to the functioning organism and was thus given more opportunity to spread unknowingly from

FIGURE 1:
Ali Maow Maalin, the world’s last case of naturally occurring smallpox. Maalin’s reversion began on 10 October 1977 in Merka Town, Somalia.

FIGURE 2:
A drawing of anthrax bacilli by Robert Koch, who discovered these rod-shaped, pathogenic microorganisms in 1876.
person to person.

Infection theory, which carried a certain optimism with respect to its therapeutic application, was no longer tenable. The utopian aspect of the sanatorium cure, progressively undermined by Thomas Mann in the telling of Hans Castorp’s tale, was ultimately to be sacrificed to the increasing realization that disease could not be cured by orderly or moral living. It was the legacy of the age of leprosy that man was without responsibility for his own suffering; it was the danger of “touch” in its most active and willful sense that brought on the moral and physical debility. Both the words “contagion” and “contamination” were derived from the Latin for “contact with filth,” and “miasma” from the Greek word for “defilement.” With the advent of the bacteriological era, however, it was the mechanical, rather than moral, aspect of touching which gained prominence and ultimately eclipsed the idea of infection. Disease now represented little more than the unwitting contact of the healthy individual with the vehicle of the germ, and the diseased person no longer bore any responsibility for the disease. The body of the sick was but the most obvious carrier of the virus, and a healthy person or an inanimate object could pose an equal threat. “Disease is no longer related to individual responsibility,” stated Georges Canguilhem, “no more imprudence, no more excess to incriminate, not even collective responsibility as in the case of epidemics. As living beings, we are the effect of the very laws of the multiplication of life, as sick men we are the effect of universal mixing, love and chance.”

Any moral responsibility for disease lay with the parasite, itself: as an organism adapted to existence in the tissues and cells of a higher form of life, it had, like human beings that have become parasites on society, lost the capacity to earn an “honest” living. No longer spiritualized and ennobled by the disease, the tuberculous, by no fault of his or her own, could not help but take on the parasitic nature of the organism he or she housed. It was here that optimism was temporarily lost: if tuberculosis was now understood to be transmitted like smallpox, it was necessary to revert to treatments derived from the disease itself, rather than from progressivist, utopian tactics. The idea of vaccination was, to Hans Castorp, nothing short of an “absurd, contemptible” abomination. This inoculation of himself with part of himself seemed a singularly cheerless procedure, an incestuous abomination, a self-to-self which could have nothing but a fruitless, hopeless, result.

The germ theory of disease, however, soon turned disappointment to optimism, for the new-found ability to see a specific cause made it possible to envision a specific measure of prevention. Because it had been impossible to see miasmas or environmental influences, the actions taken against them had been politically involved and complex. Though vaccines failed to prevent tuberculosis, antibiotics were soon developed which could finally provide, through the relative simplicity of drug therapy, the measure of control that had been lacking in nearly a century of struggle against tuberculosis. In addition, any pessimism engendered by the understanding that a scheme of disease prevention which failed to take into account the fact that there were always more diseased in an epidemic than there were sick was doomed to failure was soon pushed aside by the realities of smallpox. In the mid 1960s, the World Health Organization and the Centers for Disease Control, riding on a wave of success
brought by the Salk polio vaccine, were able to conceive of the global eradication of smallpox only because the disease had no carriers. What, in fact, made smallpox truly exceptional was that all infected patients evidenced an obvious, easily recognized rash, and by isolating them and vaccinating their contacts, the disease could be prevented from spreading.

The eradication strategy applied to smallpox attempted to employ an “around the block, house by house” method, conceived in terms of reaching all susceptible victims with vaccination. In Africa, where newly independent nations were eager to improve the quality of life, this meant tying smallpox eradication to measles vaccination, a foremost concern on a continent in which nearly ten percent of all children died of measles before their first birthday. For a tiny additional cost, smallpox could be eradicated from all of West and Central Africa while measles was curbed. While in the midst of the West African campaign, however, the Smallpox-Eradication Program made the controversial recommendation that vaccination for smallpox be abandoned in the United States. It had been found that the side effects of universal vaccination were more statistically dangerous in the U.S. than the modest threat posed by the disease’s importation into the nation’s heavily vaccinated population, and with the reservoir of smallpox steadily dwindling, risk of such importation was small. Should a case be imported, rigid public health surveillance would be sufficient to prevent its spread. In September of 1971, the surgeon general therefore suggested that routine smallpox vaccination no longer be performed in the U.S. With fewer and fewer susceptible bodies from which to jump, the disease was being steadily backed into a human corner.

FIGURE 3:
The global smallpox eradication program first sought to vaccinate each and every susceptible individual in countries in which the disease was endemic. Here, a Tuareg native receives a smallpox vaccination in Mali, circa 1967.
but it was only on October 26, 1977, when Ali Maow Maalin recovered from the last naturally occurring case of smallpox, that the disease was eradicated through its ultimate disembodiment. Through its removal from the body, it had become completely de-territorialized.

2Ibid.


6Mann, 657.
The smallpox virus is a terrorist. It moves from one human cell to the next by forcing the cell’s own reproductive apparatus to replicate only virus, packing the infected cell to the point of rupture, and causing millions of infective Variola Major to be released into the immediate environment. The smallpox virus is a member of that group of microorganisms, neither definitively living nor non-living, which constitute a mobile collection of parasitic genetic fragments whose disembodied state requires them to locate a surrogate metabolism. Unlike the bacteria which cause tuberculosis, single cell microorganisms which reproduce by simple division in the soft tissue, blood, and bone of their host and which harm by the accumulation of their poisonous waste, a virus cannot be controlled by a chemical defense. Though a bacterial infection can be suppressed by the chemical inducement of abnormal levels of toxicity within the colony’s bodily environment, it has so far been very difficult to find chemicals that will inhibit a virus without harming the host cell at the same time. Its defensive strategy lies in its absolute interiority with respect to the body: the virus literally seeks to transform the body, from its base genetic
code outward, into the virus, itself. The principal strategy for dealing with viruses, therefore, is vaccine immunization: inoculation with a vectored vaccine is inoculation with a virus that carries a gene from another. The first mild attenuated virus infects the host and, in the process of infection, triggers an immune response to the second virus, as well. This allows the body to create antibodies for a virus without ever having been exposed. It would be unlikely, however, that given the adaptive potential of a purely genetic threat and decades of inoculation in which to have evolved, that viruses would not have found means of subverting vaccine immunization. The emergence of the AIDS virus, however horrifying, is therefore unsurprising. Exploiting the potential of viral interiority, AIDS targets the immune system itself—meaning that vaccination strategies which provoke an immune response are thwarted at their very site of action.

Though the potential of inoculation for treating smallpox was known long before its viral mechanism was discovered, it remained inconceivable that there could be any real pharmaceutical treatment for tuberculosis until British scientist Alexander Fleming's breakthrough discovery in 1928 that a chemical secreted by the Penicillium mold could kill Staphylococcus bacteria in petri dishes. He dubbed the lethal antibacterial chemical secretion "penicillin," and when the "miracle drug" as it came to be called, was introduced into the general clinical practice in 1944, it caused a worldwide sensation. Parents watched children recover immediately from ailments that just months before had been considered serious and even deadly. By 1965, with more than 25,000 different antibiotic products in successful circulation, bacterial diseases, and the microbes responsible, were no longer of great concern or research interest to physicians and scientists.¹ In the tremendous optimism engendered by the growing number and potency of antibiotic treatments, tuberculosis was moved from the "extremely dangerous" column to that of "easily managed minor infections." Had medical thought at the time been depicted as chart of disease incidence over time, it would have projected into the twenty-first century the linear triumph over all disease-causing microbes. It was easy to ignore the reports, which began appearing from the first days of their clinical use, of bacteria that were resistant to antibiotic chemicals.

The tuberculosis bacterium is an opportunist. Mycobacterium Tuberculosis is, like its close cousin Mycobacterium Leprae—the bacterium which causes Hansen's disease—an extremely slow growing microbe that under most circumstances spends its life under attack from the human immune system or lying low, causing no disease. Its best hope of vigorously reproducing lies in a diminished host immune capacity or in its continuous reinfection of the human body. The key to its survival is its ability to exploit vulnerabilities, such as those manifest by HIV-positive patients, to whom the two cheapest and most widely used anti-tuberculosis drugs, thiacetazone and streptomycin, are toxic or even lethal. Worse yet, during the first quarter of 1991, it is found that 42.5 percent of all new tuberculosis cases and sixty percent of all relapse cases diagnosed in New York City are being caused by mutant strains of bacteria which had suddenly developed resistance to many of the primary treatment drugs.² By 1993, it is apparent that nearly every common pathogenic bacterial species has developed some degree of clinically significant drug resistance, and that over two dozen of these emergent strains pose life-
threatening crises to humanity, having outwitted most commonly available antibiotic treatments.

Joshua and Ester Lederberg had shown as early as 1952 that a bacteria’s ability to outwit antibiotics was due to special characteristics found in its DNA: some bacteria had for eons possessed a natural genetic resistance to penicillin or the chemical makeup of other drugs. Should an antibiotic be introduced into a colony of bacteria in which even less than one percent of the organisms were genetically resistant, tragic results could ensue. The antibiotics would kill off the susceptible bacteria leaving a vast nutrient filled environment which the resistant bacteria could fill in a matter of days, rapidly producing a uniformly antibiotic-resistant population of bacteria within the body. Such a situation was the likely result of any insufficient drug therapy or failure to complete the course of antibiotic treatment. It should have come as little surprise, then, when researchers at the Centers for Disease Control, based on data amassed between 1982 and 1986, found a clear correlation be-
tween the number of times a patient had been treated for tuberculosis and the level of drug-resistance in the patient’s bacterial population. Medical therapy had been complicit in the encouragement of an accelerated natural selection within the body of the infected. It had become imperative that treatments instantly eradicate the microbe without providing a window for its mutation. Facing an epidemic of multiple drug resistance and a rise in tuberculosis incidence among a vagrant and increasingly HIV-positive population, New York City had to take drastic measures to control the spread of a disease for which there was soon to be no solution. In 1992, the Centers for Disease Control, in cooperation with the New York City Department of Health, spent millions of dollars to train non-professionals to work as Directly Observed Therapy (DOT) officers in a new program aimed at preventing bacterial resistance. The sole responsibility of these officers would be to monitor patient compliance with medication and to suggest incarceration in certain designated medical facilities should a patient continue to refuse treatment. There was less concern that the patient might have spread the disease, than that he or she might have served as a human lab in which microbial tactics were evolving.

Georges Canguilhem suggested that when the biological sciences embraced information theory—when the code of DNA became the dominant taxonomical and operational model—life was redefined as that which was capable of error: “Insofar as the fundamental concepts of the biochemistry of amino acids and macromolecules are concepts borrowed from information theory, such as code or message; and insofar as the structures of the matter of life are linear structures, the negative of order is inversion, the negative of sequence is confusion, and the substitution of one arrangement for another is error. Health is genetic and enzymatic correction.” He believed that mutations, blips in the transcription of DNA and RNA, were the either happy or unhappy accidents of nature that drove the organic world. He could not have known at the time that the microbial world had a certain intelligence, that a bacterium could anticipate a threat to its longevity and absorb those bits of viral DNA that would benefit its survival. For Laurie Garrett, “The Coming Plague” meant that the world, as it turned out, “was awash with highly mobile segments of DNA. And bacteria were terrific scavengers.” What Canguilhem had named error was really nothing short of terrorism, for lack of a better word, terrorism being that force that can subvert external strategies of defense to its own uses. Viruses, as mobile pieces of DNA and RNA, were able to exponentially increase their adaptive advantage by infecting more people: the greater the number of people infected, the greater the rate of mutation, and the greater the store of raw genetic material for microbial exchange. It seemed the only strategy for protection in such a situation was to attempt to keep track of the patterns of these genetic pieces as they emerged. Though it
seemed an impossible task, in 1993, the World Health Organization began to issue contracts to research groups bent on trying. In first half of the twentieth century, the mandatory reporting of tuberculosis was established in the hope of protecting the healthy body from contact with the disease. The concern now was that the disease-causing microorganism be protected from the body, as its powers of mutation would certainly exceed the speed to which its genetic character could be “mapped” by the medical community.

According to C.J. Peters, current Chief of Special Pathogens at the Centers for Disease Control, there are really only two ways to maximally protect the body of a researcher working with an aerosol-infectious virus. Crudely stated “one is to put the virus in a bag and the other is to put the virus hunter in a bag.” The second strategy overtakes the first at a time of spatial transition, when the presence of the body becomes more threatening than the presence of disease. When the first Biosafety Level Four facility is established at the Centers for Disease Control and Prevention in 1967, in response to the emergence of the lethal, incurable, and highly contagious Marburg virus, the entire biocontainment work is taking place within closed stainless steel cabinets with glass observation windows and glove ports through which workers manipulate the specimens contained within the cabinet. Only seven years later, the first “maximum containment” laboratories are established at the CDC where scientists protected within “space suits” are able to work in open laboratories. Instead of attempting to contain the “caged” pathogen in the clean world of the laboratory, the laboratory is given over to contamination into which the healthy body is the external invasion. The interior of the space suit is a cocoon of the uninfected world within which the researcher enters the “hot” area. Upon showering and dispensing with street clothes, the researcher changes into laboratory clothing and is placed in a full-body pressurized “space suit,” connected by a hose to a central, filtered air system. Entrance and exit take place through the same air-lock system, but upon exiting, the air-lock becomes a chemical shower chamber in which the exterior of the suit is thoroughly decontaminated and rinsed before being removed. The staff member then takes a second personal shower and changes back into street clothes before leaving the laboratory.

FIGURE 3:
A worker uses living cells to culture a virus in a laminar-flow biosafety cabinet in the biosafety Lab IV facility of the CDC's Vector-Borne Rickettsial Diseases Laboratory. At level IV, workers wear one-piece plastic suits for protection from potential contamination.
The similarity and point of transition between the glove box and the maximum containment facility is in the hands. The body in the "space suit" is essentially following its hands into a pathogenic environment, and it is the hands, rather than the skin, or the respiratory system, which have become the body's point of maximum vulnerability, the point at which the normal and the pathological are most likely to collide. As it has always been, it is the active potential of "touch" that poses the greatest threat, and in the "hot" lab, that potential means breakage. When a sharp instrument of dissection or a broken shard from a microscope slide penetrates the glove, the two worlds collide. The pathogen begins to consume the body from the inside, burrowing its way to the body's point of maximum interiority. The body becomes possessed by a life form which makes every attempt to convert its host into itself. The pathogen saturates the body, the effects obliterate the person, and then, as the virus hunters say, the body "breaks" with the disease, its protective envelope ruptures like a bubble.

2Ibid., 521.

3Ibid., 520.


5Garrett, 431.

The body, as the localized site of pestilence, has undergone a spatial translation. From the early days of humoral medicine, when the diseased body was thought to mirror the toxic environment, to the realization of the post-bacteriological era that the body, itself an environment, was facilitating the evolution of a microbial threat to health, the understanding of the body’s point of maximum vulnerability with respect to disease has become increasingly interiorized.

Pestilences, as those particular disease threats that were known for both their localized virulence and their universal incidence, had always inspired a dialogue in which interiority and exteriority competed for ultimate significance. For example, the medieval mind had questioned whether the leper, in assuming the mark of providential judgement, was merely the defiled object of individual disfavor in the sight of God, or was but another in a set of victims manifesting His displeasure with the entire community. It was equally difficult to be sure if the seventeenth century sufferer of the pox had been born personally predisposed to manifest environ-
mental changes corporally, or if he had become infected by the pustulent product of his stricken
neighbor or family member. In the late nineteenth century, one speculated as to whether the consump-
tive had become sickened by the urban morass of the industrial city, or if his sensitive will had some-
how encouraged the ephemeralization of his body. And as for the modern day carrier of multiple-drug
resistant tuberculosis, it had become imperative to discern whether he posed a greater threat as a
spreader of infection or as a human bacterial lab in which genetic resistance factors were being
shared.

The challenge that has been posed to mankind to reconcile a threat to the body simultaneously internal
and external is as old as the threat of the epidemic, itself. What has distinguished the trajectory of the
argument through time, however, and evidenced its evolutionary potential, has been changing location
of the line at which the distinction between interior/exterior causation is drawn with respect to the
body and the placement of the defensive technologies with which that line has been navigated. On the
side of exteriority, the infective potential of providential punishment has been superseded by the
epidemic constitution of the localized atmosphere, which has been replaced by the threat of urban
degradation, which has been undermined by the germ. On the side of interiority, the causative nature
of individual defilement has been superseded by an inborn personal predisposition, which has been
replaced by the power of the will, which has been undermined by the parasite. The technologies of
control that have been devised to reconcile these seemingly contradictory vectorial progressions are
architectures born of a sophisticated spatial and operational understanding, established to protect both
from within and without until the perceived point of vulnerability has been breached by a new disease
threat: a buffer space demarcated by symbolic dress protects the community from the threat of the
medieval leper; the red wrappings which directly negotiate the space of the body and its surroundings
at the level of the skin both protect the smallpox victim from the disease and those around him from
its pustulent emanations; inoculation and vaccination place just below the skin a defensive strategy for
smallpox, mitigating the disease in the individual and accelerating its immunization of the community;
x-ray technologies, peering far below the skin, are developed to identify and monitor the progress of
the tuberculosis epidemic; and antibiotic treatments are found to establish, through internal toxicity, a
site of defense deep within the bodily environment. As it has become increasingly clear that the threat
of a microbial pathogen is posed from a point of absolute interiority, strategies for defending the body
have begun to appear remarkably similar to those adopted at a time when absolute exteriority pre-
vailed. Operating as a mechanized version of the leper’s costume, the biohazard space suit which
protects the body of contemporary “virus hunter” has created a buffer space around the body which,
rather than serving as a sign of avoidance to the healthy community, protects the healthy body from an
environment given over to pestilence.

The subjective viewpoint with respect to disease has undergone a translation not unlike that presented
in Edgar Allan Poe’s “King Pest.” In following the action of the two witless antiheroes who move
through the plague-stricken city, the reader of Poe’s allegory has observed from a point of vicarious
safety and exteriority, his viewpoint localized in the actions of the fictional adventurers, until such time as the disease has been brought by the antiheroes onto the ship. With this singular event, the reader's viewpoint—following the knowledge that all bodies, in all ports of call, have become immediately vulnerable—has become both atomized and subjectively interiorized within the story. The body, once exterior to an atomized disease threat until it began to manifest pestilential symptoms, has today become but one of many potential localized and atomized centers of an epidemic outbreak, impossible as it is to know what genetic combinatorial mechanics have been taking place inside even the most obviously healthy of bodies. The disease threat, as it has currently been understood, maintains an interiorized position until such point as the infected body, in the common terminology, "breaks" with the disease, and provides a new source for virulent genes for another bodily mix.
ARCHITECTURES of the BUILDING
The same marginal voice that describes the furnishings of the room describes its human inhabitant:

As the curtain rises, EILEEN is discovered lying in bed on the porch, propped up into a half-sitting position by pillows under her back and head. She seems to have grown much thinner. Her face is pale and drawn with deep hollows under her cheek-bones. Her eyes are dull and lusterless. She gazes straight before her into the wood with the unseeing stare of apathetic indifference.²

By the time we have been presented with the invalid Eileen Carmody on her stark porch at the tuberculosis infirmary, we, like Eileen, have reached the end of a journey which has progressed through a descriptive pairing of spaces and bodies. When the curtain rose on Act One—Scene One, we had been permitted a glimpse into Eileen Carmody’s colorful and neatly-kept kitchen, in her home on the outskirts of a Connecticut manufacturing town; and paired with its simple abundance we had found her father, the ruddy picture of “selfish cunning” and ponderous health. In Scene Two we had discovered the hard whiteness of the reception room of the Infirmary against which stood incongruously the comfortable, if somewhat minimal, amenities of a common space; and we had met “a tall, slender, rather unusual looking fellow with a pale face, sunken under high cheek bones, lined about the eyes and mouth, jaded and worn for one still so young.”³ Scene One of Act Two found us in the assembly room of the Infirmary, “large, light and airy, painted a fresh white,”⁴ and we passed time in the company of what we might had been taken for “a crowd of cosmopolitan factory workers gathered together after a summer vacation,” but for the uncanny universality of a certain “hollow-chestedness and a tendency to round shoulders” and a general air of tension “marked by frequent bursts of laughter in too high a key.”⁵ By the time we have reached Eileen, lying with stark indifference on her ephemeral porch, we have observed the space of action dematerialize and the bodies inhabiting it waste away. Within the room “scantily furnished with the bare necessities” has been found the body so reduced by disease that it evidenced only its most essential aspects.

Watching as the slow progress of disease exerts its limitations equally upon the frame of the body and the space of inhabitation, O'Neill’s audience must certainly be affected by the dramatic impact of sheer visual persuasion; however, striking as this physical spectacle might be, The Straw is perhaps more profound, at least in its relation to its subject matter, in the structure it forms as a dramatic text. Through the separation and equalization of setting, character description, and stage direction, it speaks in a remarkable way to that project of health which made architecture, character, and personal behavior complicit in the battle against tuberculosis. Were one to separate the parenthetical stage direction from the scripted voice in O'Neill’s play, the resultant text could be read as the conflation of bodily action and spatial demarcation: in short, it would define an architectural program—the spatial super-narrative that runs through both fictional and autobiographical accounts of the disease. Though numerous individual stories can and have been told against the common background of the weakening body and the minimalizing structure, only within the dramatic genre could the common, even epi-
SCENE—Four months later. An isolation room at the Infirmary with a sleeping porch at the right of it... The room, extending two-thirds of the distance from left to right, is, for reasons of space economy, scantily furnished with the bare necessities—a bureau with mirror in the left corner, rear—two straight-backed chairs—a table with a glass top in the center. The floor is varnished hardwood. The walls and furniture are painted white. On the left, forward, a door to the hallway. On the right, rear, a double glass door opening on the porch. Farther front two windows. The porch, a screened-in continuation of the room, contains only a single iron bed painted white, and a small table placed beside the bed.¹

It is with these words that Eugene O'Neill sets the stage for Act Three of The Straw. Within his italicized text he establishes the site for the dialogue that is to follow, the conventions of dramatic writing rendering parenthetical the body of unspoken details necessary to the play’s eventual enactment. Upon all descriptive, motivational and directional notes are placed a uniformity of tone.
emic, tale find its individualization defined and located by nothing more than a scripted dialogue, set against an architectural typology. The physical setting in which the disease progresses is crucial not only to the story of tuberculosis, but to that of many epidemic afflictions, however, nowhere is it distilled as cleanly as in O'Neill's italicized notations.


\[2\] ibid.

\[3\] ibid., 348.

\[4\] ibid., 364.

\[5\] ibid., 372.
It was in those most ancient and horrific dermatological pesti-
ences, diseases like leprosy and smallpox which left their indelible 
mark upon the flesh, that contamination was most easily imagined 
and observed, and they provided a model for defilement that went 
beyond their corporeal origin. The ancient Hebrews understood 
and treated leprosy as a condition not limited in its infective 
capacity to the physical body. Following their elaboration of the 
rules for dealing with the leper himself, the legislative authors of 
Chapters XIII-XV of Leviticus went on to direct their people in the 
correct procedure for dealing with a similarly infected dwelling, a 
condition manifest by “hollow strakes, greenish or reddish” on the 
walls. If, after having closed the house for seven days upon their 
appearance, these “strakes” were found to have spread, it was then 
 advisible to remove the discolored stones and cast them away. 
Should the foul decay continue even after the house was scraped 
and plastered, that is, should the dwelling become so contaminated 
at its core that it would forever penetrate its architectural skin, it 
would have to be destroyed for the protection of those who would 
enter. Just as the inhabitants could physically absorb the defects of
their surroundings, the building, itself a porous entity, could become infected with an environmental disease.

Though impossible to prevent the absorptive nature of building materials, it was conceivable to adjust the placement and arrangement of the home with respect to dangerous sources of fever. The Hippocratic tradition held that disease was due to natural causes—those causes being disturbances of the composition of the material constituents of the body, as related to atmospheric and climatic conditions. The ancient Greeks and Romans, believing epidemics were borne of bad air and swampy water, gave much attention to the orientation, position and drainage of buildings, as was demonstrated in the writings of Vitruvius and Columella. Though the medieval mind was more likely to associate pestilence with providential judgement than environmental contamination, when the Black Plague began sweeping Europe in the fourteenth century, the Paris Faculty dutifully warned against habitation near marshy, miry, and fetid places, and against the evils of standing water. They also published recommendations for securing and protecting the home against the dread disease. Observing the plague to have been moving from the south, they advised keeping all north-facing windows open and sealing those facing south. at least until the decontaminating potential of the midday sun or a lit fire had taken effect. The Paris Faculty also suggested keeping windows glazed or covered with waxed cloth to keep out all but the pure north air at midday. Writing in 1546, Fracastorius made similar prescriptions in Chapter VII of his influential *Contagion*, encouraging people to “observe carefully whether the contagion is being conveyed into your district from some other district then shut the windows on that side, and live on the other side of the house.”

The prevailing ideology of humoral medicine, under which such prescriptions fell, was based on the conviction that both individual bodies and places could be characterized in terms of an inherent opposition of primary qualities—hot and cold, wet and dry—and that any malady, or constitutional disturbance, could be rectified by balancing the specific deleterious inequality. Attempts to determine
the direction from which pestilential winds were blowing and to modify accordingly the inhabited building were the attempts to apply the principals of humoral medicine to the building as a kind of body. Just as Fracastorius advised, in order that "the air you breathe may be purer, [to] always keep in your mouth either juniper berries...or the seed of a citron," he similarly suggested placing "flowers and sweet-smelling fruits" in the opened north windows.* The technique of balance employed by humoral medicine was equally applicable bodily and architecturally.

It is possible to read in Malachias Geiger's plan for a plague hospital of 1634 an attempt at the architecturalization of humoral balance at the scale of an institutional building. Designed like many of the monastically-based leprosaria which preceded it to be isolated from the surrounding population by an encircling moat of running water, it created an inland island in which the bounds of environment and building coincide. It prevented, if only conceptually, the potential of environmental malady by subsuming the selected "healthy" land to the space of the building. The plague hospital, as an institutional building, was analogous to the sickened society in the same way the sickened house had been made analogous to its sickened individual inhabitant. With rooms divided among the rich and poor encircling a large central court with a central, octagonal chapel, it constructed a built critique of the conditions which had necessitated its existence. The idea that spaces for controlling disease should counter the conditions in which it was propagated, which in the late medieval world was the central hearth around which people gathered in the home or the central cathedral which formed the center of the dense economic and architectural collectivity, meant that the plague hospital must be least dense at its center. The central chapel was, in fact, designed as little more than a gazebo protecting an open altar. If the center was the point of propagation, the periphery, whether represented by the windows of the individual house or the marketplace of the medieval community, was the point of introduction, and the plague hospital responded to the threat with an impenetrable facade. The plague hospital was not merely a place to house the sick, but a way to balance them in space to counter the course of the disease.

FIGURE 1:
Plan of the Pest House in Leiden, designed 1635 as a hollow square of halls surrounded by a moat and crossed by a sewer.

FIGURE 2:
Malachias Geiger's 1634 plan for a plague hospital never built, showing in elevation patient rooms to the left, and in plan, to the right.

2Ibid., 112-13.

3Ibid., 141.

4Ibid.
Applying the rigors of taxonomic classification to the pathological world, Sir James Carmichael Smyth (1740-1826), celebrated physician to George III, distinguished between two major categories of pestilence. He divided those epidemic distempers which beset mankind into the general contaminations, maladies caused by the putrid fermentations of nature which were manifest in maliciously repetitive internal disorders, and the specific incursions, diseases such as smallpox or measles which were identified by the breakdown of somatic integrity and which could appear only once in an individual's lifetime. Though his treatise on *Contagion* (1799) made it clear that both types developed when masses of people were "shut up in a close palce, without the greatest attention to cleanliness, and a renewal of air," it was their typological differences that needed to be taken into account when devising methods of prevention and treatment. The victims of general contamination needed only to be removed in a timely manner from the repellant urban compost heap, that source of environmental toxicity their lifestyles had created, and placed in a fever hospital where they would pose no danger to one another. The smallpox patient,
however, was himself the source of contamination, and his virulent emanations could penetrate not only fellow bodies, but clothing, furniture, and inhabitants. It was, therefore, inadvisable to permit the smallpox patient treatment within a general infirmary. Even smallpox as it was aquired through inoculation, that practice of inserting the infectious material beneath the skin to obtain immunity at less risk of death, was still contagious and potentially lethal, and the convalescent inoculée required the same degree of bodily isolation as the patient recovering from a naturally-acquired attack. Separate medical institutions arose in the eighteenth century for treating and confining the smallpox victim who, if allowed to remain in the close quarters of the home, was certain to infect all those who came near.

When 1746 brought the onset of an especially severe epidemic attack, the awakening public conscience in London that had begun to create charitable institutions for the lower classes began to direct its attention toward smallpox. The County Hospital for the Smallpox was created on September 26, 1746, at Middlesex “for the relief of poor distress'd housekeepers, labourers, servants, and strangers, seiz'd with this unhappy distemper, who will here be immediately reliev'd in the best manner without expense.” Established to provide both medical preparation for inoculation and treatment for naturally-occurring cases, the hospital's institutional scope required it to obtain several removals before finally locating itself, in 1752, at Cold Bath-fields, in a facility designed to accommodate up to 130 patients. Following the current theory that foul and putrid air contributed to hospital and prison fatalities, the new facility was designed according to the recommendations of Dr. Stephen Hales, who in addition to serving as one of the Vice Presidents of the Hospital was also an authority on the ventilation of public institutions. Dr. Hales combined his knowledge of the physiological mechanisms of circulation in plants and animals with studies on the nature of air to arrive at a ventilation system able to promote the maximum environmental conditions for
health. Several London buildings, including St. George's Hospital and Newgate Prison, and a number of county hospitals and prisons had already been provided with fresh air through the addition of Dr. Hales's roof ventilation windmills. The new Small-Pox Hospital, which contained four floors with eight rooms on each, was ventilated after Hales's plan a floor at a time, the bad air drawn out of each room through a hole four inches square near the ceiling. The fresh air entered from the other side of the room through a long perforated trunk, located under the bed to prevent drafts, which was supplied by two ventilator diaphragms seven feet long and three feet wide that were fastened to the ceiling in a centrally located gallery and worked by means of levers. A little more than a year after the ventilators were installed, Hales reported that one-third fewer patients had died.3

Hales's ventilation system was essentially able to accelerate the healing potential inherent in the established treatment for smallpox. The "cooling treatment," which prescribed airing the sick before open windows under light bedcoverings, had been popularized a century before by the English physician Thomas Sydenham who, in so doing, reversed the traditional treatment that had long entailed the crowding of patients into sealed rooms behind drawn bed curtains to absorb the effects of the "hot" treatment. It was the need for a place in which to ventilate the victims not only of smallpox but of many other contagious fevers that ultimately led to the creation of fever wards separate from general hospitals and to the later introduction of separate fever hospitals such as the Manchester House of Recovery which, after its construction 1796, became the model for many more. It was the French, however, both before and after the Revolution, who took the lead in rehabilitating one major source of persistent contamination, the public hospital, through the creation of a new and salubrious pavilion arrangement. Rather than relying on a complex ventilation system to provide air flow to an essentially closed, neoclassical structure, these low slung buildings, ventilated on both sides and grouped around an open court for free circulation of air, established what was clearly an architectural response to the problem the Hôtel-Dieu had come to represent. As a sanitary code embodied in a building, the pavilion plan dominated infirmary construction for

**FIGURE 1:**
Rebuilding the new Hôtel-Dieu within the shell of the old after the fire of 1772: a virtual inoculation of Classical Planning beneath a Gothic facade.

**FIGURE 2:**
A comprehensive view of the Hôtel-Dieu, from the Turgot plan of Paris, 1739.
the next century. For if a system of ventilation could accelerate recovery in the case of a sickened individual, the pavilion ward system as an idealized plan might accelerate a public health initiative which, though bogged down in a deep political mire, sought the ultimate elimination of sources of contamination.

It has been argued by Barbara Maria Stafford that, in addition to having spawned the creation of specialized medical institutions, dangerous overcrowding in general infirmaries like Paris’s Hôtel-Dieu, Infirmerie de la Charité, Hospice de Bicêtre, and Salpêtrière, fostered the emergence, after the middle of the eighteenth century, of a system of practical observational medicine. The habit of mixing different diseases within the same ward selected for the development of a perceptual structure sensitive to the signs of those rare and common illnesses which sprang from an enforced close proximity. When the sinister Hôtel-Dieu burned in 1772, the investigatory report of 1777, issued by the Commission Charged to Examine the Means for Ameliorating the Diverse Hospitals of the City of Paris of
the Académie des Sciences, led to the future specialization of Parisian infirmaries. The medical community, forced by necessity into an observational mode, now sought to create new medical institutions that would structure physically what they had learned to see diagnostically: the specialty hospital would now physically reconfigure a pathological world in which diseases were grouped into orders, genera, and species in a rationalized domain that restored their original distribution. Thus the Hôpital Saint-Louis, the former annex of theHôtel-Dieu which had opened in 1607 to serve northern Paris specifically during epidemic periods was renovated according to the pavilion model in 1780 to serve first as a center for immunology and later, under the direction of Jean-Louis Alibert (1766-1837), as the premier clinic for the study of skin diseases. It was Alibert’s keen dermatological observations that produced the first classification system for cutaneous illnesses based on the botanical method, and he insisted, unlike his predecessors, that the changing aspect of these maladies be scrupulously illustrated. Michel Foucault’s *The Birth of the Clinic* has documented the transformation that took place in the eighteenth century when the hospital as a place in which disease was uncovered in the patient was replaced by the clinic’s selective process in which the examination of the “pure” disease took precedence over the particularities of its individual manifestation. When medical knowledge became concerned with the symptomatology of a disease as it could best be understood through an observational averaging of clinical data, what was required was a neutral domain, one that was homogenous enough to allow the comparison of

![Plan for a new Hôtel-Dieu in the pavilion style by Julien David Le Roy and Charles François Viel, 1773-77.](image3)

**FIGURE 3:**

Transverse section, longitudinal section, a plan of one ward of Le Roy and Viel’s project for a new Hôtel-Dieu. In addition to the idea of draft from one narrow end of the ward to the other, air is introduced by ducts from the ground floor expelled through a row of domes in the ceiling, each of which terminates in an exhaust pipe and flag, shaped mobile extension that could turn in the wind.

**FIGURE 4:**

The Musée de l’Hôpital Saint-Louis now houses a set of over four thousand polychrome wax and resin casts of cutaneous diseases created for use in nosographical instruction.

![Plan for a new Hôtel-Dieu in the pavilion style by Julien David Le Roy and Charles François Viel, 1773-77.](image4)

**FIGURE 5:**
similar pathological events. The patient was but the accident of the ideal case, caught in a neutral gaze which "directed upon manifestations, frequencies, and chronologies, concerned with linking up symptoms and grasping their language, was, by its structure, foreign to the investigation of mute, intemporal bodies; causes and locales did not interest it: it was interested in history, not geography."6

The fever hospital was that specialist medical institution which most retained the traces of its origin in the monolithic, isolationist public infirmary. As the designated home of the most lethal and horrific pestilences it was seen by the poor, urban populations who constituted the large majority of its patients as little more than a laboratory in which a program of political genocide was taking place. The prominence of the London fever hospital as a medical agency in the East End and its association with the systematic, clinical program of post-mortem investigations has made the public outcry and high profile of dissection as a political issue around 1830 understandable.7 It also explained the sudden refusal of the population, both in London and in Paris, to take treatment in the fever hospitals during the massive cholera epidemic of 1832. This obstinance, however, in necessitating home visits, led to cruel discoveries about the way a huge segment of the urban population lived: cholera struck poor, urban populations in incredibly disproportionate numbers. Medical doctors at the time, with their relative disinterest in the individual situation, began to apply their clinical gaze upon the living conditions with which they were immediately confronted.

With the practice of statistical analysis gaining ground, when the Paris Commission on Cholera was formed to investigate the outbreak, it took as its problem the correlation of information and its analytic framework, a map of Paris divided into forty-eight quartiers. Analysis of each of the forty-eight neighborhoods sought to correlate fluctuations in temperature, climate, and exposure to the death rates as they had been recorded. However, neither these investigations into a specific environmental cause nor attempts to correlate population density with mortality rate yielded statistically significant results. Districts with comparable population densities had widely differing mortality rates, whereas districts with sharply contrasting densities had comparable mortality. It was only when investigators began to look at the density of population in each dwelling did the results begin to yield.

The "macrogeographic" approach, which compared mortality to population density per arrondissement or quartier, failed the investigators because each building in Paris at the time was a microcosm of the whole. Francois Delaporte, to whose groundbreaking study of the 1832 epidemic in Paris in its relation to an urban planning this study is greatly indebted, described the prevailing condition in which "a single building might contain an aristocratic hotel at the end of a tranquil, provincial courtyard, in which one family lived nobly, while on the noisy and dirty street side one might find dark shops and
separate flats, some rented to bourgeois families, others to poor and sometimes wretched families who lived under the roofs, in the attics." Each block of houses represented nothing less than a comprehensive sample of urban society. It was only when the frustrated investigators began exploring a "microgeographic" approach, focusing on the specific number of square meters of dwelling space per inhabitant, rather than relying on a district average, that a significant correlation began to emerge. In modifying the scale of their focus, the Paris Commission was also modifying the ancient Hippocratic legacy that directly related the health of man and environment. It was not enough to simply apply the Hippocratic approach at the scale of the individual inhabitation, the statistical interpretation required, and gave rise to, a new understand of disease etiology: re-establishing health now meant to restructing the relation of man to the elements as refracted through his immediate environment, the analysis of what was to become known as "living conditions."

The healthy/unhealthy dichotomy with respect to the environment had been a major preoccupation of medical thought throughout the seventeenth and eighteenth century and had long been associated with programs of urban improvement, but by the eighteenth century, the intellectual environment that had given rise to statistical analysis was eager to embrace a new, more complex interrelationship. The simpistic dichotomous structure of the pathological world was supplanted by what was called the "analysis of the pathogenic ensemble," and the relative health of air, light, and housing was now being measured by a functional gague—the function of "inhabiting." The building was re-interpreted as that envelope which structured and influenced the relative health or morbidity of the relationship between the inhabitants and the external elements of which they made use. As those elements passed into the dwelling they were incorporated into it, and the entire physical complex became established as a morbid environment. Living space was now a causal space, and the building, a selection device. Social Darwinism was being accelerated by deficient dwellings.

\footnote{Barbara Maria Stafford, \textit{Body Criticism: Imagining the Unseen in Enlightenment Art and Medicine}, (Cambridge: MIT Press, 1991), 292.}


\footnote{Ibid.}

\footnote{Stafford, 292.}

\footnote{Ibid., 300.}


\footnote{Ibid., 86.}
“Before them rose a low, projecting, meadow like plateau, on which, facing south-west, stood a long building, with a cupola and so many balconies that from a distance it looked porous, like a sponge.” Thus does Thomas Mann describe the first impression of a young visitor, unaware as yet that within the porous monolith he sees from the carriage will be absorbed the next seven years of his life. Once inside the Sanatorium Berghof, Hans Castorp’s passing observation becomes disconcertingly validated: “The building seems to possess the disadvantage of being porous—the sound goes straight through it,” he observes, disturbed by the sounds of the consumptive laborings of the sick. “It is just as if one could look right into him when he coughs, and see what it looks like...he could see right into the...vitals.” The building designed to house the consumptive is, in fact, not unlike the disease itself in its essentializing manner: just as the body and spirit of the tuberculous patient have, as a result of their heightened “porosity” with respect to the dangers of modern life, become consumed to their essential quality, the sanatorium has eliminated everything but that which contributes to its healing potential, all that which is not
directly related to usurping the tendencies of the disease. In so doing, the sanitarium creates the architectural equivalent of the idealized clinical body, the body that could manifest a pure symptomatology. The sound of a single cough reverberates along a corridor in which footfalls disappear soundlessly. Oxygen tanks ominously identify the rooms of the “moribundi,” the “curious, swollen-looking, balloon shaped vessels” standing out sharply against the anonymous hallways of “white-enamelled, numbered doors,” rooms that will absorb the lives contained within them without ever compromising their own antiseptic purity. The porosity of the sanitarium is keenly selective in a way the body can never be: it is designed to absorb fully the healing properties of its mountain environment while simultaneously presenting an impenetrable surface to the pollutants of its human element. It absorbs the inculcious sounds and sights of the sickness, but none of the emanations. It cannot structure the perfect cure, however, for a disease caused not only by the environmental decay, but also by the spiritual decay, of modern life; the immaculate cure for a disease of “living conditions” the impure human will can still subvert.

It was Gustav Hermann Brehmer, a Silurian physician, who first observed in the 1840s that tuberculosis, or consumption, rarely occurred at altitudes above 1,600 feet. He reasoned, therefore, that living in the thinner air of the mountains strengthened the heart, enabling it to eliminate more efficiently the poisonous accumulations in the lungs. If the tubercular were brought to an invigorating mountain landscape, encouraged to embark on a carefully supervised program of graded exercise, fed hurculean meals five times a day, and plunged regularly under cold showers, he would thrive and recover.¹ Brehmer began implementing this scheme in “a huge Gothic pile” opened in 1859 on a 270 acre site in a mountain valley near Gorbersdorf, in the country southwest of Breslau. Modeled after the great European resorts, his sanitarium was as much a tourist destination and health club as a mechanism for administering his curative regime. By 1880, it offered accommodations for 233 patients and had spawned a number of European imitators.² The first and most influential of these was established by Peter Dettweiler, who built his sanitarium at Falkenstein, in the Taurus Mountains northwest of Frankfurt in 1876. Similar in style and intent to Brehmer’s, its philosophical grounding was radically different: patients here were encouraged to rest and avoid unnecessary exercise. Much more easily accommodated to the prevailing Victorian leisure model, the sanitariums that were to follow would universally reject Brehmer’s regimen in favor of Dettweiler’s.
Resort-style sanatoriums based upon the European model began appearing in the U.S. in the last quarter of the nineteenth century, offering rest, fresh air, copious food, and pleasant amusements. Both Gleitsmann in Asheville, North Carolina, and Solley in Colorado Springs, Colorado, consciously patterned their invalid resorts according to the sort most fully developed at Davos, Switzerland, made famous by Thomas Mann in The Magic Mountain.

In addition to scores of testimonials supporting the efficacy of the sanatorium regime, recent advances in bacteriology made the eradication of tuberculosis a reasonable goal and the possibility of stalling its progress convincing. Following Robert Koch’s 1882 discovery of the microbial cause of tuberculosis, European scientists in the 1880s and 1890s successfully linked one disease after another to its causative microorganism, including typhoid fever, malaria, cholera, diphtheria, and bubonic plague. Bacteriology led to a new understanding of the body’s immune system, and although Koch’s tuberculin antitoxin failed as anything but a diagnostic tool, Pasteur’s rabies vaccine and Behring and Kitasato’s diphtheria antitoxin made the development of a pharmacological treatment seem but a matter of time and effort. The growing popularity of evolutionary theory, coupled with a greater statistical awareness of mortality rates, encouraged the elaboration of pathological “stages”: the signs and symptoms of the illness were divided into categories indicating the stage in which the consumptive labored and the associated chance for recovery. Patients in the early stages of the disease, physicians believed, benefited less from medical treatment or nursing care as from the plentiful food, fresh air, and the regulated rest and exercise that a health resort could provide. However, after the bacteriologically-based “germ theory” brought increasing attention to the contagious potential of the disease, health resorts found it necessary to exclude consumptives, and private sanatoriums took over, distinguishing themselves in their promotional materials from the traditional health resorts not

FIGURE 1:
Alvar Aalto. Raumo Sanatorium (1928).
Olavi Boman, Aalto. Raumo Sanatorium (1928), of balcony above ward volume.

FIGURES 2 & 3:
Views of exterior facade and sleeping pavilion of the North London Consumption Hospital. The fortress-like infirmaries shown in their use. It is not an error for the new tuberculosis sanatorium.
by lauding scenery, climate, and recreation, but by emphasizing the availability of medical specialists and the attention of trained nurses. A change in terminology evident in the first decade of the twentieth century clearly marked this shift to a rationalized treatment philosophy within the institutional structure. In 1905, the editor of the *Journal of the Outdoor Life*, a magazine for concerned lay persons and consumptives, felt it necessary to clarify this distinction when he wrote:

> Until comparatively recently the terms ‘sanatorium’ and ‘sanitarium’ in connection with institutions for the treatment of persons suffering from tuberculosis is regarded as not only preferable, but also etymologically correct. ‘Sanatorium’ is from sanare, to heal (sic); a place in which to be treated. ‘Sanitarium’ is from sanitas, health, and is usually applied to a healthful place, a resort for convalescents, and not for the special treatment of disease.\(^8\)

System in the sanatorium, therefore, was more than an aspect of treatment but a giant metaphor of order erected in the face of the unpredictable, as a bulwark against it. The ideology of the new rational architecture was easily applied to a project in which order took on the didactic and reductive role of teaching patients discipline and educating them in hygiene and civics through a system of strict schedules and prohibitions. The patient for which the architect was designing was not the truly free citizen, but one bounded by the knowledge that, as expressed by sanatorium director John Hawes, “Everything which is not expressly allowed is forbidden.” Designing a sanatorium was not unlike designing a monastery: with the slow progression of the disease, sanatorium stays of up to twenty years were not unheard of, and time became as daunting and unmanageable as the illness itself. As a result, the simplest events of daily life took on a therapeutic importance and became invested with the superstition of ritual. Cementing a utopian, “healthy” relationship between technology, environment, and routine, the sanatorium was an ideal institutional structure with which to apply the tenets of functionalism. The success attained by these early functionalist buildings was certainly, in part, attributable to their existence outside the constraints of cities and munici-
palities and their provision of a highly structured institutional program. As such, they were pure experiments unburdened by the complications of a free and mobile subject. Despite their experimental nature, however, their combined result soon constituted a typology almost universally characterized by the expression of oblique angles, the elaboration of distinct functional elements, and the structural articulation of a system of terraces. Notable examples included the Tuberculosis Sanatorium for Children in Vordingborg, Denmark, by Kay Fisker and Christian Frederik Møller (1936-38), the District Hospital in Waiblingen, Germany, by Richard Döcker (1926-28), the Bucegi Sanatorium in Predeal, Romania, by Marcel and Julia Iancu (1936), and the Zonnestral Sanatorium in Hilversum, Netherlands, by Jan Duiker and Bernard Bijvoet (1927).¹⁰

In 1928 a competition was announced for the design of the Paimio Sanatorium, to which Alvar Aalto responded with the prize-winning entry. The sanatorium culture was a good fit with both Aalto’s personal beliefs concerning the spiritual in nature and the Modern Movement’s concern with healthy environments as stated in the Athens Charter: “The health of every person depends to a great extent on his submission to the ‘conditions of nature’. The sun, which governs all growth, should penetrate the interior of every dwelling, there to diffuse its rays, without which life withers and fades.”¹¹ In accommodating such a mandate, Aalto facilitated

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¹¹ Richard Döcker. The District Hospital, Waiblingen, Germany (1926-28).

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FIGURE 7:

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FIGURE 8:

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FIGURE 9:
Brubaker and Stern Architects. “Convertible Sleeper,” designed for the Indiana State Hospital, Rockville, Indiana, to connect rooms directly to open porches without moving patients.
the specific orientations necessitated by the different institutional functions through a "hinged" massing, most certainly indebted to Jan Duiker's influential Zonnestraal pavilions. At Paimio, the patient's wing was oriented south-southeast to take advantage of morning sun, forming a slight angle with the sun terraces facing due south. The communal block followed the alignment of the sun terraces. Technical and service facilities were accommodated in a single story extension on the north side of the communal block and in a separate three-story wing angled to receive sun on both elevations. Pivoted off this volume was the boiler room to the north. Aalto, in expanding the applicability of Duiker's isolated solution, broke the classically symmetrical campus plan that had prevented the Zonnestraal complex from realizing the potential located in its sophisticated detailing. The Paimio Sanatorium found its equilibrium, rather, in a taughtly strung composition that was neither campus nor individual building, an arrangement that mocked the very idea of hierarchy or centrality. The sanatorium was no longer represented by a top-down structure in which a central administrative block served a collection of subsidiary structures: the building itself, as a whole, became the absolute facilitator of treatment.

Henry Russell Hitchcock and Philip Johnson, in qualifying the movement that they would identify as The International Style (1932) recognized in the problem of mass a central concern: "The effect of mass, of static solidity, hitherto the prime quality of architectural symbol is no longer the dense brick but the open box." At the time Hitchcock and Johnson were formulating their definition, Alvar Aalto had succeeded in effecting a more subtle translation of the problem of mass that was as metaphorically relevant to the disease as it was ideologically relevant to the amassing of an architectural discourse. Aalto had given the Paimio Sanatorium a healthy institutional facade which only in plan and at certain oblique angles was shown to have been "consumed" to a minimal massing. This volumetric play identified by Hitchcock and Johnson had been, at Paimio, further dematerialized structurally. At the southwestern termination of the ward volume, the reinforced concrete frame was reduced to a single spine off which a series of asymmetrical sun terraces were cantilevered. Designed like the trunk of a tree, or a branching bronchial system, the structural spine was substantially thicker at its base than top and was supported by great tapering foundation pads. The wards, designed
with the thinnest possible cross-section, were almost membranous, a architectural filter which was inserted into the environment to catch the healing air and light.

While the structure of the ward volume was dematerialized, the interior was built up, modeled by a process of accretion, rather than being carved into the volume. At Paimio, the massing of the complex reflected the relationship of a curative community to the larger natural environment, while the detail transformed the atmosphere into an almost pharmaceutical commodity. Light, air, and motion were now viscous fluids that must be checked and monitored as religiously as the body of the afflicted. The details were designed to provide a layer of protection and modulation for which the rationalized structure was never intended. If, as the "Outdoor Life" espoused by the sanatorium culture suggested, the structure of the complex provided maximum exposure to the elements, however harsh, the details ensured the measured, scrutinized control that paradoxically accompanied it. The ceiling at Paimio was painted for optimum, quiet reflectivity; the light sources were placed outside the bedridden patient's field of vision; and the water ran soundlessly from the taps. As the sanatorium operated by combining "folk remedy" notions with scientifically-based medical practices, Aalto believed that the human factor must act as a filter and modifier within a rational design process. Writing in *The Humanizing of Architecture* (1940) he reflected that: "The methods of architecture are sometimes reminiscent of those of science, the kind of research that natural science uses can also be applied to architecture. Architectural research may well be more methodical than before, but its
essence can never be purely analytical.”

In 1904, the U.S. government reported that mortality from tuberculosis was 200.7 per 100,000. Most of the existing tuberculosis hospitals and sanitariums could accommodate fewer than 200 patients each, or less than five percent of those afflicted. The absolute shortage of public beds combined with the prevailing fear of public institutions—such as New York’s hospitals for the “consumptive poor” and “moribund cases” at Blackwell Island and North Brother Island, which were viewed as quarantine prisons for urban consumptives—encouraged ninety percent of the tuberculosis to seek treatment at home. While for architects working in in Europe the sanatorium was crucial in informing an institutional model for functionalism by proposing a curative, architectural “machine,” in the U.S., the sanatorium was most inspirational in programming an approach to healthy suburban living and suggesting a site for the elaboration of the International Style as applied to residential architecture.

The tremendous number of people living at home with a disease so associated with environmental causations and cures could not but effect the country’s domestic architecture, as homes in all areas became the backdrop for an elaborate ritual of care. The designation of the “sickroom” no longer bore any correlation with what had previously served as the victim’s personal space in the house, but was redesignated or predetermined based upon certain essential qualities. It was of paramount importance that the consumptive take the cure in a room on the south side of the house supplied with ample light to purify and invigorate both the patient and the environment. To discourage the collection of germ-bearing dust, the floor had to be wood, uncovered, and all wallcoverings removed so as not to absorb the emanations of the invalid. Gone was the Victorian throne room of the pre-germ era in which the victim lay ensconced in a pillow-laden, fabric-swathed chamber. Nothing unnecessary was now to be allowed in the room, and all remaining objects had to be easily cleaned and disinfected. The concern for an aseptic environment revealed an underlying impatience with the overdressed, overupholstered, overheated, and overdecorated tastes of the nineteenth century.
Curative modifications to domestic architecture were not limited to the interior, but substantially altered the relationship of interior and exterior as the mandates of the “outdoor life” prescribed. The verandah was the first stylistic modification of the house to find therapeutic application. In use since the late 1700s, it was popular with Caribbean and Southern planters and constituted an essential element of the Queen Anne and Italianate styles long before finding widespread popularity in the second half of the nineteenth century. The ideal anti-tuberculosis verandah extended around three sides of the house, with one side facing south, and was wide enough for a chair or entire bed to be wheeled along it to follow the sun or breezes.16 The undesirability of blurring with associations of contagious disease the use of an architectural element which, as a buffer between the public street and the private interior, functioned as an important spot for socializing, likely accounted for the rapid ascendance of the sleeping porch as the primary curative addition. Also known as California rooms, these wooden decks were moved away from damp soil and public traffic to be built over a lower porch roof or extended from a second- or third-floor room on the south side of a house. In design and

FIGURE 14:
Door hardware at Psiego Sanatorium contained its motion along the surface path.

FIGURE 15:
Room lamps and painted ceilings at Psiego Sanatorium were designed to prevent bright spots within the patient's cone of vision.

FIGURE 16:
Corridor lamps at Psiego Sanatorium contained elaborate lenses to prevent glare.

FIGURE 17:
Washbasin at Psiego Sanatorium was designed to be splash-free and silent, an intention which did not work in practice.

FIGURE 18:
Depiction of a Victorian sickroom in an illustration accompanying a poem on consumption by William Cullen Bryant.

FIGURE 19:
A sleeping porch in a crowded district in Philadelphia.
material they were as varied as the homes from which they sprouted. A standardized version could be purchased by mail through means similar to those insuring the increasing popularity of the mail-order home. Averaging about six feet by ten feet, the porch was large enough for a single bed, bureau and chair. The invalid lived outside on the porch year round and had most of what he or she needed within reach.

Southern California provided the setting in which many modern architects could test relationships between interior and exterior spaces and between landscape and community. Frank Lloyd Wright's Los Angeles houses were an attempt to reconcile a system of inert, inexpensive, prefabricated concrete blocks with a belief in the organic relationship of building to setting. In what Kenneth Frampton recognized as "the last serious effort to evolve and establish a truly civilized typology for American suburban development," Wright sought to extend into the landscape a flexible framework to be occupied as either interior or exterior space, at various times of day or night. The provision of a specifically programmed sleeping porch was transformed by Wright into a domestic complex in which all actions, even if literally taking place indoors, found direct correlation with an outdoor condition: all actions naturally flowed from inside out in an osmotic system of relationships. Rudolph Schindler, Wright's project manager for the Barnsdall House in Los Angeles, further eliminated distinctions between indoor and outdoor living by responding not only to the physical, but to the communal, aspects of camp life after having been inspired by a trip to Yosemite. In a detailed letter to his wife's parents, Schindler outlined his vision for an indoor-outdoor pavilion divided into four main studio spaces grouped around two opposed patios, rather than the traditional interior living room. Schindler described how the cooking would be done right on the table in a "more social 'campfire' affair." The completed King's Road House (1922) expanded on the idea of the central court, used by Wright for Aline Barnsdall, by fragmenting it and reintegrating the individual pieces into the external skin at strategic locations around the perimeter, facilitated by the use of sliding, Shoji-like panels. As a double residence without a bounded perimeter, The King's Road House absorbed the single-family detached house in a machine that, one imagines, could be extended indefinitely in a spiraling pinwheel.
The California health cult ultimately culminated in what Kenneth Frampton designated as “the apotheosis of the International Style.” Richard Neutra’s commission to design a house for Dr. Philip Lovell radically changed both the course of modern architectural history and the philosophy behind its design. Dr. Lovell, popular author of the Los Angeles Times column “Care of the Body” and the mastermind behind “Dr. Lovell’s Physical Culture Center,” represented the ultimate southern California product, and Neutra sought to formulate in the Health House the direct expression of Lovell’s ideology. Set on a bluff overlooking a romantic, half-wild parkscape, its symmetrical composition of dramatically suspended floors was reminiscent of Wright’s California block houses of the 1920s; but with its architectural expression emerging directly from a skeleton steel frame clad in a light-weight synthetic skin, its philosophical source seemed closer to the sanatorium tent colonies in which concern for air flow and prevention of germ absorption dominated form. Neutra’s primary concern was not abstract form as an end in itself, but as a tool for the modulation of sun and light and for the sensitive articulation of the screens of plants between the building and its general context. The effect of the designed environment upon the psycho-physiological well-being of the occupant became a central theme in Neutra’s work after his experience with Dr. Lovell. While the so-called “bio-realism” he expounded rested on largely unproven theories linking architectural form to overall health, his approach represented a crucial counterpoint to the idea that the International Style found technology more metaphorically rich than the human body, and that a supra-functionalist attitude could not emerge saturated in a sensitivity to physical and spiritual well-being.

FIGURE 20:
Rudolph Schindler, Kings Road House, West Hollywood (1922), plan showing pinwheel organization.

FIGURE 21:
Richard Neutra, Lovell Health House, Los Angeles (1927), elevation.

"Ibid., 41.

"Ibid., 12-13

"Ibid., 10.


"Ibid., 68.


"Ott, 150.


"Functional Architecture. 15.


"Ott, 149.

"Caldwell, 185.

"Ott, 90.


"Ibid., 250.
In 1917, two Minnesota children left the bedside of their mother, who lay dying of tuberculosis in a multi-purpose isolation hospital. It was smallpox, however, that the bereaved children carried with them to the orphanage, the disease having been introduced into the hospital environment by three Finnish immigrants, exposed aboard the ship that took them to New York. In the panic caused by the ensuing epidemic, an eighteen year old girl who was hastily admitted to the smallpox isolation ward with what turned out to be nothing more than the chicken pox, contracted smallpox and infected all eleven members of her family. Even in the post-vaccination era, the ship-borne disease had succeeded in sparking a local epidemic in which ninety-two persons were infected, of whom seventeen died. Minnesota having been in 1917 one of several states forbidding by law compulsory vaccination, the simple occurrence of an outbreak was hardly noteworthy; what was, however, significant was the role the hospital environment played in abetting the contagion. Though as early as the eighteenth century the hospital had been reformed in accordance to sanitary and anti-contagionist practices, and specialty hospitals were
<table>
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<th>Proportion in which legionella detected (%)</th>
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<td>53</td>
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<td>Cooling water systems</td>
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<tr>
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<td>Hot and cold water</td>
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<td>38</td>
</tr>
<tr>
<td>Business</td>
<td>Hot and cold water</td>
<td>17</td>
<td>75</td>
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<tr>
<td></td>
<td>Cooling water systems</td>
<td>24</td>
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...appearing to separate the more virulent of the pathological spectrum from the less, medical institutions had never before, outside of epidemic periods, had to deal with the massive numbers of sick individuals that U.S. urban centers were seeing on an everyday basis. Increasing public health awareness and the advent of new laboratory diagnostic tools had created means for identifying the carriers of sickness that were far advanced of their supporting physical infrastructures. Mass immigration, increased global mobility, and vaccine-induced complacency were making the conditions in the makeshift isolation hospitals, called upon to serve the needs of impoverished and immigrant populations, increasingly resemble the threat, if not the conditions, present in the medical institutions of earlier times.

By the 1970s, institutional infrastructures had appeared to have caught up, if only because advances in antibiotic and vaccine treatments meant that many more conditions could be treated in advance of requiring long hospital stays. However, reports of hospital smallpox outbreaks were still surfacing. In 1970, in the midst of the global campaign to eradicate smallpox and within a year of the U.S. Surgeon General’s recommendation that compulsory vaccination be halted in the States, a patient with undiagnosed smallpox infected seventeen other persons in a hospital in Meschede, Germany, without having had direct contact with any of them. The concern was not for overcrowded wards or for the incomplete initial diagnosis; the problem was not administrative or even operational, but physiological: smoke tests later showed the unusual mode of infection to have been the air currents leading away from the patient’s room.

No nation could be declared free of smallpox until a laboratory operating under the auspices of the Centers for Disease Control
(CDC) or the World Health Organization (WHO) confirmed it. Before 1974, about three hundred potentially dangerous specimens a year were being sent to labs to be checked, and as smallpox became more rare, the lab work paradoxically increased. With every suspected case of smallpox on the planet requiring official laboratory diagnosis, specimens were soon coming in by the thousands. In 1978, as WHO certified one country after another smallpox-free, the CDC smallpox laboratory processed more than four thousand specimens, all of them negative. It was the definitive sign that smallpox had been conquered. However, on 11 August 1978, almost ten months after the world’s last case of endemic smallpox was quarantined in Somalia, East Africa, a medical photographer in Birmingham, England, became ill. Janet Parket was hospitalized thirteen days later, after the smallpox diagnosis was confirmed, and she died one month after her illness began. Nearly three hundred persons with whom she had been associated were quarantined. The report of the official inquiry into the outbreak, Europe’s last, concluded cautiously:

We do not know how the virus reached Mrs. Parker, but we believe one of two routes to have been the most probable. The first involved airborne spread, the virus travelling in a service duct to a room immediately above the pox virus laboratory suite. This room contained a telephone that was frequently used by Mrs. Parker.

FIGURE 1:
Legionnaire's disease, at first identified as a newly emerged pathogen, was found to have been an ancient pneumonia-causing microorganism brought from an obscurity by the modern invention of air conditioning.

FIGURE 2:
Chart describing the presence of legionella in different building types.

FIGURE 3:
Legionella pneumophila, first isolated by CDC researchers in 1976, when an epidemiologic outbreak of pneumonia occurred among many American Legion conventioneers in Philadelphia. Over thirty species of the Legionella genus have since been identified.

FIGURE 4:
Graph showing sporadic cases of legionellosis, 1970-1992, USA.
The second was by direct or indirect contact transfer from a visitor from the Department of Medical Microbiology to Mrs. Parker in her darkroom.

Though only her mother, who survived the attack, was infected, as Mrs. Parker lay isolated in a smallpox hospital, her disease was partly to blame for two other deaths: Mrs. Parker's father died of a heart attack soon after visiting at her bedside, and the forty-nine-year-old director of the smallpox laboratory—the lab located on the floor above which Janet Parker worked and in which her infection had presumably originated—Professor Henry Bedson, a world renowned authority on the disease, committed suicide while quarantined at home, eight days after Janet Parker's astonishing diagnosis was made.

The news of Janet Parker's death came amidst concern for legionella, a new human disease that had emerged in 1976, brought from ancient obscurity by the modern invention of air-conditioning. The Centers for Disease Control estimated that somewhere between 2,000 and 6,000 people had been dying every year of Legionnaires disease, probably for decades, but certainly since the advent of air-conditioning, and long before that, indoor plumbing. Prior to that dramatic outbreak among American Legion conventioneers staying in a Philadelphia hotel during the Bicentennial celebration, these cases had simply been dumped into the category of "pneumonia of unknown etiology."

Energy conservation practices were encouraging the design and construction of buildings that lacked any operable windows and were sealed so tightly that inhabitants were likely to suffer "sick building syndrome" as a result of the concentration of trace chemicals in recirculated air. These air handling systems were also capable, it was feared, of rapidly disseminating mycobacterium tuberculosis, as they provided a warm, moist environment not unlike the human lung. The advent of the AIDS virus, reviving tuberculosis as one of its opportunistic minions, would prove these fears well-founded. The building, no longer clearly manifesting the "hollow strakes, greenish or reddish" on the walls described by the Hebrews in Leviticus, had become the anonymous carrier. Like those individuals identified by Robert Koch in the 1890s who could spread a disease-causing micro-organism without manifesting the symptoms of the disease, themselves, it was now evident that the building, like the human body, could support and even encourage parasitic microbial relationships.
SENSITIZE

Building One of the Centers for Disease Control’s Headquarters in Atlanta, Georgia is constructed in the 1950s when clerical and technical personnel begin falling ill from laboratory exposure. With a central laboratory core surrounded by a glazed office shell, the building masks its virulent identity behind a beurocratic facade. Unlike Ft. Detrick, former center of the Army’s biological warfare program which became referred to as “behind the fence” because of its obvious security structures and bunker appearance, the CDC’s existence as the largest federal agency outside Washington, D.C. would never be guessed from its Clifton Road facade. Nor is it apparent to the surrounding university and residential community that it is in the complex which cascades down the hill behind Building One, relatively protected by dense foliage and patches of undeveloped land, that samples of smallpox, ebola, and lassa viruses are kept.

The CDC’s Atlanta complex has evolved in response to the global disease threat, modifying and adding buildings as new microbes emerge from the biosphere with ever more sophisticated survival
tactics. The first was Marburg virus, which was recognized when it caused thirty-one cases of hemorrhagic fever and seven deaths in workers in vaccine laboratories in Germany and Yugoslavia. The second was Lassa virus, which was discovered in the course of investigating an epidemic of hemorrhagic fever in Nigeria. The startling outbreaks in the 1960s of these two unknown, lethal, and incurable viruses made evident the shortcomings of Building One within less than a decade of its completion and necessitated the design of the first facility specifically aimed at biocontainment. First built within a large truck trailer and later established in a temporary building, it allowed for isolation from the rest of the institution, but provided little except biological safety cabinets to protect the laboratory workers. It was only in a third facility built in 1975 that rooms equipped with biohazard “space suits” were made available.

Biocontainment facilities adapt rather than multiply. The requirements for the containment of lethal and incurable microbial threats are so complex and demanding of the engineering and laboratory staff that there are only two such facilities in the United States and only a few others elsewhere in the world. The CDC’s Viral and Rickettsial Disease Laboratory, built in 1988, is one. Organized much like Building One, in a radial configuration with offices surrounding a laboratory core, its strategic advantage is its third ring: a mechanical envelope encircles the building, establishing a highly pressurized negative core which thwarts the diseases’ natural propensity to spread outward. Any microscopic airborne escapee that might succeed in penetrating the pneumatic rubber door seals would be blown back into the containment area and up through ducts which would filter any dangerous particles in the air before it left the building. It is redundancy that is crucial to the building’s operation—in everything from backup power and blowers to the ability to seal off and repressurize entire sections. With three times more gross than net square feet, a difference accounted for solely by mechanical biocontainment systems, it is literally more machine than building. Housing a staff of only seventy, it merely tolerates the body, human error constituting its point of maximum vulnerability.

It is ironic that the body finds itself out of place in this building, given that the building itself was structured according to technologies of prevention at the scale of the body. After the emergence of Marburg and Ebola viruses in the late 60s and early 70s made the fear expressed by Michael Crichton’s Andromeda a real possibility, experts at the Centers for Disease Control and Prevention and the National Institutes of Health recategorized the microbial world according to the level of risk posed for the laboratory worker.
Though mandating in their elaborated form the safety standards for laboratory operations, use of equipment and design of facilities, the four Biosafety Level classifications are, simply stated: all organisms not known to cause disease are classified as BSL 1; organisms posing a modest risk to human health are classified as BSL 2; organisms for which vaccines and antibiotics are available—those diseases suitably contained within a glove box—are classified as BSL 3; and those organisms which pose a high risk for transmission and for which no vaccines or antibiotics are available—diseases for which introduction into the human body is the most serious threat and which require the protection of a biohazard space suit—are classified as BSL 4. Biosafety Levels 3 and 4 share the "hot" lab at the CDC because they are based on the same principal. Each concedes a space to the pathogen, constructs what is essentially a surrogate body, but a body in which the parasitism has been arrested in a perfect state of adaptation. Both the enclosing environment and and disease have been rendered static, unable to threaten the existence of the other unless the envelope of the laboratory worker were to break and some microbial interloper from within the worker's body compromise the pure microbial culture being contained, or the contained disease invade the body of the worker, from which it would quickly begin to spread and thus compromise the body of the collective institution.

Tuberculosis, once thought to be virtually eliminated through the advent of antibiotic treatments—clearly a Biosafety Level 3 virus—now finds itself on the shelves of the Biosafety Level 4 lab. This is because many strains of tuberculosis are now antibiotic resistant, a condition that has been caused by antibiotic treatment itself. This is
because an antibiotic that does not destroy every single bacteria in a population leaves a competitor free environment inside the body for uncontrolled mutation. In other words, the antibiotics themselves are selecting for a sturdier breed of bacteria that are resistant to treatment. The situation has become nothing short of critical in an environment in which most HIV positive patients are immune-compromised and don’t respond well to the two most effective antibiotics. With the discovery that unrelated viruses and bacteria are capable of sharing virulence and resistance factors—bits of highly evolved DNA that confer resistance to popular treatments—there is less concern that the patient might spread the disease, than that they might serve as a human lab in which microbial tactics can be shared between viruses and bacteria.

Like the body, the building, it appeared was no longer merely capable of trapping, but breeding, disease. In May of 1982 a newborn infant died on the neonatal ward of the University of California at San Francisco’s Moffitt Hospital of a strain of Staphylococcus that was resistant to the penicillins, cephalosporins, and nafcillin. The mutant strain, which had been drifting about the hospital and the local community for three years, infected a nurse on the neonatal ward, and then found its way to three babies. The only way the hospital could prevent further cases was to aggressively treat the ward staff and babies with antibiotics to which the bacteria remained susceptible, close the ward off to new patients, retrofit all organic material on which dormant bacteria might lie, and scrub the entire facility with disinfectants. This was a daunting prospect in the case of an isolated event, but nothing short of a crisis with outbreaks of resistant bacteria inside hospitals becoming increasingly commonplace in the early 1980s, particularly on wards that treated the most immune-compromised patients. Three hospital tuberculosis outbreaks in New York and a fourth in Miami drew attention to the interconnection between multiple-drug-resistant-TB and HIV when, in each instance, a patient with active drug resistant tuberculosis spread the disease to highly suscep-
tible AIDS patients housed within the same clinic or ward. New York City's public hospitals were suddenly obligated, at great expense, to construct air-flow-controlled isolation rooms for tuberculosis patients which would, for the first time, guarantee that no other hospital employees or patients would be compelled to breathe contaminated air. Other public institutions were also being called upon to respond to a growing epidemic of drug resistance. With unprecedented numbers of cases of MDR-TB appearing among the prison population, infected prisoners at New York City's Rikers Island jail were finding themselves housed in a special 140-bed tuberculosis unit which had cost the city $115 million dollars and three years to construct. It was becoming conceivable that, at the very least, hospitals and prisons might benefit from the biosafety level organization in place at the CDC which, arranged not in relation to particular biospheric or symptomological classes of disease but rather according the level of bodily protection necessary for their control, was the furthest thing from the ward structure. Tuberculosis was no longer a single disease, nor was staph or many other bacterial illnesses, and it was going to become necessary that the buildings designed for their

FIGURE 6:
BSL 3 and 4 work was done at the CDC's "maximum containment laboratory" (Building 9) from 1978 until the Viral Rickettsial Diseases Laboratory was built.

FIGURE 7:
Diagram of air and sewage systems in the CDC's Viral Rickettsial Diseases Laboratory. Mechanical systems account for the large difference between net (150,000 sq. ft.) and gross (195,000 sq. ft.) square footage.

FIGURE 8:
Common air flow patterns and air flow rates used for dual-purpose, positively and negatively pressured isolation rooms. The design has been used extensively in both hospital and detention center medical facilities.
care respond not to a disease’s superficial label, but to its inherent capacity to subvert treatment.
Fort Detrick was center of the Army’s biological warfare program until 1968, when its program was halted by President Nixon. It was referred to as "behind the fence", because its facilities were cut off from the rest of the fort’s military tenants. It is now known as the United States Army Research Institute of Infectious Diseases—USAMRIID.

Centers for Disease Control and Prevention, Viral/Rickettsial Diseases (Laboratory, U.S. Department of Health and Human Services), 7.


Ibid., 522-23.
Just as the conventions of dramatic writing formally conflate setting and action, parenthetically separating them from the scripted dialogue by which they are ultimately given life and establishing in them a kind of architectural program over which an individualizing language is laid, so the tradition of epidemic disease management, in characterizing the peculiarities of an ever evolving threat to health against the relative stability of both its site of corporal action and its sociomedical defense, conflates body and setting in a programmatic unity. The buildings that are designed or modified to facilitate epidemic disease management are the italicized space of the drama of pestilence: in structuring the space of bodily action within a pathological setting, the building creates a singular construct against which is played out the dialogue of disease.

Though the body and the building have long maintained a metaphorical similarity with respect to disease, the building has possessed the greater evolutionary advantage. The susceptible body has created in the building an artificial organism with which to engage
in a beneficial symbiosis: the slowly evolving body has sought protection within a plastic frame. In ancient times, both the defiled leper and the infected building had manifested disease dermatologically; but the building, which it had been possible to scrape and re-plaster, had been healed in a way the leper could not. The house, threatened by plague, had been closed down on a side and reoriented to protect the body from a constitutional threat that, unaided, it had been incapable of avoiding. The smallpox victim had succumbed to that disadvantage of the body that allowed disease to become trapped and fester under the skin, and to which the building had responded with a sophisticated ventilation system. In having been able to absorb all the healthy effects of the external environment, but none of its internal sicknesses, the sanatorium had become the more intelligent body. And coincident with the awareness that disease could as easily inhabit the mechanical systems of the building as those of the body, biocontainment facilities had arisen to create the equivalent of a surrogate body within which disease could be housed without the body's associated potential for contagion.

The relationship between the infected body and the infected building is a negotiated one, therefore, in that the building takes on those properties that disease shows the body to be lacking. In ancient and medieval times, when the building is seen as structurally akin to the body, or seen as establishing a kind of microcosm of the infective environment, it does little more than attempt to balance the effects of a malign environment which, unmitigated, will be similarly evidenced on the bodily inhabitant. It is only when the building evolves strategies capable of accelerating or decelerating the course of an epidemic, however, rather than merely balancing the deleterious effects of the environment, that the building increasingly becomes equipped with those properties foreign to the body, and the body is rendered the less sophisticated instrument. The building becomes selective in a way the body can never be, able to operate intelligently upon both its external environment and its afflicted inhabitants. Pestilence, however, being defined by its particular capacity to subvert protective strategies, now finds in the physiological systems that have enabled the building to improve upon bodily defenses a new point of attack. It is no longer a matter of removing and re-plastering over a point of decay: the threat, now completely interiorized, exists within the operational systems themselves. It is now unclear whether the building poses a greater threat to the body, or the body to the building; but what is clear is that the relationship is at another crucial point of negotiation. Just as the consuming effects of a disease--only identified as tuberculosis in the course of dialogue--work their way across a negotiated complex of bodily action and setting in Eugene O'Neill's play, *The Straw*, our contemporary understanding of disease is being, as it has always been, scripted against the spaces we construct to defend against it.
ARCHITECTURES of the CITY
horrific pestilence. Not solely through the figure of Prince Prospero, the duke whose “love of the bizarre” makes him the doomed host in “The Masque of the Red Death,” could this particular brand of hubris have been constructed, requiring as it did not merely a transgression of speech or action to counter a transgression of costume, but a transgression operating at a higher scale among cultural artifacts—only an architectural transgression of taste could illicit greater wrath.

Thus, with his populace decimated by an unnamed epidemic affliction, have Prospero and a band of “hale and light-hearted” courtiers retired to the seclusion of one the prince’s “castellated abbeys.” The prince, rather than having benefited from a tasteful neoclassicism, has rather, according to his sensibility, evoked the neo-Gothic, the interior of the palace having been irregularly disposed with “a sharp turn at every twenty or thirty yards.” Prospero’s architectural histrionics have found their ultimate expression, however, within the palace’s seven chambers, each of which has been defined in its respective character by a “narrow Gothic window” of stained glass, through which the chamber is illuminated by candelabra from along an enclosed, serpentine corridor. The effects here achieved, taken together, could have been nothing short of fantastic; but one chamber particularly, in exceeding all architectural propriety, had become “ghastly in the extreme.” Ghastly indeed must have been the black chamber with the red glass, but presumptuous, most certainly, having been frankly imitative of the rooms in which the victims of smallpox had traditionally been placed—the architectural machination designed to call the disease forth rapidly and accelerate its progress. The palace itself, in its complexity, had, in fact, fallen prey to a similar presumption, for in reconstructing the conditions of the medieval city, with its enclosing walls and serpentine configuration, it had unwittingly invited Contagion, who, in exceeding both sartorial taste and social propriety, had ultimately transgressed the masquerade license of the night.

An epidemic contagion, in Poe’s day, did not construct a direct relationship between an individual pathogen and an afflicted population, but was rather conceived as a product of complex and intersecting contextual conditions. The eighteenth-century epidemic was not a specific disease type with an amplified virulence, it was a nucleus of circumstances, unique to its time and place. If a particular pathological form lent its guise to an epidemic occurrence, it did so in the way a predominating symptom gave its signature to greater malady. The disease, itself, though it might be identified by the disfiguring inscription of smallpox or the phlegmatic liquification of tuberculosis, could only truly be attributed to the conditions prevailing in Marseilles in 1721, or Bicetre in 1780. Unlike today, when an author could neither presume to relate a story about AIDS by manufacturing a fictionalized disease, nor hope to encompass its particularities by describing its occurrence in a single setting, Poe could, through the pestilential personification in “The Masque of the Red Death,” embody the corporeal rigidity of plague, the epidermal ravages of smallpox, and the intestinal convulsions of cholera, within a tale simultaneously allegorical and circumstantial, but above all, spatial. The configuration of Prospero’s palace was, as microcosm of the city, the sole pathological structure: the form taken by the disease was inconsequential to the tale, or consequential only as an horrific literary hyperbole. In our
Edgar Allan Poe would have had reason to be concerned that a certain irreverent and macabre fascination might in fact invite the object of its desire. A somewhat cavalier attitude with respect to the grotesque could not have been, in Poe's day, lightly assumed, having been, as it was, as subject to the stern visage of "taste" as to the swift heel of time—for being improprietous could always only have been to call forth that aspect of shared reality so indeclicate as to have been mutually deemed unspeakable. Impropriety, in 1832 Paris, would have had no finer avatar than a certain anonymous masquerader who, in adopting the personification of Cholera, itself, with "skeleton armor, bloodshot eyes, and other horrible appurtenances of a walking pestilence" had come to the attention of Poe and his contemporaries by way of the *New York Mirror*’s June 2, 1832, issue.¹ Product, however far from idealized, of early nineteenth century New England, Poe could not but have harbored a somewhat puritanical turn of mind, the outrage of which was directed not toward devising a literary nemesis for a masquerader’s poor taste, but rather toward exposing the hubris of an imagined host who would presume to invite celebration in the midst of
contemporary picture, shaped as it has been by AIDS, the epidemic occurrence has remained a contextual condition, but it has been reconfigured within the body, being now individualized and symptomatized by its particularities of aquisition and its opportunist profile. The condition of the sufferer has remained symptomatic, whether expressed by multi-drug resistant tuberculosis or pneumocis pneumonia, of the epidemic structure as contextual datum.

AIDS researchers are now being confronted, at the scale of microscopy, with the problem that has long frustrated attempts at epidemic control at the scale of the city. Methods for controlling viruses, since the vaccine revolution, have operated by challenging the immune system with an invasion that is structurally similar to the threatening viral pathogen, but which is negligible in its reaction within the body. The AIDS virus, however, in attacking the very site of treatment—the immune system—has circumvented this favored prophylactic measure. The question has become, how do you destroy a virus in the immune system without destroying the immune system itself? Similarly, an epidemic, by its very definition as a phenomenon afflicting a higher than usual percentage of a population, has only been an operational model at the scale of the city or community. Maintaining a parasitic dependence upon the city’s most characteristic structures—requiring a dense population, a medium of exchange, and a renewable resource—the epidemic has always been an urban phenomenon. The question has remained, therefore, how may the city be cured without deurbanizing it, and how may an infected population be isolated without reconstructing the context that encourages proliferation?


The onset of an epidemic did not just sicken bodies and render static the bustling metropolis, but rather marked a “physiological” change in the social organism, regardless of the particular affliction. The city’s conceptual and physical mandate was always to serve as a homeostatic device, or that which by its heightened sensory mechanisms could dynamically maintain the functional instability by which contradictory but symbiotic dichotomies—rich and poor, home and industry, politics and commerce—coexisted within the social organism. Following Georges Canguilhem’s definition of health, or normality, as being that condition which allows for the greatest degree of adaptability to environmental fluctuations, the city, beset by epidemic disease, found its homeostatic dynamism entirely subsumed by a dominating disequilibrium of sick and well. All former categorical dichotomies, under the undue stress created by the epidemic outbreak, were redefined according to the prevailing pestilential modality or temporarily suspended. As the weakened city reallocated its energies, employment collapsed, and commerce, especially with outside sources, halted. At the first sign of distress, employers and prosperous city
dwellers fled to country retreats, rural populations became reluctant to approach the city to sell their goods, and the city was banned by neighboring metropolises. The community was respatialized.

External quarantine measures, which had long been employed by traditional societies to prevent the entrance of the *genius epidemicus*, were only extended to human beings when the concept of contagion began to overshadow the belief in demonic, or supernatural, causation. When the Khonds of Orissa barricaded the paths to their hamlets with thorns, ditches, and foul-smelling oil, their concern was not to discourage their neighbors, but to prevent the entrance of Jugah Pennu, the goddess of smallpox. Fortified by empirical experience, such practices persisted through what Charles-Edward Amory Winslow described in the *The Conquest of Epidemic Disease* as "supernatural selection." The lazaretto, the medieval Italian prototype of the naval quarantine station, was similarly encouraged: in imprisoning outside the city those who, in the course of the Crusades, had been proven ungodly by the appearance of leprosy, an effective strategy for protecting the city from contagion was cemented. Thus, by the fourteenth and fifteenth centuries, after clerical and medical jurisdiction parted company and disease causation became associated in the Western mind with contaminated bodies and objects, lazaretti became commonplace at ports and along land trade routes. The contagious character of disease was always most obvious to
those living in cities or villages, who began a tradition of naming diseases for the places in which they first appeared, the places where they were first “imported” into the community. Because the contagious model for disease transmission, being based on a theory of external disease causation, mirrored the belief in a punitive supernatural origin, it was those defensive strategies which established the larger community as a zone protected from external pathological incursion that persisted. Conversely, the traditional faith in collective rituals and churchgoing as the most effective means of appeasing God’s wrath were discouraged by physicians and sanitary officers fearful of the contagious potential of assembled crowds.

Protections had long been established in traditional societies against the evil influence emanating from the diseased, especially at such times when their numbers began to constitute a sick community. On the island of Rias, smallpox cases were permitted to be isolated at home as long as cases in the community were few, but in the event of an epidemic, the diseased were sent from the village to be isolated in special shelters. In the Book of Numbers, the children of Israel were commanded that “they put out of the camp every leper, and every one that hath an issue, and whosoever is defiled by the dead.” As contagion became the dominating ideological construct following the Black Plague, the moralistic fear of falling prey to an “evil emanation” was replaced by the neutralized conception of “contact,” and the lazaretto was expanded to reflect this distinction. Milan’s famous lazaretto, built in 1488, was an arrangement of 288 contiguous cells around an octagonal church. It was separated from the city wall by the city moat, a surrounding road, and a stream which encircled the building, itself. The four sides of the structure were divided into one-story cells faced by a continuous vaulted colonnade. Though the sheer scale of the building, spreading over 160,000 meters, could be explained by timely concerns with sheer volume—in times of plague it could be called upon to hold as many as 10,000 victims in its enclosure—its size facilitated rather another operation. In housing the sickest citizens in individual chambers around the perimeter, the hopeful beneath the colonnade, and the ambulatory toward the center, the lazaretto constructed a spatial defense to

FIGURE 1:
Tablet erected in the eighteenth century on a road outside Lhasa, Tibet, instructing travelers what to do when smallpox broke out in the city.

FIGURE 2:
The Lazaretto of Milan (1488) as it appeared in 1630; an immense hollow square of 288 contiguous cells with an octagonal church in the middle.
counter the progress of the disease.

A passage from a treatise by Alessandro Massarina, the officer in charge of sanitary measures during a plague outbreak in Vicenza in 1577, described the arrangement of the Campo di Marte, Vicenza’s lazaretto. Campo di Marte, established outside the city walls, was expanded at that time with the construction of a second isolation camp of separate wooden houses, on the city side of the river from the lazaretto proper, for those suspected of having come into contact with the diseased. Suspects developing plague in the isolation camp were taken across the river to the lazaretto, and convalescents from the latter were transferred to the former. Those who kept well in the Campo di Marte for 22 days returned to their disinfected homes in the city, there to remain under observation for an additional 22 days.4 Removing the sick and the suspect in this way from the community of well, a sanitary cordon could then be established at the heart of the city—an area for the well, isolated and closely monitored for signs for disease.

In establishing the sanitary cordon at the center of the city, removing convalescents to the outer edges of the city walls, locating sick to the perimeter of the greater community, and enforcing an impervious boundary to outsiders at the edge of trade and travel routes, the city and its environs were, in effect, balancing the course of the epidemic through a spatial defense. Epidemics had long been observed to progress with something of a “ripple” effect: a disease entered the city along trade routes, took hold in the dense central core, and then radiated in concentric spirals until it exhausted its supply of victims in the sparsely populated rural hinterlands. What Vicenza did in 1577 was to manufacture the condition that would prevail once the disease had run its natural course: the central city had been cleansed, the disease having long since eliminated susceptible victims and left only those who had had time to completely recover or those blessed with a natural immunity; just outside the city, the disease had pulled back, the situation was merely serious, for there still existed the possibility that the isolated case could arise; at the periphery sickness still prevailed, the situation was critical, but the disease had been duped into taking the form of the lazaretto, which frustrated its progress in the way the agricultural settlement would; and beyond the edge of the principality and its quarantine guard station, the disease had been pushed back into its natural territory, to the great void of “outside” from which all pestilence originated.

European leprosy, which had furnished the model for quarantine that was later applied to bubonic plague, was itself a fatality of the Black Death of 1346. When the plague decreased the human density of urban areas and, as a consequence, greatly reduced human-to-human contact, leprosy could no longer sustain itself in epidemic form. In its place came tuberculosis, a truly ancient disease which, except among the native peoples of the Americas, had warranted description by each of the ancient literate cultures and had provided for the archaeological record evidence of bone damage dating back at least to 5000 B.C. It was only by re-inhabiting the ecological niche vacated by Mycobacterium leprae, however, that the tuberculosis organism was able to achieve its true impact, for its primary strategic
advantage lay in an ability to exploit a reduced urban density. With its slow ravages and airborne spread, it could survive in a victim until such time as contact with another was made, and though an urban environment was not required for its transmission, it was clearly advantageous. The ubiquitous pestilential scourges of the past had only attained horrific proportions when they found their way into urban centers, where sheer population density instantaneously magnified any minor contagion that might have originated in the provinces. As Europe’s population recovered from plague’s decimations, microbes successfully exploited the growing urban ecologies to create altogether novel disease threats.

2Ibid.
3Numbers 5:2.
4Winslow, 121-22.
In the eighteenth century, the creeping rash of smallpox supplanted leprosy as the prime source of external disfigurement, usurping leprosy's symbolic, rather than ecological, niche. Leprosy, the disease that from antiquity down through the middle ages had symbolized impurity, sin and defilement no longer held sway over the enlightenment mind, nor did it present a real threat to the enlightenment body. Smallpox, first differentiated in the sixteenth century from the huge pustules of syphilis—the great pox—was what literally transfigured and transfixed the eighteenth century.\(^1\) Removed from any venereal kinship, its evil was without moral association, existing rather in its ability to permanently mar, when it didn’t destroy, the body as an integral whole, its ability to deface classical beauty. As Europe’s population recovered from plague's decimations, smallpox began appearing in wave after wave of increasingly frequent and severe attacks. By the seventeenth century its ubiquitous nature had made it the foremost threat to the health of the enlightened population, and it was precisely its continued presence which constituted its strategic advantage. Though it had been feasible to relocate the afflicted population
during the swift, rapid, and severe attacks of bubonic plague, smallpox epidemics were frequent enough in the eighteenth century to make it impractical to disrupt the city every time the disease appeared. It rather made more sense, in epidemic periods, to isolate the afflicted in their homes under guard for a predetermined period of time. The concern however, as expressed by physician Richard Mead in 1721, was that, “for while Contagion is kept nursed up in a House, and continually increased by the daily Conquests it makes, it is Impossible, but the Air should by Degrees become tainted, which by opening Windows...will carry the Malignity first from House to House; and then from one Street to another.” Mead recommended that the sick be removed from their houses to stations “three or four Miles out of Town” only in the early stages of an epidemic. In epidemic periods, the city should continue unmodified, the sick might remain in their homes, and their contacts could be allowed to move freely about town as long as they carried a long stick “of some remarkable colour, or other visible token” by which to warn their neighbors. It was the city itself that, through its very structures, was contributing to the virulence of the epidemic attack. In Mead’s estimation, the city was no longer merely stricken, but literally infected, and this being the case, there was no remedy but to destroy the tainted homes, “if convenient” and bury the infected goods contained therein.

While the lazaretto had attempted to negate through spatial counterbalance the natural course of the plague epidemic, it alluded to an idea of defense by acceleration that would be capitalized upon by strategies to control smallpox. By prematurely reconfiguring the city as it would exist once the disease had run its course, the lazaretto had suggested the possibility of catching the epidemic in its infancy and expediting its progress under controlled circumstances. By employing spatial strategies of defense only in inter-epidemic or pre-epidemic stages, preventative strategies for disease control were initiated that would, in the modern era, evolve into public health infrastructures.

It was in the American colonies that smallpox became understood primarily as an external threat to health. In large, European cities, smallpox had become endemic, appearing again and again in frequent and severe attacks. In the colonies, however, smallpox could more directly be linked to the arrival of infection from ships or to the introduction of infected objects. This encouraged an isolationist posture in the New World with respect to England, as well as between colonial townships themselves. The “cityhood” of the burgeoning colonial town must certainly have gained an associative power when outbreaks dispersed the population. Nearly two thousand Bostonians fled their city when smallpox erupted there in early January, 1752. When the disease returned in 1764, it again precipitated a mass exodus, dispersing the population outward from its core in every direction but toward neighboring Philadelphia. Philadelphia, founded a half century after Boston, quickly became notorious for its liberal control policies and its consequent deadly epidemics. The Massachusetts Bay Colony, however, early passed “An Act to Prevent Persons from Concealing the Smallpox” in 1731, which required heads of households to report any cases to local selectmen and display a red flag on the affected home to warn others.
As a natural occurrence, smallpox was as difficult to control as it was to behold; the advent of inoculation, however, presented an almost unbearable challenge to the dualistic enlightenment mind. For by the second decade of the eighteenth century, an ever widening group was becoming aware of new means to render smallpox less hazardous. The era had brought a new openness to the practices of other lands and cultures, and travelers accounts were being published in frequency and quantity second only to religious literature. The practice of inoculation, which gained receptivity along with many Eastern ideas at the time, involved inserting beneath the skin material from a pus or scab of a mild case of the pox in order to obtain immunity through a less virulent form of the disease. For inoculation’s opponents, however, the deliberate introduction of contagion into the body was like permitting an enemy to penetrate the walls of a town during a siege, the disease having been seen as nothing short of a structural break in the sufferer’s corporeal facade. It didn’t help its popularity, either, that smallpox in its inoculated form was still contagious and potentially lethal. It proved a gamble for the individual, but a threat to the community, as the presence of uncontrolled inoculation could conceivably spark an epidemic. Inoculation was thought, by its opponents in colonial America, as likely to spread contagion as to check it: it was one thing to infect one’s self deliberately, but quite another to infect one’s neighbor as a result. The need and desire of the individual to protect himself and his family from the disease conflicted with that of the community at large, for which the distinction between inoculated and naturally-occurring smallpox was negligible. In Puritan Boston, the conflict was to take on enormous religious significance.

The safety of the individual had never been the first concern in protecting the city from disease. When contacts were removed from the city in order to establish a sanitary cordon, they were placed in danger of acquiring the disease in camp. Following the advent of inoculation, however, it was the inoculee who was being asked to forgo personal protection in order to shield his neighbors not only from possible contact with the inoculated virus, but from the wrath of the Almighty, as well, who had been usurped of his unique powers of pestilence. In Boston, this conflict was eventually...
resolved by legislation in the 1730s that forbade the operation in the town itself in interepidemic periods and permitted it during epidemics only when more than twenty families were known to have the infection. By the 1760s, inoculation hospitals were established outside the city, and finally, in Boston, itself. The colony of South Carolina enacted similar legislation in 1738, banning inoculation in, or within two miles of the city limits of Charleston.

Inoculation’s beneficial impact on public health in the latter part of the century resulted partly from the increased practice of “general inoculations” of entire villages and towns in which smallpox threatened. By adding widespread inoculation to its earlier strict policies of quarantine and isolation, Boston and other towns in Massachusetts developed effective strategies for controlling smallpox in the pre-vaccination era. Philadelphia’s relative neglect of quarantine and isolation, and its allowal of uncontrolled inoculation within the city, undoubtedly accounted for its higher death rate.

It was also recommended in England, in the 1760s, that inoculees be isolated during the period of their convalescence, or that an entire community should be inoculated simultaneously. Simultaneous inoculation was no easy matter, however, as it required the transfer from arm to arm of the infectious material of a mild or previously inoculated case. It required, then, either great discomfort for the source or an extended period in which to accomplish it, enough time to allow succeeding generations of infectious material. For this reason, mass inoculation was rather more successful in smaller towns and villages than in large cities, and led to the establishment, in London, of an institution which could be responsible for pre-immunizing the population. The County Hospital for the Smallpox was created to serve and isolate both inoculated and naturally occurring cases. The institution located itself at both Cold Bath Fields and at Islington, as it consisted of “two houses, at due Distance from each other, in airy Situations,” one for the preparation of inoculees, and one for those stricken with the disease. This was to allow the greatest care to be taken in preventing infection from natural smallpox among those who were undergoing the preparatory measures for inoculation—that is, the dietary regulations and
evacuations that were deemed necessary to render the body in optimum condition prior to treatment. Once inoculation had taken place and the pocks began to appear, the patient was removed in a coach or chair from the house of preparation to the smallpox hospital. While the lazaretto had attempted to negate through spatial counterbalance the natural course of the epidemic, the Small-Pox and Inoculation Hospital sought to neutralize the epidemic by artificially accelerating its progress. Through a trick of programmatic separation it established a parallel measure of quarantine in which the community could gather and sicken themselves, before the natural disease did it for them.

Measures for countering smallpox were no longer designed, as the lazaretto was, to neutralize the epidemic during its progress, but to establish measures that would allow for improved surveillance. And, as the sanitary cordon had taught, methods of surveillance could only proceed effectively from a position of absolute health. As far as smallpox was concerned, this implied relative eradication. It was not, therefore, a remarkable intellectual leap to imagine that mass infection meant eventual eradication, or that it was possible to so accelerate the disease that it was rendered ultimately neutral.

FIGURE 1:
Fragment of Charles Mainland’s report of inoculations performed in the year 1772.

FIGURE 2:
Elevation of the House of Preparation at London Smallpox and Inoculation Hospital.

FIGURE 3:
Plans for the London Smallpox Hospital at Cold-Bath Fields.
This was the proposal made by John Haygarth in 1793 in his *Sketch of a Plan to Exterminate the Casual Small-Pox From Great Britain*. Haygarth proposed systematic inoculation throughout the country, isolation of patients, decontamination of any potentially contaminated articles, supervised inspectors for specific districts, rewards for observance of rules of isolation, fines for transgression of rules, inspection of vessels at ports, and prayers every Sunday. Thus, any new cases were external and more easily caught through surveillance.

The advent of vaccination made Haygarth’s proposal even more conceptually possible. It had been found that inoculation with cowpox conferred immunity to smallpox, but was much safer to the individual than inoculation and entailed no risk of spread to other persons in the community. The result was that Jennerian vaccination was adopted much more rapidly than inoculation had ever been and quickly spread around the world. People celebrated in the streets in Berlin for several years on May 14 to celebrate Jenner’s discovery—in a public gathering that would have been somewhat feared in the past for spreading disease. For certainly, vaccination, like inoculation, was still a social activity, as vaccinations were also performed with vaccine taken from the pustule or scab of a previously vaccinated person. Some persons were still inoculated directly from naturally occurring cowpox, but such application was limited by the fact that the disease was not only fickle, but geographically specific. This usually meant that the vaccine had to be propagated continuously from person to person. As troublesome as this was in larger towns, it was nearly impossible in sparsely settled areas, and the treatment posed a substantial risk of transmitting other dangerous infectious diseases. In 1843, Negri of Naples solved the problem of arm-to-arm propagation when he began deliberately passing cowpox from cow to cow. By scarifying the animals sides before inoculating them, he was able to create a large, mobile source of vaccine. The cows could then be led door to door and vaccinations could take place directly from the cow at the doorstep. The method spread through Europe, arriving in France in 1864, Germany in 1865, and England in 1881. Negri restored the cow as the source for most vaccines and reaffirmed a belief in the origin of disease from a natural reservoir.

Smallpox epidemics were far from eliminated, however, as the disease found allies in faulty vaccines and inconsistent legislative measures. Vaccine-induced complacency soon led to relative neglect, and the need for revaccination was not yet appreciated, so that by the 1830s, any earlier headway made against the disease had again been lost. Efforts at this time to implement a network of public health infrastructures built on the foundation of vaccination had come across new and widespread reaction that would persist for the remainder of the century and further fuel a worsening situation. Early nineteenth-century reformers saw in vaccination not a miraculous solution to the scourge of smallpox, but a threat to certain organized and concerted efforts aimed at eliminating what they perceived to be the
root causes of disease—urban filth and degradation. Medical and public opinion at the time was polarized between the infectionists, or anticontagionists, who attributed epidemics such as smallpox to atmospheric conditions or unsanitary surroundings, and contagionist adherents to the germ theory, who believed such epidemics were caused by the spread of specific pathogenic agents, or “viruses.” Infectionists rallied behind anti-vaccination legislation in order to aid an agenda focused on eliminating such insalubrious urban realities as foul air, filthy streets and overcrowding. Commercial interests also favored the anticontagionist view, encouraging measures that did not require the lengthy and expensive quarantine of goods and people.

While the ubiquity and acquired immunity of smallpox allowed for a certain luxury of strategic debate, the widespread and sudden cholera outbreak of 1832 required an immediate and united front. In France, the infectionist/contagionist argument was temporarily stalled—though eventually aggravated—by the traditional strategy of compromise which erected defensive measures at the borders and eliminated noxious influences in the interior. Contagionists focused their energies on repelling, through quarantine and isolation, the causes of morbidity, while infectionists concerned themselves with removing, through hygienic controls, the causes of insalubrity. That there could be any inherent contradiction between the two tactics would have been inconceivable less than fifty years before when Haygarth proposed systematic isolation and disinfection in his plan to eliminate smallpox. Diseases, up to that point, had always been understood to have—whether concerning the health of the individual or the community—both an internal and an external vector. Smallpox, however, redefined as the contagious disease par excellence, had created a distinction that cholera could not solve. Following the advent of inoculation, smallpox was known to be transferred through a specific vehicle, to produce a unique and predictable malady, and to confer immunity to the sufferer, provided he or she survived the attack. Progressing through far less deterministic means, it was difficult to similarly ascertain cholera’s infectious or contagious identity. The argument that ensued was consequently fought on the grounds of conflicting political, rather than medical, agendas.
Public health was an invention of the Enlightenment inasmuch as medical writers then set out to show how the old canons of hygiene and health maintenance could be applied and adapted to populations rather than individuals. The inception of an organized, modern, public health movement began in the 1840s with the campaign for social reform launched in England by Edwin Chadwick's enthusiastic humanitarianism. In the model used by Chadwick and the "ultra-sanitarians," an epidemic was first and foremost a problem of the dirt and decomposing matter concentrated in the unsanitary districts of large towns and could therefore be eliminated by public health engineering. Though these causes were distributed across environments, it was where they were concentrated that human bodies would be poisoned more commonly and more intensively. The discourse initiated by the sanitarians was not only overtly spatial and physical, but political insofar as these inequalities were painted as undesirable and preventable. According to their idealized "society of surveillance," higher than average death rates should alert local authorities of the need for action, and central governments should compel such public health schemes as would remove the concentrations of disease causes.

On 20 August 1831, with the threat of cholera looming, a central health commission was established in Paris with neighborhood commissions in the quartiers of Paris's twelve arrondissements, to investigate, observe, and take action when necessary to protect the public health. In addition to retaining an architect and physician to inspect homes in the most populous district, the commission supervised the inspection of all public gathering places, dangerous industries, warehouses and storage yards, and checked sewage connections, wells, cesspools, latrines, and outhouses. Comprised predominantly of infectionist reformers, the Paris commission organized their investigative strategy according to the belief that the disease was spreading through the city starting with the most obviously decaying streets and dwellings. Approaching the city as clinical diagnosticians, they proposed a surgical manipulation—urban renewal, which by demolishing and rebuilding dilapidated housing and industry would remove the city's tumorous malignancies. It was the same philosophy that led Noah Webster to be- moan the contagionist model that had misled mankind into a "fatal security" with respect to his built environment: "Supposing the laws competent to guard public health, men have not attended to the best modes of constructing houses and cities, and to the means of watering and cleansing them—means by which all the slighter pestilences might be avoided, and the more severe ones greatly mitigated." Webster proposed a new program of city planning, the tenets of which included the adequate use of sloping terrain, straight streets at right angles, lots at least 60 by 250 feet with not over forty percent of the frontage built upon, a garden behind each house, and an alley running behind the gardens through each block. The streets with their footwalks should be 100 feet wide and planted with three rows of trees.

Following the ferocity of cholera's 1832 attack, contagionists were quick to cite the ineffectuality of the many improvements that had already been made to the city of Paris:
Streets, bridges, and quays were all more open to sunlight and healthful breezes. The La Villette reservoir, fed by the Ourcq Canal, supplied water to new fountains in every quarter of the city. Certain closed-in and unhealthy areas had been razed, including the Châtelet, the Carrousel, the paddock in the Tuileries, and the neighborhood of Saint-André des-Arts. Other areas had been enlarged and refreshed by broad streets and huge open squares. Industries were banished from the city’s center. Cemeteries were moved outside the city walls.\textsuperscript{11}

Infectionists argued that the government could go only so far in making improvements, beyond which, the city itself was to blame: as a self-perpetuating organism, it had grown haphazardly over time, and the persisting unhealthy conditions were but the unfortunate natural product of the way in which the city’s population concentrations had developed in relation to its topography. Their suggestion that physicians be called in to select healthy sites for construction and that politicians encourage public hygiene as a veritable vaccine for the city was logical, but impractical. If new housing was to be built, old buildings must be torn down, leading residents to seek refuge in already overcrowded districts. Infectionist reformers were thus faced with a situation in which removal and isolation—the strategy favored by the contagionists—was the only way to practically manage the situation. Such mandated segregation was abhorrent to anti-contagionists who saw it as only creating new sources of infection: to confine people was to press them together, to concentrate the disease. Contagionists,
however, argued that opening up diseased areas allowed residents to disperse and increased the number of possible routes of disease transmission.

It was, in fact, the inability of the infectionist approach to endorse a definitive etiology and a clear-cut defensive strategy that ultimately proved to be its tactical advantage in enlisting popular support, if not in preventing the onslaught of disease, itself. What allowed the infectionist approach to prevail for most of the nineteenth century was its power to redefine the very conception of disease according to a model of increasing complexity. The 1832 cholera epidemic was not an exceptional catastrophe, in the infectionist view, but the culmination of a long series of developments revealing worsening physical, social, and economic conditions. The redefinition of pestilence involved a shift in perceptual scale, not in space—like the realization of the Middle Ages that disease perpetually hovers in geographic externality—but in a time. The epidemic occurrence was, in the nineteenth century, neither limited to nor coincident with the rapid filling of mass graves: a sudden statistical increase in mortality was but a symptom of the sickened city, whose illness was chronic and prolonged. The epidemic period was consequently conceptually lengthened and decelerated so as to provide curative opportunity, designated "prevention," at times when it could more conceivably be administered. Georges Canguilhem recognized, beginning with nineteenth century medicine, the denial of an ontological conception of disease which, expressed by a purely quantitative distinction between the normal and the pathological, was basically a deep refusal to confirm evil: medicine was no longer dualistic, meaning Health and Disease no longer fought over man the way Good and Evil fought over the World. Infectionism was the refusal to accept disease as the "evil" possession of bodies, the heritage of the contagionist viewpoint. Requiring a new model of the pathological world that described disease in terms of its special, accidental, or unexpected qualities, the nineteenth century looked to the infectionists for a pathological profile that existed at the intersection of relationships of atmosphere, topography, and public hygiene—factors combined under the heading of "living space" as the circumstance of an historical pathological phenomenon. Michel Foucault described the new awareness which held that: "Whether contagious or not, an epidemic has a sort of historical individuality, hence the need to employ a complex method of observation when dealing with it." Tuberculosis was to prove the ideal disease with which to test these ideas, for by singling its victims out one by one in slow progression, it was an epidemic perfectly suited to an epic timeline.


11Ibid., 191.

12Ibid.


14Ibid., 88.


18Winslow, 228, quoting Noah Webster. *A brief history of epidemic and pestilential diseases: with the principal phenomena of the physical world which precede and accompany them.* 2 v.: Hartford: Hudson and Goodwin, 1799.

19Delaporte, 19.


The debate which raged in the nineteenth century between the infectionist and contagionist camps was in essence a controversy over whether an epidemic was most easily defined and controlled in its individual or its collective manifestation. It was in the empirical objects on which each theory focused that the differences between the two medical ideologies became irreconcilable: infection theory treated populations, whereas contagion theory dealt with individuals. The battle lines actually coincided with the objects of study, for city doctors saw infection while rural doctors saw contagion. Infectionists looked for simultaneity, contagionists looked for sequences. It was only when medical and popular attention began to turn to tuberculosis—with its epidemic curve evident only over years, rather than months or days—that the opposing camps became reconciled within a unified, complex etiology.

The sanitarium cure for tuberculosis, which became increasingly popular after the 1870s, provided a means to collapse the distinctions between the tenets of opposing medical philosophies. As a
curative institution removed from the insalubrity of city, literally and philosophically grounded in a epic and untainted natural landscape, it removed the consumptive from the source of infection. As a mechanism of isolation, establishing an exile community in the wilderness, it removed sources of contagion from population centers. In constructing a cure for a complex and slow-moving epidemic pathology, it confirmed a willingness to treat disease itself as a symptom of a greater malady.

The most famous of the early American sanatoriums was undoubtedly that at Saranac Lake, New York. This area of the Adirondack Mountains was already established as a cure spot and hunting region for the wealthy when Dr. Edward L. Trudeau went there in the 1870s to cure his own tuberculosis. He subsequently moved his family there and, after reading about the European precedents, opened his Adirondack Cottage Sanatorium in 1884. With the growing popularity of the rest cure, townspeople in Saranac Lake were encouraged to board the increasing number of consumptives and to convert their homes into hospices. Establishing the model that would come to characterize the American sanatorium movement, Trudeau's complex with its community support system, began to operate more as a master-planned community than as a single institution. The early popularity of Trudeau's complex must certainly have followed from the ability of his personal story to capture the American imagination: as an invalid deserting the city, confronting the wilderness, and emerging a stronger man, he personified in the medical realm the ideal of American experience, while supporting in the process its suspicion of urbanity and its love of open space. While the great European sanatoriums and their initial American imitators had been luxury resorts for the upper and middle classes, the later American model was becoming increasingly rusticated and democratic: this transition was reflected in the marketing approach which touted the sanatorium not as a resting place for the enervated rich, but as a hearty popular alternative to the confinement of the industrial city.

As an experiment in controlled, high density settlement, sanatorium planning paralleled a widespread interest in late nineteenth century America in ideal planned communities. Whether invalid
resort or rural communal utopia, these settlements had in common a desire to impose order on the chaos of industrial experience while retaining at least the semblance of democratic process. They used the countryside to arouse soothing images of freedom and escape, while organizing within themselves an urban complex of networks and hierarchies. In the tradition of the transcendentalist commune, the sanatorium framed its cure as a group effort, and the metaphors invoked for it, whether by doctors, planners or patients, were all communal—the town, the school, the family. The sanatorium was a material commentary on the country, the ideal city, and the proper organization of an economy. Unlike their megalithic European cousins, for the American sanatorium, the campus plan prevailed.

When Beaux-Arts academicism surpassed Victorian eclecticism at the end of the nineteenth century, and talk of an “American Renaissance” began to circulate freely, the plan was rediscovered as an urban ordering device. Suburban American developments which had been relying on idyllic Olmstedian vistas and gracefully curving boulevards rediscovered the axis and the grid. The City Beautiful movement arose to defend the American city against

FIGURE 1:
A patient being attended by a nurse at Dermady Cottage Sanatorium, located about ten miles outside Philadelphia, Pennsylvania.

FIGURE 2:
Hygeia delivering the masses from the industrial city (seen in background); courtesy, illustration from the Metropolitan Life Insurance Company’s 1915 pamphlet, America on Consumption.

FIGURE 3:
Edward Livingston Trudeau, M.D., American pioneer of the sanatorium movement and leader, during its early years, of the anti-tuberculosis crusade.

FIGURE 4:
Saranac Lake, New York, circa 1905.
chaos through classical planning and mandated uniformity. The object of Burnham's 1909 plan for Chicago was to save the city from the evils incident to rapid growth, and more specifically, the influx of immigrants without common traditions or habits of life. Devising the site for the sanatorium cure provided the same opportunity, in microcosm, to establish *ex novo* a model of health applicable to both individual and community, in the same ironic twist that has always led eras of heightened individual awareness stumbling into communal fantasies. The Charity Organization Society of New York's 1903 proposed tent plan for a rural area on the outskirts of New York City stressed through its classically axial layout the importance of the overall plan relative to the individual building unit. The huts themselves—or more accurately, tents—were designed for ease in disinfection and replacement. They were not oriented to the sun or prevailing breezes—an important aspect of the cure—but rather existed only as the most fundamental element in an arrangement of imbedded hierarchies and shared facilities.

Contemporary with the Charity Organization Society's plan, the Dernandy Sanatorium in White Haven, Pennsylvania, showed less concern with the problem of infected residences than with the potential of the individual unit to facilitate care within a suburbanized townscape. Here, the sleeping porches and verandahs were given a specific orientation and, as the site of treatment, maintained priority over a generalized planning scheme. In this way, Dernandy's philosophy was more in keeping with Ebenezer Howard's Garden City than with the City Beautiful plans. Following the realization of the first of the Garden City prototypes in Letchworth in Hertfordshire, England (1902), classical rigidity was replaced by a loose, radially zoned plan in which houses were turned on their lots to command the sun and view. More crucial, however, than this new attitude toward nature demonstrated by the Garden City enthusiasts was the specifically economic raison d'être argued by its proponents. The City Beautiful movement, aimed specifically at ameliorating the evils of the industrialized city, was unable to insert itself within the capitalist system of urban land speculation; the Garden City Movement found its success, however, in launching an attack not directly at the heart of the industrial monster but at the fringes. Howard saw in the system of private land ownership the greatest threat to civilized existence, as it perpetuated and encouraged the exploitation of the city center and consequent unlimited sprawl. If speculation was eliminated by the company ownership of land, buildings could be spread out and open space liberally provided for. The benefits of urban life—social life and public services—could then
be combined with those of the country—quiet, healthful air, greenery, fresh produce.\(^7\)

The Woodmen Sanitarium in Colorado Springs, Colorado, began embodying many of the Garden City tenets at least a decade before Howard’s proposals. The largest of the curative tent colonies in Colorado Springs, a turn-of-the-century mecca for consumptives, the Town of Woodmen was founded by the Modern Woodmen of America. This fraternal organization was established in 1883 with one of its goals being the providership of a national health insurance for tuberculosis sufferers covering fourteen months of treatment at the sanitarium, at a cost of about 48 cents a year. Comprised of 205 tents in subdivided groups surrounding a main sanitarium building, the Woodmen complex was a self-contained community, with its own post office, waterworks, stores, and an award-winning dairy farm.\(^8\) Though the sanitarium provided for city dwellers ownership in the communal utopian cure, it could not have existed without the capitalist tenet of land speculation, either on behalf of the Woodmen or Colorado Springs, for “chasing the cure,” as it came to be known, was made possible by economic interests concerned with the rapid development of the American West.

It was said that the American West was opened up by minerals, cattle, and consumption; and Colorado Springs has long existed as testament to the validity of the statement—at least as concerned consumption. The town was founded as a health resort in 1871 by General William Jackson Palmer, based on the reputation of the hot springs with which its neighboring towns were blessed—Colorado Springs, with its ironically evocative name, was not. A Chamber of Commerce poster from the early 1900s pitched the city this way: “Colorado Springs, the city of sunshine, is the ideal all-the-year-round health and pleasure resort. The atmosphere is absolutely aseptic and free from all germ life. Epidemics of such diseases as Scarlet Fever, Diphtheria, Typhoid, etc., are unknown. There have been more permanent recoveries from pulmonary complaints than in any other climate in the world." By 1925, half the population of Colorado Springs could claim to have moved there for reasons of tuberculosis.\(^9\) Like Colorado Springs, many western city officials
and business owners sponsored eastern advertisements for climate cure. Reports of miracle cures in the west appeared in magazines, books, and handbills, often under the aegis of a particular chamber of commerce or railroad line. Railroad owners wanted more traffic and shared an interest with local residents in stimulating local economies. Many communities invited invalids to settle permanently and, with the growth of the rail system, the trickle of "lungers" became a flood. By the 1870s, there were hundreds of places to which people could relocate: in addition to the Adirondacks, the central Rocky Mountains of Colorado, New Mexico, West Texas, and Southern California were immensely popular. Tall tales circulated about places so salubrious that residents had to be killed in order to start a cemetery.\textsuperscript{10} The sanatorium culture was to become a paradigm for the commercial development of rural areas: "The sanatorium has a great educational value; it gives employment to local people; it has a payroll of from $1,000 to $1,500 per month, a part of which, at least, is expended in the neighborhood; it brings friends and visitors to nearby hotels; benefits the merchants; and creates a market for produce raised in the vicinity."\textsuperscript{11}

Uncontrolled capitalism was blamed as the cause for tuberculosis, as the source of the social problems of the cities, as well as the enticement for the overindulgence which brought on the bourgeois affliction. It was no mere coincidence, perhaps, that Thorstein Veblen devised his theory of conspicuous consumption precisely at the height of the American war on tuberculosis, demonstrating how the unproductive consumption of goods became a mark of honor and dignity, evidence of one's progress past the point of requiring full time and substance committed to the acquisition of the necessities of life.\textsuperscript{12} The construction of tuberculosis posited a critique both against its namesake "consumption" and its capitalist setting. Translated to a pathological profile, the body possessed a limited amount of energy which must be properly spent. Energy, like savings, could be depleted through reckless expenditure, at which time the body would proceed to "consume" itself, and the patient would "waste away."\textsuperscript{13} The sanatorium, unlike the unregulated capitalist monster that dominated eastern seaboard urbanity, provided a structure in which the necessity of regulation, accounting, and discipline could be applied both to the economy of the invalid and the burgeoning growth of the western town.

Most consumptives, however, waited until the disease was so advanced that they traveled only as a last hope, arriving in the notorious western cure spots impoverished and too weak to work. Many could not afford to cure at a hotel or sanatorium, but sought shelter in apartments, private homes, cheap hotels, or tent camps on the edges of towns. The geographical problem quickly ceased to be the separation of dying from incipient cases, a distinction crucial to sanatorium planning, but became concerned with the isolation of a growing indigent, contagious population. A strategy adopted by some western states was that of interstate quarantine. To prevent continued migration, Colorado, Texas, and California
unsuccessfully sought protection for communities so overburdened with consumptives that basic services were endangered. The most individual communities could generally accomplish, however, was the prohibition of tuberculosis treatment facilities, such as boarding houses and sanitariums, within city limits. San Antonio passed such a law in 1909. Various towns in the resort areas of North and South Carolina also passed these prohibitions.

Both the geographical and economic implications of an epidemic of mobile consumptives were evident in the results of the Pennsylvania Society for the Prevention of Tuberculosis and the Philadelphia County Medical Society's appeal for state support of a sanatorium system. Their 1895 meeting documented the need for two specific kinds of institution: rural sanatoriums for incipient cases and urban hospitals for those in the advanced stages of disease. While the care of advanced cases was, they asserted, a local responsibility, they insisted that the state support a sanatorium for cases showing hope of recovery. The 1901 award included $40,000 for buildings and equipment at an existing rural White Haven facility and $10,000 for the maintenance of dying patients in Philadelphia.14 This distinction was to prove short lived, however, for despite the state and the organizations' intentions to send only early cases to White Haven, nine out of ten patients who arrived there were in the advanced stages of the disease. Those with early tuberculosis were not applying for admission, and pressure to accept others "was too great to be withstood."15

By 1916, thirty states had opened their own sanatoriums, and many counties nationwide had established treatment centers. Whether east or west, the concern was for each to administer to its own. Government was called upon to halt the practice of "chasing the cure," and this was accom-

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**FIGURE 7:**
Patients on the roof garden, the House of Mercy, Philadelphia, in mid-winter.

**FIGURE 8:**
Plan of a bungalow court designed for Pasadena, California, in 1910.
plished through the standardization of medical practice and the establishment of public sanatoriums. Publications began to encourage the consumptive in the early stages of the disease to seek treatment at home so as to ease the burden on both the sanatorium system and the family economy. The treatment, now separated from its geographical source, located itself in the suburbs, in that typological hinterland which had been called upon to cure many ills associated with urbanity. Whether remaining in the home or within an organized institution, medicine superseded environment, and treatment was again to be administered to the social body rather than to the physical body.

The home cure, requiring proper orientation and therapeutic additions, privileged the single-family, detached house and encouraged suburban living. Dr. Maurice Fishberg, writing in 1922, advised that “the suburbs around cities are suitable for families in which there are tuberculous members, and the expense involved in moving them to these parts is comparatively trifling; in fact, the rent is often lower, and they need not lose their jobs, or break up their business.” Fear of infected residences and the concern for the maintenance of near surgical standards of cleanliness meant that a higher premium was being placed on the new home, and it was being provided, prefabricated, by a number of new means, including the Sears Roebuck catalog. The spare, dust-free environment was a preventative, not just curative, measure; and the ideal suburban home was one in which, in Dr. Edward Otis’s recommendation, “dust should be scrupulously avoided, as well as disorder, dampness, darkness, and bad air.” He called upon the modern homemaker to realize, as the surgeon realized, “that absolute cleanliness is really the cause of his marvelous results...so in the ultimate analysis, the social problem [of tuberculosis] is the struggle toward cleanliness. Clean bodies, clean houses, clean workshops, clean air, clean water and food, and clean minds are the essential factors involved in the solution.” By the second decade of the twentieth century, sleeping outdoors and exposure to fresh air became the prescription for a lifestyle of prevention, a part of general middle-class, suburban culture. Theorists and moralists increasingly prescribed the country life for everyone, not only those of fragile constitution. Country Life magazine extolled the rural life by carrying endless testimonials from farmers, housewives and clergy concerning the aesthetic and healthful effects to be gained from sleeping outdoors. One enthusiast correctly predicted that “the architecture of the future will produce an entirely new type of dwelling, where the sleeping quarters will be located on roofs, or porches, or wherever unlimited oxygen can be obtained.”

This prediction found its most eloquent and persuasive realization in California, where the culture of health took on religious proportions after the turn of the century. Demographers have established that health seekers made up one-tenth of the population of southern California in 1900, and twenty to twenty-five percent of the total immigration to the Southwest in the nineteenth century. The mild southern California climate was the preeminent setting for living the outdoor life without fear of the harsh winters that might turn consumption to pneumonia. The bungalow attained its apotheosis here as the first mass housing type to celebrate both the region’s casual outdoor lifestyle and its culture of immigration: the form utilized the diverse influences of Japanese, Swiss, and Indian domestic architec-
ture, turning eclecticism against itself in an attempt to explode the prevailing Victorian model. Accommodating and facilitating the celebrated suburban lifestyle, the bungalow court was popular in Pasadena where, grouped in small clusters around a central open space, it reproduced in miniature the master-planned sanatorium commune. The bungalow court remained a popular form of speculative suburban development in the area until the late 1920s.29

2Saranac Lake and Its Environ, still harboring a sizable population of ex-patients and employees. Trudeau Institute, successor of the Adirondack Cottage Sanitarium, long employed ex-patients and former staff.

4Ibid., 95.
5Ibid., 297.
7Ibid., 679-680.
9Ibid., 78.
12Caldwell, 22.
15Ibid., 79.
17Ott, 125.
18Ibid., 91.
19Ibid., 45.
Progress in reuniting infectionist and contagionist ideologies within medicine occurred as early as 1854 with John Snow's suggestion, predating microbial evidence of bacterial or viral causation, that disease transmission could occur through varied and unrelated routes. In describing communicability, the pioneer epidemiologist cited syphilis as sexually transmitted, skin diseases as transmitted by contact, and intestinal worms as requiring fecal-oral transmission. The 1832 and 1848-49 outbreaks of cholera in London directed Snow's attention to a pathology in which the "morbid" material is ingested through the mouth, multiplies in the intestine, and is excreted with the feces. Snow proposed that the cholera pathogen was being carried in water from one area to another when wells, streams, or pipes came into contact with the sewage from infected households, thus allowing the revolutionary observation that, in the case of cholera, personal contact without exposure to excreta was not sufficient to cause infection.¹

In one of the first attempts to employ graphic representation as an epidemiological tool, Snow developed a procedure with which to
map the 1854 London outbreak of cholera which culminated in the deaths of 89 persons known to have drunk from the Broad Street pump. He represented with a black bar each related death from August 19 to September 30 in the geographical situation in which the fatal attack took place, and also made note of the locations of the several local water pumps. By observing the high occurrence of deaths radiating from the Broad Street pump, Snow was able to deduce that its water was the source of the cholera outbreak. The map, in reducing a London neighborhood to its public spaces, thoroughfares, and utilities, and to the directly correlated deaths taking place therein, foretold of the radical changes in the approach to public disease management that would follow the new discoveries made by Snow and his colleagues.

John Snow, operating at the scale of the city, made a radical observation about disease transmission that, while fundamentally altering approaches to urban planning and public health, was not to change substantially the understanding of the space of communicable pathology until it was proven at the scale of microscopy. Robert Koch's 1882 discovery of the microbial cause of tuberculosis proposed not only a specific mechanism for disease transmission, but gave credibility to a research methodology as delaminated from the body of the afflicted individual as the epidemiological model which
preceded it. Disease pathology, understood in the grand tradition of clinical anatomy, was thought to follow from the derangement of the normal relations between the body's differentiated colonies of cells. The most promising avenue of investigation into the cause of a disease such as pulmonary tuberculosis was, then, the post-mortem examination of diseased lungs and a comparison of these to their healthy counterparts. Careful correlation of this data would, the theory ran, gradually coalesce in an accurate and detailed picture of the course of the disease. With the development of Koch's Postulates, however, pathological investigation was removed from the body of the infected and transferred from the clinical autopsy table to the laboratory. The disease was no longer to be identified by its symptomatic profile, but by its ability to first be isolated from the body in the form of a recognized and universally present bacterial organism; secondly, to spawn a pure culture of identical microorganisms in a laboratory environment; and, lastly, to infect a sacrificial laboratory specimen.

New York City's "Lung Block" was, for sanitationist Ernest Poole, an architectural petri dish in which a pure bacterial culture was thriving at the scale of the city. In his estimation the buildings were rapidly absorbing the tubercle bacilli with each infected resident to create a source of infection that was certain to prey on...
both current and eventual inhabitants. Following Koch's discovery, Progressivist reformers such as Poole became concerned with the threat posed by infected buildings: he wrote that "rooms here have held death ready and waiting for years." The inflammatory propaganda produced by Poole and his colleagues convinced the public that a healthy person could become infected by the very walls that had enclosed a dying consumptive: once a room or house had become permeated with tubercle bacilli, no one who dwelled there was safe. Reformer Arthur Guerard recorded that over one fourth of the New York homes he inspected were permanently infected with tuberculosis.3

Compared with John Snow's earlier study of cholera, the 1903 map of the Lung Block prepared by Poole's Charity Organization Society does not depict an isolated incident of disease contamination, but attempts a graphic representation of the microbial legacy accumulating at the site of infection. The element of time, absent in Snow's illustration, appears here in the form of an alphabetical sequence: each incident of tuberculosis has been associated with its year of appearance, thus enabling a graphical identification of buildings more or less virulent than one another based upon the number of cases they have "caused" over time. No single outside source is implied; rather, cause and effect have been subsumed by a self-perpetuating infective organism.

Infection theory was at first strengthened by Koch's discovery of the microbial life of disease as it could be sustained outside the body. But when Koch's research led him to attempt to establish laboratory, rather than clinical, methods for detecting sources of infection, his investigation led him back to the human body. Koch found in studying cholera victims that regardless of whether he examined the most deadly or the most mild cases, the bacterial source of the disease was unchanged. In fact, he found that certain individuals could carry the bacteria without manifesting any sickness at all. The natural terrain of the bacteria, he found, was not natural sources of decaying organic matter external to the body, but the body itself.

Physicians had long recognized the inadequacy of visualizing contagion as the direct passage of a "germ" from a sick person to a susceptible victim by direct contact or, for a relatively short distance, through the atmosphere. Infection theory, in fact, originated to explain the fact that illness appeared to occur even in the absence of contact and that often cases failed to occur when such a direct influence was present. Epidemics broke out without the introduction into the community of any recognizable case from without; and within the city pestilences often raged within self-imposed boundaries, never spreading beyond the borders of their initial attack. Outbreaks began and outbreaks ended without any causes that could be directly related to the presence or absence of the sick.4 It was only following Koch's identification of the "well
carrier" that these phenomena could be explained without re-
course to a sick environment, either natural or architectural. The
strength of an epidemic, Koch explained, was in fact marked not by
the number of sick but by the number of well carriers in a popula-
tion. During the first world war, British bacteriologists studying
cerebrospinal meningitis found that the proportion of well carriers
in a military command could be used for prediction of an epi-
demic: clinical cases, it was found, began to appear only when the
carrier rate reached about sixteen percent. The estimation of the
potential of any epidemic to spread had to consider not merely the
presence of sickness but number of "cases," or all those who
provided residence for the pathogen. Modern epidemiology was
predicated on the recognition that there were innumerable im-
munes in densely populated areas who would never show symp-
toms of an epidemic malady, and that it was those cases which
were the true evidence of the epidemic state.5

In the mid 1960s, the World Health Organization (WHO) and the
Centers for Disease Control (CDC), following the success of the
Salk polio vaccine, were able to conceive of the global eradication
of smallpox only because, unlike tuberculosis, the disease had no
carriers. In little more than a decade, smallpox, the disease that
had terrorized mankind for 10,000 years, was gone. The campaign
succeeded where others failed because it was based on the scient-
ific principle of surveillance, easily employed in the case of a
disease that so obviously marked its victims. To find a precedent
for the control of smallpox by surveillance rather than mass
vaccination, however, one must go back to the town of Leicester,
England, the site of a massive demonstration against the Vaccina-
tion Acts that took place in 1885. Rather than endorse compulsory
vaccination, the Leicester Board of Guardians, which was respon-
sible for carrying out the Vaccination Acts, had mandated the
immediate notification of cases, isolation of all smallpox patients,
disinfection of their quarters, and quarantine of any contacts. At
the time, the town's reliance on measures other than vaccination
was radical. Though opponents likened Leicester to "a town where
brick-built homes are gradually being replaced by wooden ones,"6
the strategy was particularly effective in minimizing transmission
of smallpox in the city, especially as compared to situations in

FIGURE 4:
Vaccinating in Brazil. The smallpox
eradication program was ultimately force
shift from a strategy of mass vaccination to
epidemiological surveillance to control the
spread of the disease in Third World
countries.
which mass vaccinations were done half-heartedly. In the eradication campaign that would take place almost a century later, however, strict attention to the principles of epidemiology and surveillance came as a mid course correction, only after the initial strategy of mass vaccination came up against an impenetrable obstacle.

The correction came out of an experience in the Ogoja district of Nigeria, where there was a smallpox outbreak in December, 1966. The massive delivery of supplies that was required for the eradication effort had not yet arrived, so the CDC's eradication team in the area was forced to stretch their supplies as far as possible. They used the technique that would later be dubbed "selective epidemiologic control" to identify the contacts of victims of a local outbreak and concentrate their vaccinations close to the source. By the time the large quantity of supplies arrived a few months later, the outbreak had been contained. Although less than half of the population had been vaccinated, smallpox was no longer endemic in the area, and the technique that had worked in Ogoja was soon applied wherever outbreaks of smallpox occurred. Called "eradication escalation" or "e-squared," the reworked strategy employed newspapers, radio, letters, mission stations, and health and volunteer agencies to track down outbreaks. When officers arrived at the site of a new attack, they attempted to first track down the original case and collect lab specimens to verify the diagnosis. They would then proceed to vaccinate all those in areas contiguous to the patient, whether geographical or sociological.

It was well known that surveillance required redundancy: it was many times harder to find every outbreak than to find most outbreaks. After project eradication escalation brought an early end to smallpox in West Africa, India became the next point of attack, and beginning in October, 1973, every village and every home in the country were visited once a month. In the village marketplaces, team members handed out smallpox cards illustrating the disease's effects and offering a $12.50 reward to anyone who reported a new case. Towards the end of the campaign, this tactic proved to be the most effective in the CDC's arsenal. When a new case was reported, a containment team went to the village, confirmed the diagnosis, listed all the residents, vaccinated them, and traced the source of infection. Guards were placed at every house where there was a new case, and some team members remained behind to vaccinate newcomers. Next came a search of all the people who lived within a radius of ten to twelve miles around the village. Two weeks later the search was repeated.

The strategy of epidemiological surveillance combined with rapid response had permitted the ultimate eradication of one of the greatest and most ancient threats to health. It had only succeeded, however, through the realization that, though the disease might not be carried at the scale of the individual body, it could be carried at the scale of the community.


*ibid.*


*ibid.,* 345.


*ibid.,* 206.
By 1989, concern was mounting over the increased incidence of tuberculosis among those who had regular contact with the large impoverished and homeless population of New York City. The situation was not considered critical, however, until 1992, when the infection that was appearing among doctors, jail guards, and the patients of inner-city clinics and hospitals, proved increasingly unresponsive to treatment. With the failure of common antibiotic treatments to halt the progress of the disease, an intensive program of epidemiological surveillance represented the only hope for controlling a rising tide of bacterial resistance. The smallpox eradication program had proven the success of surveillance strategies less than a decade before, their mission necessarily concerned less with the individual as the representation of a symptomatic case than as a sustaining environment for the disease. Once it was known to be eliminated from a community, the endemic nature of the smallpox virus disappeared forever. With the emergence of multiply-drug resistant strains of tuberculosis, however, it was no longer sufficient to employ surveillance to back the disease into a geographical corner, but into an evolutionary
corner, as well.

In 1982, President Reagan called for a war on drugs which resulted, by 1990, in more men being incarcerated in federal prisons on drug charges alone than had comprised the entire 1980 federal prison population for all crimes combined.¹ With some eighty percent of all resistant tuberculosis cases at the time being among drug users, many of whom, as a result of federal and local crackdowns, were drifting in and out of the jail and prison system, what began as an isolated case of MDR-TB among a recalcitrant tuberculosis patient was amplified inside city jails into a full-scale epidemic. Worsening the problem, on any given day between fifteen and thirty percent of prison inmates were HIV positive, providing the aerosol-infectious microbes with an enormous pool of unusually vulnerable humanity.² Perhaps it could have been predicted that the arrival of a new disease which produced severe immune deficiency and struck particularly hard in communities of poverty would spawn a reemergence of tuberculosis. Given that such communities had already witnessed a slow, steady rise in TB cases well before the new wave of immunodeficiency arrived, a resurgence of tuberculosis seemed a virtual certainty. The fact that many of the tuberculous in inner-city communities were perpetually non-compliant with antibiotic treatment programs meant that the perfect conditions for the breeding of resistant strains was established. State and federal resources that had traditionally been directed at hospitalization costs were now needing to be allocated toward the patient compliance surveillance structures necessary to follow an infected population that was largely homeless and extremely difficult to monitor.

The epidemiological term “amplification” which had traditionally referred to the conditions that escalated a disease to epidemic proportions was being revised in meaning. This amplification factor had once been defined according to the inherent virulence of the microbial strain or certain physical predispositions of the victim population. To explain the conditions that had caused a handful of non-compliant patients to amplify bacterial resistance to a full scale epidemic, amplification had suddenly become associated with communal conditions or shared behaviors. It had been redefined as a trait of the community rather than the individual.

Like the vast majority of diseases, tuberculosis does not disappear, it only becomes recontextualized. Late twentieth-century tuberculosis is a postindustrial disease, with a different patient population, managed at the national rather than the local level by health management organizations, the Centers for Disease Control, and insurance structures. It is characterized by a medical practice grounded in optics—fluorescence microscopy and radiometrics, computers and electronics, gene therapy and transgenics.³ Likewise, today’s influenza virus is not the same as that which caused the massive 1918 pandemic, having mutated beyond its initial source. A team is now searching the permafrost of Longyearbyen, Norway for a sample of the virus in its 1918 form. They will don biohazard suits and erect a dome or tent over the graves of the stricken, whom they hope have been preserved by the frozen ground, to protect the surrounding community. Not only would the health of Longyearbyen be
threatened by the virus's escape from these protective measures, the pure strain required for research would be lost. It would become a part of a microbial evolutionary soup from which it could never again be isolated. Should the researchers succeed in collecting a sample, it will be housed and protected with the confines of a BSL-4 laboratory, along with samples of smallpox, while its genetic code is sequenced. This will allow scientists to distinguish diseases that might appear in the future from these horrific pestilences of the past.

The BSL-4 lab—the “hot lab”—has sat on the edge of the Centers for Disease Control's Atlanta campus, adjacent to a residential neighborhood and relatively unprotected, since its establishment within a permanent facility in 1988. The neighborhood has sat empty now for a few months, the land on which it sits having been declared condemned by the federal government. As all attempts at controlling epidemic diseases have done throughout history, the CDC headquarters are advancing outward. Preventing the spread of smallpox now means the establishment of a protected field in which surveillance may operate against the forces of terrorism. The focus of late twentieth century measures for controlling epidemics, both microbially and geographically, has shifted from a concern with protecting the community from the disease to protecting the disease from the community.

FIGURE 1:
Aerial view of the CDC's Atlanta Headquarters showing the "hot" lab (center) and the residential neighborhood adjacent (left) that has been condemned by the federal government.

FIGURE 2:
Vulnerable side of the CDC biocontainment facilities.

FIGURE 3:
Condemned house adjacent to the CDC complex.

2Ibid., 525.

The epidemic as a conceptual model is defined by its operation at the scale of the city or community. A widespread or unusual outbreak of disease, it is first and foremost a shared affliction, maintaining a parasitic dependence on the city's most characteristic structures. It is the fact that an epidemic is essentially an urban phenomenon, requiring a dense population and a medium of exchange, that is forever complicating strategies of control. Protections against pestilential outbreaks must establish measures for curing the city without de-urbanizing it, and conversely, for isolating an infected population without reconstructing the urban conditions that encourage proliferation.

Each of the delicately negotiated strategies for defense that were developed over the centuries to combat pestilence represented a material commentary on the city's ever-evolving point of maximum vulnerability. The lazaretti that protected the urban populations of medieval and renaissance Europe from plague sought to oppose spatially the settlement conditions that had escalated the disease to epidemic proportions. With a voided center and a
densified perimeter, the lazaretto not only served to thwart the progress of the epidemic wave, it established a microcosm of the city in reverse. The smallpox and inoculation hospitals of the enlightenment era reflected the clear distinction shown by the disease between the sick and the well by establishing separate institutions which simultaneously isolated at the edge of the city those who were currently infected and those who were still vulnerable, allowing the once endemically sickened body of the city to be populated solely by unsuscptibles. The sanitarium cure, catering to an exile community of chronic invalids, reconstructed the city in a pristine natural environment according to an idealized model of classical and hierarchical urban planning, and in so doing, encouraged suburban development. The smallpox eradication program of the 1970s and 80s took over the social infrastructures of third world cities for its own purposes, engaging an existing network of marketplaces, newspapers, and radio communications in the struggle to identify obscure local outbreaks. The Centers for Disease Control, for the last two decades, maintained samples of the world’s most lethal diseases at the heart of a virtual bunker, surrounded by an institutional cityscape, which was itself surrounded by a growing urban center. These diseases represented a dense core of virulent genetic material that needed protecting from the community, reflecting the late twentieth century belief that the greatest threat for disease comes from those that exist on the perimeter, rather than at the core, of the community infrastructure.

Because each of the above strategies was an attempt to resolve the commonly-held etiology of the disease threat with the city’s perceived point of greatest vulnerability, the configuration of these measures underwent a spatial translation over time. The lazaretto forced disease beyond the periphery of both of the real city and the microcosm it established. The inoculation hospital, like the procedure itself, inserted a controlled immunizing infection just below the “skin” of the city’s surrounds. The tuberculosis cure was forced by economic necessity to establish home treatment within the suburbs as the epidemic progressed. The smallpox eradication teams found that they could control the spread of disease by surrounding it at the point of outbreak and forcing it inward. And the CDC attempted to understand the properties of both ancient and emergent viruses by containing them within an environment of maximum interiority from which the community is excluded. The threat which was once seen to exist within the dense center of the city and which was being perpetually forced out, now, atomized and dispersed, needs concentrating inward.

The evolution of defensive strategies for protecting the city has been fueled by the epidemiological reality that the microbial world is infinitely malleable. As realized by Prince Prospero in the Edgar Allan Poe’s “Masque of the Red Death” (1832), constructing a bunker in which to wait out pestilence inevitably encourages the visit of he who has been so rudely uninvited. Disease has always been that force that comes cloaked in disguise, however impropriety to the occasion.
ARCHITECTURES of the NETWORK
memories of a once indefensible pestilence, with any young democrat now upon the stage.

The tale that had come to be known as "Lady Eleanore's Mantle" was as much a product of its Province-House setting as the events which had inspired it, events that, nearly a hundred and twenty years prior to the tale's telling, had caused an ominous red banner to wave over the portal of the Province House, a banner reflected in miniature over the door of every dwelling that had likewise lain in the path of the Small-Pox. In a tradition given birth by pure human fear and suspicion that, nonetheless, has become scientifically ensconced within the practice of epidemiology, each of the red banners had sought its originary source and had traced the footfalls of its legacy back to the Province-House, which, responsible for more than one disease of nations, had been the festering source of a continual pathological incursion. That specific pestilence, "distinguished by a peculiar virulence," which had gripped the Massachusetts Bay colony had been traced even more specifically to the singular person of the young Lady Eleanore Radcliffe, who had arrived from England to seek the shelter of the Province-House and the protection of her distant relative, the current governor, after having survived the gradual extinction of her rich and high-born family. The Province-House had seldom given admittance to more numerous and honorable guests than appeared at the ball given in honor of her arrival, and at which, in the extravagant fashion of the time, the beautiful and haughty Lady Eleanor had donned a mantle which, "because it was the handiwork of a dying woman, and, perchance, owed the fantastic grace of its conception to the delirium of approaching death," had become the legendary and allegorical symbol of both her aristocratic pride and the pestilential nemesis which followed from it. As bereft of human sympathy as its originary source, the pox had spread from Lady Eleanor's courtiers at the ball across the population, eliciting that fear "so horrible and unhumanizing, as that which makes man dread to breathe Heaven's vital air, lest it be poison, or to grasp the hand of a brother or friend, lest the grip of the pestilence should clutch him...The public councils were suspended, as if mortal wisdom might relinquish its devices, now that an unearthly usurper had found his way into the ruler's mansion."

While there had been no room for doubt, as the red flag of pestilence was hoisted over door after door, that "the contagion had lurked in that gorgeous mantle," it had remained a point of unease whether the mere pride and scorn of an aristocrat was sufficient to have "evoked a fiend," or whether the colonial situation itself had allowed the population to become prey to the vicissitudes of a transatlantic presence. If the colonists had undergone immense suffering from the punishment of an imported pride, how much more might they have to suffer from the hubris of revolution? Smallpox, in the eighteenth and nineteenth centuries had been an affliction around which concern over origins could not but arise: for in the large and populous cities and towns of Europe, it was endemic, attacking whenever a new generation of susceptible children permitted its spread, and was thus seen to emerge from the inherent conditions of existence in which it arose; in the colonies, however, it was seen to be introduced specifically and infrequently from outside, and would break in violent attacks upon a large adult population that had never suffered and gained immunity as children. As much as it had been
The narrator of the *Twice-Told Tales* and his companion, by their "joint lucubrations," had done no little part in attracting the curious to the historic precincts of the Province-House, that forgotten mansion on a darksome avenue which, once the residence of a succession of Royal Governors and the site of innumerable affairs of state had, by the time of Nathaniel Hawthorne's writing in 1838, had its aristocratic purpose overturned by revolution and its aristocratic front obscured by a "vulgar range of shoe-shops and dry-goods stores." There had remained no more fitting setting than the Province-House for a night of storytelling—for embellishing upon the particulars of events the outcome of which had once been as uncertain as that of a new republic with less than a generation behind it—and story-gathering, for within its aged walls had assembled a cast of characters, themselves overrun and outpaced by time, not unwilling to offer their collective histories to the literary effusions of youth. It had been the sort of place where an old and obstinate loyalist could have been found amenable to sharing a bottle of Madeira wine, certainly hidden in the cellar by the long-deceased butler of some long-forgotten Governor, and the
suspected that the conditions of place gave birth to disease, whether one's own or another, it had been ascertained with certainty that disease could spread across borders, and that once it had entered the network of trade or politics, all places would become susceptible.

Pestilence is born with an uncertain history. Like the Province-House, it is an unwieldy monument from a less complicated era, but it is also the sustained history of the present. It appears more like the place from which it came, but it leaves its most apparent mark upon the place in which it resides. It is that structure imported by a former regime in which its last few adherents might hide, embellishing and rewriting their same story for new ears, so that they might once again spark dialogue within the greater network.


\[\text{Ibid., 282.}\]

\[\text{Ibid., 278.}\]

\[\text{Ibid., 281.}\]

\[\text{Ibid., 284.}\]

\[\text{Ibid.}\]
The origins of pestilential outbreaks had often been indeterminately ascribed by chroniclers and victims to the appearance of outsiders within the community. Leprosy, patriarch of that family of dermatological scourges which included smallpox, measles, and syphilis, had, however, been confirmed in its exotism. When crusaders returned from unholy lands carrying the disfiguring blight, it had become clear that leprosy was not merely a mark of individual disfavor in the sight of God; it was, rather, a pestilence that pitted the entire Catholic world against the pagan. Tactics for controlling leprosy had suddenly to address an enormous and multi-layered task. Leprosaria had, since their establishment in seventh century Western Europe, only been required to protect the community and the immediate family from the lepers in their midst, under the mandate of a church restriction which had prohibited the free association of lepers with sound persons at the Council of Lyons in the year 583. While these measures arose to treat leprosy as a problem that was predominantly manifest within the community, it had become necessary to establish measures that would protect the community from the disease as an external
contaminant. In addition to having found the apparent source of the disease, the crusaders had discovered the local solution: under the auspices of the Order of Knights of Saint Lazarus of Jerusalem they had soon taken over the leper hospitals they found, both in spirit and in kind, for administering to a range of contagious diseases. Between 1099 and 1113, "lazaretti," named for the order and fashioned after those they found outside the city of Jerusalem, had spread rapidly over Western Europe, numbering up to 19,000 at the height of their popularity. Placed by port cities on offshore islands, and by inland cities along major overland trade routes, the lazaretto had existed as a line of defense that could serve both to siphon disease off from within the city and to contain diseases originating outside the city.

Theories of contagion, which were fueled by leprosy's obvious transport through human movement from infected to uninfected regions, gained ground from the mid-fifteenth century onward after the bubonic plague eliminated any doubt in the veracity of the model. Among administrators and physicians the terms 'plague' and 'contagion' became almost synonymous, accentuating a tendency to blame epidemics on strangers. In addition to plague, every national group in Europe defined syphilis as a disease of other nations: a 1524 tract listed over two hundred names for the disease, each identifying it as originating in a specific location. Suspicion for spreading disease focused first on casual or seasonal migrants and later on refugee populations: in Venice it clung to Slavs and Albanians in the mid-fifteenth century, and a century later to Marranos or Portugese New Christians from the Low Countries. Pilgrims in transit from Mecca were suspect, as were all members of trading caravans or shipping interests from Africa or the New World. As points of convergence and foci of a perpetual flow of human movement, port cities found themselves threatened from all directions by a mobile contagious influence, and, like artificial epicenters mirroring the originary miasmatic locale, they fueled the network of disease transmission.

The Venetians, early threatened by the contagious potential of maritime trade, were the first to make provisions for maritime quarantine and sanitation. Though they had been electing overseers of public health from as far back as the year 1000, the office was not a permanent one, but one initiated only in the event, and for the span, of an epidemic outbreak. In such a situation, these appointed officers of the public health were authorized to spend money for the purpose of isolating infected ships, goods, and persons at an island of the lagoon, under the guarded supervision of a medical officer. Around 1374, however, in an era of understandably heightened concern, Venice enacted orders forbidding entrance to the city of infected or suspected ships, travelers, or freight, and in 1403, the city estab-
lished the first thoroughly equipped maritime quarantine station of record, on the island of Santa Maria di Nazareth. The word quar-
antine actually originated from the Italian words *quarantina* and *quaranta giorni* which referred to the forty-day period ships entering the port of Venice were required to remain in isolation before their goods, crew, and passengers were allowed to disem-
bark.

The origin of the enforced forty-day period of detention has remained vague. It may have been the legacy of the Hippocratic doctrine of distinguishing acute and typically contagious diseases, those diseases which were observed to run their course in fewer than forty-five days, from more chronic afflictions. Some scholars have argued that the frequent and symbolic use of the number forty throughout the Old Testament may have accounted for its origin. More likely, however, the time period was used because Renaissance observers noted that, after forty days, people stricken with the plague either died or recovered without further spread to others. From medieval times on, shutting the gates of a city or port to all those suspected of being ill and isolating those sick people

**FIGURE 1:**
Plan, dated 20 August 1552 and 24 April 1559, for a new lazaretto for the *Lido di Erasmo*.

**FIGURE 2:**
St. George's leprosarium, Visby, Sweden, about 1600, showing it situation outside city wall, but on a main road into town.

**FIGURE 3:**
Map of Venice, showing the location of the lazaretto on an island, foreground, right.
discovered to have entered represented the best, and often only, means available for stemming the tide of an epidemic.

The lazaretto, or quarantine station, provided a place, removed from the port city itself, where a threat to the public health could follow its course in a limited and demarcated territory. By allowing the contagion to progress through a miniaturized version of the city, populated both by infected natives and strangers, the city was balancing conflicting beliefs in disease causation along a boundary both physically and ideologically threatened. Designed within a typological language that was both fortress and gate, cloister and prison, it privileged the desire for isolation while permitting participation in the network of trade.


Although smallpox was universally known in the West by the end of the tenth century, and had caused a number of epidemics serious enough to warrant considerable attention in medical literature, it was not until the seventeenth century that it began to arouse such dread and anxiety as had been occasioned by the plague, for in its repeated incursions against corporeal integrity, it became the ultimate threat to the Enlightenment ideal of anthropomorphic unity and purity. The prevailing aesthetics of Neoclassicism were in essence an attempt to establish a stable zone of purified emptiness within an opaque ground swell; and the purificatory metaphors of the cleansing bath, the abstract void, and the surgical amputation were evidence of a desire to keep disorderly contagion at bay in all spheres. Smallpox, however, was repeatedly proving the impossibility of establishing a space free from infective contamination, either within the corporeal or the political sphere. Just as the Enlightenment mind was faced with the inherent paradox represented by the scarred body free from contagion and the unmarked body that susceptible to it, imperialist politics were forced to reconcile the colony as the pure and re-
moved culture of a politically infected and incurable population with the increasing propensity of this amputated population to view its source as, itself, contaminated. Smallpox was encouraging the complication of the colonial relationship, its presence widening the gulf between seventeenth-century Europe and its colonies in the New World.

Though the disease’s increasing severity was causing great concern in relatively densely populated Europe, it was, by and large, already endemic in the larger cities, where it mysteriously erupted in epidemics from time to time. It was thus easy for Europeans to blame the “epidemic constitution” of the atmosphere for these periodic surges in contagion. However, to many colonists in the small port cities along the eastern coast of North America, it was clear that smallpox epidemics resulted from ill persons arriving on board ships, from which the disease spread in concentric circles. Following the ensuing epidemic outbreak, the infection would die out and not appear again for an interval of as much as thirty years, as the population was not yet large enough to maintain the infection endemically. Thus, despite their strong religious beliefs in pestilence as divine punishment and the persisting beliefs among some that disease came from unsanitary neighborhoods, European settlers in North America, particularly in Boston, took practical steps early to protect themselves from smallpox by quarantining, often to the fiscal detriment of European traders, arriving ships. The fact that many young colonists were able to reach a point of relative maturity without ever having sustained the infection meant that many vulnerable North American students never returned home from their studies in England following contact. As the seventeenth century progressed, the increasingly obvious danger became a decided stimulus to the development of colleges in the colonies, and to the increasing isolation of the colonial population. In addition to encouraging an increasingly independent posture with respect to Europe, smallpox, with its calamitous impact on native populations, also helped the North American settlers to maintain their precarious position at home. The earliest evidence of local, as opposed to maritime, quarantine, was in fact established to protect the town of East Hampton, Long Island, from the spread of smallpox from local natives to the town’s population in 1662.

The colony of Virginia also undertook one of the earliest attempts to legislate mandatory isolation of smallpox victims at home in 1667, after a sailor imported the virus from Bermuda into one of the southern colonies for the first time. The slave trade was becoming increasingly suspect in the spread of the infection, and it was in its primary ports of call that epidemics began appearing more frequently: it was, in fact, a ship that arrived from St. Nevis with smallpox infected slaves in 1690 that prompted New York City to institute its first quarantine measures. However, in the same ironic paradox that
allowed the cure for smallpox to follow from intentional infection with the self-same disease, it was the slave trade that ultimately proved instrumental in instituting methods for preventing the disease in the New World. In 1706, the Reverend Cotton Mather of Boston, while routinely interrogating his recently purchased slave, Onesimus, inquired as to whether he had ever suffered from the pox. Onesimus described how he had been inoculated against the smallpox in Africa, and was therefore immune, though he had never actually had the disease. Making similar inquiries of other slaves, Mather found that many of them, as well, had had the operation in Africa, and “had the marks to prove it.” Asked how long inoculation had been practiced in their homelands, Mather’s informants stated “only that it had been done since long before they were born.” The Reverend, though accused of usurping the unique privilege of God to cure or sicken His subjects, soon began arguing vehemently for the introduction and practice of inoculation. Boston, with its predominantly Puritan population and its comparatively conservative, locally trained medical leaders, was, however, less quick to embrace inoculation than comparably sized Philadelphia, and rather relied on a strict policy of quarantine, isolation, and the exclusion of travelers and traders from neighboring communities, when smallpox appeared. Although a lazaretto and quarantine laws for the inspection of incoming ships existed in Philadelphia, in this Quaker-founded colony where the mercantilist interests of a

FIGURE 1:
Fragment from *Sick France Being Diagnos’d*. 1789–1790, anonymous colored engraving. The difficulties of sustaining international trade and colonial relationships in the eighteenth century caused both figurative and literal malaise in the body politic of many European countries.

FIGURE 2:
Portrait of the Reverend Cotton Mather of Boston by Peter Pelham. Mather was made aware of the practice of inoculation through his slave, Onesimus.

FIGURE 3:
Shapona. Yoruba god of smallpox. Formal worship of the god was controlled by specific priests who protected themselves through inoculation. While treating smallpox victims, priests collected and saved matter from the victims, usually scabs, “for future use,” and as they traditionally inherited personal belongings of persons who died of smallpox, the client’s recovery was often in their best interest. Thus suspected by the British rulers of colonial Nigeria to have been spreading the disease, an ineffective ordinance was passed in 1907 forbidding worship of Shapona in any form.
wealthy few exercised effective political control, a “reception center” for ill passengers on incoming ships was established in Province Island in 1733, and no attempt was made to isolate cases of smallpox occurring among residents of the city, or to debar travelers from neighboring communities. Philadelphia soon became the primary center for inoculation in the American colonies.

Spanish monarch, King Carlos IV, was one of the first to grasp the true potential of inoculation, and to harness its strategies of acceleration at the scale of the international network. To “ameliorate the havoc wrought by the frequent smallpox epidemics in his dominions of the Indies and in order to furnish his royal subjects the protection they deserve” King Carlos ordered in 1803 the Balmis-Salvany Expedition, which was to visit each of his colonies in turn and vaccinate his subject population with the newly discovered cowpox vaccine, which operated like inoculation, but posed very little risk of death and no risk of contagion. The disease was to be maintained during the voyage by the continuous and sequential vaccination, from arm to arm, of twenty-two orphans brought along for that purpose, for which service they would be educated at the King’s expense. The ship, that feared spreader of disease, was to be used as a protective measure in much the same way as inoculation had been used to protect the individual body: it was turning the dangerous element against itself in accelerating the course of the disease’s cure in the Spanish principalities, and in so doing, it was reunifying the compromised body politic through a universal infection.


Ibid., 239.

Two massive and devastating pandemics of 1801–02 and 1818–40 delivered the coup de grâce to many tribes of indigenous Americans.

Hopkins, 173–74.

Ibid., 254–55.
Contemporary records have revealed that various infectious diseases were carried onto convict transport ships from overcrowded, unsanitary British prisons and from ports-of-call on the long voyage from Britain to the gaol colony of Sydney, Australia. They have also shown that an epidemic occurred in the colony following the arrival of each of the first three fleets. Nevertheless, quarantine restrictions were not enforced in Port Jackson during the first sixteen years of settlement. In the wooden hospital which was erected in Sydney in late April 1788, and in adjacent tents, sick convicts shared an inadequate number of beds and bedding, irrespective of the nature of their ailments.¹

Despite the dire consequences, no immediate action was taken to prevent vessels known to be carrying an infectious disease from docking at a Sydney wharf until the convict ship *Bussorah Merchant* arrived on 27 July 1828, and the ship's master dined in Sydney before it became known that there had been an outbreak of smallpox during the voyage to Australia. At a meeting of the Executive Council of the New South Wales Legislative Council on
29 July, detailed measures were adopted for the ship's quarantine. The Governor's Proclamation on 2 August 1828 directed that the convicts and their guards were to be landed and housed in tents at North Head "on a point of land which has been selected in Spring Cove" under the care of the ship's surgeon-superintendent. On the advice of the principal colonial surgeon, all quarantined people were vaccinated unless they could show proof of prior immunity. Convicts and guards were required to wash in warm water upon landing, and were given new clothing and bedding; used clothing, bedding and other articles suspected of carrying infection were destroyed. The ship was cleansed, fumigated, and whitewashed, and all the timbers which formed the sleeping berths were burned before the quarantine ended on 17 August.

In this and the several quarantines that were immediately to follow, the colony's governor, Sir Richard Bourke, used the powers vested in him by the British government without, however, operating under sanction of quarantine legislation, as it was unlikely in the early years of penal settlement that the legality of a governor's actions would have been challenged by the masters of convict ships. The decision taken in 1831, however, to encourage immigration with funds obtained from the sale of Crown land, had signaled that the nature of the penal colony was changing. In 1831, 34 immigrant ships arrived from Britain and Ireland to be followed by 63 ships in 1832. Their masters, who planned a quick turnaround in Port Jackson with a profitable cargo of wool, tallow, or whale oil for the return voyage, might well have been disposed to challenge delays in quarantine which had no legal authority. Governor Bourke's recognition of the need for quarantine legislation was also being sharpened by the threat of cholera. In October 1831 Asiatic cholera, which had extended pandemically from India in 1826, breached Britain's quarantine defenses in the first of three major epidemics during which an estimated 23,000 people died. Cholera had also been carried in the water supplies of overcrowded immigrant ships to the North American colonies, where thousands of immigrants died of cholera or related diseases. Amidst this frightening scenario, Bourke learned in 1832 that cholera had appeared on a convict transport ship bound for Sydney, and decided that the time had come to alleviate the "considerable alarm in the public mind" by adopting quarantine legislation to control the entry of vessels to Port Jackson. On 28 July 1832 the Governor, with the advice of the Legislative Council of New South Wales, passed the first Quarantine Act, An Act for subjecting Vessels coming to New South Wales form certain places to the performance of Quarantine, which was dispatched to Britain for royal assent on 30 October 1832. Under its provisions, all vessels, goods, and passengers arriving from any place proclaimed to be infected with cholera or any other infectious disease "highly dangerous to the health of His Majesty's subjects in the Colony of New South Wales" became liable for the performance of quarantine. Amongst other provisions, Section 3 authorized the appointment of quarantine stations, or places within the harbor of Port Jackson, where quarantine was to be performed.

1832 was a landmark year for quarantines in much of the Western world, as the growth in intercontinental trade provoked serious concern with respect to the mounting cholera pandemic. Following its initial outbreak in India, cholera had spread to Persia in 1829 and to Russia in 1830. It then continued
its westward push, attacking Poland, Hungary, Prussia, Germany, Austria, and England in 1831. With ample warning of its approach, the Parisian government began preparing for the inevitable attack by imposing quarantines in the ports, establishing sanitary cordons at borders, and setting up health committees in each district of the capital. The Royal Academy of Medicine proposed the additional establishment of observation posts on the borders of suspected countries which, once the threat became reality, could immediately be turned into quarantine stations. It proved impossible, however, in industrial countries like France and England in which commerce was the very soul and support of social life, to establish an effective system of quarantine regulation because it was so easy to evade the rules. By the end of March, cholera reached Paris, and by the first of May, a royal ordinance abolished the health commissions and inspection agencies established the previous year. Cholera demonstrated the vulnerability of ancient systems of defense, of maritime quarantine and sanitary cordons, and it soon became clear that any adequate system of defense must reconcile the goals of commerce with the goals of public health, and permit the free circulation of people and goods while maintaining vigilance against disease.

Contagionist supporters of quarantine and segregation, though they had been repeatedly vindicated by the obvious spread of disease along trade routes, were finding themselves outnumbered politically and outpaced strategically. They were being increasingly confronted by the proponents of infection theory who, believing themselves to represent the forces of liberalism, were waging a battle not only on the scientific, but on the political front as well, the core issue at stake being the freedom of commerce and of persons. Though they found support in inland commercial centers like Paris, they continued to face resistance in major seaports which had for centuries relied on a practice of ritual sequestration to protect themselves from the dangers of contagious disease. In cities like Marseilles, Toulon, Genoa, and Trieste, which were under constant threat from suspect cargoes from the east, quarantine stations had functioned as important safety valves, and should they relax, for the sake of increased commerce, their sanitary regulations, they would lose not only prestige, but the valuable

**FIGURE 1:**
trade monopoly that was ensured by the centralized and bureaucratized quarantine system.\(^5\) Infectionists, insisting that epidemic disease was a problem of urban sanitation, argued that systems of control based on segregationism were not only outdated but acted as a force of violence upon the city. Diseased cities, operating under traditional strategies, resembled places under siege: communications were intercepted, prices rose, food ran short, and the city, in short, sustained far more injury from the defense than it had from the attack.\(^4\) Born in an age in which the leper had been cast out and the victim of plague had been isolated, quarantine regulations, for the infectionists, were nothing short of incompatible with the dream of a society in which all men were free and equal. In addition, the liberalization of trade was crucial to new industries whose growth was being hampered by shortages of raw materials. Freedom of travel and freedom of trade were important not only to business interests, but to those of government, which was obliged to maintain expensive quarantine stations on the Atlantic coast and to absorb losses stemming from the ban on sailing imposed on the merchant fleet. With an increasing volume of trade worldwide, it was no longer possible to put up with a system designed around slowness, isolation, and discrimination, and the disparity of health regulations from country to country gave an unfair advantage to foreign traders.

Shortly after the Quarantine Act was passed in Britain's Australian colony, a dispatch was received from the British Colonial Secretary, Viscount Goderich, enclosing a copy of a paper drawn up by the Central Board of Health in London on the subject of quarantine. The weight of the Board's argument was against the old concept of protracted detention of all vessels arriving from an infected port and in favor of a shorter period of quarantine for cholera. In the Board's opinion, quarantine was not merely unavailing but positively injurious because of the distress and panic it caused. The relief of pauperism and the prevention of drunkenness, the Board suggested, might better mitigate the progress of disease. Goderich's cover letter, however, revealed an ambivalent attitude to the Board's report. He recognized that outbreaks of cholera in England and Scotland had been inexplicably random, supporting the Board's arguments against the effectiveness of quarantine. But he also recognized the strong commercial arguments in favor of quarantine, which had been used by Liverpool's merchants to persuade the British government to place quarantine embargoes on all vessels arriving from any infected ports in the hope that vessels sailing from Liverpool with clean Bills of Health would not be delayed in quarantine in foreign ports. All things considered, Goderich observed that he would be "far better satisfied to err on the side of caution from deference
to popular feelings, than on that of temerity from respect to any Scientific authorities, however eminent." He therefore advised Bourke that he would not oppose any decisions the colony had taken to quarantine vessels. But on one point he was adamant: there were to be no unnecessary quarantine restrictions on British vessels.

Over the following years, the procedures adopted at Sydney’s quarantine station to eradicate infection evolved in the light of the ascendance of anti-contagionist beliefs concerning disease etiology. From the beginning, there was recognition of the need to minimize the disruption to trade and commerce caused by delays of vessels, people, and cargoes in quarantine, and efforts were made to cleanse and release vessels and their cargoes as quickly as possible, while their passengers remained on shore at the Station. From the time of the appointment of the first Health Officer of Port Jackson in 1838, increasing attempts were made to adopt a system of limited quarantine, described in a report to the New South Wales Legislative Assembly on the Proceedings of the first Australasian Sanitary Conference in 1884 as:

A system of sanitary inspection, with certainly a scientific method following: that of isolating the sick and for the time being detaining the persons who, having been in immediate contact with them, may reasonably be supposed to be infected, and the subsequent purification of their luggage and effects, and of the vessel itself. There has been no ridiculous detention for a fixed period without any particular object, or a huddling of the sick and the healthy together, as has been the case in the Mediterranean, and has been so justly denounced by all sanitarians. 8

In a dispatch to Lord Glenelg on 10 April 1837, Bourke foreshadowed the era of temporary expedients during quarantines in the following words: “As the Embarkation of Emigrants for this Colony is likely to be more frequent in future years than heretofore, and as the dread of contagious disease is much felt by the Colonists, I think it will be necessary to propose...the appropriation of a sum of money for establishing a convenient Lazaret.”9 Until then it had seemed to many colonists that the government was more concerned

FIGURE 2:
Diagram of an eighteenth-century quarantine station, or lazaretto, in Genoa, Italy. Quarantined people from infected vessels were housed in ‘apartments’ without an attempt to separate infected people from the uninfected. Such conditions made the validity of quarantine questioned, as it was seen to be creating secondary sources of infection.
about conditions on convict
than on immigrant ships.
Government reaction to several
tragic voyages brought hope
that the conditions on immi-
grant ships would be improved,
and that a permanent quaran-
tine station would be estab-
lished which would provide
better accommodation for
immigrants quarantined at
North Head in Sydney Harbor.
This location, which provided a
deep, safe anchorage for vessels
in Spring Cove, sloping sandy

beaches for ease in landing people and airing cargoes, and fresh water draining from swamp ground
above Quarantine Beach, was well suited for a maritime quarantine station. More importantly, how-
ever, the area was remote from Sydney residents. In late May 1837, the Governor appointed a Board
“to inquire and report on the subject of a permanent Quarantine Station” for the location. The board
had not yet finalized its report, however, when the immigrant ship John Barry arrived on 13 July 1837
carrying victims of scarlet and typhus fever. Amongst its passengers were 284 government-assisted
immigrants who had traveled by steerage class, in an area about 90 feet long and 27 feet wide and
ventilated by ten scuttles, each 9 by 6 inches. For many who had lived in such a cramped airless
environment for nearly four months, North Head may have seemed inviting by contrast. They yet had to
endure, however, a quarantine which lasted until late September, during which 37 people became
infected with typhus fever and 13 people died.10

Both contagionists and infectionists in the early nineteenth century were in agreement that every
disease had its native region, that epidemics were born like men and followed their same routes of
travel. The infectionists, however, faced with explaining the problem of disease transmission that
appeared to be contagion, looked to François-Joseph-Victor Boussais who, in answer to the debate,
was able to formulate a meol that collapsed contagionist and infectionist tenets. Boussais favored the
idea of a sharply circumscribed and mobile local influence. Just as yellow fever was born in hot, damp
countries, it traveled with ships, finding the mobile equivalent of its geographical source, in the same
way that typhus fever traveled with armies. This was because on board ships and among troops on the
march there existed local causes similar to those that had originally produced the diseases. Spread was
therefore explained by a local cause that was continuously active and continuously renewed: “It was
regularly produced and carried by such microsources as armies, ships, caravans, and pilgrims—
ambulatory epidemic material...If the sources of infection in Europe were the dark sewers of the big
cities, they had their exotic counterparts in the warm, humid, swampy countries of the east.”

Though the arrival of the infected John Barry had stalled the completion of the board’s report, a number of decisions had already been made concerning the means for establishing a permanent quarantine station. The quarantine ground had been expanded by proclamation after previous experience had shown it to

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**FIGURE 2:**
Interior view of the area allocated between decks to married people and their child steerage class on an immigrant ship in 1864, as published in the *Illustrated London News* on 13 April 1864. Such conditions were seen as natural sources of infection.

**FIGURE 3:**
Plan of the Sydney Quarantine Station in 1884, adapted from the plan appended to the Report of the Australasian Sanitary Conference of that year.
be insufficiently large. The decision had also been made to reassemble three existing wooden buildings on higher ground above Quarantine Beach for the use of healthy immigrants. Since these three buildings accommodated fewer than 100 people, tents were erected on land in front of the Healthy Ground. Unhappily, this area where healthy people were to be housed overlooked the Burial Ground, which was leveled in 1853 for this reason. High ground on the promontory on the south side of the beach had been designated as the place where a hospital was to be erected. By 10 October 1837 the quarantine had ended and the Colonial Secretary informed the Colonial Engineer that, since access to the Station was now permitted, his board should complete its report as quickly as possible. Approval of the report had been a foregone conclusion and building operations began almost immediately, using convict labor.\textsuperscript{12}

The Station's boundary line was delineated by either twelve or thirteen cairn-shaped boundary pillars, each about eight feet high, built with stones bonded with lime mortar and lime-washed for clearer visibility. The boundaries were patrolled day and night by a military guard, for whom sentry boxes were erected in 1849. On the Healthy Ground, there were four wooden buildings with shingled roofs and glazed windows, each between 20 and 40 feet apart and about 20 feet wide and 80 feet long, each housing about 25 people. The unlined buildings were described as mere wooden shells by immigrants, who complained that they were lacking in comfort and privacy. Their minimal structure apparently reflected an official view that the standard of accommodation at the Station should be similar to that occupied by immigrants on the quarantined ship, namely steerage class, but was also a means of preventing the absorption of the noxious emanations from the sick. On the Healthy Ground, single men were housed in one end building, single women in the other end building, and married people and their families in the two middle buildings. Sometimes a building was set aside for convalescents, who were normally segregated in tents on the Sick Ground until judged free from infection. Doctors were accommodated in a two-roomed house erected both on the Healthy and the Sick Grounds. Their duties included arranging for the distribution of rations, requisitioning clothing and other supplies, arbitrating in disputes and preparing daily reports for the Colonial Secretary on the health of the people in their care. The hospital was partitioned into a male and female ward. Conditions in the unlined, overcrowded hospital, where people often lay on bedding placed on the floor, were described in the Sydney Gazette on 30 October 1838 as "miserable in the extreme."\textsuperscript{13} Cleansing procedures which people were required to undertake to rid themselves of infection were usually specified by a medical board, and varied according to the virulence of the disease. Luggage, which was customarily stored under tarpaulins on shore had to be aired, and sometimes fumigated over burning charcoal and sulfur or chloride of lime. In order to minimize the heavy cost for shipping of "lay-days" in quarantine, vessels were released as quickly as possible after cleansing, the extent of which also varied according to the virulence of the disease, but invariably involved scrubbing the decks with a liberal use of chloride of lime and dismantling berths which were sometimes placed on a raft and sunk in Spring Cove for some days.\textsuperscript{14}
The infectionists, in isolating disease causing localities at every scale, had created a map of disease that had changed considerably. In the early nineteenth century, the major breeding grounds for disease lay in the Americas, from which yellow fever had come; in India, the birthplace of cholera and the plague; and in the Mediterranean, which maintained close relations with Africa and which was vulnerable to diseases from all over the world. Seaports in Europe and its colonies were seen as constituting secondary sources of infection: like revolving turntables they received incoming diseases from one part of the world and rerouted them to another, but they were now seen to do so through the provision of a space of infection rather than contagion. The goal of reform then was not to eliminate quarantine procedures entirely, but to reorganize them on a more rational basis that would counter the infectious potential of disease. Quarantine stations became centers for a hygienic operation more concerned with disinfection than isolation, and they became designed according to the belief that the conditions they imposed must counter the originary conditions found on ships. Seaports had to be transformed into places that would hygienically explode the mobile transports of disease, and quarantine stations had to facilitate the needs of commerce while serving to protect not only the individual and the city, but the intercontinental trading network, from disease.

2Ibid., 18.
3Ibid., 19.
4Ibid., 20.
6Ibid., 162.
7Foley, 20–21.
8Ibid., 10.
9Ibid., 34.
10Ibid., 36.
11Delaporte, 184.
12Foley, 36–37.
13Ibid., 38–39.
14Ibid.
Early nineteenth century Europeans and Americans took cholera as evidence that they had lived through an era of great importance to all mankind. The past fifty years had seen an endless succession of revolutions and wars, and it surprised no one that the price to be paid for the emancipation of nations was a heightened susceptibility to disease. Along with intellectual and political advances had come the arrival of new diseases on the scene, just as the era of the Crusades or the discovery of the New World had been similarly marred by the emergence of new diseases. The rebirth of the West had set into motion profound evolutionary changes at the global scale: in addition to mobilizing masses of immigrants who were seen to be moving from east to west following the determined path of human progress, western progress had attracted from the east those independent microorganisms which had recently, with advances in bacteriology, been shown to be the cause of epidemic outbreaks. In the translation of bacteriology into popular parlance, the “germ” had taken on a fundamental symbolic weight, and the manner in which much of the popular and scientific press had portrayed bacteriology was similar to the way in which writers
described current events. Rapidly reproducing germs had threatened American bodies in the same way that “hordes” of unwashed immigrants with large families had sought entrance into the American social body. As the ultimate reification of illness, pictures of individual bacteria had come to personify disease, and the popular expressions of germ theory had focused on the idea of enemy invaders attacking the body, coming from elsewhere, with unfriendly purpose. Nativist intellectuals, suspicious of immigrants and “otherness” had argued the same thing. Smallpox vaccination had shown that health was as transmissible as disease; however, in absence of similar means for curtailing new epidemics such as cholera and tuberculosis, the model it provided had become translated into prevention-oriented policies of public health aimed at effecting a kind of political hygiene upon the infectious sores of immigrant ghettos.

Infection theory, or the belief in an environmental causation for disease, was at first strengthened by pioneer bacteriologist Robert Koch’s discovery of the microbial life of disease as it could be sustained outside the body. But when his research in the cholera epidemic of 1892-93 led him to attempt to establish laboratory, rather than clinical, methods for detecting sources of infection, his investigation led him back to the human body. Koch found in studying cholera victims that regardless of whether he examined the most deadly or the most mild cases, the bacterial source of the disease was unchanged. In fact, he found that certain individuals could carry the bacteria without manifesting any sickness at all. The natural terrain of the bacteria, he found, was not natural sources of decaying organic matter external to the body, but the body itself. The disease was more likely to survive in the body when it presented no challenge to the functioning organism and was thus given more opportunity to spread unknowingly from person to person. In that light, leprosy, long thought to have been a relatively unsuccessful disease, was in fact one of the best evolved, as the presence of antibodies to leprosy within the majority of the human population showed that they housed the bacteria at some point in their lives. Rarely, however, did the bacteria call attention to itself through an obvious illness. The other strategy taken by a successful pathogen was that employed by smallpox. Smallpox had an exaggerated virulence, was
highly symptomatic, and produced no carriers. It compensated through its rapid spread for its inability to hide in the body. In the mid 1960s, the World Health Organization and the Centers for Disease Control, following the success of the Salk polio vaccine, were able to conceive of the global eradication of smallpox only because the disease had no carriers. The challenge to their operation was that smallpox was “carried” only at the scale of the international network.

Most countries in the days before smallpox’s eradication dealt with control within their own borders, attempting to keep the disease at bay through vaccination requirements for their citizens and visitors. The leap in imagination that permitted smallpox to be eliminated entirely was less the product of the concept of vaccine eradication, itself, than the increasing translation of public health policy from a local to an international or, indeed, global context. When, in 1926, a Japanese delegate to the Fourteenth International Sanitary Conference of the League of Nations proposed for the first time that smallpox should be made internationally notifiable, as plague, cholera, and yellow fever already were, a Swiss delegate objected that smallpox had “no place in an international convention” because the disease existed everywhere, and there was likely “not a single country of which it can be said that there are no cases of smallpox.” As a compromise, smallpox was declared

FIGURE 1:
Smallpox eradication program vaccination site, West Africa, late 1960s.

FIGURE 2:
Judge magazine published this cartoon "They Come Arm in Arm," in 1892, depicting a Russian Jew and a German immigrant walking into the US immigration Office in arm with a shrouded figure labeled "Asiatic Cholera."

FIGURE 3:
Wanting to be vaccinated, New Yorkers line outside of the Brooklyn Headquaters Building of the Department of Health following a 1947 outbreak.
internationally notifiable, but only when in epidemic form. Only two years later, British scientist Alexander Fleming made the breakthrough discovery that a chemical secreted by the Penicillium mold could kill Staphylococcus bacteria in petri dishes. He dubbed the lethal antibacterial chemical secretion "penicillin", and when the "miracle drug" as it came to be called, was introduced into the general clinical practice in 1944, it caused a worldwide sensation. In the tremendous optimism engendered by the growing number and potency of antibiotic treatments, tuberculosis was moved from the "extremely dangerous" column to that of "easily managed minor infections." Optimism soon enveloped discussion of nearly every infectious disease affecting human populations. In 1948, US Secretary of State George C. Marshall declared at the Washington, DC gathering of the Fourth International Congress on Tropical Medicine and Malaria that the conquest of all infectious diseases was imminent. Through a combination of enhanced crop yields to provide adequate food for humanity and scientific breakthroughs in microbe control, Marshall predicted, all the earth's microscopic scourges would soon be eliminated. Dr. Jonas Salk's 1955 mass experimental polio vaccination campaign was so successful that cases of the disease in Western Europe and North America plummeted from 76,000 in 1955 to less than 1,000 in 1967. The excitement engendered by that drama prompted optimistic declarations that the disease would soon be eradicated from the planet.

Forces were converging in the 1960s to turn attention to international health. The boom in jet travel increased the possibility of introducing exotic diseases from abroad. Veterans of the Vietnam War brought home both "oriental" venereal diseases and a strain of malaria resistant to known forms of treatment. Even germs from outer space were a frightening prospect in that decade when man first went to the moon—a possibility, however remote, given vivid expression in Michael Crichton's novel The Andromeda Strain. To keep disease at bay in the US, it was becoming increasingly clear that the Centers for Disease Control, the epidemiological arm of the federal government, would need to fight contagion at the source, and it extended its mandate overseas. International rescue missions, mounted only occasionally in the 1950s, became commonplace in the 1960s, as the CDC was being required to respond as readily to an overseas distress call as to one from the states. Not only were soldiers in Vietnam picking up diseases all but unknown
in the US, but any international traveler was at risk. Americans traveling abroad were being warned against cholera, which had spread from India and Pakistan as far west as Iran. A German physician who developed smallpox shortly after he returned home to India had exposed everyone aboard the plane which continued on to America, all of whom had to be tracked down. In the summer of 1962, a Canadian boy developed smallpox after returning home from Brazil by way of New York’s Idlewood Airport and Grand Central Station. Hundreds of New Yorkers who might have had contact with the youth were vaccinated and put under surveillance. The US was spending twenty million dollars a year to guard against the introduction of smallpox, primarily as it was being introduced into developed countries from the Third World.

By the end of World War II, Spain and Portugal were the only European countries that still had endemic smallpox. When these two countries were freed of it by the early 1950s, for the first time the disease ceased to be a matter of concern to most Europeans. Persons unknowingly infected while traveling or living in areas of Africa or Asia where the disease was still endemic became the main threat to a smallpox-free Europe. In 1958, the Soviet Union went before the World Health Assembly, the legislative body of the World Health Organization (WHO) in Geneva, to request an international campaign for the elimination of smallpox, winning virtually universal support. By 1965, advanced technology, an improved vaccine, and the success of the CDC’s smallpox unit in Brazil, greatly enhanced the possibility of global eradication, and even though many politicians and scientists remained skeptical, the White House announced a program in November 1965 that would protect 105 million people from smallpox and measles in 18 African countries. The Agency for International Development would contribute technical assistance, vaccines, jet injectors, field supplies, and freezers and other refrigeration equipment; participating countries would pick up the local costs and operational personnel. From its old smallpox unit, CDC created the Smallpox-Eradication Program (SEP) in January, 1966, which, though it would require a worldwide effort to reach all citizens at risk for smallpox—even those in the midst of wars, social tyranny, famine, or disaster—began amidst optimism in 1967.
The smallpox problem, however, proved much worse than expected. Only a tiny percentage of the smallpox cases in northern Nigeria had actually been reported, and it was Sierra Leone, it was soon found, that had the highest incidence of smallpox in the world, nine times greater than in India. Worldwide, the WHO had reported 131,418 cases of smallpox in 1967, when the real figure was closer to 10 to 15 million. In light of this situation, the CDC could only hope that vaccinating eighty percent of the people in West Africa would reduce the number of cases to fewer than five per 100,000 of population, and improved surveillance would take over from there. It was necessary that the program adopt an offensive rather than a defensive posture, and the plan of attack dispersed dozens of skilled tropical disease experts all over the world in search of small outbreaks of the virus. Once such an outbreak was identified, the local government was mobilized and residents of the area were vaccinated. Occasionally this was carried out forcibly, in some instances necessitating the forced entry of private homes and the assistance of local police to assist in vaccinations. Because both superpowers wholeheartedly supported the campaign, few governments resisted the public health measures that often took on military overtones. Though the teams braved civil wars, floods, religious battles, and a variety of geographic and logistic problems, the final scare came in vaccinating refugees and villagers of Ogaden, Somalia, during a bitter war with Ethiopia. Of more concern than the logistical difficulties of the war was the immediacy of the Hajj, when thousands of devout Somali Muslims would make their way to Mecca, where they would eat, sleep, and pray for several days with some two million other followers of Islam from all over the world. If infected pilgrims were part of the Hajj, all efforts at eradication would fail. This last campaign in the war against smallpox succeeded, however, with two months to spare.

In an era of global air travel and increased mobility, no nation of the world could be considered truly safe from the disease until it had been eliminated in every politically hidden corner of the world. It was only on May 8, 1980, when the World Health Assembly formally declared that “the World and all its peoples have won freedom from smallpox, which was a most devastating disease sweeping in epidemic form through many countries since earliest times, leaving death, blindness, and disfigurement in its wake and which only a decade ago was rampant in Africa, Asia, and South America,” that the network and the globe, became completely asymptomatic.


The heritage of the early nineteenth century split between infectionist and contagionist ideologies concerning disease causation was still in evidence in the division of funding routes in biological warfare research after WW2. Funds allocated toward research into infectious diseases were aimed at the detection and prevention of those natural pathological threats that might be encountered in war zones. The other funding stream was directed toward research into possible defenses against the contagious threat of planned attacks with weapons employing natural or altered disease agents. It was through the institutional evolution of the Centers for Disease Control that this persistent ideological and fiscal distinction was gradually blurred.

Product of federal infectious disease prevention programs, the CDC descended from a World War II agency established to fight malaria, the disease which ravaged the South throughout the 1930s and threatened war efforts on southern military training bases in the 1940s. The job of undertaking malaria control was consequently assigned to a new unit of the US Public Health Service called
Malaria Control in War Areas (MCWA). With no space for it in crowded wartime Washington, DC, the MCWA was located in Atlanta, in the heart of the malarial zone. In 1946, MCWA changed its name and greatly broadened its mission: as the Communicable Disease Center—the first of three names for which the famous acronym has stood—the institution began gradually to undertake research into all communicable diseases not still managed by separate agencies in Washington. For the first year or so of its existence, the CDC merely took over the programs begun by the MCWA, concentrating on malaria control with an eye to eradicating it entirely. It was believed that malaria could be wiped out in a few years by “shoe-leather scientists” who would, through sheer insistence, find those isolated areas where malaria still occurred. By 1947 the National Malaria Eradication Program became official, and it was hoped that its success would spur a worldwide campaign. Eradication, it was certain, could be achieved by eliminating all malaria parasites from humans or by annihilating all anopheles mosquitoes, but these methods proved to be in budgetary excess of what the young Atlanta institution could sustain. Instead, the decision was made to attempt to reduce both the malaria parasites and their vectors through the insecticide DDT to the point where general transmission could not occur. The CDC would pay for the spray and provide equipment and experienced personnel; state and local governments would pay for the labor involved. The massive spraying operation was carried out by two- and three-man crews operating from light trucks, and the CDC set up observation stations in three notably malarial areas. Though the control of malaria seemed initially successful, freeing

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many of the CDC staff to investigate other diseases, any hope of eradication was soon proven prematurely optimistic.

In the CDC's Savannah lab, researchers were attempting to understand how a "super-fly" had developed sudden resistance to DDT. The scientists found that some flies were converting DDT into a less harmful substance, and others were changing their habits, by resting on floors rather than ceilings and walls, and staying still rather than moving about, so as to lessen exposure to insecticides. More disturbing however, was a marked increase by 1952 in the resistance of the malaria causing mosquitoes to DDT. In the absence of suitable and safe insecticide substitutes, the resistance phenomenon represented nothing short of a renewed threat to world health. It was obvious that the practical application of insecticides had outpaced fundamental research. The adequate control and appraisal of the malaria threat could no longer depend on the "environmental engineering" strategies once in effect, but would require the concerted efforts of zoological and parasitological research combined with intensive field surveillance. Until the first teams went out from the CDC, surveillance in public health meant watching persons who had been in contact with certain serious diseases like tuberculosis, smallpox, or syphilis to detect the first symptoms of an oncoming attack so that protective isolation could take place. Beginning in 1950, the term became applied to specific diseases rather than to individuals, and its methodology began to focus on the systematic collection, constant evaluation, and dissemination of relevant data.1

A powerful spur to this end was the onset of the Cold War. As the Iron Curtain descended across Eastern Europe and China and the possibility of biological warfare loomed, health officials went on the alert. The outbreak of the Korean War in 1950 underscored the urgency of the situation, and methods of disease surveillance which had been developed to cope with the threat of malaria were

FIGURE 1:
Field decontamination of body bags during the 1955 Kikwit, Zaire, Ebola outbreak. 3 people died in the epidemic.

FIGURE 2:
Communicable Disease Center, Headquar ters, as mosquito. 1951.

FIGURE 3:
DDT being sprayed from an MCAV truck during the 1940s in an effort to control malaria by eliminating the anopheline mosquito.
soon utilized as an early warning system against man-made epidemics. With the loss of the United States’ nuclear monopoly and the triumph of communist armies in China, the CDC as the designated agency of response for disasters and epidemics suddenly found itself supported by a funding route aimed at the defense of biological warfare, an exotic new threat to health. The possibility of biological warfare became general knowledge in the scientific community in December 1950, when the Executive Office of the President issued the Health Services and Special Weapons Defense, a manual that stated categorically that “an enemy could employ...biological warfare against us effectively.” The manual cited two forms of possible attack: the creation of clouds of pathogenic aerosols over cities and the contamination of water and food supplies by sabotage. The first would produce large numbers of casualties in urban areas; the second would target specific groups. Long familiarity with typhoid fever and the epidemic of amebiasis that spread from the Chicago World’s Fair of 1933 were reminders of the ease with which malicious contamination could occur. Besides widespread inoculation, the best defense seemed to be the early detection of an airborne attack through a kind of health radar network. Air sampling devices were set up in Atlanta, Chamblee, Savannah, and New Orleans to get a base line against which the introduction of harmful agents in the air could be measured. The CDC envisioned a grid of these air-sampling stations in strategic areas, each operated in conjunction with a local air-pathogens laboratory. Sorting out biological-warfare assignments among the various units of the Public Health Service—CDC, NIH, and the Environmental Health Center—was not complete until the spring of 1951, by which time the CDC had appointed a committee on biological warfare and had begun research. For ten years the Department of Defense had engaged in biological-warfare work, and it provided funding for some of CDC’s work.\(^5\)

If the Korean War meant that the CDC give priority to defense-related activities, then it was imperative that it build an organization which, though initially designed for defense, could be converted into a panoply of peacetime uses. The idea for an Epidemic Intelligence Service came out of a meeting of Public Health Service officials in July 1950, the prime importance of which was to determine means for detecting masked biological warfare attacks, something difficult to do without fast and reliable morbidity reporting.\(^6\) To solve the problem, the EIS would establish both a surveillance system and a means for reporting to health departments, government agencies, academic facilities, and the public on a weekly basis. The CDC was becoming the head of a system of disease intelligence which, by employing surveillance as science, focusing on statistics, and maintaining officers in strategic locations on call to go wherever an epidemic arose, was unable to give priority to either natural or artificial threats to health. Though it had received its mandate from militaristic imperatives, as the epidemiological arm of the Public Health Service, the responsibility of the EIS was civilian, and it received more than 200 calls nationwide its first year in existence. Maintaining its strategic position outside the immediate influence of Washington politics, it soon became an institutional catch-all for public health programs that had become neglected by or mired in federal bureaucracies.

When the Foreign Quarantine Service, one of the oldest and most prestigious units of the Public Health
Service, was transferred to the CDC's auspices in 1967, few realized the enormous implications the move would have on the Atlanta institution's future. The Quarantine Service had maintained a staff of some 660 people, located at every port and international airport in the nation, at 414 points along the borders of the US, and 36 locations abroad. Quarantine officers were responsible for giving vaccinations, supervising medical and psychological examinations for persons applying for entry into the US, and compiling epidemiological data from around the world. It made sense to transfer the Quarantine Service to the CDC because quarantine was a means of controlling communicable disease, but what did not make sense was the way the Quarantine Service was run. Very little appeared to have changed since 1900; the medical officer in charge of the Mexican border, stretching from Brownsville to San Diego, had an annual travel budget of only $75; men in the service spent their time boarding ships and checking chest X-rays and vaccination certificates; they greeted international arrivals at the airport and went down the aisles looking in the eyes for jaundice. Forced to question how quarantine should be done at the end of the twentieth century, the advisory committee on foreign quarantine made sweeping recommendations to reduce the scope of activities, concluding: "There is no way, and never has been, of building a wall around a country which is impenetrable to communicable disease, and yet which permits international traffic to continue....Quarantine is essentially still using the concept of the 'thin red line.' It is bound to break down because it disregards the basic ecological facts about communicable disease in the 'jet age.'" When President Johnson asked for a reduction in overseas personnel in order to balance payments, the CDC closed the quarantine offices in Paris and Montreal. Ignoring arguments that the health of the nation was being compromised, it reduced the number of quarantine inspectors to sixty. Eliminating six hundred positions without endangering the nation's health required striking a delicate balance between disease-surveillance technology and epidemiology. Better epidemiology would provide an early warning system for the occurrence of communicable diseases anywhere in the world, and better surveillance within the states would pick up any threats to health that slipped by. The new system would only succeed, however, through the maintenance of effective commu-
cation between state and local health departments. In the US all disease surveillance began at the local level, working its way upward through state capitals and, eventually, to the CDC headquarters in Atlanta. If any link in the municipal-to-federal chain was weak, the entire system was compromised. At the very least, local weaknesses could lead to a skewed misperception of where the problems lay: states with strong reporting networks would appear to be more disease-ridden than those that simply failed to monitor or report all outbreaks.

Now that disease had only to pass through an informational, rather than a physical, barrier, concern became focused on the potential of a mysterious infectious disease from a remote and primitive location to run rampant in an industrialized western city before being detected or halted. Any imaginable pathogenic microorganism now existed within a twenty-four hour plane flight from every city on earth, and once it hit that network, it could spread anywhere in a day. Warfare, trade, religious pilgrimages, and the seductive lure of cities all guaranteed that a continuous cycle of new microbial invasions would beset urban populations which generally lacked protective immunity, and increased urbanization in the Third World would ensure an escalating disease incidence. Richard Preston saw in the panning of the Kinshasa Highway one of the most important events of the twentieth century—one that had affected every person on earth—because, as the primary artery leading across the focal point of the AIDS epidemic, it had already cost at least ten million lives.

To support defensive strategies based upon the informational networks, the world had a crucial shortage of real infrastructure. When in 1989, tropical disease experts gathered in Honolulu for the annual meeting of the American Society of Tropical Medicine and Hygiene, they staged an extraordinary war games scenario, envisioning a global pandemic of an airborne, nearly one hundred percent lethal virus. In playing out the scenario, what they discovered was that: “There were no pre-packaged infectious disease hospitals anywhere in the United States or at WHO in Geneva that were ready at a moment’s notice to be airlifted into an epidemic. Virtually no civilian hospitals in the United States were equipped to handle a highly contagious, lethal microbe, either in patients or inside their laboratories.” In addition, only one permanent maximum-containment facility existed inside the US Public Health Service system, and the once vast network of overseas high-security laboratories that had been run by the Rockefeller Foundation and the CDC no longer existed. In the event of such an emergency then, the Public Health Service and the WHO would be forced to choose between two rather less than ideal options: they could deploy all security research capabilities and personnel to the epidemic site, thus putting large numbers of personnel at risk; or they could ship all patients, blood samples, and tissue biopsies to the CDC’s laboratory, the Institut Pasteur, and Fort Detrick, risking the chance of civilian exposure should samples break open during transport. Given that the Pentagon had just two portable biological containment facilities, and only one such facility was available in the civilian sector, the US was ill prepared to deal with any epidemic that was spreading in more than three locations. These were but pieces in a larger picture of concern for the state of preparedness in confronting emerging disease threats: five major US government and several international studies
addressed the preparedness issue between 1988 and 1994, sharing a sense of urgency and despair over the status of public health infrastructures and infectious disease research in the United States and Europe.\textsuperscript{12} Suspicious of the World Health Organization (WHO), many scientists believed there was no option but to acknowledge the CDC as an international resource, to fund it appropriately, and to secure its mandate in legislation. By charter the United Nations was proscribed from doing anything that might be viewed as disrespecting national sovereignty. In times of crisis the UN interpreted that to mean that its agencies, including WHO, could not intervene in a nation without the official invitation of its recognized government. The role of WHO would then be limited to controlling international dissemination of information about an epidemic and ameliorating any political difficulties between authorities from the nations involved.

One of the universal ironies of epidemiology was that most new
epidemic outbreaks proved, after investigation, to be very old diseases that had either evolved in their virulence, or shifted in their geographical or demographical focus. Tuberculosis, once viewed as the scourge of the industrialized world’s cities, with advances in antibiotic therapy, had seen its mortality rate reduced to about 3.3 deaths in every 100,000 cases by 1970. Most of the new tuberculosis infections were not then occurring in the industrial cities of the Northern Hemisphere, but in villages and cities of the developing world, and the 3 million new deaths the disease was causing every year were occurring primarily in areas in which appropriate antibiotic treatments were insufficiently available. By 1991, with an escalating worldwide AIDS epidemic contributing to the appearance of tuberculosis among immuno-compromised patients, the global supply of streptomycin was tapped out. The second oldest antibiotic in commercial use was no longer being manufactured by any company. Unpatented, cheap, and needed solely in developing countries, it offered no significant profit margin to potential manufacturers in the US. When drug-resistant strains of tuberculosis surfaced in major US cities that year, the FDA was in a mad scramble to entice drug companies back into the streptomycin-manufacturing business. The microbe which, following the outbreak of the Black Death in the fourteenth century, had taken over the ecological niche vacated by Mycobacterium leprae, was again following in its path. M. leprae, the causative microorganism behind the ancient and disfiguring disease leprosy, was easily destroyed prior to 1977 with the antibiotic dapsone. But that year a dapsone-resistant strain of the bacterium surfaced in Ethiopia. Though dapsone continued to remain the drug of choice for treatment, resistance increasingly rendered the use of antibiotics problematic. Within ten years the situation became severe, with high percentages of the M. leprae strains from around the world appearing invulnerable to the drug. Subsequently, resistance emerged all over the world to the alternative treatment, rifampin, and a patient in Ethiopia was found to have essentially untreatable leprosy, suffering from a strain that was completely invulnerable. Using PCR genetic fingerprinting techniques to trace back in time over 470 multiply-drug resistant strains of the tuberculosis bacterium, a team of researchers from the New York City Health department discovered that all of the multiply-drug-resistant bacteria descended from a strain that first emerged in Cairo, Egypt, in 1961. By the end of that decade the strain’s descendants could be found in New York, New Jersey, Dublin, Geneva, Copenhagen, London, Kampala, Nairobi, Ontario, Halifax, Winnipeg, and Saskatoon. A decade later they were seen planet wide.

The problem of evolved resistance, which had originally contributed to the creation of an informational surveillance system within the CDC, was, more than a quarter of a century later, testing the system’s limits. The surveillance system that had been founded on the model of a military intelligence service, designed to detect and counter overt counter-strategies from either political or zoological opponents, was being forced to respond to a threat that was nothing short of terroristic. Among the nations of the world, those with the capacity and the will to pose a threat for biological warfare could be identified and monitored; the conditions in which resistant malarial mosquitoes arose were well known and their breeding grounds could be eliminated without recourse to insecticides; but the strategy employed by a resistant microorganism which preyed on the disabling conditions of another
epidemic while still maintaining its capacity for spread to the healthy population, and whose true danger could only be identified after an expensive and painstaking course of treatment had been undergone, was nothing short of subversive and opportunistic. "The increasing frequency of resistance was indicating the need for a stronger partnership between clinical medicine and public health," wrote the CDC's director of bacterial research, Dr. Mitchell Cohen, in 1992. "Unless currently effective anti-microbial agents can be successfully preserved and the transmission of drug-resistant organism curtailed, the post-antimicrobial era may be rapidly approaching in which infectious disease wards housing untreatable conditions will again be seen." Not only did the physical infrastructure not exist in which to isolate the resistant infectious disease at its source, the informational defense was inadequate to the crisis. While the AIDS virus was testing the limits and proving the imperatives for a globalization of health, the 34 disease detection labs worldwide that were supposed to alert the global medical community to outbreaks of dangerous viral diseases were found in 1993 to have shocking insufficiencies in laboratory skills, equipment, and general diagnostic capabilities.

The only way to cover for the weak links in the surveillance network, it has been proposed, is by a kind of hypernetworking. Various computer databases have been established to link on-line physicians and scientists in both developed and developing countries: Satellite, the HIV Sequence Database at Los Alamos National Laboratory in New Mexico, and GenInfo at the US National Library of Medicine, are all attempting to amass a store of data on the identificatory properties of a world of rapidly evolving microbial pathogens, from the base genetic sequences out, in the hope that methods of detection can begin to outpace the rate of spread. The solution, however, poses its own vulnerabilities. As research on the genetic properties of disease-causing microorganisms progresses, and its documentation on networked databases becomes ever more sophisticated and complete, it is now just a matter of months or years before the genes for the virulence and airborne transmission of influenza, Ebola, and Lassa are nailed down and before, in the words of epidemiologist Karl Johnson, "any crackpot with a few thousand dollars' worth of equipment and a college biology educa-
tion under his belt could manufacture bugs that would make Ebola look like a walk around the park." Genetic engineering has already shown it to be a simple enough matter to insert genes coding for just about anything into the DNA or RNA of a virus. Johnson believes that the discovery of the genes for hemorrhagic diseases, such as Ebola virus, could lead to their insertion into other viruses, such as influenza or measles, that are adapted for respiratory transmission. And he is not alone among biologist in expressing that concern. The terroristic potential that exists in the very informational coding of the pathogen, and in its necessarily ubiquitous defense, has the potential to spread to the susceptible malevolent will.


( Ibid., 35.

( Ibid., 38-39.

( Ibid.

( Ibid., 42-43.

( Ibid., 157-58.


( Garrett, 395.

( Ibid.

( Ibid., 682.

( Ibid., 243.

( Ibid., 440.

( Ibid., 414.

( Ibid.

( Ibid., 603.)
The movement of people and goods across international or intercontinental boundaries has always been associated with the transport of disease. Though the contagious nature of pestilence has presupposed the existence of a geographical point of origin, this causal specificity has done nothing but complicate strategies of prevention by underscoring the necessity of defending against a double-pronged attack. Any political entity seeking protection within an infected global network has, throughout history, been forced to balance the necessity of checking boundaries and isolating populations with the desire for eliminating external sources of infection and instituting hygienic standards, all without endangering personal rights and economic stability. The solutions that have been devised for striking such a balance in the face of a pestilential outbreak have not only had to reconcile these forces of contraction and expansion simultaneously, but have had to do so within an environment of increasing international interdependence.

The Crusades paradoxically represented both a means for eliminating an exotic source of infection—through the conversion of pagan
populations—and a vehicle for its rapid transmission. Leprosaria, which had been constructed merely to house the providentially stricken from amongst the community, were being augmented by lazaretti which, placed along travel and trade routes, could protect the entire Catholic community from the heathen. Colonial relationships in the eighteenth and early nineteenth centuries were complicated by the fact that smallpox was endemic in Europe, and epidemic in its colonies. While colonial subjects sought to distance and isolate themselves from the infected motherland, European nations felt justified in continuing to establish colonies in the typhus and yellow fever ridden American and North African continents for purposes of eliminating the miasmic sources of infection that were hindering trade. When a worldwide cholera epidemic proved equally destructive to both European and colonial populations, both Paris, France, and Sydney, Australia, were forced to question the effectiveness of strategies of isolation. The preservation of economic and social life in many places meant adopting the belief that pestilence spread not through contaminated people and objects but through the replication of a disease's native conditions of birth on board ships. As mandatory vaccination programs eliminated the threat of smallpox among the nations of the West, it became apparent that the cost of maintaining such a program of internalized protection could only be eliminated by eradicating the disease entirely. It thus made more sense to initiate public health programs externally and to maintain surveillance internally. As the mandate for maintaining the public health internationally became increasingly focused in the hands of a few agencies—like theCDC and theWHO—it became unclear where the distinction between the health of one nation and the sickness of another could be drawn. Through this defensive trajectory that begins with the lazaretto and ends with theCDC, it might appear that the evolution of the reconciliation between defenses of expansion and defenses of contraction was one-sided, with defenses of expansion having clearly won out.

However, not only does the defensive reconciliation persist through to the present day, it undergoes a spatial transformation in which the devices of expansion and contraction change position with respect to the network. This spatial translation, however, can only be observed by considering as a metaphorical body that geographically- or politically-demarcated entity that takes as its defense the negotiated space of action. It is the body of the community that seeks protection in the twelfth century from a disease carried by a band of returning Crusaders, and the means of securing that protection both isolate the community from the disease and extend the mandate of the community to ameliorating external points of infection. Enlightenment smallpox threatens the unity of an expanded, but nonetheless fragmented, national body, and defenses such as the Bamis-SalvanyExpedition in 1803 attempt to stall the amputation of a diseased limb: strategies of expansion attempt to effect contraction. Smallpox eradication efforts seek to protect the healthy body of the multi-national First World from the threat of an infected Third World, but in so doing, strategies of isolation and treatment that were once used at the boundary of the threatened entity are externalized, while strategies of identification and disinfection are internalized. The threatened geographical body is today the world itself, the network having been completely subsumed as a kind of circulatory system for the global corpus. Disease is no longer entering the network from outside, it exists as a parasite hidden at a point of maximum interiority. And
the global body, in order to isolate itself from its own infectious source, is creating a sensitized dermis that registers informationally those changes within. The external threat to health is now the defense itself which, in bringing the secrets of the pathological world to the surface, could allow them to erupt across the protective facade in a manner that compromises the whole. Strategies of defense that once sought to protect the network from disease, now protect disease from the network.

Defending against pestilence has always been a matter of deciding if the threat of a hidden pathology is greater than that of a universal contagion. As illustrated in Nathaniel Hawthorne's tale "Lady Eleanore's Mantle," the existence of a localized threat—represented by the author as pride—has called disease forth, but the presence of an external influence—represented by the British government—has accelerated its spread. What Hawthorne has shown is that the two cannot be easily separated. For the colonists in America, removing themselves from the contagious influence would have meant taking on the same pride that had sparked the outbreak. Because the strategies of protection have, necessarily, countered the strategies of the threat, and because the threat itself vectorially opposed, the strategies of protection have always represented paradoxical subversions. Pestilence, and its associated defense, has evolved like the Province House in which Hawthorne's story unfolded: the structure which once housed the malign external influence has become subsumed and internalized until it has been rendered superficially innocuous; however, through its very internalization, it has become a place in which the loyalists of the past regime may safely hide.
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ing had provided him with no canonical foundation for the terms’ philosophical reconciliation.

Thomas Mann’s *The Magic Mountain* (1927) is, at its most reduced, the tale of Hans Castorp’s initiation, through disease, into an “alchemistic-hermetic pedagogy” that is nothing less for the protagonist than a “transubstantiation, from lower to higher, ascending degrees.”1 Taking first under the pedagogical wing of humanism, Hans learns that nature is evil when it places noble souls in bodies unfit for the world, and he is instructed that, in the words of his philosopher mentor: “Within the antithesis of body and mind, the body is the evil, the devilish principle, for the body is nature, and nature—within the sphere, I repeat, of her antagonism to the mind and to reason—is mystical and evil.”2 Confronted with the embodiment of Jesuit anti-humanism, Han’s is faced with the realization that life would not be life without “the recklessness of death,”3 and that all human progress, if there is such a thing, is due to illness alone: “Men consciously and voluntarily descended into disease and madness, in search of knowledge which, acquired by fanaticism, would lead back to health.”4 Confronted with a view of nature at once both antagonistically evil and mystically sustaining, Hans must look to disease, itself, for answers.

Castorp began to realize, in his time spent on the balcony absorbing the effects of his salubrious environs, that, like his illness, nature was a process and a history, not a condition. In his readings on the biological, he became aware that his ego, as a living unit of a very high order, was “remote indeed from those very simple forms of life which breathed, took in nourishment, even thought, with the entire surface of their bodies. He knew it was built up out of myriads of such small organisms, which had their origin in a single one; which had multiplied by recurrent division, adapted themselves to the most varied uses and functions, separated, differentiated themselves, thrown out forms which were the condition and result of their growth.”5 His body was but a microcosm of all nature, a collectivity rather than a unity, and his powers of reason—the very spirit which animated his internal nature—was but a greater nerve that had, by an accident of adaptation, become lodged at point along the onion-skinned hierarchy of biological development from which it could observe and question. “This body, then, which hovered before him, this individual and living I, was a monstrous multiplicity of breathing and self-nourishing individuals, which, through organic conformation and adaptation to special ends, had parted to such an extent with their essential individuality.”6

His consciousness, then, like a political head of state, could only guess at the multitudes of secret revolutions and subversions being effected within his domain at any point in time, and it was nothing more than an attempted internal *coup* that was forcing this very realization. Placed within a structure of self-same, encapsulated redundancies, his consciousness could only understand his internalized nature insofar as he understood his place within the externalized city, state, or social community, which themselves reproduced the conditions of organic life. Thus, “in the innermost recesses of nature, as in an endless succession of mirrors, was reflected the macrocosm of the heavens, whose clusters, throngs, groups, and figures, paled by the brilliant moon, hung over the dazzling, frost-bound
The engineering text that Hans Castorp brought with him to the Sanatorium Berghof had begun to gather dust—if only metaphorically, in that most aseptic of environments. Product of modern progress and evidence of his former life on the “flat land,” the book’s contents had become increasingly irrelevant to the young engineer as his stay expanded from weeks into years, and his existence became consumed by the imperatives of the tuberculosis cure. Like the thousands, or even millions, who had been proven maladapted to the pace of a post-industrial existence, Hans had been stricken with a disease which reduced life to its essential physical and spiritual basis, in a reciprocal violence that served to call life’s attention back to its atrophied core. And like the many who sought treatment within the sanatorium culture, his cure was dependent on his ability, both physically and spiritually, to readapt to the natural environment. This re-adaptation was nothing short of a philosophical dilemma, however, which Hans was ill-prepared to handle. In his previous life, he had not had reason to question the dualism of mind and body, that is really the dualism of spirit and nature, and his educational preparation for a life of engineer-
valley, above the head of our muffled adept.” Though his awareness was limited by its place within this structure of imbedded hierarchies, it was free to generalize from one to the other and disregard spatial distinctions. It was no longer fruitful to talk of “outside” and “inside”:

The atom-world was an ‘outside,’ as, very probably, the earthly star on which we dwelt was, organically regarded, deeply ‘inside’....in the very innermost of his nature, and in the inmost of that innermost, perhaps there was just himself, just Hans Castorp, again and a hundred times Hans Castorp, with burning face and stiffening fingers, lying muffled on a balcony."

But what did sickness represent in this organic house of mirrors? If the human parasite sickened nature like the microbial parasite sickened Hans Castorp, how deep did the chain of sickness run? Locating the core malady meant locating the core distinction between the organic and its inorganic environment, between lifeless matter and life, which originated with the first organic molecule that separated itself from matter, forever destroying the cosmic unity of the material and the immaterial. Life itself, then, was nothing more than the sickening of matter: life was the spirit dishonored. Han’s submersion in the life of disease brought him to the realization that,

Disease was a perverse, a dissolute form of life. And life? Life itself? Was it perhaps only an infection, a sickening of matter? Was that which one might call the original procreation of matter only a disease, a growth produced by morbid stimulation of the immaterial? The first step toward evil, toward desire and death, was taken precisely then, when there took place that first increase in the density of the spiritual, that pathologically luxuriant morbid growth, produced by the irritant of some unknown infiltration; this, in part pleasurable, in part a motion of self-defense, was the primeval stage of matter, the transition from the insubstantial to the substance. This was the fall. The second creation, the birth of the organic out of the inorganic, was only another fatal stage in the progress of the corporeal toward consciousness, just as disease in the organism was an intoxication, a heightening and unlicensed accentuation of its physical state; and life,
life was nothing but the next step on the reckless path of the spirit dishonored; nothing but the automatic blush of matter roused to sensation and become receptive for that which awakened it.  

Hans Castorp, Thomas Mann’s “simple product,” in deciding that life is but the sickening of the material, does nothing less than reconcile opposing humanist and anti-humanist beliefs concerning the nature of Nature. Epidemic disease has always provided a sort of historical litmus test for determining a society’s position with respect to the potential of the natural environment to sicken or to heal, being that affliction of the both body and society that arises with all the force and violence of a natural disaster. As the defenses that society constructs, whether physical or ideological, for combating pestilential attacks are arrayed to either take advantage of or to protect against nature, they form the outer shell of a series of encapsulated defenses placed before a pathological threat. As Thomas Mann, through Hans Castorp, shows, however, in a structure of imbedded redundancies, the external at times becomes indistinguishable from the internal, and strategies for protecting man against nature—or nature against man—often get lost within the hidden recesses of the individual body.


*Ibid*.


*Ibid*.

The problem of determining epidemic disease causation, and establishing means for thwarting its progress, has always involved the positioning of an empirical borderline between the world of the living and that of the non-living, the destructive force of pestilence having arisen from is propensity to blur the distinction. Primitive peoples had seen in pestilence a kind of demonic possession, and they had established procedures to ward off or propitiate the influence of the supernatural. Greek medicine in the fifth century BC, though revealing for the first time a world no longer the playground of chaotic personalized forces but an orderly universe of law, had nonetheless resorted to the concept of an "epidemic constitution"—a belief in climatological or astronomical causation—to explain those widespread pathological phenomena which could not be understood on known objective grounds. The pandemic of bubonic plague which began in 1348 had led to widespread acceptance of the potential of contagion outlined in the hundreds of Plague Tractates which had initiated widespread public health instruction; and plague had, by the sixteenth century, prompted Fracastorius to elaborate a clear and convincing doctrine
of contagion, the contagious element conceived as a gaseous emanation rather than a living organism.

The distinction between living and non-living matter was long considered theoretically tenuous, and the recognition of this fact was of major importance to research into the modus operandi of contagion. Athanasius Kircher, a German-born Jesuit priest, made an important contribution to epidemiological thinking when, in developing his Scrutinium Physico-Medicum Contagiosae Luis, quae Pestis dictur (1658), he considered the “natural” rather than the “divine” causes of plague. Providing not only a standard iteration of the modes through which plague was generated by putrefaction, including marshes and decaying mud, dead bodies of men and animals, and decomposing vegetable matter, he elaborated the very means through which organic decay became contagion. Kircher described how, under hot and moist conditions, the general atmosphere could precipitate the creation of contagious particles, called seminaria, which in the living produced disease and which propagated in the bodies of the dead. The victim of plague was not merely evidencing an environmentally-induced imbalance in the four basic elements held by the doctrines of humoral medicine to constitute health, but was rather being sickened by the presence of the deleterious seminaria, which were spread by contact. Kircher’s real contribution, however, was in his discussion of the way the non-living seminaria of plague, which internally caused progressive putrefaction and externally produced corruption of the air, propagated in living material: “To whatever degree, corpuscles of this sort may be normally non-living, yet under the influence of ambient heat and in proportion to the degree of the infectious decomposition, produce an offspring of innumerable imperceptible worms, so that the more corpuscles are present in the effluvia, the greater will be the number of little worms generated. When this occurs they may be considered no longer as evidences of life but as actual living effluvia.”¹ This conclusion, which the author assumed to be startling to his readers, was supported by records of his own original observations made with a “very delicate” microscope.

It had long been believed that organisms were literally “born” of material nature, and Kircher had quoted Aristotle, Pliny, and other both ancient and contemporary authorities in support of the general principle that all putrefying substances generate worms. At this period, the doctrine that living things—not merely insects, but even fishes, reptiles and mammals—were spontaneously generated by organic decomposition had been generally accepted. Though the assumption that the living germs of disease were spontaneously generated by the decomposition of organic matter had proved to be the major defect in Kircher’s epidemiological theory, it is nevertheless clear that the Scrutinium Pestis had represented the first effective presentation of the theory that living organisms were the primary cause of disease. When Francesco Redi’s experiments finally disproved the theory of spontaneous generation; and Antony von Leeuwenhoek’s effectively described, through microscopy, the existence of bacteria and protozoa, there was, by 1700, enough available theoretical and observational evidence to have made possible the formulation of the equivalent of a germ-theory of disease.²

Medicine, however, soon fell under the sway of a very different concept, as the ancient legacy of
epidemic constitution resurfaced to obscure progress toward establishing an etiology of organic causation. Having been called in by Hippocrates to explain only those residual epidemic phenomena that existed outside of objective scientific method, the concept was emerging rationalized in Enlightenment medical circles largely through the influence of respected British physician, Thomas Sydenham. In the author’s preface to the third edition of his Collected Works, Sydenham proposed that all diseases “be reduced to certain and determinate kinds, with the same exactness as we see it done by botanic writers in their treatises of plants,” in keeping with the prevailing eighteenth century belief that the pathological world could be mapped and that, though inherently non-living, it had a parallel structure to the life that it threatened. If a particular disease emerged in one region rather than another, that simply proved that the distribution of pestilence was like the distribution of animal or plant species; however, like any plant or animal species, a localized disease could eventually become acclimated to other regions. The medicine of species, then, was but an effort to definitively locate the causes of disease in nature, and in attempting to classify diseases, comparisons were made between epidemic diseases among humans and epizootic diseases among domesticated animals, as part of a program of public health conceived in terms of an agrarian society.

Sydenham, responsible for the revival of the naturalistic spirit of Hippocrates, made, in one important respect, an important advance over his Grecian master. It was said that Hippocrates recognized only disease, not diseases. The patient and his malady were inseparably connected as a unique happening, one which would never recur. Sydenham, on the other hand, saw in the patient what he saw in the greater pathological geography, a characteristic process which had been observed previously and would certainly be seen again. For him, diseases were entities, and his outlook upon illness was, therefore, ontological. Part of definitively “mapping” a pathological entity, in Sydenham’s methodology, included recognizing the specific balance between the three causal factors that the disease identifiably struck: the first was an internal factor, being the development within the body of an abnormal composition of the humors; the second was an external factor, being the local

FIGURE 1:
influence of climate and season, heat, cold, moisture, and dryness; as was the third, being the mysterious epidemic constitution of the atmosphere, characteristic of a given year. A disease such as gout was chiefly determined by the humoral factor; the regularly endemic maladies, such as the respiratory diseases like tuberculosis and the intermittent fevers like smallpox, chiefly by the seasonal climatic factor; widespread unusual epidemics, like plague, by the epidemic constitution. The specific characteristics of a given disease at a given time were determined by the interaction of all three.⁷

What makes it possible to begin viewing the causative factors of an epidemic as constitutional and environmental in the eighteenth century is the increasing ability to render the concepts quantifiable. The availability of meteorological instruments such as the barometer, thermometer, and hygrometer means that as the science of the atmosphere becomes quantified, so does late eighteenth century epidemiology. It is now a matter of seeking to totalize events in their determination, for it is believed that if sufficient data
is collected and analyzed some "natural" laws of epidemics will emerge behind the apparent contingencies of the weather and ailments of the populace. There is no longer any difference between an individual disease and an epidemic phenomenon. According to Sydenham "an epidemic is a finer-grained constitution, with more constant, more homogenous phenomena." It is enough that a sporadic malady be reproduced a number of times for it to constitute an epidemic. Michel Foucault describes late eighteenth century epidemiology as a mathematical problem of the threshold: "The sporadic disease is merely a submarginal epidemic. The perception involved is no longer essential and ordinal, as in the medicine of species, but quantitative and cardinal."9

Though specific diseases were seen by Sydenham and his contemporaries to be more or less repeatable, an epidemic was not. A byproduct of the stress placed upon the doctrine of the epidemic constitution was the conception that one epidemic disease merged into and was transformed into another. Chapter XI of Noah Webster's 1799 History of Epidemic and Pestilential Diseases reviewed certain pestilential periods with a view to showing that diseases gradually progressed and developed from measles and influenza to diseases of the throat or anginas and, finally, to pestilential fevers, and that such pestilential periods were generally worldwide in their incidence. He cited the decade 1788-98 as one in which a particularly severe epidemic constitution was characterized by a progressive development of epidemic diseases of diverse sorts culminating in America in yellow fever. A decade ushered in by severe earthquakes and an eruption of Vesuvius, there was reason to conclude epidemic diseases "to be the effect of some access of stimulant powers to the atmosphere by means of the electrical principle." He therefore argued against quarantine for epidemic diseases but made a distinction between these and contagious diseases. An epidemic disease—a disease due to the general epidemic constitution of the atmosphere—could be distinguished from one due to infection or specific contagion by two characteristics. First, it was always "preceeded by influenza, afflictions of the throat or acute and malignant fevers." Second, it predominated "over other diseases, totally absorbing them or compelling them to assume its characteristic symptoms." Quarantine was therefore
effective and justifiable when dealing with infections like smallpox, but was useless when dealing with a true “epidemic.”

It was generally believed that if the death rate from one disease decreased, the death rate for another must automatically increase, on the principle that nature abhors a vacuum. Since epidemic constitution and season determined the character of an epidemic, a change in these factors which was favorable to one disease must be unfavorable to another. If plague increased, smallpox must necessarily decrease. In the pathological world, disease balanced disease.
1Charles Edward Amory Winslow, The Conquest of Epidemic Disease: A Chap-
the History of Ideas. (Princeton: Prince-
Univ. Press. 1943), 146-47.

Ibid., 159.

Ibid., 162.

4Francesco Delaporte, Disease and Civiliza-
Civilization: The Cholera in Paris, 1835-

5Caroline Hannaway, “Discussion,” in
Abraham M. Lilienthal, M.D., ed., Time
Places, Persons: Aspects of the History
Epidemiology. (Baltimore: Johns Hop-
Univ. Press. 1980), 41.

Winslow, 162.

Ibid., 172-73.

Hannaway, 40

6Michel Foucault, The Birth of the Clinic;
Archaeology of Medical Perception, tran-
A.M. Sheridan Smith, (New York: Rando

7Winslow, 174.

Ibid., 227.

Ibid., 242-43.
ACCELERATE

From the time of Fracastoro, Cardano, and Paracelsus, disease, as a contagious force, was seen as a legitimate part of nature, obeying the same laws of geographical distribution as living organisms and spreading along naturally determined paths. Legacy of the belief that disease originated through the putrefaction of living material as it was accelerated within closed, dank, and marshy locales, hospitals were beginning to be redesigned in the eighteenth century to reflect a new standard of cleanliness. Public health ideologies, by the turn of the nineteenth century, began to elaborate a strategic defense aimed more at the dirt, itself, than its products. Interpreting the built environment like their primary preoccupation with geography, they held the geographical antithesis between France and India key to their goals, and they compared the “uncultivated, arid plains” of Asia with the breezes and streams of France. The small poorly ventilated rooms of the old hospitals were like the rotting algae deposits left by the Nile, which could only be ameliorated through designs that emphasized the importance of evacuating polluted air and ensuring cleanliness by means of proper plumbing and ventilation. In effect, they believed that space
SANITARY & TOPOGRAPHICAL MAP

of the City of NEW YORK


of the CITIZENS ASSOCIATION.

ROBERT L. YELLI.

SAI 1868.
could be arranged in such a way as to encourage the spread of disease or to oppose it.¹

Investigation into the 1832 cholera pandemic had ruled out weather and topography as primary causes, and suddenly rendered a whole mode of inquiry virtually obsolete. Though the discussion had grown out of Thomas Sydenham's conviction that among the possible factors contributing to epidemic diseases were climate, seasons, rainfall, wind, and quality of soil, this rediscovery of Hippocratism had been proven insufficient to describe the particulars of the cholera threat without a major revision. Doctors now not only had to consider atmospheric factors but also the unsanitary conditions that had been implicated by the epidemic. The Parisian physician François-Joseph-Victor Broussais had distinguished three kinds of disease source: miasma generated by the decomposition of dead organic matter from sources such as swamps, beaches, cemeteries, and sewers; congregations of individuals as were found within prisons, hospitals, besieged cities, and vessels; and diseased individuals. Broussais's trinity of disease causation had not been revolutionary, however, in proposing new sources of disease, but in finally eliminating the disparity between

FIGURE 1:
View of "Gotham Court," New York City.

FIGURE 2:
Fragment from the Sanitary and Topographical Map of the City and Island of New York, prepared for the Council of Hygiene and Public Health of the Citizens Association. The map shows the way dangerous marshlands and sewers intersect with the city.

FIGURE 3:
A view of Romney Marsh, Kent, from the low-lying marshy tracts and 'contours of death' in the foreground to the rising upland 'contours of health' in the background.
natural and social causes of illness. If Hippocratism and humoral medicine had supposed that every species, and likewise every disease, occupied a habitat in harmony with its essential nature, by contrast the complex which had become known as “living conditions” had encompassed those features of the environment that tended to hinder rather than promote a species’ development. In so doing, this idea had focused the study of epidemic disease on its social and historical, rather than its natural or theological, dimensions. The problem had become the establishment of a model that could describe man’s failure to adapt to the artificial environment that he himself had constructed.

Unlike the universal scope of smallpox, the 1832 cholera epidemic selected its victims almost exclusively from among the urban poor, and it soon became apparent that “the nosological frameworks should as a general rule form vast mirrors reflecting the prosperity and misery of the people subject to observation.” The tranquil cyclicity of the seasons was replaced by the violence of urban life. Some
hygienists however, influenced by the emerging ideology of social Darwinism, argued that the cholera epidemic was but a necessary evil consuming the surplus population. According to Emile Littré, it was one of nature's regulatory mechanisms for maintaining demographic equilibrium: "As the population continues to grow, will it not exceed the available resources? If so, one would almost be tempted to believe that the Asiatic cholera morbus, which has invaded so vast a portion of the globe, is a necessary evil." The word "purge" suddenly appeared in the medical literature in 1832 in connection with cholera: "In our view this is the way [the cholera] may go, choosing its customary prey among those who...have worn themselves out through abuse and who, therefore, could only cause deterioration in the species...in short, as though it were charged with inflicting upon mankind I know not what frightful purge."

Should pestilence, then, be seen as accelerated by human squalor, or tacitly accepted as a force of acceleration within an inevitable process of natural selection? Was humankind encouraging its own downfall from within, or stubbornly resisting nature's measures from without at eliminating the unfit. Was the population weakening itself, or was nature making it stronger? The debate that had been engendered by the introduction of historical and social causes

![Sanitary and Topographical Map of the Twenty-Third District.](image)

**FIGURE 4:**

Sanitary and Social Chart of the Fourth Ward of the City of New York: To accompany a Report of the 4th Sanitary Inspection District, Made to the Council of Hygiene of the Citizens' Association. The map shows the location of tenant houses and tenements where the space allotted to each occupant is less than eight hundred cubic feet; shanties and untenable buildings, "proves in an extremely offensive condition, surface gutters, liquor stores and drinking places, insalubrious localities, houses where typhus had occurred during the past year, houses where smallpox had occurred during the past year, and other such information considered necessary to evaluating the threat to health represented by the neighborhood.

**FIGURE 5:**

This map, prepared in 1865, showed both the location of marshy areas and crowded tenements, as well as the places where attacks of cholera, fever, scarletina, and smallpox had occurred since 1849.
into a natural picture of disease was only to be solved by the next great epidemic wave, with the emergence of tuberculosis as an unusual new threat to health.

*Ibid., 151-53.

*Ibid., 85.

*Ibid., 91.

*Ibid., 52.

*Ibid., 52-53.
Tuberculosis, known also as phthisis or consumption, was an altogether different kind of disease. Unlike malaria, yellow fever, cholera, or smallpox—the prevailing pestilential scourges of the eighteenth and early nineteenth centuries—it was not characterized by swift and dramatic visitations. It was rather an endemic, debilitating constitutional illness to which people succumbed slowly over a period of years. Given that the public health infrastructure had been developed in response to the threat of highly infectious and volatile diseases, it proved to have serious limitations as a means for curtailing the spread of tuberculosis.

Cholera policy had been heavily influenced by social data about where disease occurred and who succumbed, and cholera prophylaxis had accounted for the most fundamental and innovative changes in public health care in the nineteenth century. Though the defects of the natural environment were still considered necessary to the profile of disease causation, by mid-century, urban health officials had begun to blame deficient drainage, filthy streets, polluted water supplies, poor ventilation, and improperly
constructed buildings as the primary culprits. In the name of cholera eradication, health officials had directed the razing of slums and apartment homes, and relocated immigrant populations. Sanitationists had arisen to advocate home plumbing, waste disposal, and water system regulation. This focus remained nearly unchanged at the end of the century, when tuberculosis took over as the primary threat to health.

The cholera or smallpox model had serious limitations as a template for understanding tuberculosis. When applied to consumptives, the mathematical curves used to describe such volatile diseases proved to be neither dramatic or sharp. Using the mortality rate as an indicator of the effectiveness of their health measures, health officials missed most of the information about tuberculosis. The very identification of the ill even proved problematic, since the early stages of the illness passed unnoticed, periods of remission were common, and diagnostic protocols varied widely. Cholera was a good fit to a bureaucratic system, and since it was a waterborne disease, federal and local environmental controls largely succeeded in bringing it under control. Environmentalism—as represented by an interest in geography, hygiene and sanitation—thus spilled over into consumption management through theories about the role of soil, climate, and air quality in contributing to the slow progress of the unconventional epidemic.  

Consumption, in its obvious focus within the lungs, was considered first and foremost to be a disease of the atmosphere, a disease that seeped into the body from the defects of its surroundings. The idea of an atmospheric culprit grasped the public imagination long before it was proved that the disease was caused by microbes, but somehow persisted, even among the scientific, long after. Researchers had believed foul air to be potentially lethal since early in the century, and Pasteur's research, Lister's work, and John Tyndall's *Essays on the Floating Matter of the Air* (1882), were part of a growing list of cautions about the air people breathed.  

Most people at the time assumed that moist or re-breathed air poisoned the lungs, and that even the most robust person, exposed to foul air for a long time—through poorly ventilated houses and apartments, closed windows, constant breathing of dust or pollution—would eventually develop consumption. Doctors prescribed for their consumptive patients travel to high, dry places, and the sanatorium, conceived as a retreat for upper- and middle-class tuberculous, soon arose to cater to the curative trend. Such organized pilgrimages for health had a long history, rooted in traditional beliefs in the palliative properties of climate. The romanticized character of the phthisic bohemian wanderer thus continued the long reinforced social convention of leaving a deadly, miasmic locale for a more salubrious one.
Mid-century artists and writers, in articulating the transcendental separation of wilderness and city, established the foundation for the therapeutic reinterpretation of the American landscape in the 1870s and 1880s. It took Goethe and his imitators, however, to translate the mountainscape, previously viewed as a barren, inhospitable and undesirable country, into an Arcadian source of health, uplift and freedom. Mountainous areas were particularly targeted in the therapeutic geography for the effects on heart and lung action to which any inhabitant of lower altitudes could immediately testify. For the tubercular, the simple exercise of relocation permitted "aseptic" oxygen to penetrate deeper into the lungs and aid healing. These beneficial effects, however, only took place above the "altitude of immunity" line that was established by climatologists at about 5,000 to 6,000 feet above sea level.4

Hans Castorp described the air at the Sanatorium Berghof, that fictional mountainous locale that served as setting for Thomas Mann’s *The Magic Mountain*, as nothing less than “fresh,” and having “no perfume, no content, no humidity; it breathed in easily, and held for him no associations.”5 Not for nothing, Castorp told his visiting uncle, was it famous far and wide: “It had great properties. It accelerated oxidation, yet at the same time one put on flesh. It was capable of healing certain diseases which were latent in every human being, though its first effects were strongly favorable to these, and by dint of a general organic compulsion, brought them, as it were, to a triumphant outburst.”6 The special properties of the mountain air, then, were capable of normalizing that illness, characterized by an inconsistent symptomatology.
and an unsure course, which had thwarted treatment through its absolute unpredictability. This fickle disease, however, was nothing but a symptom of a greater malady which was represented by man’s inability to match the pace of modern progress with an adaptive response. The pristine environment of the sanatorium thus provided a means for restoring the natural adaptive balance. The influence of evolutionary theory, which provided proof that nature enacted distinct and graded processes, had made it seem plausible that, if the consumptive began engaging in the “Outdoor Life” within the environment appropriate to the affliction at an early enough stage in the illness, the disease would progress predictably and respond to treatment uniformly. The untainted environment was called in to bring the tuberculous population to a normalized state of unhealth which could then respond to a rationalized treatment strategy.

After surveying fellow practitioners and employing “the statistical methods of French sanitarians,” Henry Bowditch, an influential Boston physician, determined that consumption was dependent upon the natural qualities of the residential site and its underlying soil porosity. His “Law of Soil Moisture” was elaborated upon in a three part series in 1869’s *Atlantic Monthly*, which included an exhaustive study of Massachusetts’s climatic properties with respect to the affliction. Bowditch’s soil moisture theory invigorated a growing literature on meteorological conditions and their influence upon disease incidence, called “climatology.” Climatologists began to “map” the continental geography, producing complex directives as to where any particular consumptive should go. Some climatological physicians pronounced judgments based upon the stage of the disease, others used the character of the tubercle infiltration. Alfred Loomis who, for example, had cured himself in the Adirondacks, believed that fibrous phthisis cases did better in Colorado, whereas catarrhal phthisis responded best in the Adirondacks.

As the tuberculosis epidemic
progressed and the isolation of the sick population became the primary imperative within public health strategies, geographical directives were required to become much more flexible. By the 1870s, the establishment of a railroad network meant that there were hundreds of places to which consumptives could relocate. Sheer demand allowed the sanatorium to become both paradigm and justification for the economic development of the American landscape, and its responsibilities began to shift from the hands of American entrepreneurship and philanthropy to the auspices of government bureaucracy. In Pennsylvania, this transfer took place through the forestry department. Joseph T. Rothrock, the state’s first commissioner of forestry, adopted the cause of consumption as an argument for the conservation and replenishment of the Pennsylvania woodlands. In the late decades of the nineteenth century, loggers had destroyed many of the state’s forests, leaving the land eroded, susceptible to fire, and almost devoid of wildlife. Seeing the tuberculosis epidemic as a potential cure for the endemic exploitation, he reasoned that the mountains of Pennsylvania could certainly prove as therapeutic as the Western Rockies. Rothrock, described by contemporaries as a master of political fait accompli, initiated his sanatorium by first establishing a camp and then asking for legislative support. Pennsylvania’s first state sanatorium thus began in 1902 with a single small cabin in the state forest preserve near Mount Alto, a sparsely populated region in the south central part of the state. Rothrock sought voluntary contributions for the construction of additional cabins, as well as for the provision of fuel, water, medicine, and weekly visits by a physician. Despite the primitive conditions, he was soon able to report that every cabin was occupied and that “results were astonishing.”

The power of progressive reform movements in states like New York and Massachusetts had caused Pennsylvania to appear suddenly, by comparison, far behind in the creation of a public health infrastructure. The state’s recent smallpox and typhoid fever epidemics only cemented fears that the board, as it existed, was insufficient to operate at the new standard. The Pennsylvania Bureau for Vital Statistics was created in 1905 not only to keep tabs on existing health reform measures, but to produce figures

**FIGURE 4:**

Before and after going to the Adirondacks. From Harper’s New Monthly Magazine, August, 1870.
that would generate support for new programs. “Is it not appalling,” asked the health commissioner’s first annual report following the state’s 1906 record 9,258 deaths from tuberculosis, “to think that nearly ten thousand human lives should be swept away...by a disease now known to be preventable.” It was an unnecessary and “lamentable sacrifice” which the department of health felt duty-bound to diminish. By the spring of 1906, the state’s Republican party had committed itself to “the establishment and support of dispensaries, hospitals and sanatoriums for the treatment of the consumptive poor,” and in 1907 the legislature appropriated another $600,000 for the construction of one or more sanatoriums over a two-year period. This government action spelled huge success for Rothrock and the forestry department. In 1907, his camp at Mount Alto was transferred to the health department and became the nucleus for the state’s first sanatorium. In addition, he had personally purchased some land and water rights adjacent to the original camp for the construction of a private sanatorium there. Having spent $1,120 for the property, he improved it with one building and several cabins, and in August, 1907, sold it to the state for $27,550.18

The enormous economy of the sanatorium movement rose, flourished, and vanished, however, without ever establishing its efficacy against the disease. From the beginning of the sanatorium movement through the 1940s, nearly 25% of all patients died while under institutional care, and another 50% of all released patients succumbed within five years of discharge.11 The War on Consumption was nonetheless deemed a success, and sanatorium treatment came to be seen as superfluous years before the development of the antibiotic treatments which returned its structures to the hands of the resort and hospital economies. It can only be speculated that this imagined success and the decline of the sanatorium infrastructure was the result of the financial burden the long term care of the tuberculous population placed on government budgets.

In describing the tuberculosis epidemic thirty years after the development of effective pharmacological treatment, Larry Lutwick notes: “The rate of decline was roughly exponential, but follows more closely a curve defined by the Gompertz equation, which is used by actuaries to estimate life expectancy. It is not clear that any medical intervention had an impact on the prevalence, as has been noticed for several major infectious diseases.”12 Karl Peterson notes as early as 1911 in The Fight against Tuberculosis and the Death-rate from Phthisis: “We have to stretch our ideas of time a little and we should realize the possibility of a typical epidemic curve in the frequency of phthisis. Indeed the mortality from phthisis in England has been declining since 1838, i.e., long before any special measures had been taken for the control of the disease or segregation of the sources of infection—tuberculous human beings or animals—had been attempted.”13 Contagious illnesses typically follow an epidemic curve, at first rising rapidly in frequency, reaching a plateau, then gradually subsiding. Tuberculosis is no exception, but its cycles are apparently unusually slow, not spanning months or decades but centuries: at present we are living at the apparent end of a long epidemic wave, which appears to have begun in Europe in the late seventeenth century, “just as the industrial revolution commenced, as town’s began to turn from overgrown villages into sprawling metropolises, as science came of age and
the pace of its discoveries began to accelerate."\(^{14}\)

The "epidemic" identified in the mid 1800s was nothing more than the peak of a greater epidemic cycle too prolonged to be detectable within a single lifetime, or even a single generation. It was clearly a constructed epidemic, an optimistic attempt to prolong the era of large-scale and dramatic visitations in order to prove a belated solution; an opportunity to apply, in hindsight, a philosophy of treatment altered just enough to accommodate a constitutional illnesses to which people succumbed slowly, over a period of years, rather than one which could sweep quickly through a city or region only to disappear for several years. Patients, practitioners, and the community came together to build the optimum environment for treatment that would collapse the distinction between the medical mandates of isolation and the political and social ideologies of environmental causation.


\(^{2}\) Ibid., 37-38.


\(^{4}\) Ott, 40.


\(^{6}\) Mann, 445.

\(^{7}\) Ott, 38-39.

\(^{8}\) Ibid.


\(^{10}\) Ibid., 153-156.

\(^{11}\) Caldwell, 116.


\(^{14}\) Caldwell, 8.
QUANTIFY

Between Robert Koch's 1882 discovery of the microbial cause of tuberculosis and his 1893 elaboration of the potential of the human carrier, the microbial causes of glanders, erysipelas, diphtheria, tetanus, E. coli, malta fever, cerebro-spinal meningitis, and chancreoid were identified. By the late 1890s, the burgeoning field of bacteriology also located the microorganisms responsible for influenza, aerogenes infection, plague, and dysentery. Along with these discoveries came a new definition of infectious disease: no longer represented by the external invasion of lifeless seminaria or the malign effects of the surrounding environment, disease etiology was reworked according to a parasitic model. In the struggle toward symbiosis taking place between the microorganism and its bodily habitation, disease represented a draw in which neither the host nor the parasite could destroy one another, an unstable biological balance. The practice of epidemiology arose to analyze the factors that caused the balance to fluctuate, and its ultimate institutionalization within the public health system was effected to alter the trends in favor of man.
The phenomenon of infection constitutes an accelerated evolution extraordinarily favorable for the observation of adaptive changes, for in the microbial world, generations succeed each other with great speed—at least two every hour under suitable circumstances. New forms of parasitism, or infection, constantly arise, and among existing forms, modifications in the relationship of parasite and host are constantly taking place. In the accelerated evolution of microorganisms, the body, as the natural environment for the parasite, is relatively static. But it is nonetheless a position of value for both parasite and host in Georges Canguilhem’s definition of life as a normative activity. Health, in Canguilhem’s model, represents an organism’s optimum capacity for adaptation to environmental modification: it is in the “possibility of tolerating infractions of the habitual norm and instituting new norms in new situations” that health is maintained. The sickened body loses that capacity known as health to establish other norms in other conditions. But, likewise, the causative microorganism is only healthy, in the normative sense, when it can pose the least threat to its host or evolve the capacity to spread quickly from one threatened host to another. Disease, as the imperfect adaptation of parasite to host, can no longer be read as our mal-adaptation to nature, but nature’s attempt to become adapted to us.

A parasite is an organism so closely adapted to another that it cannot exist apart from him, and therefore perishes when the host dies, unless transmitted to another. In the case of such uninterrupted transmission, the parasite is never subjected to environments other than those to which it is most perfectly adapted, and, in consequence, evolution may progress in the direction of a more perfect mutual tolerance between invader and invaded. When such a parasitism begins, the host’s reactions are likely to be violent, and either the invader or the host may succumb. As adaptation perfects itself, reaction is less energetic, and disease becomes less severe and more chronic. Finally, a stage may be reached in which mutual adjustment is so nearly perfect that the host may show no signs of injury whatsoever.

When conditions are such that an infection can saturate almost the entire population of crowded regions, the result is
what the Germans call Durchseuchung. The accidentally less susceptible survive, and through generations a gradual alteration of the relationship between parasite and host becomes established. The simplest demonstration of such changes is the rapidity of spread and the virulence of a disease when it is first introduced into the reservoir of an aboriginal—that is, entirely susceptible—population. When measles first came to the Fiji Islands in 1975, as a result of the visit of the King of the Fijis and his son to Sydney, in New South Wales, it caused the death of 40,000 people in a population of 150,000. Though measures at the prevention of such horrific consequences are generally desirable, as Hans Zinsser described, “It is not at all unlikely that the successful control of an epidemic disease through several generations may interfere with the more permanently effective, though far more cruel, process by which nature gradually immunizes a race.”

The nineteenth century brought three events that drastically reduced the death rate from smallpox in North America: the first was the introduction of vaccination; the second was the abolition of the slave trade; and the third was the appearance of a new and less virulent form of smallpox, dubbed Variola minor, which appeared and spread as a kind of natural immunization against the more virulent variety of smallpox. Introduced at Pensacola, Florida in July 1897, most likely from Latin America, it soon predominated because of differences in control measures. After it spread across North America, it remained the predominant type of smallpox until the disease was eliminated from Canada and the US due to widespread vaccination in the 1940s. Epidemiologists are convinced that, given time, the disease would have naturally immunized the population, because its causative organism was better adapted to a stable symbiosis. But as Georges Canguilhem observes, “if we delegate the task of restoring the diseased organism to the desired norm to technical means, either magical or matter of fact, it is
because we expect nothing good from nature itself."6

The only thing that would have prevented the ultimate eradication of smallpox by technical means, other than the vicissitudes of politics and the limitations of bureaucracy, would have been the existence of the disease as a parasitic microorganism among animals. The fact that most pathological microorganisms may take several species as host has been held as the primary drawback to the smallpox model of disease eradication, for the only way to eradicate a disease with a known animal vector is to eliminate the species altogether—a strategy with obvious ethical drawbacks. The technical drawbacks to identifying zoological sources for rare and remote disease agents have, in addition, been proven equally great. In the epidemiological optimism of the 1950s which followed the development of the Salk polio vaccine, biological research stations had been established throughout the Southern Hemisphere, staffed largely by scientists from the Northern Hemisphere, attempting to identify the natural reservoirs of both ancient and remote disease threats. All sorts of agencies had funded and administered theses outposts, including the Rockefeller Foundation, agencies of the government of France, the United States, Germany, and the United Kingdom, as well as a variety of small private interests. The US government alone had operated 28 overseas laboratories, and the Rockefeller Foundation’s Virus Program had manned facilities in 8 countries through which over sixty viruses were discovered between 1951 and 1971.7

Field research has shown that there have historically been two chief sources of new diseases. The first has been the modification of parasitisms already existing in man by gradual adaptive changes in their mutual relations; and the second has been the invasion of man by parasites, well established in the animal kingdom, by new contacts with types of animals and insects to which mankind was not previously exposed. The rat has long caused diseases in man by being the ideal reservoir, or the animal best adapted to the long term habitation of a parasite outside of the human body. For more than any other species of animal, the rat has become dependent on man, and in so doing, has developed characteristics which are amazingly human. As Hans Zinsser has noted, both the brown and black rat are omnivorous, breed at all seasons, hybridize easily, develop marked social and racial prejudices, adapt to all kinds of climates, make war on their own kind, and are quite individualistic unless in crisis:8 “Gradually these two have spread across the earth, keeping pace with each other and unable to destroy each other, though continually hostile. They have wandered from East to West, driven by their physical needs, and—unlike any other species of living things—have made war upon their own kind. The gradual, relentless, progressive extermination of the black rat by the brown rat has no parallel in nature so close as that of the similar extermination of one race of man by another.”9 The concept of the zoological reservoir has shown that disease is but a chain of parasitism progressing from the greater to the lesser adapted, through a process exemplified by the jump of the AIDS virus from chimpanzee to human. The virus had been merely looking after its own interests when it moved from an endangered rain-forest animal to one that was not endangered at all.10
The reservoir species, which in Canguilhem’s words is “the grouping of individuals, all of whom are different to some degree, whose unity expresses the momentary normalization of their relations with the environment,” poses the same threat at the scale of the natural environment to the health of mankind as the human carrier, that asymptotically normalized host, presents to the health of the community. As an internalized environment, each is able to house the parasitic pathogen silently and surreptitiously. The true epidemic potential, then, is represented not by the number of sick individuals, but by the unquantifiable scope of the parasite’s speciated launching pad.


"Zinsser, 67.

"Ibid., 68.


"Canguilhem, 40.


"Zinsser, 197.

"Ibid., 308-9.


"Canguilhem, 143-44.
SENSITIZE

The great success achieved by the smallpox eradication program was being increasingly seen as an aberration, rather than a goal that could easily be repeated with other diseases. The malaria eradication program had ended in parasite resistance to treatment and mosquito resistance to DDT. Bacteria were emerging on the scene resistant to those antibiotic therapies that had, in the not so distant past, rendered staph, leprosy, and tuberculosis amenable to control. Despite numerous attempts to rejuvenate old drugs to match new strains of bacteria, there was much evidence to indicate that the antimicrobial era of therapeutics was rapidly passing, and it was being increasingly suspected that no chemical might ever be found that did not eventually induce resistance. These new "iatrogenic" forms of disease had actually been created as a result of treatment: pharmacology was accelerating microbial evolution, and a worldwide epidemic of microbial resistance was the result. The story told by a 1993 congressional report on tuberculosis had read as "Tuberculosis Is Back" rather than, more appropriately, "Tuberculosis is Back in the News," for it was not its return that was so
extraordinary, but that its decline had ever been considered definitive.²

Along with the reemergence of several old diseases, many new viruses were appearing as the inevitable natural consequence of the ruin of the tropical biosphere. AIDS, Ebola, and any number of other rain-forest agents were surfacing from the most ecologically damaged parts of the earth to strike along that tattered edge where rain forest or savannah met rapid settlement. Any distinction between the old and the new, however, was merely nominal, for not only was it a fact of epidemiology that most new diseases turned out to be old diseases,³ but that the old were forever being renewed. C.J. Peters, current Chief of Special Pathogens at the Centers for Disease Control, compared the situation to dipping your hand in a river—each time you put your hand in, you were putting it into a different river. Viruses operated along very much the same principle: “The samples you’ve got and the symptomatology they represent may look the same as what you’ve seen in the far or recent past, but once you ‘dip your hand in’—well gloved and within the appropriate biosafety environment—you may find that you’re dealing with a different organism and must react accordingly.”⁴ For this reason, it was deemed necessary, however controversial, to maintain a small amount of the smallpox virus for research so that any new disease in the future that might look like smallpox could be distinguished from that ancient foe.⁵

With humanity approaching the last decade of the twentieth century, the concept of the Global Village, first elucidated in the 1960s by Canadian philosopher Marshall McLuhan as a term for the sense of worldwide inter-connectedness created by mass media technology, has begun to enter mass consciousness in the context of Earth’s ecology.⁶ Within the last decade, many scientists, particularly in the US and France, have voiced concern that HIV, far from representing a public health aberration, may be a sign of things to come. And they are calling for recognition of the ways in which changes at the micro level of the environment of any nation can affect life at the global, macro level. Biological models are no longer formed according to a clear-cut, Linnean determinism, but are predicated on the belief that “nothing is clear, everything is too complicated, everything is a mess, and just when you think you understand something, you peel off a layer and find deeper complications beneath.”⁷

Responding to the complexity of new pathological models, American scientists, particularly virologists and those who are practitioners of the fledgling field of microbial ecology, are encouraging the development of large-scale monitoring and surveillance schemes. Satellites, biological containment laboratories, computers and PCR devices are the tools they hope to use to spot changes in ecologies that might promote microbial emergences. Failing that, they hope to be equipped to swoop in with a scientific rapid strike force that can identify and destroy emerging microbes before an outbreak progresses to an epidemic.⁸ ProMED, brainchild of Stephen Morse and Joshua Lederberg, is the most ambitious of the
proposed schemes, involving a vast international network of monitoring systems that would keep an eye on diseases emerging not just in hospitals and clinics but also in agricultural crops, livestock, wild-caught animals, and sampled water supplies. It could serve as a watchdog not only for natural emergencies but also for the terroristic deployment of biological weaponry.

It has become clear that it is humanity, not nature, that is the new source of disease. The emerging threats to health in the late twentieth century are but the world mounting an immune response against the human species: “The earth’s immune system, so to speak, has recognized the presence of the human species and is starting to kick in. The earth is attempting to rid itself of an infection by the human parasite.” And the only way to protect ourselves from nature’s immune system is to augment our slow biological adaptation by the evolution of more complex sensing devices.

FIGURE 1:
Virus hunter in the field. With the earth mounting an immune response against the human parasite, the only way to protect ourselves is by the evolution of more complex sensing devices.

FIGURE 2:
Attempts at eradicating malaria through widespread spraying of DDT in the 1940s and 50s only resulted in mosquito resistance.

FIGURE 3:
This house, at the intersection of animal and human habitats, is typical of settlement patterns in developing countries that have led to the escalation of new disease threats.

"Tuberculosis currently infects eight to ten million people annually around the world and kills two to three million. In 1981, one third of the global population, or one billion people, or one third of the global population, were believed to have been infected.


"Ibid., 117.

"The Centers for Disease Control in Atlanta became one of the two repositories for the virus, the other being the Research Institute for Virus Preparations in Moscow.


"Garrett, 602.

"Ibid.

"Peters, 407"
The drawing of a definitive line between the living and the non-living was always crucial to establishing the origin of disease and protecting against it, disease having operated as that force that resisted the distinction. The pre-Enlightenment mind was able to conceive of the emergence of life from the decay of the non-living—spontaneous generation. It seemed reasonable to assume, then, that disease might constitute the process of generation of another life form from the dying body, however instigated by non-living forces. Even after Enlightenment medical circles sought to quantify disease causation through the re-emphasis of climatic and atmospheric factors, the particularities of cholera required that living forces be introduced in the form of man, himself, who was being sickened through the pollution of his own environment. The cure proposed for early modern tuberculosis, that disease of both natural atmospheric and man-made living conditions, held that just as certain environments, combined with certain modes of habitation, could produce disease, other natural settings, enhanced through the rigorous planning of the built environment, could correct it. And just as the disease was proving the necessity of
ameliorating the conditions of urban life, the solution it proposed was establishing the model for the preservation and maintenance of the natural environment. Once infection became redefined as parasitism with the advent of bacteriology, life became temporarily restored as the source disease; and as techniques of magnification became sophisticated enough to observe the nature of the viral entity, the distinction between living and non-living factors was again blurred, for it was impossible to determine if these scavenging particles of genetic material could actually be considered alive. Living nature was now the most dangerous of the external threats to health, containing innumerable species of animal that could each be housing a pathological microbe that only needed a swift evolutionary leap and a convenient adjacency to become hazardous to mankind. The living source for disease moved from the internalized “worm-like” life seen in the diseased body of the plague victim to the flora and fauna of externalized nature. Likewise, the non-living source for disease was transformed from the fluctuations of atmospheric conditions external to the body, to a pure fragment of highly internalized informational code.

This translation of disease etiology from a basis in medical topography to a historical epidemiology thus proceeded through a series of steps though which the role of nature was transformed: a belief in the direct influence of the natural environment on health based on discreet observations of climate and geography gave way to a conviction in the influence of the human environment on health based on that environment’s ability to be modified and ameliorated; the statistical understanding of natural variations in mortality levels calculated by place, season, or time gave way to a complex model of disease based on the epidemiologically determined contours of microbial evolution. This translation, however, neither resulted in a more definitive understanding of the role of nature in relation to health nor simplified methods of identifying and controlling epidemic outbreaks. Fueled by a technological genealogy bracketed by the barometer and the electron microscope, the evolution of the literal or ideological terrain of disease merely shifted the space of pathological nature as it exited in relation to the body.

Of greater influence even than the progress of medical technology on this spatial transformation was the elaboration in the early nineteenth century of Charles Darwin’s evolutionary theory. The eighteenth century model of the medicine of species, which held that diseases populated the earth according to botanical models, suggested the possibility of adaptation, but was without a model of pathological life that might sustain it. Social Darwinism was even applied in the nineteenth century to the malign man-made environment before the existence of a living pathological microorganism was convincingly posited: social development was seen to have outpaced the natural, and mankind was unfit for the environment it had created. The advent of bacteriology, however, allowed the realization that disease was but microscopic nature slowly becoming adapted to its human environment. Field epidemiology and failed eradication programs showed that human disease was actually part of a greater chain of parasitisms involving other hosts and vectors. Because evolution proceeded within a natural structure of mutually influencing and interconnecting levels, it was equally correct to say that
humanity was the parasite on the natural environment, and any
disease we sustained was but nature’s immune response to us.

Hans Castorp, protagonist of Thomas Mann’s *The Magic Mountain* (1927) had come to understand, during his stay at the sanatorium, both his place in nature and the nature of his disease. He had been forced to the realization that evolutionary adaptation, itself, that throwing out of forms, was but a response to an initial, originary sickening. Long before there had been humanity to question the unity or dichotomy of mind and body, matter and spirit, there had been a great epidemic that had created life out of material nature. It had surely been a sickness, he speculated, that had wedded the pure and untrammeled spirit to the decay of life. Each of the adaptations of form that populated organic nature were redundancies that had been created in response to disease and, thus, to life. Lifeless matter had not sickened, it had itself been sickened.

Figure 3 (p. 14), “Inoculation Instrument.” From: Genvieve Miller, *The Adoption of Inoculation for Smallpox in England and France*, (Philadelphia: Univ. of Pennsylvania Press, 1957), Figure 12.


Figure 1 (p. 34), “Airtight Cabinets.” From: Centers for Disease Control and Prevention, pamphlet, *Viral/ Rickettsial Diseases Laboratory*, (U.S. Department of Health and Human Services), 3.

Figure 2 (p. 37), “TB Poster.” From: Centers for Disease Control and Prevention, pamphlet, *Dateline: CDC at 50*, (U.S. Department of Health and Human Services), 12.

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**Figure 2** (p. 8), “Pustulent Smallpox.” From: Barbara Maria Stafford, *Body Criticism: Imaging the Unseen in Enlightenment Art and Medicine*, (Cambridge: MIT Press, 1991), 296.


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Figure 2 (p. 68), “North London Consumption Hospital.” From: F. Rufenacht Walters, M.D., *Sanatoria for Consumptives: A Critical and Detailed Description*, (New York: E.P. Dutton, 1902), Fig. 41.
Figure 3 (p. 68), “North London Consumption Hospital, Open-Air Gallery.” From: F. Rufenacht Walters, M.D., *Sanatoria for Consumptives: A Critical and Detailed Description*, (New York: E.P. Dutton, 1902), Fig. 43.

Figure 4 (p. 69), “The Brehmer Sanatorium.” From: F. Rufenacht Walters, M.D., *Sanatoria for Consumptives: A Critical and Detailed Description* (New York: E.P. Dutton, 1902), Fig. 14.


Figure 6 (p. 70), “District Hospital, Waiblingen.” From: *Functional Architecture: The International Style: 1925-1940*, (Köln: Benedikt Taschen, 1990), 65.

Figure 7 (p. 70), “Bucegi Sanatorium.” From: *Functional Architecture: The International Style: 1925-1940*, (Köln: Benedikt Taschen, 1990), 287.

Figure 8 (p. 70), “Zonnestraal Sanatorium.” From: Jan Molema, *Jan Duiker*, (Rotterdam: Uitgeverji, 1989), 79.

Figure 9 (p. 71), “Convertible Sleeper,” designed for the Indiana State Hospital, Rockville, Indiana, by Brubaker and Stern Architects.

Figure 10 (p. 72), “Zonnestraal Sanatorium, Perspective.” From: Jan Molema, *Jan Duiker*, (Rotterdam: Uitgeverji, 1989), 85.


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Figure 1 (p. 80), "HVAC Unit," now known to encourage the growth of Legionella pneumophila.


Figure 3 (p. 82), "Legionella Pneumophilia." From: Centers for Disease Control and Prevention, pamphlet, Dateline: CDC at 50, (U.S. Department of Health and Human Services), 16.


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Figure 1 (p. 86), "CDC, Viral/Rickettsial Diseases Laboratory." From: Centers for Disease Control and Prevention, pamphlet, Viral/Rickettsial Diseases Laboratory, (U.S. Department of Health and Human Services), 13.

Figure 2 (p. 88), "Early CDC Laboratory." From: Elizabeth W. Etheridge, Sentinel for Health: A History of the Centers for Disease Control, (Berkeley: Univ. of California Press, 1992), Plate 7.

Figure 3 (p. 88), "CDC, Building One." Photo: the author.

Figure 4 (p. 89), "USAMRIID." From: Outbreak, 1995 (motion picture).

Figure 5 (p. 89), "CDC Interior." From: Outbreak, 1995 (motion picture).

Figure 6 (p. 90), "Early Maximum Containment Facility." From: Centers for Disease Control and Prevention, pamphlet, Viral/Rickettsial Diseases Laboratory, (U.S. Department of Health and Human Services), 2.

Figure 7 (p. 90), "CDC, Viral/Rickettsial Diseases Laboratory, Section." From: Centers for Disease Control and Prevention, pamphlet, Viral/Rickettsial Diseases Laboratory, (U.S. Department of Health and Human Services), 7.

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Figure 8 (p. 91), “Isolation Room.” From: Kenneth E. Gill, P.E., “HVAC Design for Isolation Rooms,” Heating/Piping/Air Conditioning 66 (February 1994), 45.

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Figure 1 (p. 110), “Charles Maitland’s Report.” From: Genevieve Miller, The Adoption of Inoculation for Smallpox in England and France, (Philadelphia: Univ. of Pennsylvania Press, 1975), Fig. 4.

Figure 2 (p. 114), “House of Preparation, London.” From: Genevieve Miller, The Adoption of Inoculation for Smallpox in England and France, (Philadelphia: Univ. of Pennsylvania Press, 1975), Fig. 9.

Figure 3 (p. 115), “Smallpox Hospital, London.” From: Genevieve Miller, The Adoption of Inoculation for Smallpox in England and France, (Philadelphia: Univ. of Pennsylvania Press, 1975), Fig. 8.


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Figure 7 (p. 128), “Patients on Roof Garden.” From: Barbara Bates, Bargaining for Life: A Social History of Tuberculosis, 1876-1938, (Philadelphia: Univ. of Pennsylvania Press, 1992), 64.

Figure 8 (p. 129), “Bungalow Court, Pasadena.” From: James Steele, Los Angeles Architecture: The Contemporary Condition, (London: Phaidon, 1993), 41.

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Figure 3 (p. 135), “Plan of the Lung Block.” From: Katherine Ott, Fevered Lives: Tuberculosis in American Culture since 1870, (Cambridge: Harvard Univ. Press, 1996), Plate 18.


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Figure 1 (p. 140), “Aerial View of the CDC.” Modified from photo obtained from Dekalb County, Georgia, government offices.

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Figure 2 (p. 143), "Vulnerable side of CDC." Photo: the author.

Figure 3 (p. 143), "Condemned House." Photo: the author.

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Figure 1 (p. 156), "Plan, Lido di S. Erasmo." From: Comune di Venezia, Venezia e la Peste, (Venice: Marsilio Editori, 1979), 90.

Figure 2 (p. 158), "St. George's Leprosarium." From: Peter Richards, The Medieval Leper and His Northern Heirs, (Cambridge: D.S. Brewer, Ltd., 1977), 48.

Figure 3 (p. 159), "Plan, Venice." From: Comune di Venezia, Venezia e la Peste, (Venice: Marsilio Editori, 1979), 200.

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Figure 1 (p. 162), "Sick France Being Diagnosed." From: Barbara Maria Stafford, Body Criticism: Imaging the Unseen in Enlightenment Art and Medicine, (Cambridge: MIT Press, 1991), 163.

Figure 2 (p. 164), "Reverend Cotton Mather." From: Donald R. Hopkins, Princes and Peasants: Smallpox in History, (Chicago: Univ. of Chicago Press, 1983), Plate 30.

Figure 3 (p. 165), "Shapona." From: Centers for Disease Control and Prevention, pamphlet, Dateline: CDC at 50, (U.S. Department of Health and Human Services), 27.

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Figure 1 (p. 168), "Normannia Passengers." From: Howard Markel, Quarantined: Eastern European Jewish Immigrants and the New York City Epidemics of 1892, (Baltimore: Johns Hopkins Univ. Press, 1997), 102.

Figure 2 (p. 172), "Lazaretto, Genoa Italy." From: Jean Duncan Foley, In Quarantine: A History of Sydney's Quarantine Station, 1828-1984, (Kenthurst NSW, Australia: Kangaroo Press, 1995), 23.

Figure 3 (p. 174), "Between Decks in Steerage Class." From: Jean Duncan Foley, In Quarantine: A History of Sydney's Quarantine Station, 1828-1984, (Kenthurst NSW, Australia: Kangaroo Press, 1995), Plate 2.

Figure 4 (p. 175), "Plan, Sydney Quarantine Station." From: Jean Duncan Foley, In Quarantine: A History of Sydney's Quarantine Station, 1828-1984, (Kenthurst NSW, Australia: Kangaroo Press, 1995), Plate 10.
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Figure 1 (p. 178), “Vaccination Site.” From: Elizabeth W. Etheridge, Sentinel for Health: A History of the Centers for Disease Control, (Berkeley: Univ. of California Press, 1992), Plate 11.

Figure 2 (p. 180), “They Come Arm in Arm.” From: Howard Markel, Quarantine: East European Jewish Immigrants and the New York City Epidemics of 1892, (Baltimore: Johns Hopkins Univ. Press, 1997), 89.


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Figure 2 (p. 188), “CDC as Mosquito.” From: Elizabeth W. Etheridge, Sentinel for Health: A History of the Centers for Disease Control, (Berkeley: Univ. of California Press, 1992), 55.

Figure 3 (p. 189), “DDT being Sprayed.” From: Elizabeth W. Etheridge, Sentinel for Health: A History of the Centers for Disease Control, (Berkeley: Univ. of California Press, 1992), Plate 1.

Figure 4 (p. 193), “Kinshasa Highway.” From: Richard Preston, The Hot Zone, (New York: Doubleday, 1994), Fig.1.

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Figure 2 (p. 214), "Pneumatiks." From: Barbara Maria Stafford, *Body Criticism: Imaging the Unseen in Enlightenment Art and Medicine*, (Cambridge: MIT Press, 1991), 425

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Figure 3 (p. 221), "Romney Marsh, Kent." From: Mary J. Dobson, *Contours of Death and Disease in Early Modern England*, (New York: Cambridge Univ. Press, 1997), 45.


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Figure 2 (p. 228), "The Drive." From: F. Rufenacht Walters, M.D., *Sanatoria for Consumptive: A Critical and Detailed Description*, (New York: E.P. Dutton, 1902), Fig. 62.

Figure 3 (p. 229), "On the Lawn." From: F. Rufenacht Walters, M.D., *Sanatoria for Consumptive: A Critical and Detailed Description*, (New York: E.P. Dutton, 1902), Fig. 49.


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Figure 1 (p.234), "Tubercle Bacilli." From: Katherine Ott, *Fevered Lives: Tuberculosis in American Culture since 1870*, (Cambridge: Harvard Univ. Press, 1996), Plate 17.

Figure 3 (p. 237), “Rat Control.” From: Centers for Disease Control and Prevention, pamphlet, *Dateline: CDC at 50*, (U.S. Department of Health and Human Services), 47.

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Figure 2 (p. 242), “Attempts at Eradicating Malaria.” From: Centers for Disease Control and Prevention, pamphlet, *Dateline: CDC at 50*, (U.S. Department of Health and Human Services), 23.


