YELLOW FEVER INSTITUTE, BULLETIN No. 12.
Treasury Department, Public Health and Marine-Hospital Service.
WALTER WYMAN, Surgeon-General.

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ORIGIN OF SANITARY MEASURES DIRECTED AGAINST YELLOW FEVER,

BY

Passed Asst. Surg. J. M. EAGER.

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Section D.—QUARANTINE AND TREATMENT. Asst. Surg. Gen. W. J. PETTUS, Chairman of Section.

THE EARLY HISTORY OF QUARANTINE—ORIGIN OF SANITARY MEASURES DIRECTED AGAINST YELLOW FEVER.

By P. A. Surg. J. M. EAGER.

FEBRUARY, 1903.

The public sanitary measures included in the comprehensive term "quarantine" have been more extensively applied in America against yellow fever than against any other disease. Most of these measures had their origin long before yellow fever was known to the world. The way they came into existence and how they were later used as a protection against yellow fever is one of the most interesting topics in sanitary history—one without which no account of the prophylaxis of yellow fever would be complete. In the present writing the term "quarantine" is not limited to its narrower sense, but is taken to mean any restraint, owing to contagious disease, of intercourse on land or by sea. It includes such incidental measures as disinfection.

The history of quarantine is closely interwoven with that of medicine in general and of shipping. We read of these practices being applied against leprosy in biblical times, and Captain Cook, the English navigator, tells us that the savages of the South Sea Islands, who had not advanced beyond the stone age at the time of his visit to those islands, resorted to rude sanitary precautions in the case of arrivals from neighboring places.

The story of the beginnings of quarantine is associated particularly with the epidemiology of leprosy, pest, and syphilis. Cholera and yellow fever were later considerations. The first reported prevalence of yellow fever was at Bridgetown, Barbados, in 1647, the year before the great pest of Habana. At this time quarantine measures had been practiced against other malignant contagious diseases, a maritime quarantine station having been in operation at Venice in 1403, nearly a century before the discovery of America. It was only necessary to include yellow fever in the category of contagious exotic diseases and apply against the malady the procedures already in vogue. The first appearance of yellow fever in Europe occurred at Lisbon in 1723, and is described in the article "Yellow fever in Portugal" (Bulletin No. 4, Yellow Fever Institute, United States Public Health and Marine-Hospital Service). It was not, however, until 1821, following an extensive epidemic in Spain, that quarantine was applied in Europe against yellow fever. The Spanish academies were interpellated as to the nature of the disease, and as a result of their replies yellow fever was declared quarantinable. Inquiry in England in 1823 and 1824 was followed by an act of Parliament directing quarantine against yellow fever in the same way as against plague. Quarantine theory and practice have from the beginning followed medical dogma. Religion, astrology, and crude or false doctrines of etiology extended their influence. Like most branches of practical medicine, the practice of quarantine passed from the hands of priests into those of empiricists. It took ages for public sanitation to establish itself on a scientific basis.

LEPROSY AND LAND QUARANTINES.

The first quarantines of which any mention is made in literature were land quarantines used as a protection against leprosy. The ancients regarded this disease as of African origin, and Lucretius states positively that it first came from Egypt. In the Old Testament the first indications are found of precautions taken against contagious maladies. Leviticus, Numbers, and the First Book of Samuel give directions for the sequestration of lepers, first in the desert, then outside the camp, and afterwards without the walls of Jerusalem. In these books the inspection of persons for the detection of leprosy is detailed. Persons afflicted with skin diseases were directed to present themselves before the priests. An observation of each case was made, and, according to minutely described symptoms, isolation of the patients was ordered for a prescribed period.

The crusaders on their arrival outside the walls of Jerusalem found lazarettoes still in existence, and after taking the city from the Mussulmans sent all contagious maladies to these isolated places. The name Hospital of St. Lazarus was given to the place of sequestration. Returning to Europe, the members of the military expeditions brought

back with them not only numerous diseases, but also the word "lazaretto," as applied to a place for the isolation of the victims of communicable maladies. As a result lazarettoes were built outside the gates of nearly all the principal cities of Europe. Leprosy itself had, however, been introduced into Europe many centuries earlier. It is spoken of as a foreign disease by the earlier Greek and Latin writers. Pliny thinks that leprosy was introduced into Europe by Pompey returning to Rome from Syria after his celebrated triumph over fifteen nations in Asia. It is implied that leprosy walked with the three hundred princes before the triumphal car of the conqueror. These surmises give rise to the interesting query whether leprosy was not the first quarantinable disease introduced by sea. As a quarantinable disease leprosy takes precedence in several ways. For instance, it was the first quarantinable disease (quarantinable from the point of view of the United States quarantine regulations) of which the causative germ was discovered.

During the epoch of the crusades leprosy became widespread in Europe and resulted in the extensive establishment of isolation stations. Leper houses existed at Metz, Verdun, and Maestricht as early as the seventh century, for long before the crusades the disease had spread from Italy into the Roman colonies of Gaul, Britain, and Spain, and thence into the most remote countries. Mathew Paris estimates that at the time of the great epidemic of leprosy in western Europe succeeding the movement against the Mohammedans 19,000 lazarettoes were in operation in Europe. Religious orders conducted the houses bearing the name of St. Lazarus, but in northern Europe many dedicated to St. George were under secular supervision. Not only were persons suffering from leprosy and other contagious diseases sent to such asylums, but the insane and individuals whose separation from society was deemed an advantage to the populace or the ruling powers were also confined there. In these places of isolation quarantine measures, that afterwards had their application at maritime stations and ultimately were directed against yellow fever, developed primarily. Lepers were not strictly confined to the leper houses. They were, however, required to wear a special costume, to limit their walks to certain roads, to give warning of their approach by sounding a clapper, and to forbear communicating with healthy persons and drinking from or bathing in any running stream.

PEST AND EARLY VIEWS OF ETIOLOGY.

In connection with pest and later with syphilis the greatest advances of mediæval times took place in public sanitary methods, leading to the establishment of maritime and land quarantines. During the Middle Ages more attention was given to the isolation of leprosy than of other diseases now known to be virulently contagious, for the reason

that the minds of medical men were hampered by accepted doctrines. One of the first of these dogmas was founded on the fact that, while in the sacred Scriptures minute attention is given to precautions against leprosy and skin diseases, no measures are prescribed against pest. Yet most disastrous epidemics are recorded in the Old Testament.

By the word pest is understood not only bubonic plague, but the different epidemic diseases, whatever they may have been, that were formerly included under that term. In their application to this group of maladies the various docrines of etiology had a most important bearing on etiology. The history is preserved in a great number of documents, many of them obscure and quaint, but all interesting as showing the gradual development of public sanitation. From an etiological standpoint the history of public hygiene in its relation to epidemiology is divided into four periods, during all of which widely diverse views of causation of epidemic disease were held, the state of knowledge in each successive epoch advancing nearer the truth. First came a chaotic period up to the time of Hippocrates, secondly the centuries that intervened from the time Hippocrates set forth his views of etiology to the middle of the sixteenth century, when Fracastoro, basing his observations on the epidemic prevalence of syphilis that extended throughout Europe, announced a theory of contagion. Then followed an interval lasting until the evidence of a living contagion gained credence. Lastly came the time when specific germs were found to be the cause of epidemic disease. The last era, however, brings the history of quarantine to such a recent time as to be outside the scope of the present writing.

The word plague as well as pest was given by ancient medical writers to any epidemic disease that wrought an extensive destruction of life. Oalen, for example, used the word in this sense. History is replete with epidemics. Instances of ancient prevalences are the disastrous disease, recorded in II Kings, causing the destruction of the Assyrian army; the plague of Athens, described by Thucydides; the great pestilence in the reign of Marcus Aurelius, that extended over almost the whole of Europe, and the plague of Justinian, descriptions of which are given by Procopius and Evagrius. The plague of Justinian lasted for fifty years and has a decided interest in connection with the present subject, having been introduced in all probability largely by sea. It began at Pelusium, in Egypt, 542 A. D. After spreading through Egypt it appeared the next year at Constantinople. In subsequent years it advanced over the entire Roman world, making its initial appearance in seaboard towns and radiating inland. Frequent epidemics occurred in succeeding centuries, one of the most important of which was the great cycle of epidemics in the fourteenth century, which has been given the name of the "black death." Throughout all

this extensive period notions and practices relating to public sanitation were being evolved in accordance with the prevalent tenets of causation. In the earliest period religion, superstition, and stellar influence took the principal place in the confused ideas of etiology. Ill-ordered doctrines led to all sorts of irrational practices. Among the Greeks, in the rites of Æsculapius, the sick were not permitted to enter the temples, where they underwent treatment, without first being purified by various baths, frictions, and fumigations. All this was accompanied by ceremonies similar to those practised within the temples, namely, magical performances and fervent prayers recited in a loud voice, often with musical accompaniment. As an accessory to the purification preliminary to being admitted, the patient was required to pass the night stretched on the skin of a sheep that had been offered as a sacrifice. Here he was ordered to compose his mind for sleep and await the arrival of the physician. Throughout these ages as well as in more recent times a fanciful association between the phenomena of the material world and the destinies of mankind closely linked the doctrine of etiology with astrology. The persistent belief of learned men in the relation of stellar conditions to epidemics is in part explained by the fact that astrologers who predicted epidemics wrought charms against the impending pestilence, thus saving their credit, in event the disaster did not materialize, by claiming that it had been averted through their efforts. These primitive views of the origin of epidemics did not necessarily place the cause of the disease outside the earth and its immediate surroundings. Winds, thunder and lightning, fogs, and other meteors were blamed for causing pestilence, and the flight of birds and insects were supposed to be dependent phenomena. Xanaphanes, five hundred or six hundred years before Christ, expounded an idea that the sun was a torch and the stars candles that were put out from time to time. According to his notion, which was seriously accepted, the stars were not heavenly bodies in the wider sense, but meteors thrown off from the earth. So a belief in stellar influence did not carry the mind outside worldly ranges. For this reason other practices than prayers and sacrifices were believed to be effective. They consisted chiefly in efforts to dissipate the meteors, such as huge and numerous fires, and to avoid meteoric influence by confinement in closed or otherwise protected places.

During the period under consideration, the promptings of superstition were paramount and the epidemiologists of the times confined themselves principally to interpreting the signs of the heavens. More advanced views came as the result of reasoning, but the path of discovery by experimental science was not entered upon until after many centuries.

ETIOLOGY ACCORDING TO HIPPOCRATES.

The doctrines of etiology took a more determinate form under the teachings of Hippocrates. According to Hippocrates, disease has its origin either in the régime of life or in the air that surrounds the living body and enters into it. He made therefore a twofold etiological division of diseases, those dependent on the personal régime, and those dependent on the quality of the air. Regarding the latter class, when many individuals are attacked by the same disease at the same time, he supposed the cause to be a common one, namely, the air breathed. Hippocrates believed that a régime of life, which differs with different persons, could not be the cause of a malady that attacks alike the young, the old, men and women. On the other hand, when diseases of different sorts occur, it was clear to him that the cause is individual. Epidemic disease, according to the Father of Medicine, is often promoted by a specific, unknown, and extraordinary condition of the air due to the presence of the *quid divinum*, which may also exist in miasms and certain other impure things. This *quid divinum* has given much trouble to the followers and commentators of Hippocrates, and the judgment as to what he conceived it to be must be left to the fancy of the student of his writings. It seems probable, however, that Hippocrates meant the scourge of divine wrath. It was this very idea that for centuries prevented the application of sanitary measures to epidemic disease. Men regarded pestilence as a punishment inflicted by the Almighty on delinquent humanity and an attempt to turn aside a weapon borne in the divine hand was considered vain and impious.

The influence of Hippocrates's views, with their bearing on sanitation, extended with slight abatement almost to the time when Fracastoro announced his doctrine of contagion. Throughout all this period, moreover, the controlling power of Platonism held experimental inquiry in check. It was believed that the true nature of things could be discovered by the action of reason and not in any important degree by experience and observation. Thus, it will be seen, the measures directed against epidemic disease were often misguided, ineffective, and dependent on all sorts of false doctrines.

GALEN'S VIEWS OF EPIDEMIOLOGY.

Galen, not dissenting from the views of Hippocrates, was of the opinion that any disease that caused the almost simultaneous death of a large number of people should be regarded as of the nature of pest. He did not hold to any view of contagion in these maladies, that is, of their direct communication of man to man, though he evidently believed that the corruption of the air was more intense in the neighborhood of the sick than elsewhere. Pest, he declared, was born of a

pollution of the atmosphere and assailed man by way of respiration. This doctrine was accepted by the pupils of Galen. In the commentaries of the books of Hippocrates on epidemics, or popular diseases, as they were called, it is asserted that pestilential maladies proceed from a special condition of the heavens. These commentaries, at one time attributed to Galen, have since been demonstrated to be the production of his disciples. The long line of Greek, Latin, and Arabic medical writers down to the time of Avicenna, the Mohammedan physician, adhered to the teaching of Hippocrates and Galen, and when they speak of contagion the term must always be understood to mean contracting a disease by breathing altered air. The masters of medicine of the middle ages held similar opinions. Bernardo Gorgonio, professor of medicine at Montpellier, France, in 1300, and Arnaldo da Villanova, who lived toward the end of the twelfth century, gave the name of pestilent fever to every deadly fever and maintained the cause to be a corruption of the air. Guglielmo Varignara, professor of medicine at Bologna in 1302, not only denied the contagious nature of measles and smallpox but declared that the buboes of plague were not contagious. Gentile, who died of pest at Foligno, Italy, in 1348, believed that the poison of pest existed in the air and was due to a putrefaction of this medium. John Godesden, a leading English physician of the fourteenth century, announced the same views. De Chauliac, an eminent French physician of Avignon, who observed the terrible epidemic of 1348–1361, recorded casually his idea that pest could be contracted by contact with the sick, but assigned as a primary cause decomposition of the air due to the conjunction of planets whereby a certain subtle substance is evolved capable of producing epidemics. Another famous physician of those times, Raimondo da Vinario, who was a spectator of the epidemics of pest in 1348–1361 and 1373, says that it is a very dangerous thing to have to do with persons stricken with pest; that one person sick with pest may infect an entire city; that those employed in public hygiene in times of epidemic prevalence take the malady by contagion; that physicians more than any other class are likely to catch the disease; and that monks are generally exempt from pest because they are isolated in monasteries and thus free from outside exposure. Still there is not room to believe that this master of medicine had any precise conception of the nature of contagion. Like so many others, he put his faith in corruption of the air brought about by an influx of stars, planets, and constellations, and in poisonous exhalations emanating from the earth. The danger of contact with the sick he conceived to be due to the air filled with pestilential poison that had been inspired and afterwards exhaled by the victims of the disease. Da Vinario held also that garments worn by the sick and other fabrics in close contact with them contained the infective principle, and hence should

be transported with the sick to a distant and isolated place. Notwithstanding all this, he does not mention the necessity for purification of infected things nor ever suggest the caution of destroying fomites. There can be no stronger evidence than this of the tenacity with which the physicians of the middle ages adhered to the accepted doctrines of their predecessors.

THE BEGINNINGS OF RATIONAL ETIOLOGY.

It took centuries of involuntary observation to shake the idea that epidemics are of celestial origin and to be combated by prayers, fasting, and processions. The first advances toward broader ideas were not made by medical men. The record of reformed views is found in works on jurisprudence and in the narratives of travelers. In the books of jurisprudence of the emperors of the East it is noticed that care should be exercised in having relations with persons arriving from places where pest reigns. It was ordered, in consequence, that those so exposed should be separated from others for the purpose of observation. The term of forty days (whence the word quarantine) is named, this being the supposed maximum period of the duration of acute maladies. Whether this isolation was practiced in a particularly selected place or in the houses of the suspects is not known.

Merchants traveling in the East and detained at Alexandria or Cairo during the prevalence of pest observed that cloistered monks did not contract the disease. Many of these merchants, exiled by pestilence, staid constantly within the boundaries of their residences, transacting all business through barred windows and from terraces that crowned the house tops. The stubbornness with which medical men held to the doctrine of aerial corruption of celestial origin is shown by the report made to the Marseille government in 1720 by a body of distinguished physicians, in which the condition of the air was pronounced to be the sole cause of pest, the idea of communicability from man to man being absolutely rejected.

One of the most ancient edicts commanding the segregation of sufferers from pestilential maladies had for its authors two laymen, Sagacio and Pietro de Gazata, and is found in the chronicles of Reggio d'Emilia. The document, dated 1374 and written in low Latin, orders that all persons sick with pest be taken outside the city, into the open country, a camp, or the woods, there to remain until dead or cured. The parish priests are required to promptly report all cases of pest under pain of death by fire. After registering these historical facts, the chronicler adds:

> And I saw in this same year that these orders were observed in Reggio, for which cause all were grieved and terrified more than by the fear of the illness which, when God permits, can not be averted.

ORIGIN OF THE DOCTRINE OF CONTAGION.

The credit of having created the doctrine that pest is contagious by contact with the sick and their effects is chieffy due to Jacobo della Torre, known also by the name of Jacopo da Forli, from the name of a city in central Italy, where he was born in the second half of the fourteenth century. Contagion had been referred to obscurely and timidly from Aristotle down, but now the idea took a practical form. The old notion was that fomites were a sort of tinder that caught from the air an infection existing independently of the sick. Many writers, including Galen, believed there was an extreme degree of atmospheric pollution in the vicinity of the sick, rendering such neighborhoods dangerous, but this was considered a primary cause of the illness rather than a direct emanation from the sick.

Della Torre's doctrines were not accepted by the various schools of medicine and were for a time absolutely forgotten. Fracastoro proclaimed the same theories at a later period, when they were better received, and to him is generally given the honor of announcing the theory of contagion. Jacobo della Torre advised the magistrates of his native town to remove outside the city all persons affected with pest and to isolate them, as well as all persons who had been with them. The authorities were warned against delay, for it was avowed that every precaution would be futile should the disease become diffuse throughout the city. In his recommendations no mention is made of purification, but he asserted his disagreement from the accepted belief in the stellar origin of the infective principle. Della Torre's disciple, Michele Savonarola, attained greater eminence than his master, and so far vindicated the honor of his school as to declare that even persons in good health may transport the pestilential virus to distant places, and that those who are not brought in association with the victims of pest or with pest-bearing things escape the disease. But Savonarola did not fully indorse the teachings of his preceptor. He could not shake off a belief in astrology and admitted that the origin of pest resided in a disorder of the air generated in consequence of planetary contact.

Giovanni da Concorrezzo, toward the second half of the fourteenth century, was so profoundly convinced that pest came exclusively from universal aerial pollution that he denounced as useless every precaution to check the advances of the disease and affirmed that all measures designed to avert contagion are inefficacious.

At this period, when the world had about decided that in epidemics sanitation was not worth while, three observing men lent their influence to broader views and thus gave a potent stimulus to the doctrine of contagion. These writers were Alessandro Benedetti, Marsilio Ficino, and Gerolamo Fracastoro.

BENEDETTI AND FICINO.

Alessandro Benedetti, anatomist and military surgeon, wrote a treatise on pest, published in the last decade of the fifteenth century, in which is presented a résumé of his doctrine concerning pest. Pest, he declared, is not only catching by contact with the sick, but by fomites. The latter, he believed, are capable of receiving and preserving the contagion for long periods. Convalescents from pest, and the things that have been in relation with them, should, he said, be purified before being brought in touch with healthy persons.

Marsilio Ficino was born in Florence in 1433, and passed his childhood in the court of Cosmo de' Medici. He was a priest as well as a physician. Pest had, in Ficino's time, tormented Tuscany, and in 1479 broke out in Florence. The Grand Duke Cosmo de' Medici requested Ficino to prepare a book treating of the pest with the scope of instructing the people how to protect themselves from the scourge. The book, published about 1480, was written in Italian. In writing it, Ficino was associated with Tommaso del Garbo, Mengo da Faenza, and others, and the volume bore the title of Counsel Regarding the Pest. The book is a rare one in its original tongue, but fortunately was translated into Latin and is still preserved in different libraries. The list of the works of Ficino refers to this treatise by the title of Antidotus, and it is so cited in many medical books printed in later years. The theories given in this work as to the origin and nature of epidemic disease are the same fantastic stuff that antecedent writers dealt out, but the ideas as to how the disease may be imparted are of a much better sort. The view is advanced that pest can be communicated from man to swine, and that cats and dogs convey the disease. The reader is informed that pestilential poison may abide in the air for long periods and may infect food. Advice is given to boil all drinking water, or to impregnate it with iron rust; to dilute wine with water so prepared; to add an acid sauce to the food; to choose dry food and fruit grown in balsamic and elevated regions, and to dwell on hills or in the mountains. Treating of prophylaxis and dietetics during times of pest, there is a long list of injunctions relative to exercises of the body and the quality of the food. For example, it is enjoined to shun the heat of the sun and of fires; to avoid sweating and the drying of sweat on the body; not to eat fish, or if needs be, to eat small fish from some clear running stream with a rocky bed, and to fry them in oil and treat them liberally with lemon juice, pepper, and cinnamon; and, lastly, there is an enumeration of fruit and vegetables to be chosen or avoided. Overeating and overdrinking are admonished, and it is advised to cook all meat well and prepare it with aromatic condiments. To preserve the health of those in attendance

on the sick, it is directed to keep as far apart as may be from the bedside; to ventilate the sick rooms; to fumigate the house with burning terebinth wood; to carry in the hand a firebrand, a pot of lighted charcoal, or a sprig of rue, mint, sage, or myrtle; and to bathe the body, morning and evening, with warm vinegar. Directions are given to sprinkle the house with preparations of terebinth, juniper, sandal, rose, rosemary, laurel, and similar herbs. The reader is informed that walls, partitions, and all structures made of wood are capable of preserving the contagion for more than a year, and that their disease-bearing qualities should be corrected by washing, fumigations, and fire; that garments of wool and similar stuffs, if not exposed to the air and sun, fumigated often, and well washed, may still contain contagion after three years. The statement is made that the morbid principle can diffuse itself through division walls and enter neighboring habitations. Caution is prescribed in moving animals, money, furniture, and bundles from place to place because of the danger of conveying disease.

FRACASTORO AND SYPHILIS.

Gerolamo Fracastoro is generally credited with being the author of the theory of contagion, but, as has been seen from a review of the works of previous writers, it can only be claimed for him that he elaborated the theory, presented it in a popular form, and lent to the idea the influence of his high authority.

An important event at this period of history was the extensive prevalence of syphilis in Europe, a spread of the disease that gave it every likeness to a general pestilence. The chroniclers of this occurrence were convinced that the disease could propagate itself at a distance, and that it could be communicated by intercourse not more intimate than conversation and social commingling. The malady diffused itself through all classes of society, and history names a king and other potentates among the victims. In Italy the belief prevailed that the disease had gained access to the country with the invading army of Charles VIII, of France. The Italians called it the "morbo Gallico." In France it took the name of the Neapolitan disease. Wide credence was gained by another theory to the effect that the malady had come in by sea with the naked savages of America. In this case it must have spread and taken root very speedily, for it is said that when Columbus went to Barcelona on his way to pay homage to Ferdinand and Isabella, of Spain, syphilis flourished in that seaport; public prayers were being offered as in times of pest, and precautions were being taken against the disease as in case of leprosy.

Laws were made in France for the regulation of syphilis. By an act of the Senate at Paris, dated March 6, 1496, persons affected with

the disease were forbidden under pain of the halter to have any dealings with well persons, and it was ordered that the sick should be segregated in places set aside for their reception in the Faubourg St. Germain. Notwithstanding the rigor of the ordinance, many stricken persons eluded the vigilance of the sanitary guards and moved about in the city of Paris, thereby spreading the disease. The provost then found it necessary to make public cry, warning all persons that thereafter pretensions of ignorance would be disregarded by the authorities, and any individual, native or stranger, afflicted with syphilis and found within the city would be summarily cast into the river and left to his fate.

Some years later there was similar trouble in the Italian part of the Tyrol, trouble which so interfered with one of the most important ecclesiastical gatherings of the times that Pope Paul III, by advice of Fracastoro, removed the Council of Trent to Bologna. Fracastoro had previously written a dignified and graceful medical poem, in Latin, entitled "Syphilidis sive Morbus Gallicus," after whose hero, the shepherd Syphilus, the disease received its name.

His interest in this prevalence of syphilis influenced Fracastoro to publish, in 1546, the work "De Contagionibus." The great feature of this writing is the presentation of the subject in such a catching way that it took hold on the popular mind, and even had decided effect in loosening the deep-rooted medical opinion of the times. The lesson of contagion was taught by a number of clever similes. For example, Fracastoro divides contagious diseases into three classes, namely, disease catching by contact, in which he compares the mode of communicability to the way in which one decayed fruit spoils another perfect one; disease carried by fomites, a process likened to the persistence of soot on a smoky wall; and disease conveyed to a distance, in which manner the virus is carried just as the volatile essence of garlic or of an onion is borne through space, affecting the nostrils and causing the eyes to water. Fracastoro taught that the poison of disease consists in corpuscles, and that it affects first the minute particles of the animal body. He says that this poison persists in the body, in fomites, or in the air, in proportion to a kind of stickiness existing between the conveying medium and the poisonous corpuscles; and that woolen fabrics and the like absorb, retain, and transport contagion with ease, because they contain interspaces to lodge the corpuscles, and are of a nature to protect the poison from the light, heat, cold, air, dampness, and other conditions injurious to it.

So we see that, with the acceptance of the views of Della Torre, Benedetti, Ficino, and Fracastoro, things were fairly in the way for a beginning of quarantine on a practical basis.

MARITIME QUARANTINE.

Maritime quarantine originated in connection with the Levantine trade. Its early history is associated with that of shipping in the Mediterranean, especially with that of the traffic of Venice, Genoa, and Marseille. Although commercial activity in these waters was initiated by the Phœnicians, the maritime pioneers, records of disease introduced by sea are not found bearing earlier date than the period when Roman navigation was well established. As has been seen, the practice of isolation was first applied against communicable disease by the Hebrews, but their lazarettoes, it appears, were little used in connection with foreign trade, leaving out of the question commerce by sea. In the exchange of commodities with foreign countries the Hebrews were largely dependent on the Phœnicians and Arabs. Had the Jews been active in outside commerce, we should probably read in the Old Testament of sanitary laws applicable to caravans and vessels.

As has been already mentioned, Pliny implies that leprosy was introduced into Europe by Pompey on his triumphal return from the East. It is altogether probable that the Roman ships, laden with spoil from Syria, and bringing many prisoners of war to Italy, carried in leprosy.

In connection with the question of the first recorded introduction of disease by sea a curious error has entered into writings on the subject. J. Freind, adducing evidence in his History of Medicine that Procopius was a physician, quotes a translation of Procopius's works by Dr. Howel, and says that the great Byzantine historian describes the pest at Constantinople (A. D. 534) as having originated at Pelusium, in Egypt. This is indeed what Procopius wrote. But it happens that later writers—evidently reading Freind's history—say that Procopius states the epidemic in question was carried to Constantinople by ships and that this invasion of disease became later the foundation of the quarantine establishments on the Mediterranean coast. It is, however, true that the Italian epidemics of the sixth century began in the maritime towns and thence spread inland; but it does not follow that the writers of the time considered the intervention of ships essential to the introduction of disease by sea. For example, Francesco Alfano, professor of medicine at the University of Salerno, which in those days was reputed to be the greatest medical school in the world, writing in 1577, says that the corrupt air capable of introducing pest may be blown over sea and land for long distances; otherwise how could it be explained, he asks, that pest was transported from Ethiopia to Athens and to all Attica? It was considered, moreover, that a ship might easily be pestridden. Even by going to sea a vessel with all well aboard at the time of departure could not always escape the

scourge. The infection extended over the water. Matteo Villani, of Florence, writing in 1581 of the epidemic of 1346, which spread from Asia into Turkey, Egypt, Russia, Greece, and Italy, says that in those evil days numbers of Italian galleys flying from the pest left the stricken ports for healthier harbors. Their crews perished miserably at sea. Some reached Sicily, Pisa, and Genoa, and the disease went with them.

EARLY MARITIME SANITARY LAWS.

There is but little known of ancient laws relating to maritime commerce, and even this little was lost to the world until 1147. The story is an interesting one. Justinian, during his reign, confided to ten jurisconsults the task of collecting and adjusting the numerous Roman laws, together with the various sentences and rulings of judges and magistrates. A compendium of these documents and of the laws promulgated during the rule of Justinian was published. It is known by the name of the Codex of Justinian. The only part of this code that treats of ships is called the *Digestum*, and it was lost for hundreds of years. Finally, in 1147, the papers were discovered at Amalfi and made public. The *Digestum* treats of the reciprocal rights of the owners and renters of ships, but no mention is made of sanitary matters. During the long period when this important legal instrument was lost, the Venetians, Genoese, and other Latin maritime nations supplied the deficiency in part from the initial sources of Roman law and in part by custom and agreement. Of this sort are two collections, one known by the name of *Recognoverunt Proceres* and the other called the *Consolato del Mare*. Besides these, there is a great number of documents, such as constitutions, decrees, ordinances, sentences, and the like, which pertain to maritime rights. It is a remarkable fact that, notwithstanding the detailed attention given to most maxims relating to shipping, the *Recognoverunt* and the *Consolato del Mare* are silent too on the subject of sanitation. Therefore, in the Middle Ages, in event of contagious prevalences, it rested with each individual city or country to make such provisions as were deemed opportune. Such an edict is the one, said to be the most ancient of its kind, already mentioned as having originated at Reggio d'Emelia, in 1374, and commanding notification and segregation of cases of plague.

The Venetians were, it is generally admitted, the first to make provision for maritime sanitation. As far back as the year 1000 there were overseers of public health, but at first the office was not a permanent one. The incumbents were appointed to serve during the prevalence of an epidemic only. The first information we have of this kind of public office is under date of 1348, when Nicolaus Venerio, Marinus Querino, and Paulus Belegno (their Christian names given in the Latin of the text) were appointed overseers of public health.

These officers were authorized to spend public money for the purpose of isolating infected ships, goods, and persons at an island of the lagoon. A medical man was stationed with the sick. As a later result of these arrangements, the first thoroughly constituted maritime quarantine station of which there is historical record was established in 1403 on the island of Santa Maria di Nazareth, at Venice. The island had previously belonged to the hermit monks of the order of St. Agostino. The record of the foundation of the first maritime quarantine is found in a Venetian manuscript written by Giovanni Tiepolo, a patrician. The chronicle reads:

> 1403. The pest began at Venice. A place for a lazaretto was seized from Friar Gabriel, of the order of Hermits, and Santo Spirito was given to him.

Neighboring States engaged in commerce in the Mediterranean speedily followed the example of Venice. The first maritime quarantine station at Genoa was founded in 1467, and at Marseille in 1526. The Marseille quarantine, one of the most complete of its kind, occupied the island of Pomique. This establishment had, in former times, been a leper house, but, in 1476, was converted into a plague hospital, and later became a maritime quarantine station.

It was not until 1459 that a public bureau of sanitation existed in the Republic of Venice. In that year officers, called conservators of sanitation, were regularly appointed. This information was handed down by a contemporary seafarer, Ser Domenico Malipiero, a Venetian patrician, an expert in commerce and diplomacy, who, in 1488, commanded the men-of-war under Captain-General Ser Jacopo Marcello at the celebrated naval battle of Gallipoli. In the contest against the Ottoman fleet the captain-general was killed, and Malipiero (who had a grade relative to that of vice-admiral at the present time) took command and was victorious. Malipiero wrote certain annals of his life which he bequeathed to his son-in-law. This interesting diary, in Venetian dialect, remained secret until 1844, when it was published in the Italian Historical Archives.

The city of Barletta became at one period of the Middle Ages the richest commercial port, next to Venice, in the Adriatic. This was owing to certain concessions granted the city whereby the traffic of a large territory was compelled to enter and leave by her gates. The privilege was not without its drawbacks. Barletta underwent three pestilences of a particularly aggravating character. The first, in 1384, was a strange malady that caused the sufferers to lose their skins like a molting snake. The other two epidemics (1498 and 1656) were probably bubonic plague, and in the last 35,000 souls, almost the entire population of the city, perished. These afflictions gave rise to the practice at Barletta of absolutely refusing entry to any infected vessel until the expiration of a long period of observation at a place outside the entrance of the port.

During all this period land quarantines were in operation at times of pest. Offenses against quarantine, both land and maritime, were severely punished. Pietro Follerio, a great Neapolitan jurisconsult of the sixteenth century, mentions whipping, the mill, exile, and death as penalties for infringement of sanitary regulations. A quarantine proclamation and command made by Don Carlo d'Aragona imposes rigorous punishment for surreptitiously entering the city of Palermo during a prevalence of pest. Torture, long service in the galleys, and work among the sick in a pest hospital are named among the penalties. Even the nobles were subject to heavy fines and long imprisonment in the castle.

BILLS OF HEALTH.

Sanitary bulletins were incident to quarantines and cordons. They were so called because they were stamped with the "bollo" or seal of the authority issuing them. When the system of sanitary bulletins was fully developed these patients, in their connection with ships, were designated as clean, when beyond suspicion; touched, when from a noninfected place in active communication with infected places; suspicious, without sickness aboard, but having received goods from places or from ships or caravans from places where pest prevailed; and dirty, when from a place where disease existed.

Professor Bo, a member of the council of health of Genoa, in making researches relative to ordinances of sanitation proclaimed in France in 1850, found an interesting document in the archives of the "Conservatori di Mare di Genoa," a body of officials to whom in mediæval times was confided the vigilance over public health. This writing, dated 1300, makes mention of bulletins of health (*bullettones sanitatis*) with which ships from the littoral of Corsica and Sardinia were required to be provided. Prior to 1300 there is a record in a rubric of the statutes of the city of Urbino, Italy, in which, referring to precautions against pest, it is written that no person shall leave the gate of the city without a proper bulletin, and that, to this end, watch shall be kept day and night at the city gates and walls. During the pest at Naples, in the year 1557, citizens, usually merchants, were stationed at the gates of the city to examine bills of health. Corruption and lack of diligence on the part of these persons were punishable by death. Sentinels, some on foot and some on horseback, made a patrol about the city walls to prevent clandestine entrance. Bills of health to be acceptable had to be stamped with the seal of the university of the place from which the traveler came. They gave not only the day but the hour of departure, together with a description of the traveler. Sanitary bulletins were also issued to accompany merchandise, but in times of severe pest all articles except aromatics and medicaments were considered suspicious. The facts here given are

taken from the instructions written by Pietro Follerio, an eminent jurisconsult, who was assigned by the viceroy of Naples to superintend the province of Campania during the prevalence of pest with the special duty of indicating means for the betterment of public hygiene. It is worthy of notice that the provisions of public sanitation in those times are usually found, not in books of medicine, but in treaties on jurisprudence. This is explained by the fact that the medical profession was looked to for scientific indications only, and that the application of sanitary measures founded thereon, limiting or compromising as they often did the rights of the public or the constitutional privileges of citizens, was a matter for legal consideration and action.

AN EARLY SANITARY CONGRESS.

The efforts of some of the pioneers of quarantine were at times ill-advised, did not always meet with general approval, and sometimes, indeed, occasioned strong outbursts of popular indignation. The experience of Girolamo Mercuriale (called the Æsculapius of his time) and of his colleague Capodivacca is an instance. In the summer of 1576 the frequence of strange febrile diseases, often very mortal, was observed at Venice. The supreme magistrate of health of the Republic of Venice, suspecting pest, called a conference of great physicians, among others Girolamo Mercuriale, Capodivacca, and Nicola Massa. As for the verdict Massa wavered, and the other members were divided into two camps, one body for and the other against pest. Mercuriale and Capodivacca asserted decidedly that the malady was not pest, but an epidemic of fever, due to the excessive heat of the season. This opinion carried the day, and no precautions were taken against the spread of the disease. Unfortunately for the optimistic diagnosticians, the illness increased, and speedily took on all the characters of pest. The populace uprose and made an effort to lynch Mercuriale and Capodivacca and burn their houses. Both the physicians, fortunately for them, escaped by flight, their property being saved by prompt action of the authorities.

EARLY EFFORTS AT DISINFECTION.

The armament of disinfection in early days was full of oddities. In the process of purification time was more trusted than anything else. Gian Filippo Ingrassia, appointed by Philip II of Spain to establish a public sanitary service in Sicily, begins his book on pest and contagious disease with the following distich by Martello:

Lana, aura et linum captant contagia pestis;
Ignis, furca, aurum sunt medicina mali.

Before reviewing the different means besides fire, the gallows, and money used against contagion, it is interesting to make a survey of

the things, in addition to wool, the air, and garments, that were reckoned infectible. Animals were considered capable of conveying disease. During the pestilence at Palermo in the year 1575 Ingrassia caused all the dogs in the city to be brought together alive on a certain day and cast into a common pit, where they were covered with quicklime and then with earth and stones. As to cats, they were allowed to live, so as "not to have worse war with rats," says Ingrassia, but all cats that had been near suspected houses were required to be kept closed up. There were similar restrictions for fowls and pigeons. Elsewhere geese and cattle were banished from the cities during epidemics. Habitations, ships, and even the sails and cordage with which vessels were rigged belonged to the category of infectible things. Nicola Massa, a Venetian physician, who published in 1556 a book on pestilential fevers, names the following as fomites: Wool, hair, cotton, linen, hemp, silk, thread, and all things made from these substances; skins, feathers, and the like; and all merchandise, as well as sacks, baskets, boxes, casks, and cords that cover them. Massa considered as noninfectible all metals and objects made of them, including arms and cooking utensils; precious stones and marble; grain, flour, and meal; vegetables, fruit—fresh and dried—and nuts, wine, oil, and vinegar; and all drugs and aromatics. In regard to metallic money he said that those who held it in suspicion might allay their fears by receiving it in a vessel of vinegar.

Exposure for many days to the air in selected places and to the dew was looked upon with great favor. The dew of the dead of night was supposed to be particularly efficacious. This practice originated in the more or less accurate observation that during the season when the mists of the Nile were thickest the pest in Lower Egypt began to diminish.

The vapors of volatilized aromatic substances, known technically as "perfumes," were credited with great virtues in correcting the alteration of the air generated by pest. Cloves, cinnamon, cedar bark, camphor, mints, resinous wood, and similar substances were kept boiling in pots of vinegar and rosewater for long periods. One recipe containing garlic and known as the "vinegar of the four thieves" enjoyed high repute. Fumigations in summer differed from those in winter. Aromatic wine was added in fumigations for cold weather, being assumed to have a special property of correcting air at a low temperature. It was also considered advisable to lengthen the period of isolation in winter because cold was thought to have a tendency to conserve the contagious principle. Sulphur fumigation was not regarded with favor in early days. The strong sulphurous fumes were said to alter the air unfavorably rather than rectify it; but sulphur came more into vogue in the eighteenth century. The burning of gunpowder was also thought useful.

Huge fires, kept burning for weeks, were used from the most ancient times. The physician Acron is reputed to have rendered great service by the use of fires at Athens during the pest at the beginning of the Pelopennesian war. Fires made of shavings and chips were thought preferable, because they produce a clear flame, without smoke. Aromatic wood was added to these fires, but special caution obtained against burning anything producing an offensive odor, such as the wood of certain nut trees, for fear of liberating vapors likely to add to the disturbed condition of the air. Not only were garments and similar articles burned, but sometimes houses and ships as well. Opposition often existed against such measures on the ground of further deteriorating the atmosphere.

Mixtures of lime were favorably regarded and whitewashing of infected apartments was habitually practiced. Acid fumigations are spoken of in the eighteenth century. Muriatic acid fumes, suggested as a disinfectant in 1774 by Guyton Morveau, of Paris, were used in 1800 to disinfect rooms, garments, mattresses, and the like, after the epidemic of yellow fever in Spain ("Yellow fever in Spain," Yellow Fever Institute, United States Public Health and Marine-Hospital Service, Bulletin No. 5). With all these measures, great stress was laid in cleaning up infected cities during and after epidemics, giving special attention to sewers, wells, cesspools, and disposing properly of dead bodies. In reading the chronicles of the middle ages the conviction can not be avoided that, were it not for occasional epidemics, public sanitation would have fallen entirely into disuse.

MEASURES ADOPTED IN A PEST-STRICKEN CITY.

To gain a precise knowledge of what measures were usually practiced in places afflicted with an epidemic in early days, it is instructive to examine specifically the provisions adopted in a particular city. A suitable instance is presented in the Treatise on Plague, by Alessandro Massaria, who was in charge of sanitary measures at Vicenza, Italy, during a prevalence of bubonic plague of one year's duration in 1577. The first death was attributed to garments clandestinely introduced from Padua, where plague prevailed. After a necropsy establishing the diagnosis the furniture in the house was burned and every exposed person stripped, given new clothes, and removed outside the city. The house was purified by aromatic fumigations and painted with milk of lime. All infected vestments and bedding received a treatment with strong lye. The disease, however, spread, and in one year the city, with a population of 30,000, suffered 1,908 deaths from plague. As soon as the epidemic established itself the city was divided into 32 sections and a daily house-to-house inspection made by 64 trustworthy citizens, two to each precinct. All cases of sickness were reported to one of four public physicians. These physicians served for periods of

fourteen days. Infected habitations received the same treatment as in the initial case, except that the furniture was not burned in all instances, but washed instead with lye and left in the sun and open air for thirty days. All garments were put in running water for two days. Persons exposed or under suspicion went to the Campo di Marte, outside the city walls, where wooden houses had been built. A river separated the isolation camp from the lazaretto, where the sick were lodged and where physicians and nurses were in attendance. Suspects developing plague in the isolation camp were taken across the river to the lazaretto, and convalescents from the latter place were transferred to the former. Those who kept well in the Campo di Marte for twenty-two days returned to their disinfected homes in the city, there to remain under observation for an additional twenty-two days. Convalescents from the lazaretto passed twenty-two days in the isolation camp, and were afterwards confined to their houses in the city for another twenty-two days. At the height of the epidemic all the houses in the city were closed for forty days, and none but the guards were allowed in the streets. At this time 5,000 persons were fed from public funds, and there were about 400 persons in the lazaretto and 500 on the Campo di Marte.

EARLY MARITIME QUARANTINE STATIONS.

The maritime quarantine stations of the sixteenth century consisted of an anchorage, barracks for suspects and convalescents, and a place where purification could be applied. The practice, with obvious modifications, was the same as in the case of an infected city. The personnel of these stations consisted in many places, at the earliest times, of surgeons and their assistants, for plague, being regarded as a surgical disease, did not fall clinically into the hands of physicians. At a later period the physicians conducting the stations were aided by surgeons, barbers, and experts in aromatics, because, as Massa says, the physicians were so limited in their acquirements as not to know how to do manual operations or treat external maladies.

With a view to learning how the various methods of disinfection were practically applied at early maritime quarantine stations, it will be interesting to relate what was done to a Catalan ship that arrived at Palermo from Barcelona on the way to Naples at the time Ingrassia was chief of sanitation in Sicily. The account at least shows that the sanitarians of the sixteenth century were thoroughgoing. This vessel had 97 persons aboard, 18 of them passengers. Three seamen and two passengers had died of a disease suspected of being pest. The deaths occurred while the vessel was taking on cargo in the harbor where she lay at anchor. The cargo consisted of barrels of salted fish, cases of sugar (destined for Palermo, and already disembarked and in

store), salted cheese, salt in bulk, a quantity of sumac, and merchandise, including many bales of cloth from Barcelona, a port not under suspicion. The master of the vessel was at once required to give 20,000 scudi security not to leave the harbor until given pratique. To make assurance doubly sure, the rudder was taken away from the ship and a watch set. All persons, except the sick and a sufficient number of seamen to guard the ship, were sent ashore to a place known as the Borgo, where all garments were taken from them and they themselves exposed to the fumes of boiling pitch and afterwards washed with vinegar. Some of the clothing was burned and some washed, aired, and perfumed for fifty days.

The sick were sent to a lazaretto, the Cuba, a huge stone building, which still stands at Palermo as a monument of early quarantine.

The treatment given the cargo was as follows: Barrels of salted fish, washed outside, first with sea water and then with vinegar; cases of sugar, salted cheese, and sumac, coverings removed and burned and the commodities without further treatment delivered to the owners; salt, no treatment, not being considered infectible; merchandise, aired and perfumed ashore for 50 days, and the cloth unrolled and hung from the rigging of the ship for 50 days. The sails and cordage of the ship were taken down, submerged in the sea for a week, and then hung from the masts, yards, and booms in the air, sun, and dew, by day and night, as long as the ship remained in quarantine. Fumigation was made in the interior of the ship by boiling pitch in caldrons between decks. Fifty days were set as the period of detention, instead of forty, because the season was winter.

FURTHER HISTORY OF QUARANTINE.

Without touching on quarantine in America, which is another and interesting story, it is profitable to take a view of the further history of quarantine in Europe. Following the discovery by Anthony van Leeuwenhoek, in 1675, of bacteria, called by him "animalcules," there was a wide belief in the casual connection of microscopic creatures with disease, a belief supported by the doctrine of living contagion enunciated by Marcus Antonius Plenciz, of Vienna, in 1762, but it was without marked effect on quarantine procedure. The theory, in fact, lost hold on the public and medical minds to such an extent that in the early part of the nineteenth century the doctrine of a living contagion was looked upon as an absurd assumption. It was not until the middle of the last century, following the investigations of Pasteur, Pollender, and Bavaine, that quarantine practice became established on its modern scientific basis.

English quarantine procedure prior to 1800 did not differ much from that of the Mediterranean ports. English vessels, which did

not begin to enter the Mediterranean until the time of the Crusades, were usually, in early years when engaged in the Levantine trade and from infected ports, sent to Mediterranean quarantines for treatment. In 1710, under the reign of Queen Anne, a rigorous quarantine act was passed in England, and in 1721 two ships with cargoes of cotton goods from Cyprus, where plague prevailed, were burned by the sanitary authorities in English waters. A quarantine station was established in 1741 in Stangate Creek, on the Medway. Here vessels, not treated at Mediterranean quarantines, were submitted to practically the same procedures as were in vogue at French and Italian ports. Floating hulks were also used as quarantine stations in England from about the middle of the eighteenth century. The act of Queen Anne's reign was qualified by later enactments, and during the pest in Poland, in 1780, vessels bound for England from the Baltic were compelled to undergo a typical old-fashioned quarantine. A few years later there was an order in effect directing all vessels on the way to England and liable to quarantine to show a yellow flag at the mainmast head when in sight of other vessels at sea during the day and a distinctive light at night. From the beginning of the nineteenth century quarantine restrictions were, by changes in the laws and their application, materially relaxed in Great Britain, and as a substitute for former practice it has not been the custom in modern times to detain any vessel unless there has been communicable disease aboard during the voyage, or such exists on arrival. Following the decision of the Spanish Government in 1821, that yellow fever was to be considered quarantinable, an inquiry on the subject was made in England in 1823 and 1824, which resulted in the passage of a law directing the same procedures to be applied against yellow fever as against plague.

In France, until the year 1821, vessels from the Levant were not allowed to enter at any ports except Marseille and Toulon. The sanitary regulations of these ports were fortified by royal edicts. With the appearance of yellow fever on the frontier of Catalonia in 1821, an appalling epidemic that spread from Barcelona and killed 25,000 people in five months, a law was passed by the French Chambers, March 5, 1822, making a uniform sanitary code for all France, which, with certain subsequent modifications, formed the basis of French maritime sanitary practice.

Quarantine in the different continental European maritime countries during the eighteenth century was practically on a uniform basis, and during the first half of the succeeding century quarantine was practiced on the same lines in all European countries engaged in Eastern, American, and African trade, England excepted.

The international sanitary conferences at Paris in 1851 and 1852, in which participated the different European powers having interests in the Mediterranean, marked the close of the old régime of quarantine.

Delegates were present from France, Austria, the two Sicilies, Spain, the Roman States, Greece, Portugal, and Turkey. England was not signatory. Regulations were adopted much less restrictive than former ones, it being admitted that the efficacy of many measures formerly practiced was doubtful or negative, science having proclaimed that, for the most part, pestilential maladies are not contagious. This surprising declaration was followed by a revolution in quarantine methods on the Continent and resulted in the general adoption of practices based on the limited communicability of epidemic diseases. These changes, with which the early history of quarantine closes, were brought into effect at the beginning of the new era, during which the doctrine of specific living causes of epidemic diseases have been built up on the substantial basis of experimental medicine.

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