from the Sanitary Map, size 8x9 feet, which was made and compiled at the time. It is an accurate map of the city and shows the location of every house, hut, outhouse and insanitary place in the city; separate sanitary cards were made also for each premise, containing not only a complete record of sanitary information but a plan of the same.

The total population of Manila, exclusive of officers and men of the army and navy, was found to be 244,732, and the number of buildings 19,463, divided as follows: Americans, 8461; Filipinos, 181,361; Chinese, 51,567; Spaniards, 2382; British, 201; German, 226; Swiss, 78; Portuguese, 52; Japanese, 203; Turks, 16; French, 66; Indian, 53; Russian, 13; Italian, 13; Australian, 4; Arabs, 12; Chilean, 3; Malaysian, 5; Cuban, 10; Mexican, 5; Uruguay, 1. Total, 244,732.

The total number of buildings are the following: Good buildings, 3739; poor buildings, 1135; small buildings, 1333; shacks, 13,256. Total, 19,463.

AGREEMENT BETWEEN THE HISTORY OF YELLOW FEVER AND ITS TRANSMISSION BY THE CULEX MOSQUITO (STEGOMYIA OF THEOBALD).*

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(Read on Feb. 19, 1902, before the Pan-American Sanitary Congress.)

The early history of yellow fever, notwithstanding the scarcity and vagueness of the data referring to the first 150 years after the discovery of America, enables us to establish a very plausible connection between the earliest undoubted epidemics of yellow fever, described by Du Tertre and by Cogolludo in the fourth decade of the seventeenth century, and the previous ones which, under the names of "plague," "pestilence" and "malignant fevers," usually attacked the newly-arrived Spaniards at Santo Domingo, Terra Firma and Vera Cruz, ever since the conquest of Mexico in 1519, as also between those same fevers and the "modorra-illness" or "pestilential modorra" which had been recorded, under similar circumstances, at Santo Domingo and at Darien, during the first twenty-five years after the discovery.¹ If this connection be accepted, the unavoidable inference must be that, since the American Indians have no natural immunity against yellow fever and that disease had never been known among Europeans before coming to America, there must have existed, before the discovery, endemic

foci of yellow fever on this side of the Atlantic offering climatic conditions suited to the development of the yellow fever mosquito and enabling that insect to perform its functions as transmitter of the disease. As may be gathered from the contemporary chronicles of Las Casas, Oviedo and Herrera, such endemic foci did exist in the Island of Santo Domingo (Hispaniola) and on the coasts of Venezuela (Nueva Andalucia) and Columbia (Castilla de Oro) ever since settlements were made in those places by newly-arrived Spaniards. As a rule, the disease broke out in its full force during the summer months and, after a lull during the cooler season, it would break out again the following summer, until all the new-comers, having once suffered an attack remained thereafter proof against that illness.

The most significant statement which I have been able to find in order to connect pre-Columbian epidemics suffered by the aborigines with those which subsequently attacked the Spanish invaders, occurs in the *Chronicles of Herrera*,² which he published in 1599, eighty years after the conquest of Mexico. In chapter 6 he explains "how it happens that the country of Vera Cruz and that northern coast is so sickly * * * from April till September, at which time those who go out in the sun to attend to their business are taken sick * * * while in the months from November till March, the weather is cold * * * and, the earth being then dry, the country becomes as healthy as it is in Mexico (City), and those who arrive at that time are safe not to suffer." Chapter 8 is headed: "About the *cocolitzle* sickness, and wherefor the northern coast of New Spain is so scantily peopled," and it opens thus: "It has already been stated that the city of Vera Cruz and all the northern coast is sickly, owing to its hot climate which makes the illnesses more deadly * * * and children can not be reared in it because any disorder gives them fever; this is why the population there is so scanty. If in Montezuma's time its population was so numerous, notwithstanding that the same general diseases (epidemics), called "*cocolitzle*" prevailed, and in some years more than in others, as happens now, that was due to the fact that Montezuma, in view of the mortality and scarcity of inhabitants in that part of the country, used to collect from Mexico and other parts, where the population was numerous, eight thousand families * * * and sent them to the places where the *cocolitzle* had been severe, giving them houses and lands and exempting them from taxes for a term of years; in this way the coast was repopled, whenever it became necessary, with those who were not needed in the places from which they had been taken. So also the name *cocolitzle* has been given to general diseases of smallpox, which they have suffered, and to universal plagues."

I wish to call particular attention to Herrera's remark: "as happens now," referring, no doubt, to the year 1598 in which he wrote—whereby he identifies the "pestilence" which, up to that time, the newly-arrived Spaniards suffered every summer in Vera Cruz, with the "*cocolitzle*" which in Montezuma's time attacked the inhabitants of the high plateaux around the City of Mexico who had been sent to repopulate the coast upon which Vera Cruz was subsequently built. Both diseases were annual and prevailed in the summer season, as does now yellow fever in the same spot, after the lapse of three and a half centuries. It was not, therefore, without good reason that a belief prevailed among the inhabitants of

* My own experiments of yellow fever inoculation, ever since 1881, when I decided to submit my mosquito theory to a practical test, have always been performed with the domestic day mosquito of Havana. I had previously consulted the distinguished Cuban naturalist, D. Felipe Poey, about the classification of the samples which I showed him, and he informed me that from similar samples which he had taken to Paris in 1817 or 1820, the species had been named "*culex* mosquito" by Robineau Desvoidy. D. Felipe had previously called the insect "*mosquito de Cuba*" (Cuban mosquito). The experiments made by Drs. Reed, Carroll, Agramonte and Lazear were started in June, 1900, with a brood hatched from eggs of the identical insect which, at Dr. Lazear's request, I had handed to him. All the successful experiments have hitherto been made with that particular mosquito.

From a medical point of view, it would be quite illusory to admit, *a priori*, that other mosquitoes, whose external and functional characteristics differ materially from those of the *culex* mosquito of Desvoidy, share with the latter the faculty of transmitting yellow fever, even though they should happen to belong from the naturalist's standpoint—to a common group or species, such as the *Stegomyia fasciata*, of Theobald.

So far as I can judge from the written descriptions by former classifiers, the *culex* mosquito (Desv.), *culex tenius* (Wied.), and *culex elegans* (Pic.) represent but one identical insect, and must therefore be considered as the "yellow-fever mosquito." About the other synonyms included in the *Stegomyia fasciata* species, in the absence of direct experiments of inoculation, the faculty of sexual reproduction between males and females classed under different headings, should be resorted to before prejudging their capability of transmitting the disease.

1. "Epidemiologia primitiva de la fiebre amarilla," in *La Cronica medico-quirurgica de la Habana*, May 15, 1897.

2. *Chronicles of Herrera*, 1599. Chaps. 6 and 8, Book 9, 4th Decade.

Vera Cruz that yellow fever had existed there ever since the foundation of the City—as Humboldt was informed when he visited the place at the beginning of the nineteenth century.

If Montezuma had in view the protection of the coast of his empire against foreign maritime invasions, when he adopted a measure which seemed well calculated to maintain alive the cocolitzle infection, he must have relied upon its success and cherished the hope that, after having by his dilatory policy induced Cortés to remain on that coast from April till the middle of August, the Spanish leader would have been forced to abandon his enterprise in consequence of the havoc which the Mexican cocolitzle would have made among his soldiers. That Cortés had not to submit to the sad fate, which befell General Leclerc in Santo Domingo in 1802, must be attributed to the circumstance that the 600 Spaniards who came with him had previously gone through epidemics of “modorra” at Darien and at Santo Domingo; another proof being thus afforded that the two names belonged to one identical disease.

On the American coast and islands—with the exception of the Island of Cuba—where the Spanish discoverers made their first settlements, those who came for the first time to America had always to reckon on the “modorra” or “pestilence” which, as a rule, attacked them in the summer months. The propagation of the infection was not generally limited to the seaboard, as happened on the coast of Vera Cruz; this difference arising from the peculiar orography of the Mexican territory, on the one hand, and, on the other, from the circumstance that the modorra or cocolitzle disease, like our modern yellow fever, was only transmissible within moderate altitudinal limits above the sea level. Mexico, indeed, differs from the other places mentioned above by the fact that its shores toward the Atlantic consist of a comparatively narrow strip of lowlands at the back of which rises a continuous wall of highlands, altogether beyond the reach of those pestilences which I claim to have identified as our modern yellow fever. That condition of things did not occur along the shores of Santo Domingo (Hispaniola) nor of Darien, so that no obstacle existed there to prevent the propagation of such epidemics from the coast to the interior. The Indian population was very numerous, before the discovery, on the islands as well as upon the continent. They lived in crowded huts, forming separate villages—some of them with 1000 or 2000 inhabitants, of peaceful habits and devoted to agriculture, but ever ready to change their dwellings or to scatter in the woods whenever danger was apprehended from enemies or from some contagious disease. Under these circumstances it will be readily understood how, upon the occurrence of an epidemic of yellow fever, many would escape from the contagion, but the germ would spread over a wide area, and, by reason of the mild winters, the infection would not be easily extinguished.

The final confirmation of the rôle which appertains to the culex mosquito Desv. (now included in the genus *Stegomyia* of Theobald), in the transmission of yellow fever, has now been sanctioned by the experiments of Drs. Reed, Carroll, Agramonte and the lamented Dr. Lazear, at Quemados de Marianao during the winter of 1900, afterward by those of Dr. Guiteras at the Experimental Station of Las Animas, last summer, and finally by the splendid practical results obtained by the Chief Sanitary Officer of Havana, Major W. C. Gorgas, during the epidemic-year which has just been completed.

With those facts and the ones which I had gathered in former years, it is now possible to determine with some degree of precision the conditions which are necessary in order that yellow fever may develop in an epidemic form in a given locality, not too highly situated above the sea level and where temperatures between 25 and 35 C. (77 and 95 F.) either temporarily or habitually prevail. A distinction will, however, have to be made between localities in which the yellow fever mosquito already belongs to the fauna of the place, and others in which that species of mosquito does not habitually exist. The conditions, in either case, may be reduced to three. They will be, in the first instance, as follows:

1. Presence of a yellow fever patient within the first 5 days of his attack and exposed to be bitten by mosquitoes, or else the mere importation of one or more contaminated mosquitoes.

2. Abundance of mosquitoes of the required species, so that some of them will be likely to reach a yellow fever patient in a condition to become contaminated.

3. Presence of persons liable to contract the disease and so placed that they may be bitten by the contaminated mosquitoes.

In the second instance, when mosquitoes of the particular species did not previously exist in the locality, the conditions will be:

1. Introduction of mosquitoes of the required species, previously contaminated or under such circumstances that they may become contaminated from yellow fever patients simultaneously or subsequently introduced.

2. Circumstances which may enable the contaminated mosquitoes which have been introduced to continue inoculating a series of non-immunes during a sufficient length of time to allow the insect to develop a new brood, so that the new generation of yellow fever mosquitoes may come out in time to contaminate themselves from some of the patients inoculated by their predecessors.

3. The same conditions as in number 3 above.

Whenever two of the above conditions have been fulfilled without any outbreak of the disease following, the other condition must be supposed to be wanting; and, vice versa, if an epidemic of yellow fever does develop, the third condition may be supposed to have been fulfilled even if not actually demonstrated, unless the reverse can be absolutely proved.

Instances of the first class are, for obvious reasons, by far the more frequent; they include the epidemics recorded in the southern states of the Union, in the South of Spain, in the Canary Islands, in the Balearic Islands, Western coast of Africa, Italy (Leghorn in 1804), in all of which countries mosquitoes of the yellow fever species are known to exist. As instances of the second class may be cited the epidemics recorded in the northern parts of the United States, in Saint-Nazaire (France), in England, in Canada (Quebec), Madrid (Spain), in which countries the outdoor temperatures are only suited for the active functions of the yellow fever mosquito during a limited period, and even then may not be such as would allow the reproduction of successive generations of that insect.

Inasmuch as the only natural means by which yellow fever is, so far, known to be propagated, consists in the inoculation of the pathogenic germ through the bites of contaminated mosquitoes, the propagation of the disease across the sea would, in many instances, be inconceivable unless those insects have some propensity to take up their abodes inside of vessels and to thrive in

them, even when confined within the hold during a considerable length of time. A confirmation of this fact has recently presented itself; the Mosquito Commission of the "Orleans' Parish Medical Society" having reported that five mosquitoes of the "*Stegomyia fasciata*" species had been found last summer in the hold of a fruit vessel just arrived in that port. Indeed, there is a possibility that such a thing did occur as far back as Columbus' first voyage of discovery. After discovering and exploring the island of Santo Domingo, he sailed from the coast of Higüey on Jan. 11, 1493, for Spain, but on February 14, his carabela having been assailed by a terrible hurricane since the 12th, he was so exercised over the thought that he might yet be unable to convey the glorious news of his discovery that, he wrote, a great fear took possession of him and every mosquito sufficed to worry and disturb him. If that expression is to be understood literally and Columbus was referring to the hours of night, the mosquitoes which worried him were probably our "pungens," otherwise they must have been our day mosquito, the regular yellow fever mosquito, those two being the only species whose domestic proclivities would have been likely to induce them to board the admiral's carabela while it lay close to the shore of Santo Domingo. The following year (1494), also, there is collateral evidence which induces me to infer that contaminated mosquitoes must have been conveyed from Santo Domingo to the Canary Islands, the homeward trip at that time being made along that route. From historical data which I had set down in my recent paper,¹ I had come to the conclusion that the first name given by the Spaniards to the epidemic which caused so many deaths among them, at Santo Domingo in 1494, had been "modorra pestilencial"; a name which I had never met before (as applied to any human disease) and only once again with reference to the severe epidemic, of the same kind, which attacked the Spaniards who went with Pedrarias Davila to Darien in 1514, until a short time after the publication of the aforesaid paper¹ when I accidentally came across the following remarkable passage in Humboldt and Bonpland's Travels³: "What remained of the Gaunches (in the Canary Islands) perished mostly in 1494, in consequence of the terrible pestilence called the modorra, which was attributed to the number of dead bodies left exposed to the air by the Spaniards after the battle of La Laguna." On Feb. 2, 1494, Antonio Torre had sailed from Santo Domingo for Spain, bringing Columbus' full description of his second voyage to that island and also Dr. Chancas' interesting letter telling of the many men who had latterly been taken sick, though he felt very hopeful that their illness was not a dangerous one. It proved otherwise, however, for that was but the forerunner of a terrible epidemic to which I understand that the name of "modorra pestilencial" was given. The obvious inference is, therefore, that some of Antonio Torre's vessels had harbored mosquitoes which had bitten, in Santo Domingo, patients of modorra. The contaminated insects must have been left at the Canary Islands and there developed the epidemic among the Gaunches which is mentioned by Humboldt and Bonpland.

The following instances may be cited to show the coincidence of a remarkable abundance of mosquitoes and great mortalities among the Spaniards in Hispaniola and on the coasts of the Spanish main, within the first decades of the discovery of America.

In Hispaniola, after referring to another outbreak of the usual scourge (1502-1503) on that island and to the yellow color which the patients retained for many days, Herrera⁴ goes on to describe the fauna of Santo Domingo, and incidentally mentions "the mosquitoes which are there very troublesome." In 1509, on the coast of Venezuela, when Nicuesa attempted to establish his governorship of Nueva Andalucia, according to Las Casas,⁵ "the men who were left at the Belen river died in large numbers and were greatly distressed by the mosquitoes." In Darien, in 1514, Pedrarias Davila's nephew having been sent to reconnoiter the Cenu river, with 200 men, these began to sicken and die, and, adds Las Casas, "being new to the country, they were devoured by the mosquitoes." Finally, on the coast of Mexico, where Vera Cruz now stands, Bernal Diaz del Castillo, notwithstanding his previous experience at Darien, complained very bitterly of the intolerable torment caused by the mosquitoes.

On the Island of Cuba, on the contrary, the abundance of mosquitoes is not particularly emphasized by the early chroniclers and it so happens that on this island the earliest outbreak of a fever which bore any resemblance to yellow fever occurred in 1620, during the summer months only and never recurred again till 1649; but this time with a more permanent character. Pezuela⁶ refers to it in these terms: "In the spring of 1649, the city (Havana) was thrown into consternation by a horrible epidemic. Since the smallpox which had decimated the newly-settled towns in this island at the beginning of the sixteenth century, it had known no contagions nor illnesses, excepting those which properly belonged to its hot climate and the malignant fevers of the summer of 1620," and he adds: "In July and August (1653), Santiago de Cuba and Bayamo were afflicted with the same fevers which, three years before, had caused so many deaths in Havana." From those data, it must be inferred that the yellow fever mosquito did not originally belong to the fauna of this island, but that gradually a race of the species developed in Cuba, capable of accommodating itself to its climate which is somewhat cooler than that of Santo Domingo or of Vera Cruz; otherwise it would be difficult to account for the fact that having a sufficient non-immune population and notwithstanding that the three regular fleets (*flotas de India*) from the infected ports of Carthagen de Indias and Portobello, from Honduras and from Vera Cruz, met each year at Havana in June, before proceeding on their return trip to Spain, 100 years elapsed after the first Spanish settlements were made in Cuba before yellow fever made its appearance on this island.

In Campeche and Merida de Yucatan, on a parallel corresponding to that of the center of the Island of Cuba, the first epidemic of yellow fever, after its occupation by the Spaniards (1547) occurred in 1648, and its description by an eye witness, the Historian Cogolludo, is indeed more accurate and detailed than any that had previously been published in any language. Since then epidemics of yellow fever have at different times broken out in Yucatan, the yellow fever mosquito having apparently adapted itself to the climate of Yucatan one year sooner than to that of Havana.

Farther toward the equator, in the Guianas, where the Dutch made their first settlements in 1580, I have no information regarding the early medical history of that

3. Humboldt and Bonpland's Travels, London, 1814, and Philadelphia, 1815, vol. i, p. 216.

4. Chronicles of Herrera, Decade 1, Book 5, Chapter 11.

5. Historia de las Indias, iii, p. 330.

6. Historia de la Isla de Cuba, ii, pp. 106 and 112.

country; but in 1763, an expedition of colonists having been sent by the French Government to Cayenne, most of them died of a fever which, according to Béranger Féraud, could have been no other but the yellow fever.

South of the equator, on the coast of Brazil, the first epidemics on record are those of Bahia and Pernambuco (Recife) in 1686; but the facility with which it extended in the neighboring country shows that the yellow fever mosquito must have already existed there. Not until 1850 did yellow fever extend as far south as Rio de Janeiro; it has, however, been endemic there ever since. The present limits of the endemic yellow fever zone, so far as latitude is concerned, may therefore be placed at the 23d parallels, north and south of the equator.

In equatorial Africa, through the slave trade with the West Indies, endemic centers must have developed soon after the discovery of America; and some have persisted to this day, principally in the French colonies on the west coast, notwithstanding the racial immunity which most of the indigenous races possess.

Beyond the Atlantic shores, yellow fever epidemics have only been recorded in some ports of the Mediterranean and on the Pacific coast of South and Central America. The fact that no permanent endemic focus has ever developed on the Pacific side of the American continent, is a curious feature which must probably be attributed to the following circumstances: 1, the necessity of crossing the mountain range of the Andes in traveling from the Atlantic to the Pacific coast and, 2, the cooler temperatures which usually prevail along the western coast of South America. The first of these conditions impedes the spontaneous migration of contaminated mosquitoes across the highlands, while the cooler temperatures may prove incompatible with the development of successive broods of the particular species, on the Pacific coast, except at certain epochs, when unusually high temperatures have been known to occur during several successive years.

CONCLUSIONS.

As the outcome of the above historic and etiologic considerations I beg to submit the following conclusions:

1. The endemic foci of yellow fever in America, from the pre-Columbian times to the beginning of the seventeenth century, were comprised within a zone between the 20th and the 8th or 9th parallels of north latitude, reaching, toward the east, as far as the Leeward Islands and limited toward the west by the Atlantic coast of the American continent. During the seventeenth century, that zone extended farther north up to the 23d parallel and southward to the parallels of Bahia and Pernambuco. Finally, in 1850, it reached Rio de Janeiro.

2. The transportation of mosquitoes of the yellow fever species, in sailing vessels, appears to have been of frequent occurrence, ever since the early times of the discovery of America. To it must, probably, be attributed the coincidence of the severe epidemic of the so-called "modorra pestilencial" in Santo Domingo, in 1494, with another very fatal epidemic of the same name, in the Canary Islands, the same year. Apart from the conveyance of contaminated mosquitoes, healthy ones must have been frequently imported into subtropical countries, where they are found now to exist, having acclimated themselves to their new abodes. This is known to be the case in Italy, in the south of Spain and coasts of the Mediterranean, as well as in the South of the United States and in other countries. The previous existence of the yellow fever mosquito must be con-

sidered, *per se*, to constitute a dangerous complication whenever a case of yellow fever happens to be introduced in a place usually free from that infection.

3. The range of the Andes and its prolongation along the Isthmus of Panama and Central America, appears to have stood as a barrier, protecting to some extent the western coast of America against the migration of contaminated mosquitoes. That obstacle, however, is about to disappear when the Panama or the Nicaragua canal comes to be opened; let us hope, therefore, that, by that time, through the joint efforts of all the nations interested, all the existing foci of the disease will have been extinguished and that the adoption of measures, similar to those which have proved so successful in the hands of our sanitary department, will henceforth provide reliable means for controlling the propagation of yellow fever.

THE DIAGNOSTIC VALUE OF TUBERCULIN.

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As a general proposition it may be said that prompt accurate diagnosis is the most difficult and at the same time the most important thing in medicine or surgery.

This is especially true in the matter of tuberculous diseases. Recognized early, they are very largely curable; recognized late, the prognosis is relatively and almost absolutely bad. In other words, in tuberculosis the promptness of the diagnosis very largely determines whether the given case shall result in recovery or death. If, then, early diagnosis is of such great importance; if it enables us to transform a hopeless disease into one which is in a large measure curable, it behooves us to make use of every harmless means within our power to discover the lesion and determine its nature at the earliest possible moment. The microscope, the stethoscope, the clinical thermometer and the tape measure are in the hands of every physician; their value is admitted and when properly used they will, as a rule, make possible a definite diagnosis at the time of the first examination.

However, there are cases of tuberculosis where there is no sputum nor discharge for examination; where the stethoscopic findings are inconclusive; where there is no fever nor deformity. In these cases, where all other signs fail, we have an aid so searching, so harmless and in my opinion, so helpful, that I wish to urge for it a much more general use among the profession. I refer to the hypodermic injection of tuberculin.

In 1890 Koch first advocated tuberculin as a remedy for tuberculosis. When it was found later that it would not cure the disease the majority of the members of the profession abandoned it and now that it has found its place as an aid to diagnosis they refuse to reconsider it.

Much has been written on the value of tuberculin as a diagnostic measure, and its use has been advocated by some of the best men in the profession. Nevertheless, it has not been employed as generally as it should be. There are several reasons for this. 1. We habitually neglect to use all the diagnostic resources at our command. 2. It was formerly thought that the administration of tuberculin, even in moderate doses, might aggravate the disease. 3. The reaction is not always clear and definite. This, however, is usually due to insufficient dosage.

The principal objection urged against tuberculin is its supposed possibilities for doing harm. It is no doubt true that the enormous doses given in the first years of