The amazing story of the Pasteur movement—I

For the associates of Louis Pasteur, building nations and fighting disease were one campaign. Beginning a series on these great cultural optimists, by Garance Upham Phau.

At the origin of the science of life—biology and medicine—there stands a towering figure: Louis Pasteur. Yet, even in the centennial of the institute that bears his name "L'Institut Pasteur," 1888-1988, his discoveries and contribution to mankind are still belittled. Pasteur is remembered for the rabies vaccine, or milk "pasteurization," but what is most essential is lost: his method and his loving morality. Without those, there can be no true science. Where is the proof, where is the unique experiment that demonstrates Pasteur was right, that Pasteur is still right, in his method? How is that method and that inner ideal of importance today?

The answers can be found simply in a beautiful story, a story which contains more marvels, in which more strange discoveries unfold, which is more heart-rending, than any fables: the Pasteurians' involvement in Africa and Asia.

"Truth is richer still, and more gorgeous than any fables" (Emile Roux).

For truth is what you do, in that a person's work carries within itself the principles by which the decisions are derived and acted upon, and the mind enriched for further work: "Working, that's the only thing that's fun," said Pasteur.

There exist several comprehensive accounts of the Pasteurians' activities in what were then called the colonies, from the 1880s until World War II, and our purpose here is not to write yet another such account, but rather to seek out the melodic features in the life and thought of those men. To unfold the uniqueness of the Pasteurian endeavor, and derive inspiration for today.

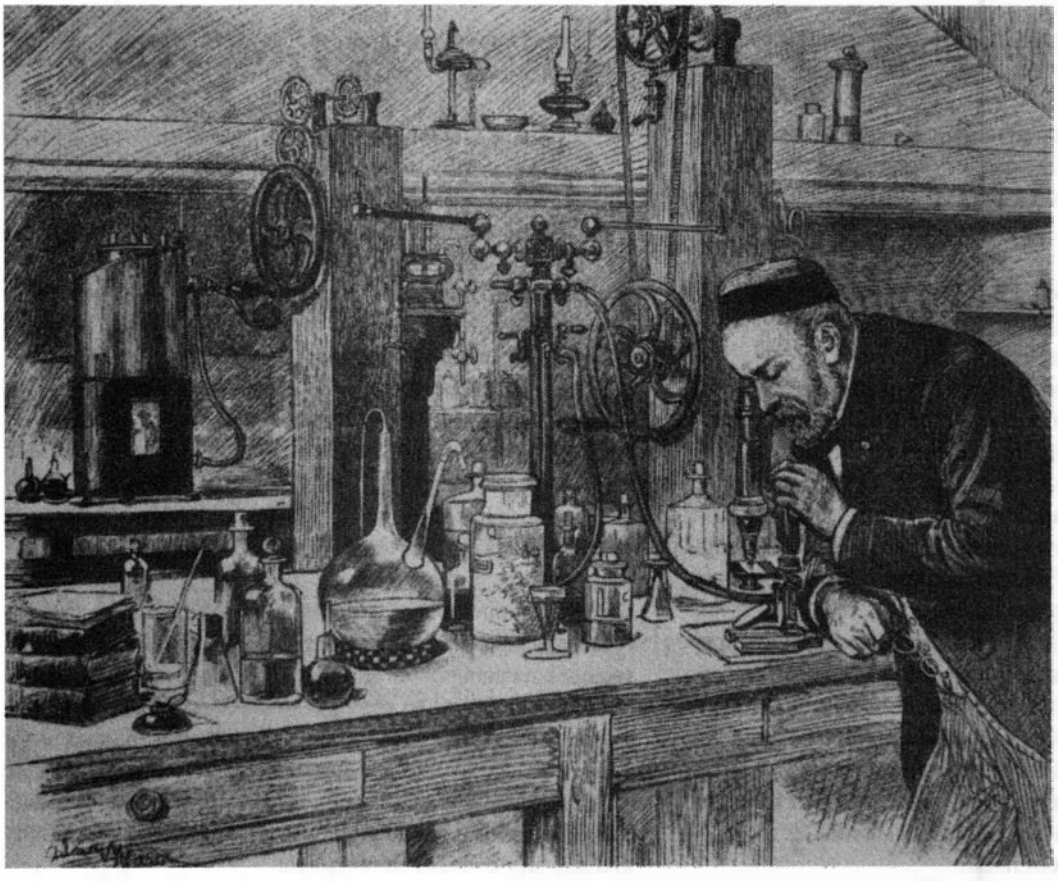
Pasteur's moral outlook and entrepreneurial skill is all but forgotten. Yet, Pasteur was an economist *because he grasped the phenomena governing life,* and, as such, he was the type of man who builds nations. We shall identify the key points as we proceed.

In the latter part of the 19th century, France undertook the colonization of Northern, Eastern, and Central Africa, as well as Indochina. Besides colonization proper, at the same time, development projects were undertaken by the French entrepreneur Ferdinand de Lesseps: The Suez Canal was conceived and finished over a 20-year period, and the Panama Canal was initiated. Projects were also undertaken by Gustave Eiffel: Besides the famed Eiffel Tower and the Statue of Liberty (the metal structure is his), he built bridges, railway stations, and sea locks the world over.

This is a period marked by Pasteur's favorite word, "enthusiasm," a Greek word meaning "the inner-God," as he was wont to explain.

Albert Calmette, a Navy physician and pupil of Pasteur, and founder of the first Pasteur Institute overseas, in Saigon, stated: "Without Pasteur's discoveries, the development and emancipation of the indigenous populations, and the building up of their territories, the colonial expansion of France and other civilized nations would have been impossible."

Pasteur initiated a *political movement* to take over France's military and colonial administration's policy orientation



Louis Pasteur in his laboratory, from a 19th century portrait. "Work is the only thing that's fun."

around principles of achieving such well-being among the colonized peoples as would make them wish to associate with France. To this day, if there are good remembrances associated with France in Asia and Africa, it is because of the Pasteurians. Vietnam, ravaged by wars, still cherishes the memory of Alexander Yersin.

Today there still exist dozens of Pasteur Institutes: Tunisia, Algeria, Mali, Madagascar, Senegal, Guinea, Morocco, and so forth. Without the Pasteurians, those territories would have been inaccessible for development because of epidemics and insect infestation; only the sea coasts, sad memory of the slave trade, had been known. Pasteur's pupils sought to transform those regions and to revolutionize their economy, and they strenuously fought against imperial looting policies both on moral and scientific grounds.

As a leading Pasteurian, Charles Nicolle understood that should the policy of plunder dominate, epidemics would swiftly cross the seas and destroy the nations guilty of imperial ideals. Only the scientist, physician, and teacher were entitled to be a *colon* (colonist), he said, only those ready to give and not to steal.

Postwar International Monetary Fund amorality has mocked Nicolle's warning and destroyed the Pasteurian project with devastating consequences. Now, as we approach the 100th anniversary of the creation of the Pasteur Institute, it is not only proper to pay tribute to Pasteur and his many pupils, but it is also necessary to recall this development effort so as to recapture the spirit and the method necessary to save Africa today.

From yeast to microbes

First, we may recall succinctly, Pasteur's thought on the etiology of infectious diseases.

Pasteur experimentally established that live organisms were the cause of fermentation in wine. Since fermentation resembled decay of a diseased tissue, said he, human and animal infections must be due to microorganisms growing at the expense of their host.

He concluded that his work on grapes established the principles upon which the mastery and treatment of all contagious disease could be carried out: There had to be a different microorganism at the origin of each individual disease, and the dissemination of that microorganism accounted for the transmissibility of disease from one person to the next.

In 1857, Pasteur experimentally proved that alcoholic fermentation "correlates with the presence and multiplication of organized beings, distinct ones for each fermentation." Those ferments are not "dead albuminoid matter, but real live beings. . . . The yeast comes from outside, and not from inside the grape."

Because the yeast has optical properties characteristic of living organisms, it effects a rotation, i.e., it carries out a transformation of energy, or work, in relation to light.

In 1878, Pasteur demonstrated again, conclusively, that there was no fermentation if there was no yeast on the grapes. And quickly, he established a parallel between the "disease of grapes," fermentation, and the process of *morbidity* of virulent diseases.[1]

My principles, he said, are of "limitless fecundity and practical consequences. A new light may soon be shed on the etiology of contagious diseases."

Pasteur conceptualized health as best understood from the principle of the growth or regeneration of live organisms, in the fascinating capacity for healing, for the tissues to reconstitute themselves, which is parallel to the behavior of crystals. There lay the future mastery of living things.

For Pasteur, who was a foremost scientist in crystallography, the "becoming" of the organic germ was comparable to the "becoming" of the chemical molecule.

"Nothing is more intriguing than to compare living species and mineral species all the way in the wounds of either, and the healing of the latter by nourishment, nourishment that comes from the inside for living beings and from outside, through the crystallization milieu for the others."

This difference between "inner" and "outer," or the characteristic of life must be a dissymmetrical force.

Life folds on itself out of itself.

It is the "morbidity" process and the "healing process" which fascinated Pasteur: The first would be the expanding life of the microorganisms, the second the life of the higher organism. Both express the principle of self-reflexive expansion.

Nicolle noted that all living phenomena can be reduced to physico-chemical processes if we cut an "instant slice" or a moment, but the moment itself is "dead," it is in the "series of succession of those moments" that the sense of life is to be found. "Hence, a mechanical approach shall always fail" in the endeavor to establish a science of the living.

Pasteur's intuition is to situate light as the organizing principle of life; life that is manifest in the act of rotation (see his comments on east-to-west vibrational rotation), and in its dissymmetrical nature.

His thought is the continuation of Nicolaus of Cusa and Gottfried Leibniz. And, like them, his scientific and philosophical thought is totally bound up with his love of mankind, hence his real political commitment.

So he writes to his scientist friends and future leaders of his Institute, working in different institutions:

"If only I had a few million, I would tell you all, my friends, Roux, Calmette, I would tell you: 'Come, we shall transform the world with our discoveries.' "

And, in 1868, twenty years before the founding of the first Institute in Paris, he initiated the political movement that would send his pupils the world over, because, said he:

"Disseminate laboratories! It is there that humanity becomes greater, stronger, and better."

The Pasteurian movement was born.

In 1876 he entered the senatorial race in his home district, refusing stubbornly to deal with petty local issues: "With me it is science, in all its purity, that shall enter into the Senate." His definition of democracy was reiterated in a recent book by Maurice Vallery-Radot which is well worth the study:

"True democracy is that which allows each individual to give his maximum efforts in the world. . . . Why is it necessary that alongside this fecund democracy, there be another, sterile and dangerous one, which, under I know not of what pretext of chimerical equality, dreams of absorbing and annihilating the individual in the State? This false democracy has a taste, I dare say a cult, of mediocrity. Everything which is superior to it is suspect. . . . One could define this democracy: the league of all those who wish to live without working, consume without producing, attain employment without preparation and honors without deserving them."

Pasteur was political in the real, and too often forgotten scientific meaning of the term: He fought against usury, against evil, and for man to organize his national economy as a Gaspard Monge or a Lazare Carnot, the scientific heroes of early 19th-century France, understood it. When the science of economics was called polytechnics, it included introduction of scientific inventions to improve man's productivity and mastery over his environment.

For Pasteur, the pursuit of science was the concrete expression of man in the image of God: all loving.

"Happy is the man who carries within him an inner God, an ideal of beauty, and who obeys it: ideal of art, ideal of science, ideal of the fatherland, ideal of science, ideal of humanity, ideal of the virtues of the Gospel. Therein lies the living sources of great thoughts and great actions. All are illuminated by the reflections of the infinite." (Speech to the French Academy, April 27, 1882.) Pasteur's "inner ideal" is the poet Friedrich Schiller's concept of "beauty" with . . . work!

"Working, that's the only thing that's fun."

The Senate race he lost, but for history, he won.

The birth of the Institute

1880: Pasteur outlined a program of research on bubonic plague.

1881: Pasteur went to the French town of Pouillac with his collaborator and future head of the Pasteur Institute, Pierre Roux, to study yellow fever in sick people coming from Senegal.

1883: He sent Roux, Strauss, Nocard, and Thuillier to Egypt to study cholera. After the death of Thuillier from cholera, the team would be forced to return to Paris.

1888: The Paris Pasteur Institute was founded, and a few months later in 1889, Pasteur sent his close collaborator Albert Calmette to found a Pasteur Institute in Saigon, fol-

lowing a discussion with the French Minister of Overseas Colonies.

1893: Pasteur sent his nephew A. Loir to Tunis.

From that point, the Pasteurians deployed throughout Africa and Asia, and the Paris Pasteur Institute became an international training, research, and coordinating center for the movement Pasteur initiated. The Pasteur Institute carried on his work for posterity.

1897: Military physician Charles Louis Laveran, who discovered the hematozoon, came to Pasteur in this year and took responsibility for exotic pathology. Working in collaboration with Elias Metchnikoff, Laveran was fascinated with protozoa (to which belong the hematozoa, and the many trypanosomes, and leishmanias). His department included three big laboratories: Protozoology, headed by Mesnil; Microbiology, headed by Marchoux (world expert on leprosy); and Medical Entomology, headed by Roubaux.

1906: Roubaux went on missions in the Congo.

1908: Society of Exotic Pathology founded by Mesnil and Laveran.

Roubaux looked at the role of insects in the dissemination of contagious diseases, studied the "biology of common flies," as a vehicle of parasites, and the "biology of glossines: biting flies."

1909-13: Missions to the hinterland of Senegal, Dahomey, and Ivory Coast, up to the southern borders of the Sahara.

Roubaux also found that cattle raising protected man, because flies preferred cattle to man.

Health, polytechnics, and defense

In 1897, Laveran came to work with Pasteur. Laveran, who had discovered the hematozoon responsible for malaria during a mission to Constantine (Algeria) in 1880, was a military doctor, like Calmette. He would assume responsibility to train and deploy the medical military expeditionary corps, when the "Corps de Santé Coloniale" (Colonial Health Corps) was founded in 1903.

For those men, health, political economy, and defense were not distinct, separate domains, they were indivisible one from the other.

What was at stake for the Pasteurians was to establish in practice a science of the living, a science of the ecology and economy of a nation. Health policy flows from that.

The thought of a nation is reflected in its health policy or development of individuals who compose the nation and are associated with it, because health is the relationship of man with the biosphere.

Therefore, health consists of:

- increase in the population capacity of a given area;
- increase in the quality (well-being, productivity, and creativity) of the individuals who compose it.

The Pasteurian movement is the antithesis of the zero growth-promoting Club of Rome, founded in 1972 to map out ways to stop population growth among the "non-white" populations: The Pasteurians went to Africa and to Asia to *increase* the number of people living in those areas. Health is defined as the establishment of a harmonious relation between water/soil, plants, animals, and man, and a harmonious relationship between microorganisms and macroorganisms.

A military doctor with the rank of general, from Bordeaux, kindly showed the author the motto of the Bordeaux Naval Medical School, "Ecole de Santé Naval." The Pasteurian-trained Bordeaux students are told they have the mission to: "allow an economic and cultural development by developing agriculture and implanting industries, all the while taking into account the epidemiological conditions."

Exotic pathology, for which Laveran and Mesnil assumed responsibility, meant the study of the big endemics of hot-climate countries, study of the species and evolution of bacteria, parasites, viruses (even if the means to see them is still lacking), finding treatments and/or vaccines, and large-scale epidemiological studies and control. Before 1914, the agents of all the major diseases affecting man were known and identified, even polio.

But that did not happen without a fight. The fight was as political as it was scientific.

Professor Mahé of the Brest Naval Medical School could tell his pupils in 1875: "Be challenged! A poisonous breath is exhaled by the earth and the waters." Clearly Mahé saw "telluric factors" and not etiological agents at the source of diseases. Ignorance and stupidity, otherwise labeled the theory of "spontaneous generation," of diseases held sway in the Army. A. Corre, a well-known military practitioner of his time, like the majority of his colleagues, greeted the Pasteurians' discovery of each pathogenic agent with utter cynicism. Corre disputed Laveran's discovery of the hematozoon agent for malaria, and insisted it had to be a disease caused by a chemical compound of the soil!

However, Pasteur had shown the way, and the discoveries of pathogenic agents followed in rapid succession by his pupils and those of the great German bacteriologist Robert Koch:

1873: Otto Obernier—spirochete of the "recurrent fever."

1879: Armand Hansen—bacillus of leprosy.

1880: Laveran—hematozoon of malaria.

1883: Robert Koch—bacillus of cholera.

1894: Alexandre Yersin—bacillus of bubonic plague.

1901: Forbe, then Dutton and Castellani—trypanosome of sleeping sickness.

1903: Leishman and Donovan—agent of the Indian disease kala azar, *leishmania donovani.*

This gives but an idea of how rapidly medicine progressed.

In 1881 Carlos Finley, a brilliant Cuban physician, first discovered the way insects transmit diseases—the case of the transmission of yellow fever by the mosquito *Aëdes aegypti,*

today known as the main transmitter of what are called "arboviruses" (diseases such as dengue fever, maguari, or St. Louis encephalitis, and a suspected agent for AIDS transmission). Finley presented his discovery to the Havana Academy of Medicine amid skepticism in 1881, but the discovery of the agents of transmission followed immediately every few months, every year, following the discovery of the pathogenic agents themselves.

Albert Calmette

Born in 1863 in southern France, Albert Calmette, a pioneer in the Pasteurian enterprise, is best known for his groundbreaking discovery in the fight against tuberculosis: the BCG vaccine. BCG stands for "The Bacillus Calmette-Guerin," Guerin having been his associate in the 20-year effort to effect a mutation in the Koch bacillus, the agent of TB. Some 250 "passages" were realized on animals before the microbial agent would undergo an irreversible mutation, making it appropriate for vaccination. To this day, in 1988, it is estimated that 20 million people suffer from TB in the world, mostly in poverty-stricken industrial cities or in the developing sector.

At the time of Calmette's effort, TB was the main killer in the European industrial heartland, debilitating the labor force of France, Luxembourg, Belgium, and Germany.

It is in that industrial heartland that Calmette chose to build the second major Pasteur Institute of France, the Lille Pasteur Institute. It is relevant to put emphasis on two endeavors of the Lille Institute that are less well known than the discovery of the BCG:

First is the world responsibility assumed by the Lille Pasteur Institute in the training of military and civilian physicians on assignment to Africa or Indochina.

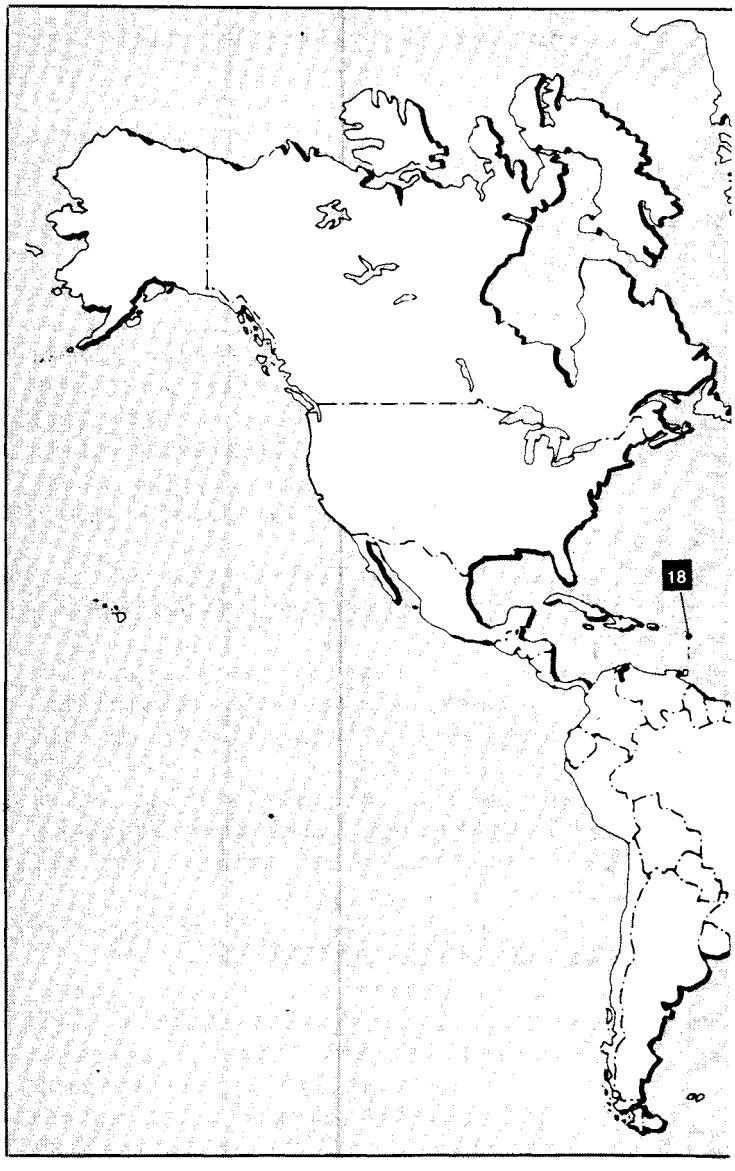
Second is the exemplary treatment campaign organized and waged by Calmette during those 20 years of work on the BCG during which there was only "hope" to administer to TB victims.

That prophylaxis, as we shall see, was not the exception, but the rule adopted by the Pasteurians in the fight against *all* epidemics in the tropical and semi-tropical regions.

Today, it has been strange to see the outcry against the Proposition 69 referendum on AIDS in California: The prophylaxis adopted by Calmette had been similar.

Calmette arrived in Lille in 1895, and the Lille Pasteur Institute was founded in 1899 as a scientific research center, a teaching institute, and a prototype for the creation of overseas institutes. If the Pasteurian misssionary often arrived in the colonies with a microscope, a backpack, and if possible a cow (for smallpox vaccination), if the beginnings of the Pasteur Institute abroad were financially less than glorious "barracks," the purpose, the final goal as the case of Yersin typifies, was the most modern scientific pilot laboratory, hospital, and farming station.

In part, this came from Calmette. He repeatedly stressed



The Pasteur Institutes

Asia

1. Saigon (Vietnam): 1890, Calmette.

2. Nha Trang (Vietnam): 1985, Yersin.

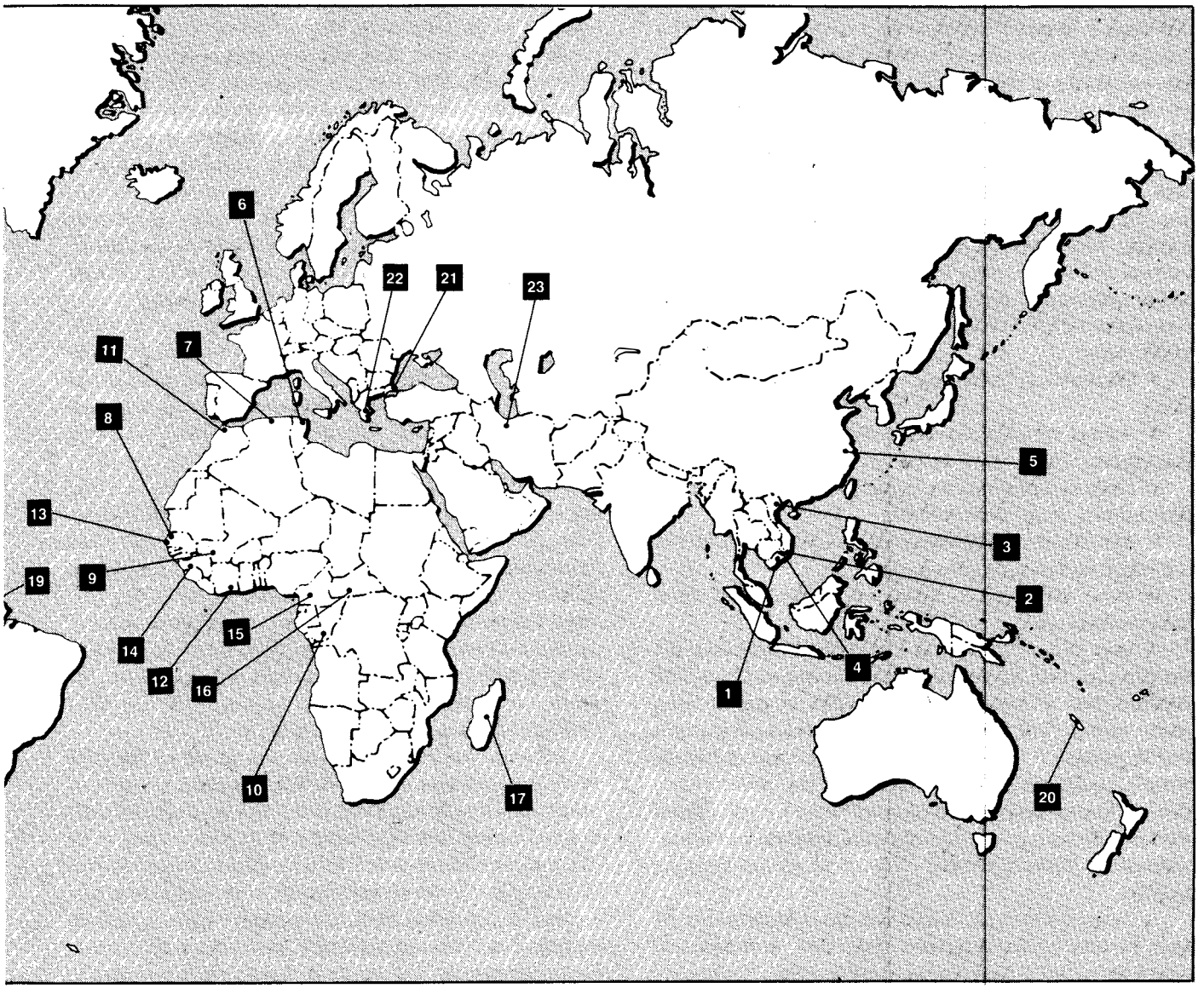
3. Hanoi (Vietnam): 1925, Bernard.

4. Da Lat (Vietnam): 1936, Yersin.

5. Shanghai (China): 1938, Raynal.
Main secondary laboratories are in Heu in Annam County (Vietnam), Phnom Penh (Kampuchea), and Vientiane (Laos).

Africa

6. Tunis (Tunisia): 1893, first laboratory created by A.



Loir, nephew of Louis Pasteur. 1903, Institute created by Charles Nicolle.

7. Algiers (Algeria): laboratory, 1894. Institute, created by Sergent brothers, 1910.

8. St. Louis (Senegal): laboratory, 1895.

9. Bamako (Mali): Pasteur Institute of Bamako, specializing in leprosy, set up in 1906; later called Marchoux Institute.

10. Brazzaville (Congo): 1908.

11. Tangiers (Morocco): Remlinger, 1908.

12. Abidjan (Ivory Coast): 1908.

13. Dakar (Senegal): created by Marchoux, Calmette, and Mesnil, 1924.

14. Kindia (Guinea-Conakry): "Pastoria" monkey farm set up by Calmette in ca. 1924.

15. Yaoundé (Cameroon): Institute created in 1959, previously called Yaoundé Medical Center.

16. Bangui (Central Africa Republic): 1961.

17. Tananarive (Madagascar): bacteriology laboratory, 1897, Pasteur Institute, 1927.

Other areas

18. Guadeloupe: 1948.

19. French Guiana: laboratory transferred from Cayenne in 1940, becomes Pasteur Institute.

20. Nouméa (New Caledonia): 1913.

21. Istanbul (Turkey): Constantinople Pasteur Institute created by Maurice Nicolle, brother of Charles in 1892.

22. Athens (Greece): Calmette, 1920.

23. Teheran (Iran): 1921.

that tropical countries' laboratories were to assume a major responsibility for the development of a region, and no Institute was worthy of the name if it did not assume those industrial and agricultural tasks, and did not teach the Pasteurian scientific method.

Hence, by agreement between the Corps de Santé Coloniale and the Pasteur Institute, candidates going to the colonies were to spend several months getting trained and acquainted with many technologies at Lille; Lille taught the colonial physicians such a wide array of sciences as to make one hesitate to call them "physicians." Renaissance scientists, scientific apprentices in the science of living, might be a better term:

- Microbiology/pathology. Tropical and temperate zones.
- Animal epizootics. Studies in wild and domestic animal diseases. Cattle breeding.
- Study of fermentations, training of people in industry: beer brewery, wine, milk products.
- Agriculture development. Virus of plants. Bacteria of soil which further plant growth.
- Water management. Biological purification of waste and industrial water.

A Navy physician at age 20, Calmette had worked on the Far East squadron, participated in the war against China, and then had gone to Gabon where he spent 18 months studying exotic pathology. It was there he took his resolve to launch a war on epidemics. When he had managed to come see Pasteur himself, he became an "enthusiast" right away. Months later, Pasteur, having talked to the Minister of the Colonies about the idea of creating the first overseas Institute in Saigon, selected the young Calmette, 27 years of age, to head the project.

In Saigon, where he studied venoms, Calmette discovered the first treatment against snakebites, treatment that would save 20,000 lives a year in India alone. Then he returned to Lille, and went on to Algiers to create the Institute there with the brothers Edmond and Etienne Sergent, later initiating the Guinea primate center project Pasteurella. Calmette spent a life devoted to the well-being of the people of Africa and Asia. Medical practice does not begin or end with the laboratory. For him, the war on disease is first fought with in-depth scientific epidemiology, something all but forgotten today.

"It is during my stay in Lille," Calmette wrote, "that the problem of the scientific and social fight against tuberculosis becomes for me a veritable obsession. I was better situated than anyone to measure the entire extent of the misery and ruin caused by this illness in working-class circles, and I was able to verify every day the uselessness or inefficiency of the efforts, in any case poorly coordinated, of the institutions of public welfare and the works of private initiative."

The tubercular workers "could no longer earn their living, nor take care of the needs of their families . . . humiliated or reluctant to ask for charity, they go on working until their strength deserts them, then they stop, waiting to die in abject poverty." So in 1904, Calmette created the Northern League Against Tuberculosis, and established the Preventorium Emile Roux. "It seemed to me," he says, "indispensable to create an organism appropriate for searching for the ill, because, at the moment when the sick persons are the most contagious, they almost always continue to live the same life as everyone else, frequenting the workshops, the factories, themselves not suspecting in any way the dangers presented for their surroundings by the disease which has struck them."

The BCG vaccine would not be ready until in 1924. Calmette, dismissing "Lady-Do-Rightly"-type charity as inept, recruited industrial workers, and trained them at the Institute to engage in a vast volunteer operation to test the population and find the infectious people, either sick or not yet sick. Then came prophylaxis of the workplace vis-à-vis the contagious persons, who ought to be removed if working in a job that would endanger others. Prophylaxis in the household, such as removing young children to foster care when parents were infectious, and also educating the family and patients as to the means of transmission of TB (which Calmette was the first to do research on), the danger of spitting, the danger of sweeping a floor with a dry broom, etc. Finally, the Preventorium also supplied social assistance: food to the needy, home care, nursing care, even laundry service (up to 8,000 kilos!), housing, financial help, etc.

Calmette was roughed up and denounced by the Lille medical corps for his war on TB! Were Calmette to visit New York today, how stricken with horror he would be at the sight of a rich society, leaving TB-infected beggars to sleep in the street, along with the mental patients thrown out of hospitals 10 years ago. He would be horrified at the refusal to implement epidemiological study and measures against AIDS on the part of the medical community. Surely, he would remember his opponents, and those of Pasteur, who preferred to speak of "sociological" or "weather" factors and the "rights of the tuberculosis sufferer to be left alone" (to die).

The League fulfilled its purpose: preventing the spread of TB, and protecting the workplace and the family in the 20-year period which preceded the finding of the BCG.

A mission

"At the point that we have arrived at what is called modern civilization, the culture of the sciences in their most elevated expression is perhaps even more necessary to the moral state of a nation than its material prosperity." (Louis Pasteur, 1870.)

This "higher purpose" of Pasteur's pupils had nothing to do with today's race for Nobel Prizes; James Watson has as much in common with Charles Nicolle as a chameleon seeking to resemble a human genius.

Throughout Africa and Asia, the Pasteurians went on exploratory missions which were the prelude to the establish-

ment of laboratories and experimental agricultural and animal stations.

Most of the missions were organized around one task, such as seeking out trypanosomes in Guinea, but around it they engaged in comprehensive epidemiological research on man and cattle, vaccinations as available (initially smallpox, rabies), mapping of paths over mountains or through jungles, mapping of water flows, searching for insects and sites of insect larvae on rivers and in marshes.

To give a taste of this, I shall tell you of the mission to Guinea of Dr. Martin, as recorded from his diary.

Martin's story is typical of those pioneers who established Pasteur Institutes.

In June-July of 1905, Martin carried out a two-month exploratory mission in the Fouta-Djallon, called the "Swiss Alps" of Guinea from the roughness of the terrain with sharp peaks of over 1,500 meters (about 5,000 feet), and torrential rivers to cross. The mission was to travel 900 kilometers by foot or litter. Martin had with him 50 men, mostly local mountaineers, to carry the equipment, microscope, et al., and the menagerie of animals needed for experiments: sheep, goats, monkeys, dogs, cats, guinea pigs, parrots, and two heifers from which the Jennerian vaccine was collected.

The trip was exceedingly hard: 35° C or more during the day and colder nights; heifers which at times had to be carried upside down on a pole over steep terrain; floods and even hurricanes; and no decent food.

Martin's diary recalled:

"Corn, tapioca soup, eggs bought from the villages were often rotten, and if a scrawny chicken was caught, the cook plucked it live, and carried it 10 kilometers under the sun, [so] it was half-cooked when it finally got into the pot." At night they looked for a "cave," in which "to crawl on all fours, stinking and full of rats."

"Sometimes as we got down to a well-deserved rest, an invasion of giant black ants made us decamp. . . . Sometimes it was a cloud of bees and we had to catch the animals running away in all directions. The laboratory operations were done outdoors, we set up a small table, put up the microscope to examine blood samples, amidst the awful noise of the menagerie of animals. . . . Then, time came for the medical examination.

"Out from the neighboring villages a sorry troop would scurry: the chronically ill from malaria, sleeping sickness victims in a state of semi-drowsiness, individuals affected with appalling sores from elephantiasis."

Vaccination sessions attracted a lot of people when the villagers had already been educated about the benefits by colonists. It is worth recalling the terrible facts about smallpox in Africa before the Pasteurians' arrival: Over half of infant deaths were due to smallpox, and in many areas 90% of the 20-year-olds had the facial scars showing they had survived this scourge.

Martin discovered trypanosomes on the most diverse domestic animals: horses, cattle, pigs, goats, and sheep. Since he wanted to bring those viruses back to France, he had to bring back a traveling menagerie much larger than the one he had departed with.

The precarious traveling conditions, and the lack of equipment for transport of cultures in hot climate, meant that the way to bring back a sample of any disease was to bring back one, or two, or more animals infected with it. Sometimes one infected animal and one uninfected of the same species, so as to transfer the disease if the first was not going to survive the length of the trip.

Trypanosomes are very variegated: Some types can adapt to the dog, as others to the dromedary. In man, trypanosomes vary within the same individual, changing every three or four days, according to Dr. Pautrizel, a world specialist on sleeping sickness and formerly WHO representative. Hence no vaccine has ever been found. Martin found that sleeping sickness affected all the villages because the *glossina palpalis* (tsetse fly type) was omnipresent, even at high altitudes.

Later, Martin carried out similar missions in the Congo, and established a Pasteur Institute in Brazzaville.

Calmette and the science of epidemiology

The case of tuberculosis

1899: Preventorium

1905: Northern League against TB

1924: Bacillus Calmette-Guerin (BCG)

Preventorium "Emile Roux," Lille, 1899 anti-TB prophylaxis dispensaries

Laborers are trained, and go to carry out testing

—in communities

—in households

—in factories

Mapping of the spread of TB

—propagation of the disease by household/workplace

Decision making involves:

- hygiene laws concerning food handling, schools
- case-by-case evaluation for sanatorium
- isolation of contaminated people
- placing of TB-affected households into foster homes
- studies in contamination (digestive tract)
- education, welfare help, housing

Reference

[1]The parallel will be shown to extend to the means of transmission of diseases a few years later when Edmond Sergent, the founder of the Algerian Pasteur Institute, showed that *drosophila* flies carry the yeast onto the grapes and that vineyards protected by fly netting yield grapes that do not ferment to produce wine.