Scientific Representations at the UPR School of Tropical Medicine. III: The Evolution of Science, the Last Era (1941-1949)

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The essay examines the scientific representations that unfolded and evolved at the University of Puerto Rico School of Tropical Medicine (STM) under the auspices of Columbia University (1926-1949). It focuses on the emerged scientific representations and on the nature and evolution of sciences at the School, and has been divided into four sections: images of science, evolution during the first two eras (1926-31 and 1932-40), the unfolding last era (1941-49), and special technical studies. This article on the STM's scientific endeavors is the third in this historical serial collection about the images and evolution of sciences at the institution, and portrays the events and processes of the last scientific era. It analyzes the faculty's principal investigations, development of research programs, and concomitant scientific productivity and research outcomes. The scientific representations have been brought forth through the analyses of different sources: academic and research reports, and publications in external and local venues. The analysis of the STM's scientific evolution has been organized in three distinct chronological stages, while also considering other time evolving models (e.g., historical moments). The main themes of the collection are the scientific images and knowledge exemplars: the emergence of a tradition. An analytical framework of research schemas, exemplars of knowledge, and epistemes proved useful and constructive. These studies on the history of science allow for the postulation of an 'enriched thesis' on the different kinds of paradigmatic diseases of tropical medicine in Puerto Rico during the 20th Century, and enable further substantiation of the tropical obliviousness thesis. [*P R Health Sci J 2020;39:5-19*]

Key words: Tropical medicine history, Science history, Medical discourses

This scientific narrative is the third part of the fourth-part essay titled 'Scientific Representations at the UPR School of Tropical Medicine.' The fourth-part essay belongs to a historical series about the University of Puerto Rico (UPR) School of Tropical Medicine (STM) under the auspices of Columbia University, published in this journal. The purpose of the essay is to address the kinds of science that prevail at different moments and the nature of their epistemological contribution. The analysis focuses on the scientific representations (e.g., models) and exemplars of knowledge (e.g., theses, discoveries, iconic publications) that have been generated through the examination of official research and academic reports, and faculty's publications in external and local venues. The essay has been divided into a collection of four papers: the first concentrates on manifest images of science, the second deals with the evolution of the sciences during the first two eras (1926-31 and 1932-40), this third part portrays the development of science in the last era (1941-49), and the fourth reviews special research studies (i.e., methodological, epidemiological, animal models, therapeutically, immunological, biological, and field studies). As in the previous paper, this one also examines the conditions and practices that explain the continuities and discontinuities of different aspects of science that occurred at the STM.

This historical quest has been organized throughout the traditional model of chronological stages into three periods: 1926-1931, 1932-1940, and 1941-1949. However, whenever needed, other time evolving or time strata models were used for a better understanding or conceptual organization of diverse scientific events and processes. The principle of evolution and the particular approaches of conceptual history and microhistory have been advantageous for the operational or continuous treading of the traversed paths of this history of science. A historic philosophic outlook has been developed and used based on the following scientific notions: research schemas (plans, programs), paradigms (including particular exemplars

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of knowledge) and epistemes (epistemological conceptual fields). This third article of the historical serial collection further expands on the previous established theses that parasitology became the hegemonic science of tropical medicine during the third era, and that a mature science spectrum characterized the last STM scientific scenario.

Science in the Third Era: 1941-1949

The start of the STM scientific last era coincides with the U.S. entrance in World War II (1939-1945); therefore, medical research and clinical services at the School would be disrupted in different ways. Three internal leadership changes also would be of significance during this period: a Puerto Rican bacteriologist, P. Morales Otero, will replace parasitologist G.W. Bachman as Director-in the midst of growing dissatisfaction of local employees, which seems to be a starting point for Columbia's eventual exit-; A.W. Hoffman, Head of the Medical Zoology Department, will end his life tragically and will be succeeded by J. Oliver-González; and at around the same time D.H. Cook, Head of the Chemistry Department, will return to Columbia and C.F. Asenjo will replace him. Hoffman and Cook were the last of the faculty members who were at the School since its foundation (1). However, perhaps what is more relevant is the new generation of scientists that took over the leadership of the two emblematic basic sciences of tropical medicine in Puerto Rico at the time. The schistosomiasis research program had to wait until 1954 to achieve worldwide recognition of its epistemological tradition with the Oliver González circumoval test, whereas the nutrition program had a similar result in 1946 (at the STM) with C.F. Asenjo's and A.R. Freire de Guzmán's demonstration of the rich source of ascorbic acid of the *acerola* (West Indian cherry) (2). Both achievements entailed appreciable public health benefits.

In 1941 the war's first impact over the STM was personnel reduction attributable to leaves of absence for army services (in addition to study leaves) (3). In 1942 the new School Director, Morales Otero, and now consultant on Epidemiological Diseases to the U.S. Secretary of War, mentioned that the institution "have had to meet the challenge and adapt to the emergency." A Central Committee for Civilian Defense on the Island placed the School in charge of all educational activities related to civilian medical matters (4). The Committee provided the funds for the establishment of the Blood Bank at the School. The University Hospital was 'conditioned' as an emergency disaster unit. The war's second impact was related to the 'transportation and lack of shipping' situation, which affected the acquisition of equipment and materials, and caused a shortage and a rise in prices of foodstuffs that were necessary to feed laboratory animals and the monkeys at the Santiago Primate Colony-a special diet prepared by the Chemistry Department was of some help (5).

As mentioned earlier, in order to focus on the most important research programs at the School, the examination of several special methodic studies (e.g., methodology, experimental, epidemiological, and field studies) will be deferred for later-except to mention them as part of a main research schema. A systematic examination of the research reports by departments (i.e., Reports of the STM Director, 1940-41 to 1949) suggests the following ordered sets as an index of the most important research disciplines at the School during this era: 1) medical zoology (parasitology, ethnology) and chemistry (nutrition); 2) bacteriology, clinical medicine and dermatology; and 3) pathology, the University Hospital, and public health-which will be subsequently reviewed in an inverted way for a lasting impression.

An effort has been made in this last era (1941-49) to single out plans or research programs (schemas) of series of studies that clarify and reflect possible research paradigms (exemplars of knowledge) and epistemes (epistemological fields) (6). Thus, to achieve this purpose, the analysis subsequently will concentrate on the examination of the research reports included in the STM Director's Reports for the period that started on June 30, 1941 and ended on June 30, 1949. Interestingly, in the case of medical zoology, for example, the reports show a historical thought-movement, from a mere listing or enumeration of problems (1935-43), to a conceptual organization of investigations into epistemological assemblages of main topics of research (1943-49). This historical phenomenon occurs in almost all of the School's disciplines (except for pathology and public health) with the following thought movement initial dateline profiles: 1940-41 (dermatology); 1942-43 (bacteriology); 1943-44 (medical zoology); 1944-45 (clinical medicine); and 1944-45 (chemistry, with a permanent regression in 1946-47). The diversity of these research patterns does not favor a hypothesis of a mere stylistic factor of the reports induced by a change in the School leadership, and seems to reflect more of a conceptual historical research schema change.

After the first years of the era, pathology eventually became mostly a supportive and supplementary area in terms of research, while the Hospital's role (now differentiated from a Clinical Medicine department) was mainly that of a venue for clinical investigations performed by other departments. During this time, besides organizational work as a new department, public health was mainly concentrated in teaching and training. Thus, either it played a supporting role in certain epidemiological and field studies or it functioned as an applied discipline that conducted practical public health studies funded by government agencies. The Santiago Primate Colony's reports only covered four years of the era (1940-44) since there were official ideas that it was going to be 'transferred' from the School to the Health Department (HD) for financial reasons-but it was temporarily 'left in the hands of the College of Natural Science of the UPR' at Río Piedras (7). The experimental studies with monkeys from the primate colony are reflected in the research reports of the departmental disciplines. The reports of the Blood Bank covered the years between 1942-49, and deal mostly with routine services and useful or practical blood studies (e.g., isoagglutinins, anti-Rh serum, and incidence of blood factors).

A. Pathology

In the 1940-41 academic year the department of pathology expends a lot of its faculty's efforts on training physicians for new District hospitals in the field of general pathology, with the expectations that it will relieve them of some routine work. Besides some pathological cases viewed as research (e.g., a case of schistosoma miliary pseudotuberculosis, death related to antimonial Fuadin treatment) and some unsuccessful investigations with experimental animals (e.g., the above mentioned herpes virus with rabbits, and a failed attempt of transmitting a suspected typhus to laboratory animals), the most important research was on Weil's disease (a severe form of leptospirosis): carrier rate among wild rats and gray mice reservoirs, laboratory diagnosis of suspected cases, isolated strains, and epidemiology ("so far three human cases reported in P.R.") (8). An interesting new research on synthetic estrogens started in 1941-42, in collaboration with G. Gould of the Presbyterian Hospital, but it has to be discontinued in 1942-43 due to time limitations since the department received special grants from the Legislature to study murine (endemic) typhus fever and Weil's disease on the Island, because "both... seem to play an important part among the acute febrile illnesses of P.R.": 46-47. In these investigations, carried out during 1940-1945, the department used human pathology cases and experimental animal studies (9). After 1945 pathology's own research diminished substantially. Instead, its participation was in collaboration with other School departments and institutions (10). During the period's last two years, research by the pathology department was limited to: a) the completion of a study on balantidial dysentery in the Island; b) a review of 1,600 consecutive autopsies (1926-1948) of rheumatic fever on the Island (active and inactive 40 positives, 2.5%); and c) a review of literature and of 1,463 autopsies (only seven positives, 0.48%) of clinical amebiasis in P.R.-'rare' but "impossible to explain" its low frequency (11).

The relative decline of pathological research during these years could be associated, at least, to the following factors: heavy burden of routine services, concentration of efforts to train general pathologists for emerging district hospitals, apparent reduction of personnel with research experience, and commitment with Legislature grants to study health outbreaks that caused public concerns. Collaboration and tenacious single-handed efforts were the response.

B. Dermatology

During this last scientific era, dermatology was the discipline with the best organizational research schema under the leadership of A.L. Carrión. In terms of organizing research under epistemological assemblages of main lines of investigations, which medical zoology and chemistry achieved during 1943 and 1945, the discipline of dermatology showed its template (arrangement) since the start of the era (with a temporary hiatus in 1945-46). The main research programs were: 1) Studies on Chromoblastomycosis (a chronic deep fungal infection of the skin and subcutaneous tissue that occurs as a result of traumatic inoculation); 2) Studies on Dermatomycosis (a superficial fungal infection of the skin) (e.g., tinea capitis or ringworm of the scalp; tinea corporis or ringworm of the body; athlete's foot; tinea unguium or onychomycosis-an infection of the nail); and 3) General 'Survey' on Fungal Disease in Puerto Rico-which really was an accumulative collection of rare or presumptive cases through the years (e.g., trichomycosis, a bacterial infection of the hair shaft; tinea negra, an uncommon superficial dermatomycosis; presumptive sprue bronchomoniliasis, an infection of the bronchi with Candida fungi; actinomycosis, a rare infectious bacterial disease; and otomycosis or fungal infection of the 'outer ear') (12). To this schema, mainly based on the clinical distinction between deep and superficial tissue infections, other lines of research were added throughout 1944-49 (13). In the 1947-49 Director's Reports, a new research schema ('plan') emerged around 'a series of studies on the physiology of fungi of chromoblastomycosis'; that is, of changes and responses to the actions of chemical and physical agents (e.g., temperature, oxygen requirements, and age viability of mycelium-i.e., the vegetative branching of a fungus) with the acknowledgement that it 'will require several years' to yield returns (14).

A.L. Carrión came to be known as a worldwide expert in the identification of medical related fungal species and received specimens from many countries around the world (e.g., Venezuela, Brazil, Argentina, South Africa, Quebec, Java, and Puerto Rico-from I. González Martínez). Even today his name, articles and dermatological clinical images appear in research and history articles on the clinical condition of chromoblastomycosis-in 1935, as mentioned above, he described one of the etiologic agents of chromoblastomycosis. His atypical clinical research methodology (i.e., gradual accumulation of specimens and clinical cases), systematic and incisive basic science approach, and vital clinical medical service at the University Hospital (i.e., on the etiology, diagnosis and treatment of skin diseases) definitely constitute a unique exemplar of knowledge of science at the STM (i.e., the formation of an international expert). In June 30, 1949 Carrión was one of the faculty members that resigned because of the School's closure.

C. Clinical Medicine

The Department of Clinical Medicine became a separate academic unit from the University Hospital division in 1941-42, which is a usual academic tendency that tends to reduce service load and strengthen research capability among clinical departments. The Director's Report of that academic year mentions that 'special emphasis' was placed on sprue research (e.g., action of different liver fractions and extensive gastroscopic and rectosigmoidoscopy observations). The report also mentions several individual studies of 'interest to the staff' on diverse topics, most of them in collaboration with the School's basic science departments (e.g., schistosomiasis and filariasis,

tropical anemias, balantidial intestinal infestations, mal del Pinto, rheumatic fever, Weil's disease, enzymatic anthelmintics, lymphogranuloma venereum, tropical lymphangitis, vitamin B complex, clinical and experimental Moniliasis). Research also was being conducted by its own divisions of pediatrics (e.g., causes of diarrhea in infants related to nutritional status, treatment of dysentery with sulfa drug sulphaguanidine) and surgery (e.g., surgical aspects of elephantiasis, lymphogranuloma inguinale, incidence of thyroid disease, occurrence of peripheral vascular disease) (15). The work on determination of blood volume in normal persons, which had to be temporarily discontinued due to war obstacles to obtain Congo Red dye-today it has long been abandoned because of its carcinogenic properties-was again under way. Another project of bone marrow changes in tropical diseases also had difficulties to obtain German dyes, but substituted them successfully with domestic Wright's stain (that facilitates differentiation of blood cell types) (16).

In 1942-43, the 'most important' research of the clinical medicine department pertained to clinical aspects of nutrition on the Island, and was propitiated by the acquisition of a biophotometer to determine dark adaptation related to vitamin A deficiency. An interesting technical research schema turn occurred in these years at the department: incorporation of several equipment, laboratory techniques and clinical methods that will potentiate its own clinical investigations (e.g., techniques on liver fractions; quantitative tests for urobilinogen-a by-product of bilirubin-in feces and urine; the biophotometer; use of gastroscopic and rectosigmoidoscopy procedures; and T wave unipolar electrocardiogram). For example, the 1942-43 Director's Report mentions the following research plan: "the general overall plan for research work entails the establishment of techniques for determining nutritional status as regards the vitamins": 33. The plan included recruitment of a research associate in chemistry that enabled the use of various laboratory techniques (e.g., quantitative determination of vitamin contents by chemical methods; a technique to determine the ascorbic content of foods for hospitalized patients; identification of nutritional status of several groups differentiated by income levels with special attention to sprue). There were no explanations in the report as to why this recruitment was necessary when the School's chemistry department specialized precisely in vitamin studies (17).

The clinical medicine historical thought movement toward an organization of investigations into epistemological assemblages of main lines of research started to manifest in 1943-44 with the phrase, "research can be divided". However, it became the standard model in 1944-45, with the following organization: a) 'Clinical studies on sprue' (e.g., presumed vitamin A deficiency; discontinuation of liver treatment and inclusion of yeast administration–the report mentions that cases of sprue had 'diminished considerably'); b) 'Clinical studies on filariasis' (e.g., antistreptolysin titre test that checks for a strep infection-it measures streptolysin O antibodies in blood plasma-based on the worldwide and STM interest on the occurrence of secondary bacterial infections in filariasis; survey completed in the insular Penitentiary; and mentions a 'no conclusion' statement of an old interest on the relation of filariasis and recurrent tropical lymphangitis); c) 'Clinical studies on schistosomiasis' (e.g., chemotherapeutic effects of antimonials compounds: Fuadin-of 150 cases, 58% cured, tartar emetic, and anthiomalin; liver tests revealed evidence of hepatic damage); d) 'Deficiency studies' (e.g., vitamin deficiencies of hospitalized patients; effects of a "full sprue diet" continued; the nutritional "Buena Vista" new field study in progress with 3 methods: dietary, biochemical and physical condition); and e) 'Electrocardiography studies' of normal persons with the new technique of T wave unipolar electrocardiogram (18). This research schema continued during the academic years from 1944-45 to the last year in 1949, with an addition of a 'miscellaneous' category in 1946-47 and two new research topics in 1949: hematological studies and physiological research. During the years there were several additions to the already established research topics, such as sprue, filariasis and schistosomiasis (19). The 1945-46 Director's Report mentions the following outcomes of the Buena Vista nutritional field study: a) diets (n=110 persons, fasting urine samples) are 'inadequate in every nutritional essential' (thiamin, riboflavin, niacin); b) blood levels (n=103 persons) 83% deficiency vitamin A, hemoglobin levels only 17% less than 11.5; and c) weights (32% underweight, 5% overweight)-'each family received a brief report of findings and advice on ways and means to improve their diets' (20).

The research schema of the Clinical Medicine Department during the last STM science era definitely was well organized and highly productive. It benefited from three factors: 1) a relative academic distance from the clinical service load-even when the faculty performed their main clinical work at the hospital and the outpatient clinics; 2) an innovative technical research schema turn, early in this last era; and 3) a continual collaboration with basic science departments, in particular with medical zoology. It also made a notable effort to emphasize research in tropical diseases (i.e., sprue, filariasis and schistosomiasis), thus honoring the faculty academic titles of professors in tropical medicine.

D. Bacteriology

If we set aside the studies on tuberculosis and recurrent tropical lymphangitis of the previous era (1932-40), bacteriology-with a Puerto Rican bacteriologist now as STM Director and still head of the department-continued the most important research program of the unit: the studies on the hemolytic streptococci, sometimes called the streptococcus problem in the tropics. Although bacteriology thought movement epistemological assemblages of main research topics occurred in the 1942-43 academic year, their research program schema was well delineated since the first year of the era (1941-42), and consisted of two main lines of investigations: first, completion of the study on the hemolytic streptococci isolated from the

throat of normal monkeys, which were found to be of human origins; and second, continuation of the long line of work on Brucella and brucellosis. They also conducted chemotherapeutic studies on experimental Brucella infection in mice (with sulfa drugs class antibacterial, sulfanilamide, and with the sulfamidic antimicrobial, sulfamethythiazole) and animal experimental studies on the pathogenic bacterium Welchii infection, a common cause of food poisoning (with sulfa antibacterial drugs, sulfanilamide and azosulfamide). Other collaborative investigations were on experimental schistosomiasis in the guinea pig with parasitologist W.A. Hoffman and on experimental leprosy in rats with pathologist C.A. Krakower. These experimental animal leprosy studies, which continued for several years until 1944-45, were a source of frustration and a sense of 'loss of time', because *Mycobacterium leprae* is an intracellular bacillus incapable of extracellular survival (21).

Figure 1. *Department of Mycology and Dermatology*. Archives and Special Collections at the Augustus C. Long Health Sciences Library of Columbia University, School of Tropical Medicine under the Auspices of Columbia University, Report of the Director 1938.

In the 1942-43 Director's Report, the epistemological assemblages of bacteriology main research topics were presented as a series of 'studies on'. First, there are the two main schemas of hemolytic streptococci and the Brucella group (22). Second, there are studies on the intestinal or enterobacteriae *Proteus bacilli* (usually found in fecal and other putrefying matter and widely distributed in water and soil) and the Weil Felix reaction (an agglutination test for diagnosis of rickettsial infections), with a good summary of the technical results, but unclear clinical outcomes. Third, studies were conducted on dysentery in which the department reported that it has developed a 'rapid method for the class of races of the Flexner strain or group of dysentery bacilli'. And the fourth are the 'loss of time' experimental animal leprosy studies. Different laboratory studies using the Weil Felix Reactions were included in various publications (e.g., studies on murine typhus in wild rat populations and their fleas; and experimental typhus). Several veterinary studies also were productive (e.g., cow mastitis with the United States Public Health Service {USPHS}; and a study of heavy losses in poultry in 1943 that was the consequence of feeding animals with high salt foods) (23).

During the years of this last era other epistemological assemblages of research topics were added as reconceptualization of previous particular studies: a) the already mentioned studies on murine typhus of rats in San Juan; b) studies of enteric bacteriology (diarrhea and intestinal infections) of the salmonella group (food poisoning) and shigellosis infections; and c) another variation of enteric studies, under the label of typhoid fever, a bacterial infection also due to *Salmonella typhi* and *Eberthella typhosa*, including a study of a recent epidemic in 1948. A new research category was included in 1944-45, under the name of 'studies on bacteriophage', that initiated with a survey of city sewages as a prelude to animal experimentation with phages (a virus that infects and replicates within bacteria and archaea microorganisms). The research schema associated with viruses emerged in the last two years of the era before the closure of the School. It started with the establishment of a specific research laboratory within the department. The studies performed concentrated on influenza: an epidemic of 'obscure etiology' in Patillas, but with negative influenza results; a cooperation with the U.S. armed forces in a presumptive influenza outbreak also with negative outcomes; and a study of the "Coamo strain" Type A Influenza in 1948 (24).

Bacteriology maintained an active research profile and a public health visibility throughout the STM scientific epistemological field. It consistently fostered and nurtured laborious work, innovative research investigations, and public health compromise (in veterinary and human medicine). In a sense, it fulfilled with definite limits some of the earlier aims and expectations of the School in relation to studies on tuberculosis, dysentery and other epidemics. Nevertheless, bacteriological science at the STM was associated mainly with the research schemas of hemolytic streptococcus and veterinary studies on brucellosis, with the first being its paradigmatic case.

E. Chemistry and Nutrition

With respect to chemistry, the thought movement mentioned above occurred during 1944-45 and 1945-46, but there were some clear areas of research programs since the start of the last era in 1941. The 1940-41 Director's Report mentions that one of the main research lines of investigation of the department was completed: the studies on the nutritional value of Island forage crops, which were financed during the previous four years with funds that were appropriated under

the Bankhead Jones Act through the Agriculture Experiment Station. The report concluded that this research contributed a "fund of knowledge" on feeding and care of domestic farm animals on the Island. After the end of this first line of research, a second research program started, partially financed by the Insular Departments of Agriculture and Commerce, on the chemical composition and nutritional value of fatty oils of native plants and fruits (e.g., avocado, soursop or *guanábana*, papaya, grapefruit seeds, tropical almond). This research was strengthened by the establishment in 1941-42 of a phytochemistry laboratory (i.e., chemicals derived from plants) by C. Asenjo. The projects on native oils also included studies of shark liver oil (provided by Fisheries Laboratory of Mayagüez), higuereta castor seed oil (it has antibacterial and antifungal properties), and *Sterculia* sp. seed oil (from the Island's widespread "anacaguita" tree). An ethnobotanical variant of these investigations included studies on other native plants in 1943-44, with presumed healing properties: a) the antibacterial "maya" juice (*Bromelia penguin L*); and b) the antimalarial plant "molinillo" (*Leonotis nepetifolia L*). A third important research line examined the physical effects (i.e., on growth, reproduction and bone calcification) of low vitamin diets (E, A) in experimental animals (i.e., albino rats and monkeys). It was propitiated by the incorporation in 1941 of chemist Marianne Goettsch from Columbia University. A fourth research program was on vitamin content (e.g., riboflavin or vitamin B_2) of native foodstuffs (30 foods), carried out in collaboration with the UPR Agriculture Experiment Station.

As mentioned above, the 1944-45 Director's Reports organized these lines of chemistry research under two epistemological assemblages: a) 'studies on nutrition' (e.g., yeasts, tropical oils, vitamin A, riboflavin or vitamin B_2 and thiamine or vitamin B_1 content of tropical fruits); and b) 'studies on native plants' (e.g., "molinillo," "maya" fruit). The 1945-46 report differentiated the topic of 'studies on edible yeasts' ("levaduras comestibles"), which signaled its new distinctiveness and significance. Interestingly, the 1946-47 Director's Report readdresses a list of several research topics-a regressive chemistry epistemic turnover-such as diets of rice and beans (with experimental animals), edible yeasts (with rats), heat effects on the nutritional value of yeast, vitamin E deprivation of the monkeys, vitamin content of tropical foods, and a clinical study of excretion of fecal fat in sprue patients. The 1947-48 report somewhat follows this previous descriptive path, but reinserted some of the oldest and newest general headings: 'studies in nutrition' (with experimental animals), 'studies on nitrogen metabolism', 'studies on the vitamin content of tropical foods'(e.g., niacin-a form of vitamin B_3-and 'carotene'-a precursor of vitamin A-content in common diets), 'studies of folic acid' (requirements of the rats), 'phytochemical studies'(of sugar cane peel wax, and the medical botany doradilla fern), and a clinical study of two patients with chyluria (presence of chyle-milky lymph/fat fluid in the urine) who were given mineral oil as a laxative or as an emulsion. In general, the last Director's Report in 1949 maintains the approach and content of the two previous reports, including the study on the excretion of fecal fat by normal subjects and sprue patients in cooperation with the clinical medicine department (25).

The vitamin studies of the last STM scientific era (i.e., low vitamin diets in experimental animals and vitamin content of foodstuffs) were the epistemic extensions of the nutritional and deficiencies studies in the common Puerto Rican diet of the first two research periods. At the end, the epistemological research field of chemistry seems to be bound at both historical limits by vitamin exemplar of knowledge studies: from the first STM scientific publication in 1927 by D.H. Cook on "Vitamin Studies in PR", to the 1946 iconic article on the high ascorbic acid content of the West Indian cherry ("acerola") by C.F. Asenjo and A.R. Freire de Guzmán.

F. Parasitology

During the war years (1941-45), the research field of parasitology was structured poorly, and was comprised of lists of individual studies, some of which were carried out by faculty members from the School or from the UPR Campus in Río Piedras. Others responded to the particular needs of outside investigators, either from a U.S. University (i.e., Howard Medical School), or from the local Armed Forces medical corps and the USPHS, or from the Agriculture Experiment Station (26). However, some of the topics of these studies were going to be part of main research lines of the Department during post war years (1945-49), such as immunological diagnosis, chemotherapeutic treatments, and biology and ecology of parasites and their intermediate hosts. It is significant that all the investigations during this period (from the Report of the STM Director ending on June 30, 1945 until the last report of 1949) were organized under the following research categories: a) studies on *Schistosoma mansoni*; b) studies on filariasis; c) investigations of other parasitic infestations; and d) studies on vector arthropods (mainly insects).

Since parasitology was the leading tropical medicine science in P.R., from the perspectives of scientific investigation and the history of science, we will concentrate on the two most important research schemas of this final STM era: filariasis (27) and schistosomiasis (28).

1. *Filariasis*

A preliminary analysis of the interconnections of the available two decades of filariasis research papers presents a unique phenomenon. First, the set of articles is elucidated better through the historical notion of moments and conceptual links instead of phases or stages (29). Second, several subsets of correlated research studies create nets and strands across periods which generate modules that mix particular scientists and specific lines of research problems. Third, the central dynamic module that interconnects and illustrates almost the entire network is the diverse work of visiting professor F.W. O'Connor (~1927-1935), which becomes the necessary reference for the

majority of the studies, irrespective of periods. Fourth, the analysis then brings forth a kind of matrix or complex network of scientists/problems. We will provide an illustration of this scientific schema.

The first period (1927-1930) presents the primordial essay of O'Connor (1927) and the correlated works of W.A. Hoffman, R.A. Marín, and A.M.B. Burke (1928), but it is the O'Connor and G.R. Burke (1929) article on lymphangitis and filariasis, and the O'Connor (1929) experimental treatment paper, both previously mentioned, that generate several strands that map across future moments. For example, the O'Connor and G.R. Burke article establishes the model for a variety of future research ventures (e.g., surveys, collection of biological materials, clinical clarifications); and the O'Connor experimental treatment resonates in elephantiasis and recurrent lymphangitis studies. It has to be noted that the previously mentioned 1935 O'Connor and C.R. Hulse study on filariasis in Puerto Rico, which includes studies that were carried out in three distinct periods (between 1929 and 1930), constitutes an epistemological state-of-the-art kind of review. Also, an operation for elephantiasis known as Auchincloss or modified Auchincloss (1930), based on an interesting study by O'Connor, R. Golden, and H. Auchincloss (1930) on roentgen demonstration of calcified filariae in human tissues, stimulated several surgical treatments (30). This analytical schema looks promising to approach the actual tangles, richness and voids of this kind of research.

The filariasis schema analysis shows that there is a void in publications between the first three historical moments (i.e., 1927-1930, 1931, and 1932-1939) that will be revived with four articles in 1946 (31). Finally, there is a 1947 article on chemotherapeutic treatment of 26 patients hospitalized because of filariasis with oral Hetrazan (antiparasitic agent diethylcarbamazine, still used in filariasis treatment), by faculty members D. Santiago Stevenson and J. Oliver González in collaboration with R.I. Hewitt from Lederle Laboratory-with positive results against blood microfilariae and some adult worms. There are still referential vestiges of O'Connor, A.M. B. Burke, and Hoffman, Marín and Burke studies within the filariasis surveys and family studies, but not on the chemotherapeutic ones of this final moment in 1946-47 (32).

The 1941-42 and 1942-43 Director's Reports did not mention any research on filariasis. The 1943-44 Report discusses a filarial survey of the inmates of the Insular Home for Girls, which was published in the 1948 STM Journal, but it refers to the incidence of filariasis bancrofti in government institutions for children on the Island (33). The Director's Reports between 1944-45 and 1948-49 include the following studies on filariasis: immunological skin tests studies for army personnel in Panama and San Juan under the leadership of army medical corps Z.T. Bercovitz (2 studies); incidence of microfilariae in clinical cases (1 study, by STM faculty F. Hernández Morales); experimental animal filariasis studies (3 studies) (one with cotton rats, one with rabbits-'not encouraging', and one with rats and dogs); chemotherapeutic studies (6 studies- 'encouraging and positive results' with Hetrazan); and prevention and control studies (one study at the Boys and Girls Charity School, and one at the Insular Home for Boys, with Hetrazan used for treatment and prevention of infestation) (34).

In conclusion, the theoretical historical notions of moments and conceptual links demonstrate the transcendental significance of the work of visiting professor Francis W. O'Connor on tropical filariasis. It also opened the pathway of alternative microhistory ways of looking at and reviewing times past.

2. *Schistosomiasis*

G.V. Hillyer's history of schistosomiasis in P.R. reviews the 1940s decade, and emphasizes three aspects: a) the results of the "largest stool survey" in P.R.'s history (1945) as reported by T.H. Weller and G.J. Dammin from the U.S. Army Medical Corps (19,139 Selective Service Puerto Rican registrants apt for military service; age range: 18-38 years; incidence: 10%); b) studies on the biology of *Schistosoma mansoni* and its host in different forms and mediums, particularly by J.F. Maldonado (STM, Dept. Clinical Medicine); and c) the international use of the "Puerto Rican strain of *S. mansoni*" in experimental schistosomiasis studies: "the use of ...P.R. isolates has driven greater progress in the field... than any other geographic isolate" (35). A useful historical timeline from a worldwide perspective on schistosomiasis research during the 20th Century, based on K.S. Warren, has been included in the references section (36).

An examination of research reports and faculty publications at the STM show the existence of the following historical moments on schistosomiasis studies during the last era: first, a period of pathological studies, which became depleted towards the end (1940-1943); second, the phase of an abundance of clinical studies (1944-1945); third, an upsurge of several chemotherapeutic trials and a correlated community control intervention (i.e., Los Peña) in 1946, made possible by a contract with the National Research Council; and a final age (1947-1949) characterized by the continuation of the field control intervention and a variety of research investigations (i.e., biology studies, diagnostic tests, clinical effects of drug tests, surgical treatments, clinical techniques and public health biological control measures), which are indicators of the richness of a solid scientific epistemological tradition.

Pathological studies prevailed during the first years of the period. For example, pathologist C.A. Krakower studied the effects of physical and chemical changes on schistosomal cercariae (i.e., infective larval form) in 1940, and noted in particular the detrimental effects of sunlight and ultraviolet light (UV) under experimental conditions (UV "permanently injures the cercariae after 20 minutes of exposure and is lethal within 45 minutes... strong sunlight has almost the same effect": 43). That same year, Krakower, Hoffman and Axtmayer methodologically showed that the albino rat is a suitable host for the study of resistance to infestation by *S. mansoni*-today it is known that different animal species (e.g., mice, rats and rhesus

Figure 2. *Laboratory for research in pathological anatomy and virus diseases*. Archives and Special Collections at the Augustus C. Long Health Sciences Library of Columbia University, School of Tropical Medicine under the Auspices of Columbia University, Report of the Director 1938.

monkeys) are resistant to reinfection with *S. mansoni*. They also demonstrated that a modification of the method for examination of *Trichinella spiralis* was effective to differentiate live from dead worms in infested host tissues. E. Koppisch published a study in 1941 based on 147 autopsies on the histopathological characteristics of schistosomiasis and the pathological states of the disease (e.g., hepatic and colonic in the beginning). Most pathological effects are due to deposition of ova in tissues, such as colitis, cirrhosis and, eventually, spleen enlargement (37). Two emblematic events marked the end of these first years of the era. First, in the 1942-43 Director's Report the following epistemological statement was asserted: with "some assurance... *Australorbis glabratus* is the only intermediate host of *S. mansoni* in Puerto Rico, and possibly in the Western Hemisphere": 44. Second, E. Koppish delivered a clinical lecture on Manson's schistosomiasis in 1942 at the annual meeting of the American Medical Association in Atlantic City, which summarizes the state of knowledge at the time (38).

The years 1944 and 1945 encompassed a transformational stage in which clinical research carried out by the Department of Clinical Medicine will surge and predominate (e.g., tropical medicine physician F. Hernández Morales), sometimes in collaboration with the Medical Zoology department (e.g., Head J. Oliver González). The 1944-45 Director's Report mentions two main research aspects: a) the biology of the intermediate host (*A. glabratus*), and b) observations on intradermal precipitin reactions to antigens (of both cercaria and adult forms), which were carried out in cooperation with the chemistry department. The 1945-46 report mentions the following research topics: a) diagnostic skin test studies were completed, and b) research on the efficacy of certain therapeutic drugs is underway, in collaboration with clinical medicine. Interestingly, the report states that intramolluscan life cycle phase studies are being conducted to fill 'gaps of knowledge', and that an educational film on schistosomiasis disease has been produced-both aspects could be deemed as exemplars of knowledge (39).

The schemata of chemotherapeutic studies was originated in 1946, based on a contract with the National Research Council. The plan was centered on testing several antimonial drugs and included three aspects. First, an initial survey of an endemic area (i.e., Los Peña community, *barrio* Sábana Llana, Río Piedras) was done, with the main purpose of finding "sufficient patients" with schistosomiasis to be chosen for hospitalization and drug testing-this is another variation of the earlier tropical medicine discourse on abundance of material, but now became a kind of strong biopower exertion about the use of induced recruitment of medical bodies. Second, drugs were tested on experimental animals infested with the disease and were to be carried out in conjunction with testing in humans-but the results were "not gratifying", except for three antimony compounds with 'better results' (i.e., Urea Stibamine, Stibanose, and Neostibosan, which also were used for leishmaniasis and filariasis). And, third, actual testing of chemotherapeutic drugs was done on patients with schistosomiasis (40).

As mentioned above, the final STM stage of research on schistosomiasis (1947-49) was a period of continuity and episteme stamina. First, after two or three years of intervention, prevention and control measures in the Los Peña community, the studies showed the following outcomes: reduction of schistosomiasis incidence (from 45% to 9%; with antimonial Fuadin treatment), improvement of sanitary conditions (but still inadequate water supply), establishment of a medical dispensary in the area, health education activities, and positive but yet unexplained biological control results (diminution of snail population by introduction of the guppy *Lebistes reticulatus*-in laboratory conditions the guppies fed on the egg masses that contained young snails and on cercariae liberated from snails). Second, various biology studies were completed or underway (i.e., longevity and infestations of the miracidium; ecology studies of the survival and behavior of schistosoma ova; study of the intramolluscan phase; and, still in progress, investigations of infested laboratory animals with cercaria from natural infested animals). Third, studies related to two other problems of immunological diagnosis by intradermal reactions had been completed (i.e., non reduction of potency after storage for one year and positive skin reactions still obtained 18 months after treatment). Fourth, 'the cercarial antigen for diagnosis developed in the department were being commercially prepared by a local firm'-the last 1949 Director's Report did not elaborate on this information. Fifth,

the laboratory study of the guppy was published and then used in field biology control measure (i.e., Los Peña). Finally, two important studies were devised and commissioned: 1) a plan designed by the University Hospital and Lederle Laboratories to treat hospitalized patients infected with bilharzia with Hetrazan (a diethylcarbamazine antiparasitic medication discovered in 1947 and used worldwide in the treatment of certain filarial diseases and other diseases transmitted by insects), Aureomycin (a tetracycline antibiotic discovered in 1945 by B.M. Duggar at Lederle) and a combination of both drugs; and 2) a survey of endemic foci of main bodies of fresh water on the Island for the presence of the snail host was conducted in March 1949 with interesting results: 'in only 3 places were infested snails found, in 6 other all snails were uninfected, and no snails were found in previously established foci' (41).

Filariasis and schistosomiasis were the two main tropical disease research schemas at the STM. Of the two, schistosomiasis definitely is the research paradigm of tropical medicine on the Island. Its epistemological field, which extends for many decades, goes back in time from the 1904 identification by I. González Martínez of the existence of human schistosomiasis in Puerto Rico and in the Américas, passes through the experimental demonstration by W.A. Hoffman in 1927 that *Australorbis glabratus* (*Biomphalaria glabrata*) is the schistosoma snail intermediate host in Puerto Rico and in the Américas, and projects to the 1954 development by J. Oliver González of the schistosomiasis circumoval diagnostic test used worldwide.

Conclusions: History of Sciences at the STM

The third and last STM scientific era (1941-1949) starts with the disruption of medical research and clinical services as consequences of war activities and efforts. Significant leadership changes also occurred at the School. A Puerto Rican medical bacteriologist became the School's director and the faculty experienced the parting of ways of two salient scientific founders. A new generation of eminent scientists became heads of the two departments with the most distinctive epistemological research fields at the School (i.e., medical zoology and chemistry). The iconic exemplar of knowledge chemistry article on the ascorbic acid contents of the *acerola* was published in 1946. During this stage, clinical medicine research benefited from an academic relative distance of its medical services arm, and it also evidenced a significant research technical turn which contributed to the advancement of clinical studies on tropical diseases. Pathology and public health were more devoted to personnel training, with pathology overburdened by routine services and public health focused on organizational and educational tasks.

In terms of establishing significant and enduring research schemas, the last scientific era could be distinguished by several investigative disciplinary epistemological fields. First, the domain of parasitology was marked by epistemic studies on filariasis and schistosomiasis, while also building a tradition of immunological studies on trichinella. Second, chemistry conducted longstanding studies on nutrition and native plants (including Island forage crops, fatty oils, and medicinal plants and fruits), and achieved a singular vitamin research episteme. Third, bacteriology was characterized by studies on streptococcus and animal brucellosis, with an active public health visibility and images of diversity. And, fourth, dermatology obtained worldwide recognition with studies on dermatomycoses, particularly chromoblastomycosis as an exemplar of knowledge. With respect to treatment and control studies, this is the era of multiple chemotherapeutic studies shielded by public health motives and overshadowed by utilitarian ones. Field public health studies carried out by different departments (e.g., clinical medicine, medical zoology) or through interdepartmental collaboration also seem to constitute noteworthy research schemata to be further examined in coming historical investigations.

On conceptual history, the organization of investigative reports by assemblages of main research schemas shows that dermatology, bacteriology and parasitology were the disciplines with the earliest vision and clarity of their own epistemological scientific fields. Chemistry constitutes an unresolved mystery, first, because it regressed conceptually to a mere list of research activities in its reports, and, second, the clinical medicine department practice implemented an unusual independent research schema on vitamin studies with its own resources without the participation of the chemistry department, an event that goes against the STM essential attribute of research collaboration. However, on this last matter, looking instead to the clinicians' practices, then the disputed question could be how the mere acquisition of a technique (a biophotometer apparatus) could inflect a paradigmatic domain of a basic science and bend an institutional context of an ideal and real research principle.

Research principles or strategies included a variety of key and pivotal sets of conditions, practices and elements. There was a presence of notable research policies, such as: a) trained workers with free time for investigations (research assistants); b) Columbia's significant policies of visiting professors, personnel development of research assistants, technicians and graduate students, and faculty leave of absences for additional ancillary education; c) the use of grants and fellowships to initiate research programs with long term aims; and d) the judicious policy of recurrent visiting professors that substantially collaborate to enable the start and development of an epistemological investigative field (e.g., serological diagnosis of tropical diseases, a diverse and rich domain of clinical studies on filariasis that infused future research for decades, and mycological and entomological international collaboration in the identification and collection of species) with the purpose of mobilizing the institution to investigations of vital health conditions or important public health problems.

The strategy of acquiring particular techniques and apparatus, establishing new special laboratories or recruiting specialized personnel to potentiate research capacity and develop new areas of studies constituted a kind of fundamental historical

technical turn in some disciplinary areas (e.g., phytochemistry, and clinical medicine vitamin studies). The perennial existence of peculiar research approaches to the study of clinical cases of tropical diseases was manifested in two medical disciplines: dermatology (gradual collection of cases of uncommon fungal infections) and pathology (summaries of autopsies performed during several years). The fascinating end images of publishing analogous series of studies at different periods were present in several research areas across the STM lifetime (e.g., studies on parasitic infestations, nutritional studies, health and socioeconomic studies). Methodological, technological, animal experimentation, biology of parasites and their vectors, health surveys, entomological and field studies were critical enduring research elements in the evolution of science at the institution since its foundational years.

Extraordinary contingencies sometimes created paradoxical conditions to do investigative work. For example, first, with negative undertones: research disruptions due to war activities and plans for transferring the Primate Colonies to the HD because of economic constraints. Second, with positive overtones: the establishment of the Blood Bank because of war efforts. Third, with ambiguous connotations: faculty gained time for research as a result of the temporary closure of the hospital for remodeling, and the leadership changes after the parting of ways of parasitologist G.W. Bachman and chemist D.H. Cook. And fourth, tragic situations that ended with positive resolutions: the creation of the Division of Biophysics and Radiation Studies after the accidental death of meteorologist O. L. Fassig and the change in leadership after the shocking death of parasitologist A. W. Hoffman. Bachman's kind of forced departure opens the question of a widening progressive breach in the STM scientific community that reflects the administration and practices of science at the School.

The closure of the School left some unfinished undertakings. The most important is the unfulfilled promise, considered since 1938, to create a Department of Physiology, which never saw the light of day. The absence of the physiology organization could not be completely satisfied by several departmental initiatives, such as: a) some early biophysical studies on tropical climatology, and b) two new research schemas that emerged just before the closure of the School from a series of dermatological studies on the physiology of fungi and animal physiological research on the effects of diets by the clinical medicine department. Although there were other minor glimpses among scattered research at the School, the physiological research void definitely must have had theoretical and practical repercussions in the underpinnings of the field of tropical medicine in Puerto Rico.

Mishaps in research today usually are hidden because negative results typically remain unpublished. Historical research reports offer a unique opportunity to unveil scientists' frustrations with these kinds of nonsuccesses. Two STM anti exemplars of knowledge have been reviewed previously. One is the experimental animal leprosy studies which continued for several years and provoked a sense of loss of time because the leprae bacillus is incapable of extracellular survival. The other is related to the initiation of virus research at the School by the departments of pathology and bacteriology. However, this last kind of anti exemplar is more complex. Pathologist E. Koppisch did a laudable effort in training with an international expert in the pathology of the herpes virus, but may have found that animal virus research and work with the herpes virus were surrounded at the time with technological limitations and epistemological deficits difficult to overcome-it could be said that the laboratory conversation about viruses was at least indirect and filled with uncertainty. Second, bacteriologist P. Morales Otero and colleagues established a special virus laboratory (as did the department of pathology) and concentrated on the epidemic aspect of the influenza virus. After collecting laboratory samples from patients living in communities presumed to be affected by an influenza outbreak, the common reported laboratory finding was 'negative for influenza'-in this case probably reflecting the difficulties embodied by the unstable genetics of the virus and the prevalent uncertainties of virological tests. Nonetheless, they reported in 1949 that a new strain was under study, the "Coamo strain of influenza virus," which until the present time is considered as one of the prototypical forms of the influenza strains. Our final example of a research mishap also is associated with research work by E. Koppish, but now it implicates the established negative knowledge that rabbits were found to be a 'bad animal model' for schistosomiasis research on hepatic and pulmonary fibrosis. On this occasion, the problem resided in not asking a pertinent, but at the time not so obvious question: what immunological basis offered some kind of resistance to infection protection to the rabbits? (42).

Several theses have been generated thanks to the intensive and systematic narrative on the history of science at the STM. A curious kind of colonial reciprocal 'peripheral precedence' case occurred on the priority issue of the first identification of bilharzia by a Puerto Rican physician vis à vis the misconstrue of two U.S. medical scientists at the STM. The other occurrence was the identification of the intermediate host of schistosomiasis by one of the School's medical scientist vis à vis the unsound claims of the Puerto Rican medical scientist. Interestingly, the research collaboration between the School's chemistry department and the Agriculture Experimental Station constitutes an open pathway for a historical study on the two main discernible scientific colonial ambits under the influence of the metropolis: tropical medicine and tropical agriculture (43). This is attributable to their shared epistemological botanical field of plants with healing properties and farm animal forage crops.

The microhistory approach proved to be a rich and stimulating cognitive path to examine particular and general questions. The analytical framework of research schemas, exemplars of knowledge, and epistemological fields propitiated in the author a better and auspicious sense of historical representations and understanding of the practices of science at the STM. The development of other time evolving models, such as the notion

of historical moments, also enriched the conceptualization of the periodization of diverse scientific events and processes, which complemented the practical use of the traditional model of analyzing by stages.

So far, these studies on the history of tropical medicine in Puerto Rico offer pertinent and sufficient indications to postulate an 'enriched thesis' on the different kinds of paradigmatic diseases of tropical medicine on the Island during the 20th Century. Uncinariasis is the *public health paradigm* in the first decades of the century, characterized by the campaigns of the Anemia Commissions, while we will demonstrate in a future article that malaria is the public health paradigm during the middle decades of the century until its eradication in 1962. However, the present study has made the case that schistosomiasis is the *scientific research paradigm* of the golden era of tropical medicine on the Island. Of course, both types of paradigms shared common historical periods, and significant public health and scientific features.

Pathologist R. A. Lambert became the first STM director in 1926, the foundation year, and near the closure of the School in 1949, pathologist E. Koppisch became the interim last director of the School of Tropical Medicine. In between, the directors were the genealogical triad of basic and clinical medical scientists: bacteriologist/virologist (McKinley) -parasitologist (Bachman)- bacteriologist turned virologist (Morales Otero). It is thought provoking, first, this unveiled weak but persistent image of the presence of virology in the leadership of the School. Second, that Koppisch, the last director, unknowingly even to some actual colleagues, trained as a virologist in Europe. And, third, that the early and uncertain scientific turn of pathology and bacteriology toward a schema of research on virus infections constituted a historical mark or signal of what will essentially become the current public health paradigm of tropical medicine in Puerto Rico (e.g., the *Aedes aegypti* triad of dengue, chikungunya, and zika), although still unrecognized by many physicians and scientists. The historical notion that parasitic infections were things of the past contributes to this misunderstanding. The excitement and fascination of the history of medical science and further substantiation of the tropical obliviousness thesis in Puerto Rico… marvels and shadows (44).

The next article of this serial collection will present a diagrammatic representation on the special technical studies of the sciences at the STM (e.g., epidemiological, methodological, immunological, biological studies, chemotherapeutical, and entomological and public health field studies). These representations open a pathway to better understand the intricate interrelationships between the *techné* and the *episteme* horizons of tropical medical science.

Resumen

Este ensayo analiza las representaciones científicas que emanan de la historia de las ciencias que se establecen y evolucionan en la Escuela de Medicina Tropical (EMT) de la Universidad de Puerto Rico bajo los auspicios de Columbia University (1926-1949). En él se examinan las investigaciones que la facultad llevó a cabo, el desarrollo de los programas de investigación, y la evolución de la producción y el conocimiento científico. Las fuentes documentales de la investigación son los informes académicos y de investigación, y las publicaciones en revistas externas y locales. Los resultados del estudio se presentan en una serie de cuatro artículos: las imágenes de la ciencia, la evolución de la ciencia en las primeras dos etapas (1926-31 y 1932-40), el desarrollo en la tercera y última etapa (1941-49), y estudios especiales. El enfoque analítico se instrumenta mediante las nociones científicas de esquemas de investigación, ejemplares de conocimiento (paradigmas), y epistemes (campos epistemológicos). El proceso de evolución de las ciencias se organiza utilizando el modelo de etapas históricas, aunque cuando los eventos y procesos lo exijan, se emplean otros arquetipos de devenir (p.ej., momentos históricos). Este es el tercer artículo de la serie y versa sobre el desarrollo científico en la última etapa histórica de la Escuela, en un contexto en la que la parasitología se transforma en la ciencia paradigmática de la medicina tropical en Puerto Rico. El estudio postula la existencia de diferentes ciencias paradigmáticas de la medicina tropical en Puerto Rico y sostiene la fisura/olvido de lo tropical.

References

1. On Hoffman's death, the STM Director Morales Otero expressed the following: "The tragedy surrounding Dr. A.W. Hoffman's death remains fresh in our minds and the shock of its unexpectedness a heavy blow. For sixteen years Dr. Hoffman has been associated with the School-a definite part of the school life-... He had known the institution in its infancy and had helped to make it grow; he had worked along with it and identified himself closely with its life and ambitions... His colleagues mourn the loss of a friend and of a valued scientist." Morales Otero P. STM Report of the Director for the period ending June 30, 1943: 11. On Cook's leave, see: "Dr. D.H. Cook, Head of the Department of Chemistry, will be absent of leave during the coming academic year 1943-44 and will return to the Department of Chemistry at Columbia University to take part in its teaching program." Morales Otero P. STM Report of the Director for the period ending June 30, 1943: 12. On Bachman's replacement, see: "While Bachman was the director… only he and four or five other investigators were paid by Columbia University. The Puerto Rican employees felt that they were discriminated against and that they lacked voice in the operation of the School; this dissatisfaction led to the replacement of Bachman by a Puerto Rican. Columbia University then withdrew its support and left the island": 1488-not immediately. Windle WF (1980). The Cayo Santiago Primate Colony. Science 1980;209:1486-1491.
2. On Asenjo and Freire de Guzmán's achievement, see: Asenjo CF, Freire de Guzmán, AR. The high ascorbic acid content of the West Indian cherry. Science 1946;103:219. Asenjo CF, Moscoso CG. Ascorbic acid content and other characteristics of the West Indian cherry. J Food Sci 1950;15:103-106. On the circumoval test of Oliver-González, see above reference number 34. Also, it has to be noted that one of the most important scientific contributions of Oliver González in the area of immunological diagnosis was his discovery in 1941 of the dual antibody basis of acquired immunity in trichinosis, already mentioned: Oliver González J. The dual antibody basis of acquired immunity in trichinosis. J Infect Dis 1941;69:254-270. On this contribution, of significance for immunological diagnosis (e.g., Precipitin Test), Faust and Hussell mentioned: "Oliver González (1941) discovered that there are two types of antibody reaction

in trichinosis, one which is anti larval and one anti-adult." Faust EC, Russell PF. Graig and Faust's Clinical Parasitology, 7th Ed; Philadelphia; Lea & Febiger, 1964:1009.

3. Bachman GW. STM Report of the Director for the period ending June 30, 1941:15.The report also states that, in particular, the shortage of personnel 'has handicapped to a considerable extent' the work of the Department of Bacteriology: 15.
4. Morales Otero P. STM Report of the Director for the period ending June 30, 1942: 5-6. The STM "was to be the center for such work": 6.
5. Morales Otero P. STM Report of the Director for the period ending June 30, 1943: 5. On other war effects, see also: a) In 1944 the induction into the armed services of all men of military age continued to confront the School with "the serious problem of replacement," in particular of trained and experienced personnel. The report says that every department "has had to run at low gear." Interestingly, the University Hospital "had been fortunate in securing several excellent women physicians," mentions the report. Also, the war aggravated the already serious problem of lack of replacement of the nursing staff that was moving to the mainland before the war looking for better salaries and positions. On research laboratories, the report mentions: "The laboratories, where so much time and patience is required before an individual can be of definitive scientific value to the School, have also had to face a steady turnover after request for the deferment of technical personnel were no longer acceptable": 5. Morales Otero P. STM Report of the Director for the period ending June 30, 1944: 5-6. b) In 1945 the nursing situation was characterized as worsening progressively. The continued induction into the Armed Forces now included all resident physicians of the University Hospital and the affiliated Bayamón District Hospital. The scarcity of nurses is partly explained as follows: i) inadequate number of graduate nurses available, ii) "egress" to the U.S. and Armed Forces, iii) high demand for "special duty nurses" well remunerated, and iv) "lack of living quarters for nurses in the University Hospital": 6. The affiliation between the University Hospital and the Bayamón District Hospital of the HD was deemed necessary for accreditation purposes (by the American Medical Association) because of the University Hospital limited bed capacity (STM Report of the Director for the period ending June 30, 1946: 6). Morales Otero P. STM Report of the Director for the period ending June 30, 1945: 6-7. c) The 1946 Report of the Director states that 'normal times' were returning gradually. The School and the Hospital still suffered from severe scarcity of indispensable materials. Some personnel started to return from the armed forces services, improving the situation of a "steady turnover" of the staff. The most serious problem of nursing insufficiency, which almost caused the closing of the Hospital, continued but started to improve. The School "is anxious to go back as quickly as possible to its peacetime programs," and there was hope "that efforts to maintain the standards of the University Hospital at their prewar level may not be wholly fruitless during the coming year": 5. Morales Otero P. STM Report of the Director for the period ending June 30, 1946: 5-6. d) In 1947 the problem of nursing was apparently "solved to a large extent" by the establishment of living quarters and a salary increase offered to all government employees. Morales Otero P. STM Report of the Director for the period ending June 30, 1947: 5-6. However, a year later it is again mentioned in conjunction with a scarcity of physicians. Morales Otero P. STM Report of the Director for the period ending June 30, 1948: "The University Hospital continued its services, hampered by the ever present struggle to obtain the adequate number of physicians and nurses for efficient functioning": 7.
6. For operational interpretative ends in this study, see: a) conceptual 'schemas' (like a research program) refer here to 'plans, patterns, and structural forms' according to which theories and information are organized: Zalamea F. Albert Lautman and the creative dialectic of modern mathematics. In: Lautman A. Mathematics, Ideas and the Physical Real. Transl. S.B. Duffy; London and New York; Continuum International Publishing Group, 2006: xxiii xxxvii; b) 'paradigm' is used here in a concrete and precise manner to refer to 'exemplars of knowledge' by which a community of scientists reflects a compromise with a 'scientific practice': Hacking I. Introductory essay. In: Kuhn TS. The Structure of Scientific Revolutions, 50th Anniversary Edition; Chicago; The University of Chicago Press, 1962, 2012: vii xxxvii; and c) 'episteme' is considered here as a set (bundle) of relationships by which 'discursive practices' acquire a 'form of unity' as 'figures, sciences, or epistemological systems'. Foucault M. Arqueología del saber; México D.F.; Siglo XXI, 1969, 1970. Reflecting a research conceptual plan (schema) and underlying a corresponding set or network of exemplars of knowledge (paradigm) there is an episteme (like a discursive cognitive or epistemological field). Gómez Marín R. De las nociones de paradigma, episteme y obstáculo epistemológico. Revista Co-herencia 2010;7:229-255.
7. Rappleye W.C. Report of the Dean of the School of Medicine for the period ending June 30, 1944: 64. On the temporary transfer of the Santiago Primate Colony, see: Windle, The Cayo Santiago Primate Colony: 1488; and: "After the School of Medicine of the University of Puerto Rico was established, it was given jurisdiction over the colony in 1950"-until today: 1489.
8. Bachman GW. STM Report of the Director for the period ending June 30, 1941: 25-27.
9. Morales Otero P. STM Report of the Director for the period ending June 30, 1942: 31-32.
10. After the academic year 1945-46, pathology's own research diminished substantially and its participation was in collaborations with other School departments and institutions; such as: a) Medical Zoology: experimental infestation with Platynosomum fastosum (cat liver fluke), experimental Trichinella spiralis in the rat, and pathogenesis of schistosomal lesions in animal infestation; b) Chemistry: 'injurious effects of certain yeasts' on the white rat liver, (and Medical Zoology) and effect of diets on the course of schistosomal cirrhosis on liver of experimental animals; c) Bacteriology: pathogenesis of lesions on experimental animal brucellosis; d) Dermatology: experimental animal fungi infections; e) University Hospital surgical division: portal hypertension in experimental animals; and f) Army Institute of Pathology: fulminant rheumatic fever (with pathological material) among Continental American soldiers. See: Morales Otero P. STM Report of the Director for the period ending June 30, 1946: 42; June 30, 1947: 44-45; June 30, 1948: 34-35; and Koppisch E. STM Report of the Director for the period ending June 30, 1949 (Typed manuscript): 38-39.
11. Morales Otero P. STM Report of the Director for the period ending June 30, 1948: 34-35; and Koppisch E. STM Report of the Director for the period ending June 30, 1949 (Typed manuscript): 38-39.
12. Bachman GW. STM Report of the Director for the period ending June 30, 1941; 20-22; Morales Otero P. STM Report of the Director for the period ending June 30, 1942: 25-29; June 30, 1943: 28-32; June 30, 1944: 38-41; and June 30, 1945: 34-37.
13. Other lines of dermatological research were added between 1944-49; such as: 1) Studies of Tropical Dermatoses (1944-1949): a) Granuloma inguinale or G. venereum-Carrión used either name in different moments-he treated genital warts (ulcers or "verrugas") with Podophyllin (a resin from the roots of a herbaceous plant) with some success, later adding antiparasitic antinomials and the antituberculosis antibiotic streptomycin; and b) the above mentioned, Pinta or mal del Pinto); 2) Therapeutic Studies of: a) Darier's disease (Keratosis follicularis), presumptively associated with a vitamin A deficiency that he treated with Afaxin (also used for diabetes) with inconclusive results; b) leprosy, which he treated with Diasone (a synthetic bacteriostatic sulfone type antibiotic used as an antileprosy), and adding streptomycin and calciferol (vitamin D_2, effective in certain skin manifestations of tuberculosis) for cases with poor clinical response as supplements; c) 'creeping eruption' (larva migrans), treated with Hetrazan (an antiparasitic agent used for worm infestations), with positive results (but not with Fuadin, a choice at the time); d) a case of lupus erythematosus that showed extensive skin involvement not responsive to the usual treatment, was 'empirically' treated with antimonial Fuadin with initial 'notable improvement', so much better that, even after additional intensive hospital treatment with multiple side effects, it still was considered 'worthy of further investigation'; and e) chromoblastomycosis, treated with Sulfamerazine, a sulfonamide antimicrobial, and penicillin, with nonsignificant results. See: Morales Otero P. STM Report of the Director for the period ending June 30, 1944: 38-41; June 30, 1945:

34-37; June 30, 1946: 39-44; June 30, 1947: 32-37; June 30, 1948: 27-30; and Koppisch E. STM Report of the Director for the period ending June 30, 1949 (Typed manuscript): 28-33.

14. Morales Otero P. STM Report of the Director for the period ending June 30, 1947: 32-33; June 30, 1948: 27-28; and Koppisch E. STM Report of the Director for the period ending June 30, 1949 (Typed manuscript): 28-30.
15. Morales Otero P. STM Report of the Director for the period ending June 30, 1942: 20-23.
16. Morales Otero P. STM Report of the Director for the period ending June 30, 1943: 34.
17. Morales Otero P. STM Report of the Director for the period ending June 30, 1943: 32-33.
18. Morales Otero P. STM Report of the Director for the period ending June 30, 1944: 25-29; and June 30, 1945: 25-29.
19. See details: This research schema continued during the 1944-45 academic years until the last year, 1949, with the addition of a 'miscellaneous' category in 1946-47 (e.g., 'treating different conditions with different drugs'; "fully cured" 'intraduodenal' treatment of intestinal beef tapeworm parasite Taeinia saginata with Hexylresorcinol-it has local anesthetic, antiseptic and anthelmintic properties) and two new research topics in 1949: 1) hematological studies (i.e., a partial study on platelet and eosinophil counts in normal persons: normal platelet counts range 'much below standard', the eosinophil study still underway); and 2) physiological research [i.e., experimental animal studies on the growth effect of high carbohydrate and high protein diets in ovariectomized (ovaries removed) Swiss mice; and the effects of low fat, low protein, low vitamin and high carbohydrate diets on growth, reproduction and blood development of male and female mice]. Throughout the years there were several additions to the already established research topics; such as: a) sprue (synthetic folic acid studies and continuation of hematological studies); b) filariasis (experimental chemotherapy studies with an arsenic containing parasitic agent, Neostibosan, and the stibamine glucose related Neostam, with cotton rats, by J. T. Culbertson and H. M. Rose from Columbia, and STM J. Oliver González in 1946); and c) schistosomiasis (e.g., diagnosis of 'great promise' by rectoscopy biopsy in collaboration with the medical zoology department). Morales Otero P. STM Report of the Director for the period ending June 30, 1945: 25-29; June 30, 1947: 25-28; and Koppisch E. STM Report of the Director for the period ending June 30, 1949 (Typed manuscript): 23-24.
20. Morales Otero P. STM Report of the Director for the period ending June 30, 1946: 33-34.
21. Morales Otero P. STM Report of the Director for the period ending June 30, 1942: 13-18; June 30, 1943: 19-24; June 30, 1944: 13-20; June 30, 1945: 17-21. In 1937 C. Krakower and L.M. González, from the STM, reported a case of natural "spontaneous leprosy" in a house mouse (Mus musculus) found wandering through their laboratory. Krakower C, González LM. Spontaneous leprosy in a mouse. Science 1937;86: 617-618.
22. On the hemolytic streptococci, see: a) 70 monkeys brought to the School from the Santiago Primate Colony, in which 32, or 45%, harbored beta-hemolytic streptococci, 23 or 71.8% of group C and no group A strains were found; b) studies in progress on streptococcal hemolysins A, B, C, G; c) in progress a 'survey of the distribution of the hemolytic streptococci in throats of insular and continental troops' in P.R.; and d) 'the antibody response to streptococcus infections in monkeys' was initiated. On the Brucella group, see: a 'successful' attempt to develop a precipitin reaction test to differentiate between veterinary bacterial infections B. abortus and ovine B. melitensis.
23. Morales Otero P. STM Report of the Director for the period ending June 30, 1943: 19-24.
24. Morales Otero P. STM Report of the Director for the period ending June 30, 1945: 17-21; June 30, 1946: 15-22; June 30, 1947: 15-19; and June 30, 1948: 14-17; and Koppisch E. STM Report of the Director for the period ending June 30, 1949 (Typed manuscript): 9-15.
25. Bachman GW. STM Report of the Director for the period ending June 30, 1941: 14; Morales Otero P. STM Report of the Director for the period ending June 30, 1942: 18-20; June 30, 1944: 20-24; June 30, 1945: 21-25; June 30, 1946: 22-30; June 30, 1947: 19-25; June 30, 1948: 17-22; and Koppisch E. STM Report of the Director for the period ending June 30, 1949 (Typed manuscript): 15-20.
26. Particular studies carried out between 1941 and 1945 were: experimental work on the value of Phenothiazine as an anthelmintic (in cattle parasites and in schistosoma infested rabbits); Endamoeba histolytica in monkeys, an intestinal parasite causing amebiasis, and its immunological diagnosis; destruction of Schistosoma mansoni cercariae by chlorination; biological studies of the liver fluke cat and of Australorbis glabratus, the intermediate host of S. mansoni; immunological studies of Trichinella antibody in rabbit serum (parasitic roundworms, causes trichinosis), and immunological relationships between Ascaris lumbricoides (parasitic in humans) and Ascaris suum (parasitic in pigs) and serological diagnosis of Ascaris in rabbits-an ascarid nematode is the most common parasitic worm in humans; Vit. C deficiency in schistosomiasis infested guinea pigs; and immunology of filariasis (Wuchereria bancrofti) and incidence of microfilariae in cases of filariasis.
27. a) On filariasis research in P.R. during the eras of interest, see the F.W. O'Connor et al. work in above references: 35, 36, 39, 41. On filariasis 'current problems' in the 1940s, from the perspective of a Columbia University public health faculty member, well known in P.R., see: Brown HW. Current problems in filariasis. Am J Public Health 1945; 35:607-613. On Wuchereria bancrofti, the species indigenous to P.R., see: Faust, Russell, Graig and Faust's Clinical Parasitology: 453-469.
28. a) For a useful history of schistosomiasis research, see: Warren KS. Schistosomiasis: The Evolution of a Medical Literature. Selected Abstracts and Citations, 1852-1972; Cambridge, MA; The MIT Press, 1973. Background: xxii-xxxii & History of schistosomiasis: xxxiii-xxxviii. For research on Schistosoma mansoni, the species endemic in Puerto Rico, see: Faust, Russell, Graig and Faust's Clinical Parasitology: 545-553. For a history of schistosomiasis in P.R: Hillyer GV. The rise and fall of bilharzia in Puerto Rico: Its Centennial 1904-2004. PRHSJ 2005;24:225-235. For a history of bilharzia from the perspective of tropical medicine, see: Farley J. Bilharzia: A History of Imperial Tropical Medicine. Cambridge, UK; Cambridge University Press, 1991/2003. Ch. 17. Conclusion: The imperial triad: 291-304. b) For a better understanding of the disease and the research, see this pertinent information: Of the three major schistosome species, Schistosoma mansoni is endemic in P.R. and in the Americas. I. González Martínez identified the existence of bilharzia in P.R. in 1904. The intermediate snail host on the Island is Australorbis glabratus (Biomphalaria glabrata), identified by A.W. Hoffman in 1927. Incidence in endemic areas could be low, but prevalence would be very high. There are three distinct clinical syndromes: initial dermatitis (within one day of cercariae penetration); Katayama fever (20-60 days after exposure, accompanied by chills, sweating, anorexia, headache, diarrhea and cough), is rarely fatal in S. mansoni; and chronic schistosomiasis (after many years), infestation may be either asymptomatic or associated with several symptoms and signs (e.g., mild intestinal or urinary tracts, liver fibrosis or liver involvement, spleen enlargement, portal hypertension, bleeding esophageal varices and other serious complications). One of the immunological diagnostic methods widely used is the circumoval precipitin test developed by J. Oliver-González in 1954. However, a definitive diagnosis is established by the presence of eggs in feces or urine, or by a rectal biopsy. Antischistosomal drug treatments vary by species and stage of disease, and problems of drugs toxicity. During the fever stage, antimonial tartar emetic (highly toxic) is the drug of choice; Warren mentions that it was the first successful chemotherapeutic drug. For later stages, less toxic antimony preparations, such as Atisban or Fuadin, are used-for S. mansoni, Fuadin is preferred. According to Hillyer, Fuadin was widely used in P.R. between 1954-1957, until chemotherapy was discontinued due to drug related deaths. Control methods used are: a) destruction of the snail intermediate host, b) treatment infection and construction of privies, and c) provision of safe water supplies.
29. A historical moment embraces diverse but singular events which, in contrast with phases or stages, could be one or few years as units of periods of time. The initial events could be, but do not have to be correlated; however, they could be mixed or interconnected in their conceptual projections

to future events and moments. Here, the use of the notion of moments is a dynamic concept, not necessarily fulfilled by temporal linearity. The historical concept of moments, as it also deals with time changes, maintains a sense of evolving directionality, but better explains the interconnections among different research schemata. Also, the directionality could be in different time lines or moments, from future pasts to time pasts, of progression and regression, and of gaps and turns.

30. O'Connor (1927). Filariasis in association with infection of Filaria bancrofti. Hoffman WA, Marín RA, Burke AMB. Filariasis in Porto Rico I. Progress report on general survey. Porto Rico Rev Public Health Trop Med 1928;4:120-127. Burke AMB. Filariasis in Porto Rico II. Notes on family incidence and clinical manifestations. Porto Rico Rev Public Health Trop Med 1928;4:169-178. O'Connor (1929). An experiment in the treatment of filarial lymphangitis by subcutaneous injections. O'Connor, Burke GR (1929). Lymphangitis and filariasis in Porto Rico. O'Connor FW, Golden R, Auchincloss H. The roentgen demonstration of calcified Filaria bancrofti in human tissues. Am J Roentgenol Radium Ther 1930;23:494-502. Auchincloss H., A new operation for elephantiasis. Porto Rico J Public Health Trop Med 1930; 6:149-154. O'Connor FW. Filarial periodicity. Porto Rico J Public Health Trop Med 1931;6:263-272. Del Toro J, Pons JA, Rodríguez Molina R. Case report on twelve Auchincloss or Modified Auchincloss operations for filariasis. Porto Rico J Public Health Trop Med 1931;7:3-19. Torgerson WR. Preliminary report on the Auchincloss operation for elephantiasis. Porto Rico J Public Health Trop Med 1931;6:411-418. O'Connor FW, Hulse CR. Some pathological changes associated with Wuchereria [Filaria] bancrofti infection. Trans R Soc Trop Med Hyg 1932;25:445-454. O'Connor FW. The aetiology of the disease syndrome in wuchereria bancrofti infections. Trans R Soc Trop Med Hyg 1932;26:13-47. Golden R, O'Connor FW. The roentgen treatment of filariasis. I. Chyluria. II. Filarial lymphangitis. Trans R Soc Trop Med Hyg 1934;27:385-398. O'Connor, Hulse (1935). Studies in Filariasis. I. in Puerto Rico.
31. After a void in filariasis publications, a revival occurred in 1946 with the following articles: a) two filarial surveys, one of selected service male inductees-by U.S. Medical Corps members Z.T. Bercovitz and H. Shwachman (n=16,439 persons, ages 18-38, microfilariae in blood 3.42%; summary of previous surveys range: 1.9 8.0%, extreme case: 12%); and another of male inmates of the Insular Penitentiary for Men-by STM faculty F. Hernández Morales and G. González Barrientos (n=1,256 persons, microfilariae in blood 4.53%); b) a study on recurrent filariasis among 138 family members of 58 previous hospitalized patients, by F. Hernández Morales and J. Oliver González (microfilariae in blood: of patients 13.8%, of family members 4.3%); and c) a study on chemotherapy (pentavalent antimonial compounds) in experimental filarial bancrofti (cotton rats Sigmodon hispidus, vector filarial worm Litomosoides carinni, in vivo and in vitro), by J.T. Culbertson and H.M. Rose, from Columbia, and STM faculty members F. Hernández Morales, J. Oliver González, and C. Kreiss Pratt.
32. Culbertson JT, Rose HM, Hernández Morales F, Oliver González J, Kreiss Pratt C. Quimioterapia experimental en la filariasis bancrofti. PR J Public Health Trop Med 1946;22:174-209. Bercovitz ZT, Shwachman H Filarial survey among young Puerto Ricans. PR J Public Health Trop Med 1946;22:66-81. Hernández Morales F., González Barrientos G. The incidence of filariasis at the Insular Penitentiary for Men. PR J Public Health Trop Med 1946;22:99-101. Hernández Morales F, Oliver-González J. Filariasis in Puerto Rico. PR J Public Health Trop Med 1946;22:95-96. Santiago Stevenson D, Oliver González J. Treatment of filariasis bancrofti with 1-diethylcarbamyl-4 methylpiperazine hydrochloride (Hetrazan). JAMA 1947;135:708-712. Santiago Stevenson D, Oliver-González J, Hewitt RI. Tratamiento de la filariasis bancrofti con Hetrazan (1-diethylcarbamyl 4-methylpiperazine hydrochloride). PR J Public Health Trop Med 1947;23:294-304.
33. Maldonado JF, Hernández Morales F, Fox I, Thillet CJ. The incidence of filariasis bancrofti in government institutions for children in Puerto Rico. PR J Public Health Trop Med 1948;24:120-134.
34. Culbertson JT, Rose HM, Hernández Morales F, Oliver-González J, Figueroa Ortiz L, Ruiz Reyes F, Nettel R. Experimental chemotherapy of filariasis. Trans R Soc Trop Med Hyg 1947;41:18-43. Oliver González J, Bercovitz ZT. Precipitin reactions with antigen prepared from microfilariae of W. bancrofti. Am J Trop Med 1944;24:315-316. Oliver González J, Hernández Morales F. Common antigens among filarial and other nematodes of man. J Inf Dis 1945;77:92-95. Oliver González J, Santiago Stevenson D, Maldonado JF. Treatment of filariasis bancrofti with Hetrazan. Follow up observations 15 months after treatment. JAMA 1949;139:308-309.
35. Hillyer, The rise and fall of bilharzia in Puerto Rico: 227. In addition, the survey by Weller and Dammin shows the following stool findings of helminth larvae and eggs (overall incidence): Trichuris trichiura (76.3% of total cases, n=19,139); uncinaria (56.5%); Strongyloides stercolaris (10.4); Schistosoma mansoni (9.97%); Ascaris lumbricoides (6.7%); Hymenolepis nana (.15%); and Taenia sp. (.03%)-the index of helminth parasitism is 1.6: Wheller TH, Dammin GJ. The incidence and distribution of Schistosoma mansoni and other helminths in Puerto Rico. PR J Public Health Trop Med 1945;21:125-147.
36. On schistosomiasis research, a historical timeline reveals the following trends: a) after World War I, the life cycles of the schistosomes had been established and all phases of the problem were then investigated with 'ever increasing intensity'; b) after the life cycles were clarified, means for assessing worm burdens and egg loads in persons infested were developed; c) clinical and epidemiological studies were dependent on improved diagnostic techniques, which stimulated research on immunological and serological tests; d) the first successful chemotherapeutic agent was an antimony compound tartar emetic (highly toxic and requiring multiple intravenous injections); after this agent other antimony intramuscular preparations were introduced with similar problems; e) the lack of effective treatment stimulated studies on human immunity to schistosome infestation; and d) after World War II, a variety of chemotherapeutic and operative studies were carried out. Even today, studies on all of these aspects continues, which shows the complexity of all parasitic infestations and its serious implications to find effective health measures. Warren, Schistosomiasis: The Evolution of a Medical Literature: xxxiii-xxxviii.
37. Besides these pathological studies, other important investigations will become of some relevance, such as a study by J.L. Janer in 1941 on S. mansoni miracidial twins eggs, and one of the first clinical studies by F. Hernandez Morales on the use of gastroscopic and rectosigmoidoscopy techniques.
38. Koppisch E. Manson's schistosomiasis. Clinical lecture at Atlantic City Session. JAMA 1942;121:936.
39. On publications, one in 1944: the presentation of five schistosomiasis cases with pulmonary lesions which show that invasion of the lungs may produce irreversible damage if not treated adequately and timely. In 1945 there were: a) two clinical studies on the disease (manifestations of the large intestine and roentgenological changes of the small intestine); b) two studies on its treatment: one that states that the antimony compound Fuadin, with low toxicity, appropriate doses and ease of administration should be the drug of choice-157 patients treated, 58.6% stools ova negative; and a note on the treatment of 15 cases with gentian violet, which concludes that the drug has no parasitropic action against the ova; c) one on skin and precipitin reactions to antigens from both the cercariae and adult S. mansoni forms, which confirm and extend the findings that both antigens can be used in the diagnosis of schistosomiasis; d) one on the ova of S. mansoni in purged and unpurged fecal specimens, that show that the eggs of this parasite can be found more easily after a purgative; and e) a public health laboratory study with albino rats which demonstrates that adequate concentrations of chlorine in water have a 'definitive effect on the infectivity of the S. mansoni cercariae'.
40. Morales Otero P. STM Report of the Director for the period ending June 30, 1946: 47-50.
41. Bachman GW. STM Report of the Director for the period ending June 30, 1941: 22-25; Morales Otero P. STM Report of the Director for the period ending June 30, 1942: 29-31; June 30, 1943: 41-45; June 30, 1944: 33-38; June 30, 1945: 39-42; June 30, 1946: 47-52; June 30, 1947: 39-42; June 30, 1948: 32-34; and Koppisch E. STM Report of the Director for the period ending June 30, 1949 (Typed manuscript): 34-38.

42. On more recent publications on rabbits as research models for schistosomiasis, see the following (thanks to A. Román Franco for the information and references): Sood V, Lal BB, Rastogi A, Khanna R, Rawat D, Alam S. Regression of fibrosis in pediatric liver diseases. Indian J Gastroenterol 2018; 1-5. Muñoz Luque J, Ros J, Fernández-Varo G, et al. J Pharmacol Exp Ther 208; 324:475-483. Jin B, Alter HJ, Zhang ZC, et al. Reversibility of experimental rabbit liver cirrhosis by portal collagenase administration, LabInvest 2005;85:992. Dunn MA, Cheever AW, Paglia LM, et al. Reversal of advanced liver fibrosis in rabbits with Schistosomiasis japonica. Am J Trop Med Hyg 50:499-505. Cheever AW, Duvall RH, Minker RG, Nash TE. Hepatic fibrosis in rabbits infected with Japanese and Philippine strains of Schistosoma japonicum. Am J Trop Med Hyg 1980; 29:1327-1339.
43. This fascinating area of study will bring together the two iconic scientific figures of these tropical fields on the Island, both mycologists. That is, B.K. Ashford with the identification of the biological determination of uncinariasis in 1899, and Carlos E. Chardón Palacios with the discernment of the vector of the Mosaic virus (Aphis maidis) of sugar cane in 1922. Chardón was the Chancellor of the UPR (1931-1935), while Ashford was a faculty member at the UPR STM. Both were scientific emissaries of the U.S. in Latin America. To further stimulate the sociological imagination, this topic also brings out the historical personal triad of B.K. Ashford-A. Stahl Stamm-C.E. Chardón, since Stahl, a physician and a botanist, shared actual and symbolic worlds with both Ashford and Chardón. Stahl participated in the first Anemia Commission and Chardón, as Chancellor, proposed a biography of Stahl. We are in the process of delineating this inquiry with other colleagues. See the following interesting paper: Fernández Pietro L. Islands of knowledge: Science and agriculture in the history of Latin America and the Caribbean. Isis 2013;104:788-797.
44. During the weekly dialectical dialogues between A. Román Franco and me on the thesis of tropical obliviousness, we constructed the following tentative historical postscript: In the longing search for modernism *el campo* has been abandoned to migrate to the city, agriculture substituted for the factory or the urban mall, and so is tropical medicine for modern medicine. Chikungunya and Zika emerged as a reminder of days gone (a present past): we are beings of the tropics, and latent tropical diseases wait for the timely moment to pick up the thread of the historical narrative.