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ON THE COURSE AND DESTINY OF POPULATION INFECTIONS.

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IN his general observations on the course and causes of the plague in the fourteenth century, Hecker¹ says:

“That Omnipotence which has called the world with all its living creatures into one animated being, especially reveals himself in the desolation of great pestilences. The powers of creation come into violent collision; the sultry dryness of the atmosphere; the subterraneous thunders; the mist of overflowing waters, are the harbingers of destruction. Nature is not satisfied with the ordinary alternations of life and death, and the destroying angel waves over man and beast his flaming sword.

“Were it in any degree within the power of human research to draw up, in a vivid and connected form, an historical sketch of such mighty events after the manner of the historians of wars and battles, and the migrations of nations, we might then arrive at clear views * * * and the ways of Providence would be

1. Epidemics of the Middle Ages, Sydenham Society, 1844.

more plainly discernible. * * * All this, however, takes place upon a much grander scale than through the ordinary vicissitudes of war and peace, or the rise and fall of empires, because the powers of nature themselves produce plagues, and subjugate the human will, which in the contentions of nations alone predominates."

The consideration of the infectious and spreading ills that have ever more or less actively beset the life of collective man has been a theme of absorbing interest from times most dim and ancient; and the pages of written speech contain no more moving and graphic narratives than those wherein are described and set forth the advent, the agony and fatalities of destroying epidemics amidst sparse or thronging populations. The descent of the plague upon a supine or preoccupied people was likened to the falling of rain from heaven; and the prophecy concerning a numerous people that "their dead bodies shall lie in the streets of the great city," expressed the extremest mortal ill that could be visited upon man by sweeping and pitiless infection. Or, again, "To the great city that thought it would sit as a lady forever, there came in one day widowhood and loss of children," are the striking words that tell of the self-complacent negligence, and the surprise and swift desolation of an ancient and opulent metropolis.

Not decimation merely, but depopulation and desolation more than once in earlier times marked the course and termination of pestilential sojourns over inhabited areas of very considerable extent. The movements and migrations of population were then but slow as compared with present times—the losses sustained in human life being made good with difficulty, as the mention or memory of the horrors and bitter experiences of such scenes and occurrences, and to which were commonly added the miseries of extended famine, served to retard and make dubious speedy and efficient recuperation through immigration or natural increase.

That the violence and vitality of human infections, and the virulence of epidemical disease was greater then than now is conclusively shown by ample and competent testimony reaching back through many centuries; and the specific agencies whereby they

operated are now so weakened, comparatively—unless specially circumstanced—that epidemiology and pathology scarcely recognize to-day in the wasted and fading semblances of certain diseases the dreaded instrumentalities that once were armed with power to scourge and slay unhindered throughout cities and provinces, and even continents and hemispheres entire.

The histories alike of medicine and mankind present the instructive spectacle of diseases dead or overthrown, and wasted and expiring infections; and nothing can more impressively convey the lesson of the changes wrought by time and prevailing associated influences upon types and forms of life than this most certain and salient truth.

The beginning, duration and ending of infections depend clearly upon physical influences, and their variations and movements, however accidental, phenomenal or erratic they may seem, are yet controlled in orderly sequence by determinate laws that hold equable sway throughout all animate nature. Deriving their impetus and power to harm from the minutiae of quickened organic nature, the study of the fauna and flora of microscopic life becomes at once a subject of deep and absorbing interest; for, by unfailling natural law it seems ordained that in their career the lowest shall be the life dependent or adjunct of the highest—that the humblest link in the living chain shall surely touch and unite with the most exalted to complete the circle of animate existence. The life procession of these plastic and protoplastic forms and phases of organized matter is conjoined with that of man, within whose vital economy they find their appointed range, sustenance or abode. There the decrees of their being are fulfilled, and there they round out and justify the mission of their existence. Their design, domain and destiny, as merely abstract subjects of study, are inviting alike to pathologist, naturalist and physiologist; while their animus, their energies and capacities as causes of far-reaching movements hurtful to the health, or fatal to the life of man possess a personal and immediate interest to every living human being.

The observant, shrewd good sense of mankind divined the living, material basis on which infections rest, and from whence

they derive their hurtful powers, long before science accepted this belief as fact, and before any perfect demonstration of its truth was possible; and this conclusion was reflected in the every day language of the people, "nests and seeds of disease," "breeding places of infection," "nurseries of fever," "hot beds of pestilence." "plague spots," and like phrases all in common use, expressed the general conviction that plagues and pestilences, domestic and foreign, had their origin in and derived their activity from living forms of matter that were quick to respond to exciting and favoring local influences.

Why the resources of disease should fail and infections show a declining power is pertinent to the present purpose, and while the subject is too vast for a complete exposition of the process to be attempted, and, indeed, may as yet be impossible, still some note taken of the workings and mutations of nature in analogous and collateral, but more openly declared directions, may serve to throw some light on this, as yet, somewhat obscure subject—only the briefest reference, however, to a few of the leading facts in this connection being here possible.

It being granted that epidemic maladies have their essential and influential sources in the bodily forms and entities of microscopic life, and that these in their continuance through successive generations, and the transmission of their fundamental qualities of group, species or breed, are influenced, shaped and determined by their treatment and environment, then the only further admission required is that they are likewise subject to the operation of a general law observed throughout nature, and which is not invalidated by application to even the lowest forms of life.

Absolute dominion of physical agents over organic forms is declared by high authority to be the fundamental principle in all the science of organization; and that living forms in the manner of their development depend altogether on the circumstances to which they are exposed. So long as these are the same the resulting form will be the same, and so soon as these circumstances differ, the resulting form differs too. With difference in form come necessarily changes in function, aptitude and in parental or hereditary entailments.

The experience had in the domestication, cultivation and raising of animals and plants shows in a striking manner the effect of careful selection, breeding, surroundings, etc., in developing desirable and overcoming objectionable features or qualities in breed or species subjected to such treatment. Careful observation and experiment show that this holds equally good with the lower forms of life, and that in feature and function the individuals thereof breed as true to type as the higher ones, and that successive generations are modified by the conditions in which they are placed, abundant nourishment causing rapid and efficient reproduction, while starvation will restrict the increase as well as weaken the vigor of the brood.

The quality of generative prepotency, or the power to closely transmit to descendants ancestral characteristics, is marked in beasts and plants in a state of nature, being especially so in wild animals; but it is capable of acquisition in domesticated strains, and may be fixed by long continued breeding to a given desired type; and when attained, the esteemed qualities are perpetuated in the offspring with occasional flaws, reversions, and variations through continuous successive generations. Or, a prepotent individual may unexpectedly appear of unusual excellence—or the opposite—in many points, whose descendents will be strongly impressed with his distinguishing desirable or ignoble qualities. Growers and breeders of stock have long more or less perfectly understood and taken advantage of the opportunities afforded by the laws of heredity and prepotency, and have shaped and modified in strain and breed the characters and features of their flocks and herds by the selection of progenitors with a careful reference to the securing of desirable qualities of form, fibre, fleece, flesh, etc. The fierce, the wild, the coarse, the weak or the noxious instincts and characteristics of ancestral types have thus, by judicious selection and intelligent care, been eliminated, and milder, useful and profitable qualities have been impressed instead upon their progeny.

But, marked as acquired prepotency may be, it may yet disappear and be lost as a result of causes operative either from within or without, close breeding even, and in-and-in breeding certainly, sometimes resulting in its extinguishment; fertility

between relations ceasing, although the existing individuals may be in appearance the most perfect of their kind. As these artificial types, however stable they may seem, may be lost through lack of care or otherwise, so the untamed or untamable aboriginal and most markedly prepotent species may be forced to extinction by adverse conditions as of food and climate, or by the relentless pursuit of natural enemies.

In former times the unsparing vigor and wide extending power of diseases which still claim recognition amounted to inherent prepotency of their organic causes, there being a swiftness and deadliness marking their course unknown even in the worst epidemic of modern times among civilized peoples; and a review of the history and course of population pestilences, with due note taken of the progress and influence upon them of time and civilization, shows not a few resemblances between the manifest lessening of their destroying energies, with the attendant exhaustion or subjection of their living causes, and the results observed in the domestication of species and individuals derived from the animal or vegetable kingdoms of wild or primitive nature.

The virtual if not actual extinction of some of the more violent and fatal forms of human disease, together with the gradual visible weakening of others, clearly shows the past and present trend of population poisons, and the value and efficiency of measures intelligently designed and applied for the protection of population health.

In a public health sense the measure of civilization in a given community is the degree of elevation in the personal and domestic habits and environment of each individual; and, more especially, that of the aggregate personnel of the indigent, the negligent and the toiling classes, for it is in the midst of these that infections most commonly find all the requisites of prolific and typical development. The advance of civilization is marked by a growing regard for the moral and physical welfare of these classes, and in proportion as their housing, food, drink, clothing and the ultimate details of their domestic life are bettered, in just that degree is pestilence forestalled and denied the conditions amidst which it most readily feeds and breeds.

The struggle of mankind along the path of enlightenment and progress has been marked by a corresponding decline in the power of disease—a wide and very general slaughter having been the rule rather than the exception in earlier times, while now sweeping epidemics are exceptional, save among the semi-civilized or savage, and their mortality is comparatively slight.

The reasonable explanation of this may be found, it is believed, in the fact that mankind, through the arts, aids and appliances of civilization has, unconsciously often and usually in a blind, uncertain, imperfect way, produced effects upon the active causes of his peculiar infections analogous to those observed in the taming and subjection of original forms of animal and vegetable life. For, as these minute living bodies or energies are the outcome and expression of special determining conditions, then, agreeably to the laws of evolution, when the conditions which gave them birth and maintained their identities are withdrawn or altered, the character of the offspring changes too; and if, by reason of favoring circumstances of soil, season and environment, these in their begetting and growth are certain of purpose and ample in power to fatally touch the life of collective man, then plainly his first instinct and most immediate and pressing concern would be to discover and apply every measure that is capable of attacking, deranging or removing these specific and dangerous conditions.

To systematically and continually deny to morbid organisms all favoring circumstances amidst human populations, to thwart their purpose and disarm their power, to cut them off from the means of living and starve them to extinction, or to breed such types, benign in character, as will supersede and protect against the original and injurious ones, are now the conscious and avowed aims of the highest human intelligence and civilization.

As the plagues of antiquity are now scarcely known save in history, so the destroying epidemics of the middle ages, such as leprosy, syphilis, measles, typhus and small-pox, have yielded their fatal energies, and now retain scarcely a title of their former aggressive malignity amongst civilized peoples.

An accidental clue, laboriously followed up and skillfully developed, led to the discovery of protective vaccination, and the resulting conquest of a disease which, previously, was more disastrous to human kind through death and disfigurement, than all the wars waged by man during the same period of time—excessive as even such losses were. Ultimately and in effect the vaccine culture and process is simply the domestication and close breeding of a certain disease entity, as is practiced upon animals and plants, reversions to the original type being observed as with them, while in-and-in breeding results in infertility, the acquired prepotency of the benign organism being thus weakened or lost; and, without taking account of susceptibility, soil or medium of culture and other factors in the case, hence follow the abortive, atypical or negative vaccinations not infrequently observed.

Although scurvy may not properly be classed with infections, still its chief factors are bad air, bad food and bad surroundings; and while scarcely known now was, prior to the two generations past, for centuries present in almost every ship, jail, workhouse and hospital and in many private dwellings throughout the civilized world. By statistics, whose accuracy may not be questioned, it is shown that during the last two centuries the deaths from scurvy in the British Royal Navy exceeded in number all the fatalities from battle and wreck and other casualties of seafaring life; and this, too, in times when every maritime nation that could sail a ship or fire a gun was sooner or later at war with this power, and when sea-fights and blood-shed were events of the most common occurrence. Such was the havoc wrought by this one dreaded affliction, a death from which is now unknown, and which now finds scarcely a place of lodgment in all the world. And this result was brought about simply by increased enlightenment as to its causes, and a little practical care and forethought in the way of prevention.

Typhus was the close companion of scurvy, and like it has faded from sight as a palpable factor of mortality. The plague,¹ with

1. Hecker says that in the course of the Black Death in Europe,

all that the term comprised in variety of morbid features, has also passed away. Measles, which two hundred years ago was as fatal as any disease known to present times, has been brought to a type so mild as often to be scarcely recognized. Leprosy, which during the middle ages and from earliest times claimed kings and beggars alike among its victims, now reduced to a shadow of its former self, lingers precariously in a few of the by-places of the world. Syphilis retains none of the malignity that once marked its course, a death from its sequelæ even being now infrequent.

Clearly the age of population infections is passing away; for, though certain spreading diseases still survive to swell the mortality reports, yet their power is visibly decayed and surely wan-

chiefly during the years between 1347 and 1351 there was a mortality from this cause alone of nearly 25,000,000 persons, this estimate being the lowest made by trustworthy authorities of that age, and was the result of a careful examination of all attainable documentary evidence of the period named made by the author mentioned.

The ratio of mortality to population was the same as if 15,000,000 deaths from cholera should occur in this country during the next three years. A report made by order of Pope Clement showed 23,840,000 deaths from the plague in Asia, exclusive of China. Many districts and cities were depopulated, and often only one person in ten was left alive. Italy and France were terribly scourged, while Germany lost more than 1,200,000 lives in three years, the visitation being regarded as a rather light one, although during the entire course of the plague, the Franciscan friars throughout Germany alone reported a loss in membership of 124,434, while the Minorities in Italy lost 30,000.

Such was the deadliness of the infection that many died without a visible symptom, and vast numbers within twenty-four or forty-eight hours of attack. Unburied corpses lay in the fields, roads, streets and houses, and shipwrecks were often seen driving about in the Mediterranean and North Seas and drifting ashore with only the dead on board, the crews having perished to the last man.

In England 100,000 deaths at least occurred in London, and in Norwich 51,000. In France, Paris lost 50,000, Avignon 60,000 and Marseilles 16,000 in one month. In Italy, Venice lost 100,000, or three-fourths of her population, and Padua two-thirds of hers. Florence lost 60,000 and Siena 70,000. At the height of the disease in Vienna 1,200 died daily, while in the Levant, Aleppo lost 500 per day, Gaza 22,000 in six weeks, and during its deadliest prevalence in Cairo a trustworthy observer estimated the daily death rate at from 10,000 to 15,000.

ing. The tendencies of the times in the way of perfected drainage, which means cleanness and dryness of soils, cities and houses—every movement to get pure water in a more abundant supply, every effort to dispel darkness and damp by the letting in of sunlight and fresh air, every attempt to blight or poison by chemical means the living agents of infection, everything done to make cheaper and better necessary articles of food, drink or wear—in a word, every measure and endeavor in this direction tends to destroy the prepotency of plague breeders, and is a blow aimed at the sources and lives of organisms from which come not only the sweeping infections that may traverse the world, but also of the creeping infections that wait on unclean surgery and midwifery; and which still inhabit badly kept prisons, hospitals, tenements, sleeping rooms, closets, basements and the like places.

Any hypothesis that regards infectious diseases as being other than the outcome and evidence of stir and activity among miniature, definite forms of life and being, fails to account for and explain all the phenomena observed; but with increasing knowledge man has the assurance of ability to control fully the causes and circumstances of their generation and development.

The manifest course of infections coming from without, and which tend to spread widely and fatally, is in the direction of gradual and sure mitigation, in this respect keeping step with the advance of true enlightenment, and their destiny then is naturally toward final extinction; and, provided that the conditions that brought them into being and enabled them to live do not recur through negligence, and, provided further that new forms of spreading disease do not arise to take their place, then mankind in the future will have little to fear of evils to health save from those which are entirely home-bred, and which tend to domestication within his own doors.

It being evident that a number of the specific causes from which proceed epidemical impulses have been and now are greatly curtailed in their power for harm, and that others again have become to all purposes extinct, then this result and the manner and means by which such saving in human health and life was brought about becomes a matter of interest and congrat-

ulation to all; and, if the progress of time and civilization has shown, and still shows, a steadily increasing avoidance, removal or mastery of the causes of danger to human health, then this fact and deliverance constitute a triumph of human effort and intelligence over physical evil, and it may be justly claimed that men do hold largely in their hands the issues of life and death to the great body of their fellow men.

And the increasing consciousness of this knowledge and power, together with the growing general enlightenment upon public health matters, have caused mankind to depend less upon Providence than on themselves for protection; and the disposition to do this is becoming so strong that it is not unlikely in the near future that it will become a settled principle of law, and be made a part of such by statutory enactment, that municipalities shall be held responsible in actual if not exemplary damages for losses to business interests directly caused by epidemics of avoidable diseases, and which diseases were introduced or permitted to spread by reason of ignorance or lack of diligence on the part of the officials or agents of such municipality in refusing or neglecting to take the necessary plain, effective and proper steps to prevent the introduction and stop the spread of such disturbing or fatal epidemics.

