Scientific Representations at the UPR School of Tropical Medicine. II: The Evolution of Science, the First Two Eras (1926-31, 1932-1940)

Raúl Mayo-Santana, PhD

The essay examines the scientific representations that unfolded and manifested 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 kind of science practiced 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 third and last era (1941-49), and special technical studies. This article on the STM's scientific endeavors is the second in this historical serial collection about the images and evolution of sciences at the institution, and portrays the events and processes of the first two scientific eras. It reviews the faculty's principal investigations, development of research programs, and concomitant scientific productivity and research outcomes. The following historical sources were considered: academic and research reports, and publications in external and local venues. On findings, bacteriological investigations and studies on mycology and dermatological fungal infections characterized research during the first era. Parasitology became the hegemonic science of tropical medicine during the second scientific era, in conjunction with important studies on nutrition and streptococcal bacteriological infections. Variations of an earlier tropical medicine discourse of 'abundance of material for study' were: the socioeconomic toll of tropical diseases and a biopower exertion of induced recruitment of medical bodies. And public health field-community studies became a critical research approach at-end of periods. The evolution of science in the last and third era will be the main subject of the next article. [*P R Health Sci J 2019;38:209-225*]

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This scientific narrative is the second 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 (1). The purpose of the essay is to examine the general questions of the kind of science that prevails at the School and in the moments where significant scientific events and processes take place. 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 serial 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), the third portrays the development of science in the third and last era (1941-49), and the fourth reviews special research studies (i.e., methodological, apparatus, epidemiological and field studies). This second paper examines the conditions and practices that elucidate the emergence and evolution of different aspects of science manifested at the STM in different periods and paths traversed.

The wide horizons of this historical research have been organized into three stages: 1926-1931, 1932-1940, and 1941-1949; which take into consideration both senior administrative time-periods (e.g., Director's tenures) and the analysis of some serial data (e.g., publications) (2). However, the diversity and nature of the particular research problems considered raised the need to develop other time evolving or time strata models for a better understanding of diverse scientific events in addition to the practical use of the traditional model of chronological stages-such as the notion of historical moments. The principle of evolution signifies here a way in which to

Department of Physical Medicine, Rehabilitation and Sports Medicine, School of Medicine, University of Puerto Rico Medical Sciences Campus, San Juan, Puerto Rico

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Address correspondence to: Raúl Mayo Santana, PhD, Emeritus Professor, 450 Ave de la Constitución 8 E, San Juan, PR, 00901-2307. Email: raul.mayo@upr.edu

consider transcendental changes in time, with diverse kinds of directionality and transformations of significant historical scientific events and processes. As in previous articles of this historical series, conceptual history is used to explore concepts about science and tropical medicine that change in meanings and usages in different historical contexts and situations. In the process of applying a microhistory approach (i.e., the conjugation of an intensive view and broad questions on small research units) to the study of the scientific representations and endeavors that unfold and evolve at the STM, a historic philosophic outlook has been developed. This viewpoint is based on an understanding and clarification of the practices of science in terms of research schemas (plans, programs), paradigms (including particular exemplars of knowledge) and epistemes (epistemological conceptual fields) (3).

In a previous article, "The Puerto Rico Journal of Public Health and Tropical Medicine (1925-1950)," it became clear that schistosomiasis disease was the central, consistent and homogeneous focus of research at the STM, and parasitology and biochemistry were the most important basic sciences. The following general profile emerged from the previous section on images of science at the STM: bacteriology, in its diversity, informed the research work during the first period, parasitology (mainly research on schistosomiasis and filariasis) became hegemonic in the course of the second science era with biochemistry, and a mature science spectrum of tropical medicine and public health characterized the last STM scientific scenario. These scientific profiles and images project as a prior thesis to be further examined and refined. The study approaches the topics from a historical and philosophical perspective, in which scientific research and productivity illustrate the strengths and limits of the academic environment prevalent at the School. This article captures the myriad of research networks, scientific communities, epistemes and legacies.

Science in the First Era: 1926-1931

A. Discourses and Setting

In the first research report, Columbia's representatives defined the so called local "investigative field" as an "opportunity for distinctive service," since the social conditions in Puerto Rico were seen as unique for an intensive study of common tropical diseases (4). Both positive and negative factors were taken into consideration for this evaluation (5). Nonetheless, poverty and its effects on health population were the decisive element for the notion of "abundance" of available research material for study (6).

In the Director's review of research of the first two years, the following foundational research strategies-a combination of human resources and scientific approaches-were emphasized: a) basic scientists with support from their laboratory assistants and local clinical professors, b) complementary pathological studies and epidemiological work, c) the key role of visiting professors, d) the independent work of a visiting graduate student from Columbia, and e) the participation of local graduate students in several important studies (7). However, in the construction of a medical research discourse and setting, the essential attribute was portrayed as collaboration: a) inwards, interdepartmental and between individual faculty researchers; and b) outwards, with the Department of Health, and public and private hospitals (8).

The School presented a more direct and positive scientific image with the early establishment of a research program on nutrition. Nevertheless, the so-called 'Puerto Rican diet' will be considered as nutritionally deficient, mainly due to socioeconomic factors. In the research review of the third year (1928-1929), that started in a celebratory manner referring to "America's first School of Tropical Medicine located in the tropics," the report stated that the "entire question of diarrhea and enteritis in the Island needs careful investigation," and in need of correlating it with nutritional and food poisoning (9). If nutrition and schistosomiasis could be considered the golden research endeavors carried out at the STM during its life span, the serious health problem of diarrhea and enteritis (i.e., dysentery or 'intestinal diseases'), that mostly affect small children, could be seen as an early breeding research idea that never prospered sufficiently (with only 3 serial articles in 1928, one in 1935, and two in 1945) (10)-considering that it was the second cause of death in 1927 (11).

As early as the fourth year of studies, the following institutional conditions were being singled out: a young growing institution; a marked increase in productivity by the scientific staff-due to growth in personnel, expansion of research programs and greater financial support; and the opening of the University Hospital, which made possible a greater variety of clinical material and a broader scope of investigative work (12). The University Hospital increased the opportunities of the staff and created a "marked development in the scientific program," increasing the publication of scientific papers and widening the breadth of research (13). Also, a "small school for nurses" was created (14) with the opening of the Hospital in 1929.

An early review of the services (first 16 months) offered by the pathology laboratory to the physicians and the public, with no service charge but without much advertisement, established that they increased so rapidly that more space and personnel had to be assigned to meet the demand. This service was perhaps the most important element to win the hearts and minds of the community: "showing the extent to which an educational or research institution may be of direct and immediate value to the medical profession and the public" (15). Pathological dermatological specimens, mostly biopsies, contained sufficient educational material to teach the pathology of tropical skin infections. Particularly needed for teaching, a group of specimens came from experimental animals of the School, and others were obtained from institutions outside of P.R. (16). The report concluded that the variety of the material received was adequate for small classes of graduate students and that tropical diseases were well represented, both in surgical specimens and autopsies. Another pathology

departmental report (1930), stated that even with the rapid increase in the number of specimens received and autopsies performed (both doubled in one year), the policy of no service charge was maintained because of the benefits to the public image of the institution (17). The report also mentioned that "the diseases predominantly tropical in distribution have been a minor factor as a cause of death," in comparison "with more cosmopolitan forms" (18). These earlier reports manifest a conceptual denseness contrast among different notions of tropical pathology (i.e., educational material and causes of death).

The first Columbia's Dean Report (June 1930) made several celebratory and ideological expressions on the then current state of the STM, after the fourth academic year:

> *The School of Tropical Medicine has won its place in Porto Rico. It has established itself in the scientific world at large. Up to the present it has been in its first period of growth. It now has an organized faculty, composed of both continental and insular Americans, working under a carefully planned policy in harmony and unselfish understanding... and by their unselfish devotion to the ideals of the School as a whole, have developed an esprit de corps which has far greater value than buildings, land, or endowment (19).*

This academic discourse, formulated at the end of the first STM scientific historical period (1926-1931), illustrates the conscious effort toward the elaboration of a modern scientific image of colonial/imperial relationships and accommodations: acceptance by the local people, model of a universal science, construction of a common political scientific citizenship, centrality of an integrated community of scholars, disciplinary policies of organization and planning, promotion of harmony and unselfish ideals of scientific practices, and invention of an epistemological tradition (esprit de corps).

B. Research in the Early Years

The first Preliminary Report by Director R.A. Lambert (1926-27) only focused on the organizational aspects of research. It states that to fulfill its research function, the School "will need a larger number of trained workers, with time free for investigations," and that there was a plan "to obtain at least two young research assistants, who will dedicate themselves largely to research." However, he also said that already "several papers have been finished and various others will be completed," without mentioning them (20). What was the content of those papers?

Definitely, one of the scientific papers had to be the first published in the School's Journal in 1927 by chemist D.H. Cook, on "Vitamin Studies in PR" (21). Because of its historical significance, it merits our review. This short paper studied the vitamins A and B content of *plátanos* (plantains, *Musa paradisiaca*) and *yautías* (tannia, white and yellow, *Xanthosoma sagittifolium*) using the Sherman's Columbia method with young rats (that consisted of adding these foods daily and would then be compared to an initial diet that lacked the targeted vitamins). The study found that *plátanos* and yellow *yautías* were excellent sources of vitamin A, while the white *yautías* were much poorer. With regard to vitamin B, which required a modification of the methodology, the yellow *yautías* 'ranked first.' The paper mentioned that the so called "average Porto Rican diet" (i.e., rice, beans and codfish) was lacking in those essential vitamins and recommended using the foods as supplements. Caution should be exercised concerning, first, the intricate problem of what constituted the Puerto Rican diet, recognized by Cook himself in another paper, and second, that historically these foodstuffs, in particular *plátanos*, have been part of the diet of rural laborers (22).

Columbia's representative, pathologist J.W. Jobling, who visited the STM in 1927-28, the second academic year, highlighted the scarce research work carried out thus far at the School by R.A. Lambert, D.H. Cook, W.A. Hoffman, and B.K. Ashford (23). He mentioned that Lambert was studying the 'prevalence and pathology of tropical diseases' through autopsies, emphasizing the value of this information for "planning the future work of the school" (24). On Cook, who was studying the nutritional value of different local foodstuffs, he stressed that malnutrition was a problem of great concern for government officials and that the dietary problem was of "fundamental importance to the people." "Quite fruitful," was his evaluation of Hoffman's research, having discovered the intermediate host in the transmission of schistosomiasis, a finding that he thought could lead to its prevention. Ashford's studies on sprue were considered well known and, therefore, of no need for further comment, but Jobling added that Ashford was conducting some studies on fungi found in the intestinal tract.

Interestingly, while Lambert's preliminary report considered that the 'energies of the staff' were consumed largely in organizational details and focused on the need to recruit more research assistants, Columbia's representative Jobling stressed the value and significance of the few research studies for the future contribution of the School, for the benefit of the people or for the prevention of tropical diseases. The contrast in positions explains the variance in emphasis and representations.

Of the earlier research works, Hoffman's paper on the identification of the intermediate host (i.e., the snail *Planorbis guadeloupensis*, later called *Australorbis glabratus*, now designated *Biomphalaria glabrata*) in the transmission of schistosomiasis, proved by him through an experiment with rats, produced a controversy with local medical scientist I. González Martínez on the priority of the recognition of the presence of bilharzia on the Island (25). Both Lambert (who made the same error in another presentation) and Hoffman accepted their mistakes, but claimed that González Martinez's additional claim concerning the intermediate host was not valid (26). In his history of bilharzia in Puerto Rico, G.V. Hillyer ascribed the priority for the discovery in 1904 of the fluke eggs to González Martínez and the identification in 1927 of the intermediate host to Hoffman (27).

C. Visiting Professors and the Advancement of Basic and Public Health Research

The impact of visiting professors became evident in the initial review of research in the first two years. Two of the professors became significant role models: W.H. Taliaferro, Associate Professor of Parasitology at the University of Chicago, and F.W. O'Connor, a specialist in tropical medicine and Assistant Director at the Division of Medical Education of the Rockefeller Foundation (he went to work at Columbia University after his first visit to the School).

Taliaferro collaborated during several years with parasitologist W.A. Hoffman in immunology and schistosomiasis research. As a result, he assisted significantly in the initiation of one of the most successful research areas during School's lifetime (28). He also participated in teaching (i.e., Immunology of Parasites) (29). With respect to clinical methodology, the *Schistosoma mansoni* precipitin test developed by parasitologists Taliaferro and Hoffman and the chemist Cook was reported to be further applied to clinical cases of the infestation (30). This move into the field of serologic diagnosis was advanced by the presence of Taliaferro, since he was a well known authority on the diagnosis of malaria by employing immune precipitation methods in serologic diagnosis (31). The historical quest for a serological diagnostic test was justified because of the difficulties (e.g., labor and time consuming) involved in finding the schistosome eggs in stool examination (32). All the work was done with antigens prepared from the livers of the invertebrate snail host identified by Hoffman (33). Historically, this particular precipitin test, which did not pass the test of time, is a harbinger of the great diagnostic advance for a few years since J. Oliver-González's breakthrough circumoval precipitin test, which achieved worldwide diffusion (34).

O'Connor was responsible for initiating research work on filariasis at the School. In his first visit, he participated in many activities around the country. He returned to the School as a visiting professor in subsequent years and modeled the tropical medicine research strategy of field expeditions based on the Island and the Caribbean (35). He delivered a lecture at the STM (7 Nov 1927) based on his first article on filariasis, which was published in the School's Journal (36). It was motivated by his previous experience in Samoa and the 'great prevalence' of the disease in Puerto Rico. He said that filarial mosquito's transmission occurred in different vectors, *Aedes variegates* (non periodic) in the Polynesian islands and *Culex fatigans* (nocturnal periodicity) in many other countries (37). O'Connor mentioned that the latter vector was the one suspected of transmitting the microfilaria of *Filaria bancrofti* in Puerto Rico. With W.A. Hoffman he collected 45 *Culex fatigans* from a boys' dormitory at a local school, and found that four were infested (8.9%). Filarial infestation was primarily manifested by the presence of microfilaria in the blood or by the onset of acute or subacute symptoms. O'Connor divided the clinical filarial infestations ("for convenience") into inflammatory (e.g., lymphangitis) and obstructive (e.g., elephantiasis) -he limited his remarks to lymphangitis and elephantiasis. He already had observed sixty cases of filarial lymphangitis on the Island in which the patients manifested a definite symptomatic skin area in the affected limb. This observation was the basis for his first clinical study in Puerto Rico. In terms of knowledge of the disease, O'Connor said: "Notwithstanding all the work that has been done on this subject, there are few tropical diseases regarding which there are so many gaps in our knowledge": 217 (38).

The second article published by O'Connor in the STM Journal (Sep 1929) must be considered a preliminary report of a clinical trial (39), although labeled as an experiment in the treatment of filarial lymphangitis by subcutaneous injections of sulphar sphenamine (40) (i.e., an arsenic compound). O'Connor and G.R. Burke (from the Presbyterian Hospital) published a report in 1929 about 57 cases in an external journal, in which they included the curious epidemiological observation that the town of Aguadilla, with 52 cases, "has an unenviable reputation for the prevalence of elephantiasis": 142. The final results of this and other studies carried out in three distinct periods (i.e., Jan-May 1929, Aug-Nov 1929, and Jan 1930), were published by O'Connor and Constance R. Hulse as bilingual articles in the December 1935 STM Journal (41).

Thus, the contribution of these two professors, Taliaferro and O'Connor, definitely was decisive in advancing the early basic research of two important prevalent tropical diseases in Puerto Rico. The epidemiological work conducted by two other visiting professors from Columbia, Earle B. Phelps, Professor of Sanitary Science at the Institute of Public Health (on diarrhea and enteritis), and Haven Emerson, Director and Professor of Public Health Administration (on tuberculosis), seem to have the purpose of mobilizing the School to the study of two highly lethal diseases (42). Diarrhea-enteritis and tuberculosis were the two most serious conditions on the Island in 1927. As expected, tuberculosis was found to be related to general economic and nutritional problems. However, only tuberculosis seemed to fulfill this academic expectation, as evidenced by general publications in the School's Journal during the first two thirds of the lifetime of the periodical (43).

The case of these four visiting professors clearly illustrates the significance and effectiveness of an onset feature of Columbia's research and educational policy (44). The policy of visiting professorships was possible because of the financial support of the International Health Board of the Rockefeller Foundation (45).

D. Other Departmental Research

With respect to the disciplines of mycology and dermatology at the School, Ashford's work-besides his clinical research on the evaluation of liver extracts in the treatment of sprue (46) -was represented in this period by his collaboration with visiting professor Rafaelle Ciferri from Santo Domingo on the identification of several species of fungal pathogens isolated from skin lesions (e.g., two strains of *Pullularia pullulans*) (47).

It also is represented by the beginning of A.L. Carrión's intensive research work on dermatomycosis, and his collaboration with Columbia's dermatologist visiting professor Beatrice Kersten on mycotic infections (48). Tropical sprue and mycosis were the subject of the most frequent articles published in foreign or external journals during this first epoch (see Table 4 in the previous section paper on 'Images of Science'), in addition to two articles on encephalitis by Director E.B. McKinley (49). As we mentioned before, research on these two medical entities, sprue and mycotic conditions, with bacteriological investigations, characterized the research carried out at the STM during the first epoch.

Figure 1. "A Laboratory in the Department of Bacteriology" (Report of the Director 1938). Open Access digitized source: 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, Annual Reports of the Director.

The department of chemistry continued building its long standing research program on nutritional deficiencies in the common diet (50). Medical zoology and parasitology will continue its basic and clinical studies on schistosomiasis, and in the field of entomology a monograph on mosquitoes in Puerto Rico was in preparation (51). Parasitologist Hoffman did some work on a serological test for *Fasciola hepatica* infestation in cattle-an unresolved matter until today (52).

In the report on the review of research for the third year (1928-29), we must call attention to a comment that illustrates the outstanding policy of personnel development of graduate students and research assistants at the School: "A future basic science professor, then a graduate student at the School," A. Pomales-Lebrón, "started his studies on the bacterial flora in normal and pathological throats, of the respiratory tract in P.R." (53). Bacteriologist P. Morales Otero complemented these floral studies with normal individuals. Bacteriologists Morales Otero and McKinley worked on the experimental transmission of leprosy to monkeys.

In 1929, P. Morales Otero published a preliminary report in the STM scientific journal of an unusual and unique experimental infection of *Brucella abortus* in humans, with 7 normal "volunteers" who were "fed" different porcine and bovine strains of "Brucella melitensis abortus in pasteurized milk". Two cases developed symptoms and signs of undulant fever ("of the disease") with the porcine strain and none with the bovine strain. Surprisingly, in 1933 he repeated the experiment with 5 human "volunteers" with a bovine virulent strain with negative results (no symptoms and signs) in 4 of the cases and a serological transitory positive agglutination of the organism in one case, which was published in an external U.S. journal-"a family consisting of three members volunteered to ingest for six weeks the infected milk of a cow"; and two other volunteers were inoculated (54). These unusual and atypical experiments were performed with humans as the animal model, which were neither illegal nor unethical at the time. However, the question still remains about the historically doubtful nature of the so called volunteer disposition in an unequal power relationship without controls or safeguards. Also, a critical humanist counterargument must be raised that these experiments were contrary to the ancient medical guiding principle of "doing no harm," regardless of the mores and standards prevalent at time.

The first Dean's Report of June 1930 states that there were three research fellowships and two research grants at the School (55). The next Dean's Report (June 1931), mentioned the transfer of chemist J.A. Axtmayer, a P.R. and Columbia graduate, from the UPR Río Piedras Campus to work on the nutrition project of the Chemistry Department (56).

A review of the Department of Pathology of 1930, states that "routine autopsy and the examination of surgical material has continued to occupy the greater part of the time." It mentions the following interesting data on the frequency of prevalent diseases, which helps in contextualizing the health conditions of the period. First, cases of infestation with parasitic helminthes were: trichuriasis, uncinariasis, schistosomiasis, and ascariasis; and second, cases of other "tropical conditions" were sprue, malaria, filariasis, and leprosy (57).

E. Criteria for the Selection of Diseases for Research

The official reports reveal that the grounds for the selection of diseases for study at the STM during the first epoch were based on the following historical conceptual changes in the criteria used: 1) (ideal) 'symptoms and course of tropical diseases' that afflicted most of the population (58); 2) (goal) the 'primordial aim' of the STM is to offer opportunities for the study of tropical

diseases (59); 3) (plan) through a study of autopsies, the STM Director obtained prevalence and pathology data on "certain tropical diseases" that was considered of great value for planning the School's work (60); 4) (epidemiology) research by visiting professors aimed at mobilizing the School around the two most serious health conditions on the island (diarrhea enteritis and tuberculosis) (61); 5) (logistics) two prevalent tropical diseases, uncinariasis and malaria, were excluded as the main focus of research at the School since they were part of the Health Department's (HD) control programs (62); 6) (pragmatic) the criteria shifted toward the practical and the real: "the selection of diseases for study was determined by circumstances" (63); 7) (academic) the research programs were organized and reported by departments, without the need for more justification (64); and 8) at the end of the period, (convention) the criteria was based solely on past experiences or, perhaps, the beginning of an epistemological tradition: "as in the past, the problems of such diseases... have received particular attention" (65).

The most consistent research topics for the foundational years 1926-1931 were: sprue, malnutrition (dietary deficiencies) and nutrition (vitamin studies), schistosomiasis, filariasis, mycosis (fungal diseases), malaria, leprosy, tuberculosis, and brucellosis (in cattle) (66). Public health 'field station' studies (on tuberculosis, hookworm and ascaris infections) carried out in different communities and in collaboration with the HD, are mentioned in the last report of the period. The Field Station established by the STM Department of Medical Zoology at the Livingston Dorado State to "carry a 'comprehensive' study on parasitic infestation in the rural population (i.e., hookworm reinfestation, epidemiology of *Ascaris lumbricoides*, bored hole latrines, and soil contamination)" (67) was asserted with prominence. These last research endeavors served as a testimony that public health research was an important part of the scientific efforts at the STM, earlier than we expected.

Science in the Second Era: 1932-1940

This is the period in which the Director of the School (G.W. Bachman, 1931-42) was a parasitologist. The turn of events contributed favorably to the process of making parasitology and medical zoology actual fundamental sciences in the history of tropical medicine in P.R. The administrative and technical personnel of the School also increased significantly from almost a base zero in 1926 up to nine persons, including an administrator, a librarian, and six technicians (3 females and 3 males)-among them the School's future eminent parasitologist J. Oliver-González (68).

A. Pillars of Tropical Medicine in Puerto Rico: Parasitology and Medical Zoology

The study of schistosomiasis mansoni became one of the School's most important research programs through a grant in aid from the National Research Council and a grant from the B.K. Ashford Fellowship Fund. These research endeavors "on the historical, epidemiological, biological, pathological, clinical, and preventive aspects" of this widespread disease were undertaken with the collaboration and under the leadership of clinical parasitologist E.C. Faust from Tulane University Medical School. The 1934 Dean's Report mentions that this work was interdepartmental, "divided into seven main divisions, each aspect of the problem being handled by the personnel of the respective departments," which illustrates the significance of the project (p. 37) (69). A series of articles (between 1933 and 1941), with the name of 'Studies on Schistosomiasis mansoni in Puerto Rico' were published by different authors from several departments in the STM Journal. These papers were modeled after an earlier series of 1927-28.

Two articles in the 1933 series authored by Faust are of interest: one, a statement of the purpose ('need') for the series was published in *Science*; and another on the history of schistosomiasis in P.R. appeared in the STM Journal (70). On the study's need, the first remark emphasizes both the "cooperative efforts" of the STM and Tulane University, and the grants received. It also mentions the "unique opportunity" afforded for the study due to the "limited size" of the Island and "the economic importance of the disease"-a variation of the earlier tropical medicine discourse of 'the abundance of material'. The paper describes in detail the established research schema (i.e., biological, pathological, clinical, and epidemiological aspects), which shows its cogent planning and organization (71). Both articles recognize the historic priority of I. González Martínez (1904) work, that he was the first to discover the parasite's ova and to study thereafter intestinal schistosomiasis in the Western Hemisphere (72). In 1907 L.W. Sambon named this schistosome, *Schistosoma mansoni*, in honor of P. Manson. The history paper reviews the renewed interest and studies about the disease that took place with the opening of the STM. It mentions the studies by Hoffman in 1927 on the epidemiology and distribution of the disease and in the experimental proof about the intermediate host. The author mentions some results of survey and clinical data as examples of the need for further studies, and concludes that the "perplexing problems" historically associated with schistosomiasis could be elucidated by an intensive investigation. Finally, it lists the next articles of the series (73). It is important to point out that schistosomiasis was the subject with the highest frequency of publications at the STM Journal, and the most homogenously distributed throughout the years (74).

On the topic of zoology, it should be noted that a survey of animal and human parasites on the Island was in progress at the STM, assisted by scientists from the Zoological Division of the U.S. Bureau of Animal Industry in the collection and identification of material. A series of experimental investigations on *Trichinella spiralis*, the etiologic agent of trichinosis, were carried out in this era by G.W. Bachman and associates, and published mostly in external journals. However, the notable basis for this work was established by Bachman in 1928 (a precipitin test) and 1929 (an intradermal reaction), prior to his incorporation at the STM-he was the "first to use Trichinella

antigen for diagnostic purposes." J. Oliver-González also made a notable contribution on the immunology of trichinosis (i.e., the dual antibody basis) during 1940-1941 (75).

B. Probing the Puerto Rican Diet

By the start of the period, the relative importance of the nutritional research program is evident by the fact that three of the four research assistants at the School were in the chemistry department, including co-authors Trinita Rivera (BA Columbia 1927) and Luz M. Dalmau (PhDC P.R. 1920) (76). The transfer of chemist J.H. Axtmayer in 1931 was an earlier sign of the significance assigned to this research program. Another analogous series titled 'Nutritional studies of the food stuff used in the Puerto Rican diet,' published in 1931-1940, also was antedated by a similar published series, as previously mentioned (77). The research program was made possible by a grant from the Rockefeller Foundation (78). It can be said that during the lifetime of the STM there are at least three historical periods of this research schema, according to faculty publications. The first is a foundational phase (~1927-1931) in which some of the studies discussed before could be situated-this stage can be called the D.H. Cook and Trinita Rivera series. The second period (~1930-1933/1940) started with the incorporation of J.H. Axtmayer and the phase out of, then instructor, T. Rivera. The third is the integration of C. Asenjo to the chemistry research program (who came to the School with funds provided by the New Deal agency, the P.R. Reconstruction Administration) (79), and L.M. Dalmau as co-author, speaks of a long lasting period (~1935-1948) (80).

In general, the research methods most frequently used by the nutritional program were based uniformly on varying forms of experimental rat weight, growth and reproduction studies. Also, the most studied topics consisted of the determination of the chemical composition (e.g., nutrients, proteins and vitamins) of local plants or foodstuffs. There are some pertinent questions that could be of interest for future inquiries in this area, such as: Are these phases basically related to the participation of different scientists or do they have other contrasting characteristics that are not so discernible? Were other kinds of studies, already mentioned, conducted in collaboration with other School departments? What kind of recommendations did they propose, if any, as a response to the general finding of a deficiency in nutrients of local foodstuffs?

C. Other Lines of Research and Networks

The study of lymphatic filariasis gained renewed impetus at the STM during the second era and emulated prior studies by O'Connor and others (1927-1930), including two singular ones by O'Connor, Golden, and Auchincloss (1930) and by O'Connor and Hulse in 1935 (81). Lymphangitis was the disease with the most frequent faculty publications in external journals (82) in this era. In 1931, medical zoologist M.K. Tampi, from the School of Hygiene and Public Health of Johns Hopkins University, mentions that the Island "is one of the best known endemic areas of filariasis in the Western Hemisphere," but because of its low mortality and that presence of the disease was limited to some urban areas, it is considered a minor public health problem. Nevertheless, he considers that since the disease causes "considerable suffering" and "repeated incapacitation of the workers," it constitutes a serious public health problem (83).

At this moment we must make a critical statement in relation to the nature of tropical diseases such as malaria, uncinariasis, schistosomiasis and filariasis: they are serious health problems, particularly for vulnerable populations (e.g., those overburdened by poverty, hard work and malnutrition), regardless of mortality indexes. Several medical characteristics mark the perniciousness of their malignancy and symptomatology: chronic states (e.g., inflammatory processes), intensity (infestation burden), relapse/recurrence/reinfestation, drug resistance or toxicity, immunodeficiency, incapacitation/deformation, virulent parasite species, and multiple infestations (e.g., polyparasitism) (84). Health surveys, epidemiological studies and clinical data of the epoch clearly established that these tropical diseases affected mostly children and the elderly, manual and rural laborers, and the lower socioeconomic strata of the population.

In terms of bacteriology, there were several principal lines of research during this era, such as (in order of 'efforts'): tuberculosis, recurrent tropical lymphangitis, the biology of pneumococci and streptococcus infections, *Brucella abortus* (veterinary) and brucellosis, *Endameba histolytica*, and varied epidemiological and field studies (85). Bacteriology definitely was the basic sciences department with the most diverse subjects of investigation and, perhaps, with the closest association with important public health problems, which propitiated many collaborative works with other STM departments (e.g., Parasitology, Chemistry, Pathology), external institutions (e.g., Henry Phipps Institute, Philadelphia), and with local Federal and Puerto Rico government agencies (e.g., HD, Agriculture and Commerce Department, Agricultural Experiment Station, Health Division P.R.R.A., Civil Works Administration). Bacteriologist P. Morales Otero, director of the department, was the most prolific and the most multifaceted author with publications in the STM Journal in this era, and he also was the faculty member with the most publications in external periodicals at this time (86). In the 1935-36 academic year, Morales Otero took a leave of absence from the School because he was named chief of the Health Division of the P.R. Reconstruction Administration (P.R.R.A.), which resulted in the collaboration between both institutions and the use of additional resources for health research (87). Special permits also were granted to several external researchers to conduct P.R.R.A. sponsored research at the STM laboratories (88).

The 1934 Bacteriology Department report mentions that a series of three articles on the epidemiological work of tuberculosis (i.e., "surveys") was completed; the study was managed by the bureau of tuberculosis of the HD (89). The first survey, which compared the incidence of tuberculosis in a coastal

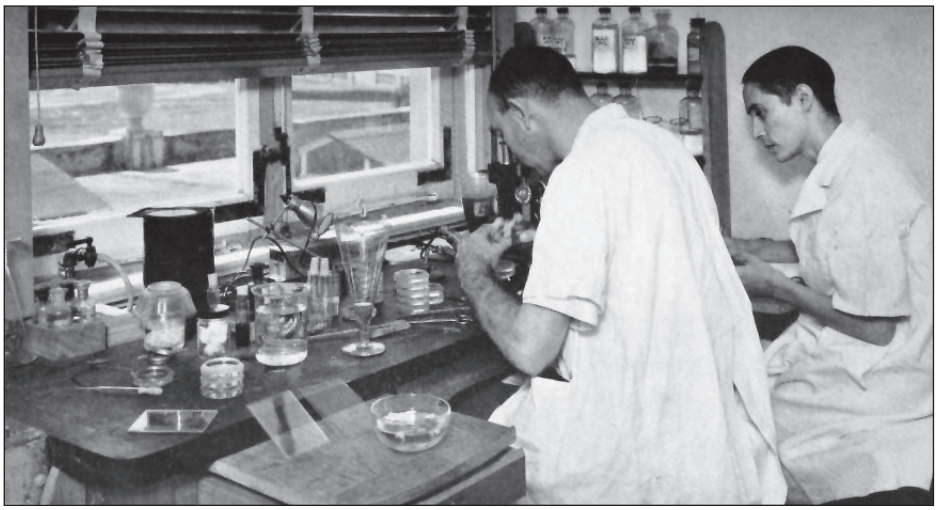

Figure 2. "Division of Parasitology" (Report of the Director 1938). Open Access digitized source: Archives and Special Collections at the Augustus C. Long Health Sciences Library of Columbia University, School of Tropical Medicine under the Auspices of Columbia University, Annual Reports of the Director.

town (Cataño) with one in a mountainous zone (Adjuntas), was the most complete and reliable (methodologically, it was based on an extended use in the community of an intradermic tuberculin test). Among a series of factors considered (i.e., "race, climate, illiteracy, poverty"), the study concluded that the "great overcrowding of dwellings" and the "nearness to large centers of population" explain the higher incidence of tuberculosis in the coastal town. In general, pulmonary tuberculosis was the predominant form of the disease (90). The 1934 Dean's Report mentions that these tuberculosis studies continued, but were 'confined' to the incidence of the disease "in the needlework and tobacco industries." The 1935 Dean's Report states that these field studies "have been finished," but the 1937-38 Director's Report (Memoria) still reiterates that they have been achieved (91). Grants from the Civil Works Administration and the P.R. Emergency Relief Administration made feasible the studies.

Under the leadership of A. Pomales Lebrón, with the participation of P. Morales Otero, the study of the streptococcus problem on the Island, which in the next years will be the main focus of the research program of the department of bacteriology, started to make progress (92). In the 1936-37 Memoria del Director, an important mention is made with respect to the collaboration between the Health Division of the P.R.R.A. and the STM's bacteriology department on a series of health and socioeconomic studies of rural workers (93). These studies were carried out under the direction of P. Morales Otero (STM/P.R.R.A.) and M.A. Pérez (P.R.R.A.), and published between 1937-1941 in the STM Journal (94). The investigations were extensive, methodologically reasonable, and offered significant information on the population and health conditions of the epoch.

Despite extensive routine services, the Department of Pathology conducted some important research studies during this era. Most of the studies were published by the department's director, E. Koppisch, either with members of other departments or single handedly. Research on the influence of dietary factors on experimental tuberculosis (white rats) was carried out (95) in collaboration between three departments (i.e., Pathology, Bacteriology and Chemistry). A study on the aspergillosis (i.e., a disease caused by a fungi *Aspergillus Spp.* marked by inflammatory granulomatous lesions) in chicks was presented at the Argentina Society of Regional Pathology of the North (96) with the collaboration of bacteriologist P. Morales Otero. A review by Koppish of 628 autopsies on tuberculosis revealed that the disease assumes the 'usual chronic form' in adults (97). Experimental work on vaccination against tuberculosis with B.C.G (bacilli Calmette Guerin) was carried out and published by bacteriologist R. Thompson and Koppisch in 1936, and two articles on the pathology of schistosomiasis in experimental animals (1937) and in humans (1941) were published by Koppisch (98). Several studies were done in collaboration with other institutions, such as Columbia University (Pathology, Surgery), the U.S. Bureau of Animal Industry and the local Presbyterian Hospital. In the 1935-36 academic year Koppish went to the University of Basel in Switzerland to study and train on the herpes virus under experimental pathologist R. Doerr, with a research program in mind upon his return. However, his virology studies with rabbits and humans did not produce remarkable results (99).

D. Hospital Based Investigations

Similar to the pathology department in terms of providing 'heavy routine service', the Hospital staff conducted investigations that were characterized in the 1934 Dean's Report as, "a worthy record of medical research": 36 (100); but, in contrast to pathology, with the participation of diverse faculty members. The burden of being a regional hospital specialized in tropical medicine represented 'a serious predicament' of an ever increasing service demands, but the situation also provided unique opportunities for the staff and the School to advance medical research. During an almost three year period of reconstruction (~May 1937-Mar 1940) where medical services were limited to the outpatient clinic, some members of the Hospital staff took advantage of the opportunity to verify and analyze investigations of a "scientific character" (101).

The majority of the hospital investigations were on the clinical aspects of diseases (mostly tropical) that were being

studied by the School basic sciences departments, such as schistosomiasis, filariasis and lymphangitis, sprue, pernicious anemia, uncinariasis, streptococcus and certain skin disorders. However, other health conditions were peculiar to a hospital environment that served a mostly poor population: vascular diseases (e.g., thromboangiitis, endarteritis), gastrointestinal disorders (e.g., mucositis), demonstrations of medical procedures characteristics of particular conditions (e.g., gastroscopic and rectosigmoisdoscopy findings with sprue patients), surgeries (e.g., elephantiasis), pediatric development (i.e., "incidence of the widening and roughening of the epiphyseal lines in children"), and the unique opportunity to follow up on previously hospitalized patients with particular conditions through an outpatient clinic (e.g., "heavily parasitized and markedly anemic young men from the mountains of the Island"-that is, hookworm disease or uncinariasis). The hospital integrated some of the STM faculty that offered definite diagnosis and follow up of certain particular diseases: etiology of skin diseases (A.L. Carrión) and all parasitic infections (W.A. Hoffman). Finally, the hospital required the continuous use of bacteriology, parasitology, and pathology laboratories and research techniques provided by other School's departments (102).

E. The End of an Era

The 1934 Dean Report mentions the 'continued illness' of B.K. Ashford, from the Department of Mycology, who, despite his ailments, continued to conduct a number of studies in sprue and the effects of ultraviolet light on mycoderma (yeasts, fungi). A.L. Carrión's work on chromoblastomycosis (fungal skin infections) continued, as well as departmental work on Monilia (103). The next report announces the "irreparable loss" of founding member Professor Ashford, who continued his work until a few months before his death. C.W. Emmons of the Columbia University Department of Mycology, who studied human actinomycosis, worked in 'splendid cooperation' with Carrión and assistant M. Otero on new cases of chromoblastomycosis (CMB) and epidermophytosis-another fungal skin infection which "represents a large portion of the skin diseases seen in the University Hospital and on the Island." In 1935 Carrión also identified a new species, *Hormodendrum compactum*, as a pathologic agent of CMB (104). In the following years, Carrión included the infectious diseases of trichophytosis and actinomycosis in his dermatomycosis studies. Also, in the last years of the era, trichomycosis-a disease of the hair (or "*piedra* of the hair"), maduromycosis ("Madura foot"), and pinta (*mal del Pinto*, pigmentary changes of the skin) also were subjects of interest (105).

Conclusions: Science in the First and Second Eras

The STM scientific narrative starts with the medical discourses on two critical intellectual ideas: one, on the actual ideological importance of the notion of 'abundance of available research material' in tropical diseases, and the other, on the emphasis and potentiality of collaboration for research practices. A set of foundational principles were clearly delineated in the first Columbia's Dean Report, which reflect a modern scientific image of colonial/imperial understanding (i.e., acceptance by inhabitants, construction of a common political scientific citizenship, centrality of a community of scholars, disciplinary organizing policies, promotion of a universal, harmonious and altruistic ideal image of science, and the normative invention of a tradition).

Variations of the earlier tropical medicine peripheral discourse of 'abundance of material' were, first, a soft conceptualization with respect to the unique opportunity offered by an Island's closed locus and the socioeconomic toll of tropical diseases, and second, a strong biopower exertion of induced recruitment of medical bodies for experimental chemotherapy. The opening of the university hospital also amplified conceptually this tropical medical discourse around the clinical notion of a greater variety of available material, thus broadening the scope of the investigative field. On the conceptual history of the fundamental polyvalent character of tropical diseases, a clinical distinction was advanced between "diseases predominantly tropical in distribution" versus "more cosmopolitan forms," and among tropical medicine connotations emanating from pathological materials needed for education and epidemiological causes of death. A conceptual approach also facilitated the identification of the historical changes regarding the grounds or criteria for selection of diseases for study at the School, a path extended from an earlier idealized justification, passing through pragmatic and logistics forms, and at the end changing into a conventional rationale.

The foundational research during the first scientific era of the School (1926-1931) was the product of the three initial researchers designated by Columbia University (in pathology, chemistry and parasitology) and the leading local physician in tropical medicine and mycology. Their respective initial contributions were the establishment of the Pathology Laboratory that provided free services to the medical community, the initiation of the long standing research tradition of vitamin studies, the seminal identification of the intermediate host in the transmission of schistosomiasis, and the dietary treatment and hematological studies on tropical sprue. Very early, two recurrent visiting professors (in parasitology and tropical medicine) made substantial contributions through their collaboration and stimulation of lasting research schemas in the schistosomiasis and filariasis investigative fields. The first scientific period also saw the inclusion of future eminent scientists that initiated very productive research for the rest of the STM existence (in studies on dermatomycoses and streptococcus), including the transfer of a chemist from the UPR Río Piedras campus to work on the project of nutritional deficiencies. The participation of research assistants as co-investigators and co-authors, who became part of the faculty later, has the notable exemplar of chemist Trinita Rivera, who did graduate studies at Columbia.

The second STM scientific stage (1932-1940) is marked by the leadership of a parasitologist and by the inception of two research schemas supported by significant grants that became the most important investigations at the School: a series of interdepartmental studies on schistosomiasis and nutritional chemistry studies. Director G.W. Bachman and associates also conducted a series of experimental investigations on trichinosis, which foresaw future achievements by J. Oliver-González on the dual antibody thesis. Filariasis research gained a renewed impetus during the second scientific era, emulating prior and current studies by F.W. O'Connor and associates. The highly productive bacteriological research was characterized by diversity with public health overtones (e.g., epidemic outbreaks and veterinary diseases), and its variety only was paralleled by the clinical tropical medicine department. The studies on the streptococcus problem on the Island became the main bacteriology research schema, followed by veterinary brucellosis studies. The questionable experimental infections with *Brucella abortus* in humans constitute an erred scientific misadventure of the times.

Two new institutional units emerged around 1938: Studies of Ultraviolet Solar Radiation, which, besides clinical physiology studies at the Hospital, formally incorporated physiological research at the School, and the Santiago Primate Colonies, which provided significant venues and resources for observational and experimental investigations. Pathological research started to show the heavy burden of routine services, overcome only by resilience and collaboration. With respect to personnel, the number of research assistants dramatically increased, particularly in the field of chemistry, but the era will be notably remembered by the "irreparable loss" of B.K. Ashford and the incorporation of C.F. Asenjo as a member of the faculty. A.L. Carrión identified a new species involved in the etiology of chromoblastomycosis, and E. Koppisch went to Switzerland to do research on the experimental pathology of the herpes virus, which initiated the viruses research schema at the School, but with unsatisfactory results (besides an early and short lived E.B. McKinley's phase).

This historical inquiry calls for an extensional modification of the hypothesis that bacteriological diverse investigations guided research during the first epoch, in terms of integrating in a parallel manner the epistemological field constituted by the biological science of mycology and the clinical considerations of dermatological mycotic infections (i.e., fungal specimen studies and health conditions). Also, at the end of the era, the ample field of public health started to effect early research input through field studies, albeit with a faculty with the lowest academic positions and without the benefits of an organizational departmental unit until 1940, but with the organic support of the HD and of other School departments.

Parasitology definitely became the hegemonic science of tropical medicine during the second STM scientific era-based on a consistent, homogeneous, and productive research schema on schistosomiasis and filariasis, and the participation of other disciplines in these investigations. However, although parasitology already was a kind of paradigmatic science during this era, the research schemata domain and scientific images will be incomplete if biochemistry nutritional studies and the streptococcal bacteriological infections investigations are omitted. It also must be noted that the productive but non homogeneous field of bacteriology stressed its public health epistemic dimensions during this period.

Resumen

Este ensayo trata sobre las representaciones científicas que generan la historia de la ciencia que emergió y evolucionó 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 los estudios técnicos especiales. Este es el segundo artículo de la serie y versa sobre el desarrollo científico durante las primeras dos etapas históricas, en un contexto donde la parasitología y la bioquímica son las dos principales disciplinas, y la parasitología emerge como la ciencia hegemónica. Los temas principales de la colección son las imágenes científicas, y los objetos y las formas de conocimiento: el surgimiento de una tradición. El enfoque analítico se instrumenta mediante las nociones científicas de esquemas de investigación, ejemplares de conocimiento (paradigmas), y epistemes (campo-epistemológico). El proceso de evolución de las ciencias se organiza utilizando el modelo de etapas históricas, aunque cuando los eventos y procesos lo exigen, se consideran otros modelos de evolución (p. ej., momentos históricos).

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2. As mentioned in the previous paper (Reference No. 2): First, an analysis of the incremental ratios in both local and external faculty publications by year suggested the use of the following historical periods: 1926-1931, 1932-1940, and 1941-1949. Second, the first of these periods (1926-31) coincides with the term of the first two directors of the School: Robert A.

Lambert (MD, Pathology; 1926-28) and Earl B. McKinley (MD, Bacteriology; 1928-31), which was a period of institutionalization. Third, the second period of publications (1932-40), coincides with the longest term of Director George W. Bachman (PhD, Parasitologist; 1931-42), which was a time of institutional stability in which the discipline of parasitology established its predominance in the local science of tropical medicine. Fourth, the last period of publications (1941-49), covers the paradigmatic change in which a Puerto Rican physician was appointed, Director Pablo Morales Otero (MD, Bacteriology; 1942-April 1949), which marks a period of tension with Columbia, and of Interim Director Enrique Koppisch (MD, Pathology; May-June 1949), which covers the period of closure with Columbia and of the STM.

3. With respect to the methods and theoretical frameworks and perspectives used in or developed for these studies and historical narratives see the following clarifying notes: a) Scientific representations are considered here as scientific models or schemata, and images as a synthesis of representations or an iconic figure. An icon, which traditionally has the meaning of an image which carries itself in terms of resemblance, is used here as a kind of an exemplar of knowledge (see below) which has been transformed into a symbolic or synthetic exemplification. I situate myself among a debate between historical notions of representations (e.g., R. Chartier's the world as representation) and philosophies of science representations (e.g., B.C. van Frasse's scientific image), but in this work a practical inquiry of research practices from a relational and contextual perspective has been undertaken. Even when I referred to scientific models as representations, they are considered autonomous of both scientific theory and data, and the schemata notion of representation is privileged. I assumed the methodological position of treating scientific activities as forms of constructions (van Frasse), representations in general in the sense of primary or primitive notions, and scientific representations as historical concepts. b) Special research studies (i.e., methodological, apparatus, animal models and biology, immunological, therapeutically, epidemiological and field studies) are part of the technical scientific horizons of the institutional science world at this epoch. c) A historical moment embraces diverse but singular events which, in contrast with phases or stages, could be one or a few years, or even less, as units of periods. The initial events could be but do not have to be correlated; however, in their conceptual projections into future events and moments they could be mixed or interconnected. 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 maintain a sense of evolving directionality, but better elucidates the interconnections among different research schemata. Also, the directionality could be in different timelines or moments, from futures to pasts, of progression and regression, and of gaps and turns. d) Examples of the diversity of the particular sets of research problems considered in the analysis are: tropical diseases, nature of parasites and vectors, kinds of research approaches and methods, sets of publications, groups of scientists, scientific disciplines, and epistemological traditions. e) The principle of historical evolution signifies here a way to consider transcendental (e.g., enlightened or illume) changes in time or singular transformations of significant historical scientific events and processes. The nature of these changes could be of different kinds, such as continuous or discontinuous, homogeneous or diverse, unitary or fissure, progressions or regressions, gaps, and turns. f) Conceptual history (R. Koselleck) is used to explore concepts about science and tropical medicine that change in meanings and usages in different historical contexts and situations. g) On the different aspects of science considered, see for example: historicity of disciplines, research schemas, exemplars of knowledge, and epistemes. h) The microhistory approach means here the conjugation of an intensive view and broad questions on small research units. h) In the process of studying the evolution of the scientific representations a historic philosophic outlook has been developed based on an understanding and clarification of the practices of science in terms of research schemas (plans, programs) (in A. Lautman's sense), paradigms (including particular exemplars of knowledge) (in T.S. Kuhn's particular sense) and epistemes (epistemological conceptual fields) (in M. Foucault's referential sense). Exemplars of knowledge are scientific theses, 'discoveries' and iconic publications. 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20. Lambert, Preliminary Report of the Director, 1926-27: 6-7.
21. Cook DH. Vitamin studies in Porto Rico. Porto Rico Health Rev 1927;2:22-23.
22. First, on the caution needed to analyze the issue of the Puerto Rican diet, see, by the same author: Cook DH. Some aspects of the food problem in Porto Rico. Porto Rico Rev Public Health Trop Med 1927; 3:59-67. In this article the question of what is the diet of Puerto Ricans was addressed by Cook, which constituted the second article published by a faculty member of the STM. Cook started by recognizing the difficulties and complications of the problem and the unfeasibility of conducting appropriate food surveys on the Island. He used a variety of indirect ingenious indices, such as: a) an estimation of the amount of food required to maintain the population, b) the amount of food actually imported, and c) "the suitability of the food stuffs grown on the Island for supplying the difference between imports and total requirements": 59. He concluded the following: 1) Puerto Rico is nutritionally dependent on imports; 2) there is no reserve food supply in case of need; 3) the main foodstuffs imported are not the best foods for an adequate diet; 4) "there is a tendency at present for the diet to be high in carbohydrate and fat, and low in protein. This defect is not apt to be corrected by the common foods now consumed on the Island": 66; 5) more milk and fresh green vegetables should be produced and consumed; 6) the importance to develop fisheries and fish distribution; and 7) promote people's education to eat a more balanced diet. Cook examined the common beliefs around the Puerto Rican diet, asserting that opinions concerning the use of dried salt codfish were "proved to be an error," because fish can just play a minor role in the diet and it is a "food of low-energy value." He ended by satirizing the "cherished idea that bacalao plays in the diet of the jíbaro": 65. Nevertheless, in his first paper he seems to accept the generalized idea of what constitutes the so called "Porto Rico diet," as this quotation shows: "These three foods [i.e., the plantains and the two starchy roots], aside from their energy value in a diet are thus shown to be valuable sources of two of the essential vitamins which are apt to be lacking in the average Porto Rican diet. Their use as a supplement to rice, beans and codfish should be encouraged in every way possible": 23. In a 1929 paper by Cook and his assistant T. Rivera, their analysis showed that rice and beans is an inadequate diet, since it would be deficient in its protein supply and in vitamins, and neither yautías nor plátanos are considered adequate supplements for the deficiencies of rice and beans: Cook DH, Rivera T. Rice and beans as an adequate diet. Porto Rico J Public Health Trop Med 1929; 5:16-20. Second, on other papers 'completed,' the first general published article was by Dean W. Darrach and published in the School's Journal [Darrach DW. The object and outlook of the School of Tropical Medicine (Inaugural Address). Porto Rico Health Rev 1926; 2(4):1-52)]. Several other articles (which appeared before DH Cook's "Vitamin studies") were by visiting professors on general topics (e.g., abstracts, extracts, reprints, summaries of conferences given at the School); such as follows: Goodman H. Frambesia Tropica and syphilis: Influence of malaria. Porto Rico Health Rev 1926;2(1):3-5. Goodman H. Modern physiotherapy (Abstract). Porto Rico Health Rev 1926; 2(6):25-26. Phelps EB. The environment (Abstract). Porto Rico Health Rev 1926;2(7):14-15. Sellards AW. Bonds of union between tropical medicine and general medicine. Porto Rico Health Rev 1927;2(8):3-8. Eliot M. Observations on rickets. Porto Rico Health Rev 1927;2(8):9-12. Sellards AW. The relationship between Weil's disease and yellow fever. Porto Rico Health Rev 1927;2(9):3-9. Flexner S. The advancement of epidemiology through experiments (Extracts). Porto Rico Health Rev 1927;2(9). Part I: 3-9. 2 (11). Part II: 9-21. Third, the first two papers published in an international journal, according to the STM Collected Papers (v.1 1926-27-28) was one by Ashford BK, Hernández LG. Blood serum calcium in sprue and other pathologic states in the tropics. Am J Med Sci 1926;171:575; and one by Taliaferro WH, Hoffman WA, Cook DH. A precipitin test in intestinal schistosomiasis (S. mansoni). J Prev Med 1928;2:395-414.
23. Jobling JW. Report on the School of Tropical Medicine. Copy of typed document; New York, June 1, 1927. Institutional Archives, Río Piedras Campus, University of Puerto Rico, 12 p.
24. Jobling, Report on the School of Tropical Medicine: 3. This study by Lambert was never published, at least in this format.
25. Hoffman WA. Studies on schistosomiasis (S. mansoni) in Porto Rico. I. Preliminary report in the distribution of S. mansoni. Porto Rico Rev Public Health Trop Med 1927;3:223-230. Hoffman's expression on the intermediate host is: "It has been established that Planorbis guadeloupensis is the intermediate snail host of S. mansoni in Porto Rico through the experimental infection of rats with cercariae given off by snails taken from an endemic area": 229. The equivocal assertion on the priority issue was: "To the Anemia Commission is due the credit for first establishing the presence of schistosomiasis in Porto Rico": 223.
26. On this issue, see: a) González Martínez I. Studies on schistosomiasis in Porto Rico. Porto Rico Rev Public Health Trop Med 1928;3:443-457. The author said: "I cannot pass over these articles without bringing forward some objections to that of Lambert and correcting manifest errors which appear in that of Hoffman; especially since the latter affect a matter which may be designated as my scientific property": 443. And also: "This error appears to take from me a mark of distinction which no one shared with me and one which was and is exclusively mine; because in February, 1904, I had the good fortune to discover the first two cases, the opportunity to report them to the local press and subsequently to publish the first study of 'La Bilharziosis en Puerto Rico.' On April 3, 1904, this study was read before the Annual-Meeting of the Medical Association": 443. b) Lambert RA, Hoffman WA. Studies on schistosomiasis. A reply. Porto Rico Rev Public Health Trop Med 1928;3:458-459. On the correction, the authors said: "Regret has already been expressed by one of us (Hoffman, this Review 1928, III, 366) at the failure to give credit to Dr. González Martínez for the first observations on schistosomiasis in Porto Rico": 458. On the issue of Planorbis, they mentioned: "Dr. González Martínez evidently believes the co-existence of S. mansoni and Planorbis in the same territory constitutes proof that the later is the intermediate host of the former. We maintain that this is not true": 458.
27. Hillyer GV. The rise and fall of bilharzia in Puerto Rico. Its Centennial 1904-2004. P R Health Sci J 2005;24:225-235. Hillyer mentioned the following: a) "Isaac González Martínez established definitively the existence of human schistosomiasis in Puerto Rico in 1904 when he reported the

discovery of fluke eggs in feces from two teenagers who had lived all their lives in the environs of Mayaguez, P.R. in the western part of the island": 225; and b) "Hoffman showed experimentally in 1927 that (helisoma) Planorbina guadeloupensis (later denoted as Australorbis glabratus, and now as Biomphalaria glabrata) was the snail intermediate host": 226. However, on the recognition priority in America, Hillyer said: "Unfortunately, in terms of identifying a new parasite, in 1902 Sir Patrick Manson had described in England a single case of intestinal bilharziosis from a patient from the Caribbean island of Antigua finding oval eggs with lateral spines": 225.On the history of the control of schistosomiasis in Puerto Rico, see also: Negrón Aponte H, Jobin WR. Schistosomiasis control in Puerto Rico: Twenty-five years of operational experience. Am J Trop Med Hyg 1979;2:515-525.

28. Mayo Santana, The Puerto Rico Journal of Public Health and Tropical Medicine.
29. STM Announcement, 1929-30: 18.
30. Two articles were published in the same year with the same titles and authors. The longest and original paper is: Taliaferro WH, Hoffman WA, Cook DH. A precipitin test in intestinal schistosomiasis (S. mansoni). J Prev Med 1928;2:395-414. The shorter version, which the authors refers as "only a summary of the work done thus far" is: Taliaferro WH, Hoffman WA, Cook DH. A precipitin test in intestinal schistosomiasis (S. mansoni). Porto Rico Rev Public Health Trop Med 1928;4:117-119. The present review of this work is based on the longer version. Taliaferro, Hoffman, Cook, A precipitin test in intestinal schistosomiasis (J Prev Med): 413-414. The serums tested came from the following subjects (results included): a) 28 persons with stools positive for S. mansoni (77 precipitin tests gave 63 positive and 14 negative), b) 5 persons negative for both S. mansoni and syphilis (24 tests gave 1 positive and 23 negative), c) 4 persons negative for S. mansoni but positive for syphilis (17 tests gave 9 positive and 8 negative), and d) some of the preparatory work was done with rabbits and two monkeys. Precipitation 'cloudiness' was eliminated by alcohol or ether extraction, with the exception of the pseudo-positives in syphilitic serums. [Note: these articles brings forth the general question of whether in some periods similar type of publications in local venues (in particular the STM Journal) were summaries or works in progress of final and more complete forms of articles published in external journals. The same kind of situation could be postulated about correlated publications in both the Boletín de la Asociación Médica de Puerto Rico and the STM Journal. On the last issue, see: Mayo Santana, The Puerto Rico Journal of Public Health and Tropical Medicine: 180.]
31. See for example: Taliaferro WH, Taliaferro LG, Fisher AB. A precipitin test in malaria. In: Fifteen Annual Report Medical Department United Fruit Company, Boston, MA, 1926:48-57; 343-357. Taliaferro WH, Taliaferro LG. Acquired immunity in avian malaria. I. Immunity to superinfection. J Prev Med 1929a; 3:197-208. Taliaferro WH, Taliaferro LG. Acquired immunity in avian malaria. II. The absence of protective antibodies in immunity to superinfection. J Prev Med 1929b; 3:209-223. Cannon PR, Taliaferro WH. Acquired immunity in avian malaria. III. Cellular reactions in infection and superinfection. J Prev Med 1931;5:37-64. Taliaferro WH. The Immunology of Parasitic Infections; London; John Bale, Sons & Danielsson, LTD, 1930: V. Malaria: 70-76; VII. Schistosomiasis: 78-84. Besides this work on the immunology of malaria, Taliaferro was considered an authority on antigen-antibody reactions, an important understanding for immunologic diagnosis: Taliaferro WH. The synthesis and activities of antibodies. The Rice Institute Pamphlet 1958;45:114-140. As reviewed in: Faust EC, Russell PF. Graig and Faust's Clinical Parasitology, 7th Ed.; Philadelphia; Lea & Febiger, 1964: 1004-1005.
32. The authors mentioned that their work was 'greatly facilitated' by previous investigations, chiefly by the work of N.H. Fairley with complement fixation tests; see, for example: Fairley NH. The discovery of a specific complement fixation test for bilharziasis and its practical application to clinical medicine. J Royal Army Med Corps 1919;32:449-460.
33. Note: The notion of "livers" in the sentence, "antigens prepared from the 'livers' of the invertebrate snail host," and in other similar expressions (i.e., "of dried 'livers' of Planorbis...;", "dried cercarial snail 'livers'...;" ,"macerated infested snail 'livers'..."), carry some level of uncertainty because of the variations, but it has a scientifically sound usage. Taliaferro, Hoffman, Cook, A precipitin test in intestinal schistosomiasis (J Prev Med): 401; Taliaferro, Hoffman, Cook, A precipitin test in intestinal schistosomiasis (Porto Rico Rev Public Health Trop Med): 117-118. Since those expressions also mention lifecycle forms of the parasite, see on the history of the elucidation of the lifecycles of schistosomiasis: Nelson GS. A milestone on the road to the discovery of the lifecycles of the human schistosomes. Am J Trop Med Hyg 1977;26:1093-1100. Russell Stothard J, Kabatereine NB, Archer J, et al. A centenary of Robert T. Leiper's lasting legacy on schistosomiasis and a COUNTDOWN on control of neglected tropical diseases. Parasitology 2017;1602-1612. Graig and Faust's Clinical Parasitology, a book which its first edition is from 1937, describes the whole biology and life cycle of S. mansoni. Faust, Russell, Graig and Faust's Clinical Parasitology: 545-553. On their review of immunologic tests for Schistosoma Spp., the authors start the section as follows: "The antigen as usually prepared is group specific. It has been obtained from snail livers infested with the sporocist-cercaria stages (and contains unknown heterologous antigens), from pools of cercariae which have erupted from infested snails, from adult worms removed from experimental hosts, and from concentrates of viable embryonated eggs": 1012. On Biomphalaria anatomy, see: Pan American Sanitary Bureau. A Guide for the Identification of the Snail Intermediate Hosts of Schistosomiasis in the Americas. (Scientific Publication No. 168) Washington, D.C.; Pan American Health Organization, 1968: 10 (Diagram of Biomphalaria).
34. Oliver-González J. Anti-egg precipitins in the serum of humans infested with Schistosoma mansoni. J Infect Dis 1954;95:86-91. Oliver-González J, Ramos FL, Coker CM. Serological reactions against egg antigens as an aid in the evaluation of therapy in schistosomiasis. Am J Trop Med Hyg 1955, 4:908-912. See also: Hillyer, The rise and fall of bilharzia in Puerto Rico: 228; who mentions: "The circumoval (COP) test was described by Oliver Gonzalez in 1954 as a schistosome egg-specific test 'which may be of diagnostic and prognostic value.' Its elegance resides in its simplicity requiring only a microscope slides and cover-slips, serum or plasma and schistosome eggs." In: Faust, Russell, Graig and Faust's Clinical Parasitology: 1012-1014, review of immunology tests for Schistosoma Spp., the Taliaferro, Hoffman, Cook, A precipitin test in intestinal schistosomiasis is not mentioned; thus, the conclusion as advanced did not survive the scientific test of time. However, the Oliver González, Ramos, Cooker, Serological reactions against egg antigens, circumoval precipitin test was reviewed in a positive manner.
35. O'Connor F.W. Diary of a Porto Rican Trip. In: Mayo Santana, Ramírez de Arellano, Rigau Pérez (eds.). A Sojourn in Tropical Medicine: 13-91.
36. O'Connor FW. Filariasis in association with infection of Filaria bancrofti. Porto Rico Rev Public Health Trop Med 1927;3:211-222. This paper was his second lecture at the STM, his first was delivered in 5 Nov 1927, on the topic of Ascariasis. School of Tropical Medicine. Clinics, Seminars and Clinico-Pathological Conferences, 23 Nov 1927, typewriter copy: 5 p.: "El Dr. F.W. O'Connor, de Nueva York, Conferenciante Visitante en la Escuela de Medicina Tropical, hablará en la Clínica del Sábado, 5 de noviembre a las 11:30 A.M. sobre "Ascariasis", y dictará su segunda conferencia sobre "Filariasis" el Lunes, 7 de noviembre a las 8:30 de la noche": 1.
37. "Culex quinquefasciatus (anteriormente conocido como Culex fatigans) es el vector de la filariasis causada por el nematodo Wuchereria bancrofti en las regiones tropicales y subtropicales" (Wikipedia, dated: 28 Sep 2017).
38. For example: a) how microfilaria access to the bloodstream; b) the longevity of the microfilaria in the human body; c) "it is presumed that the microfilaria do not develop in the human body;" d) in 14 cases of hydrocele fluid examined in the Island he failed to find microfilaria; e) the time period that the parasite requires for development in local Culex fatigans and the causes of periodicity; f) when sexual differentiation and when sexual maturity occur of the filaria larva after it enters the human body; g) the associated factors in the death of the adult in the body and on the migrations in the definitive host; and h) concerning treatment his opinion was that it has been 'most unsatisfactory' and that "all our efforts to prevent recurrences have been unavailing": 221.

39. See: O'Connor FW. An experiment in the treatment of filarial lymphangitis by subcutaneous injections. Porto Rico J Public Health Trop Med 1929; 5:11-15. The study was done with 20 outpatient cases with acute attacks in which the patient could perceived a symptomatic local area of the skin of the affected limb, where the drug was injected in an anesthetic solution. The treatment was considered to have some positive effect in modifying the severity and duration of the attacks. No definitive claim was made of the treatment and the drug since the paper's sole purpose was to open a treatment alternative for other physicians through a different method of procedure (e.g., subcutaneous vs. intravenous injections).
40. An arsenic compound that was used in the treatment of syphilis and in other dermatological conditions (e.g., warts); it was prepared from arsphenamine, formaldehyde, and sodium bisulphite. See: Voegtlin C, Johnson JM, Dyer H. Sulpharsphenamine, its manufacture and its chemical and chemotherapeutic properties. Public Health Rep 1922;37:2783-2798.
41. a) O'Connor FW, Burke GR. Lymphangitis and filariasis in Porto Rico. A report of 57 cases. Am J Trop Med 1929;9:143-177. O'Connor FW, Hulse CR. Studies in Filariasis. I. in Puerto Rico. PR J Public Health Trop Med 1935;11:167-272. (In Spanish: Estudio de la filariasis en Puerto Rico. PR J Public Health TropMed 1935;11:273-367.) The 1935 article is extensive and comprehensive; also, it included an historical introduction of filariasis in Puerto Rico. On the observation made by O'Connor and Burke in 1929, that the town of Aguadilla "has an unenviable reputation for the prevalence of elephantiasis," Rigau, The Apogee of Tropical Medicine, made the following comment based on a paper by J. Suárez: "Filariasis was present throughout Puerto Rico, with a few high intensity foci such as Puerta de Tierra... and Aguadilla...": 191 192. See: Suárez J. A preliminary report on the clinical and bacteriological findings in 60 cases of lymphangitis associated with elephantoid fever in Porto Rico. Am J Trop Med 1930; 10:183-198: "The disease is more or less uniformly distributed throughout the island with a few endemic foci here and there such as Puerta de Tierra (a suburb of the capital) and the city of Aguadilla in the western part of the island": Abstract.
42. Lambert, Review of research carried out in first two years 1926-1928: 109-110.
43. Mayo Santana, The Puerto Rico Journal of Public Health and Tropical Medicine.
44. Darrach, in his report for 1930, mentions two other visiting professors that in this period performed research work during their visits: Edwin O. Jordan, from the University of Chicago, "a previous visiting lecturer returned for a period of investigative work bringing his own laboratory assistance and equipment and supplies": 86; and W.G. Smillie of the Department of Public Health at Harvard University, who "returned and is conducting in the island of St. John a study on bacterial flora of the upper respiratory tract": 86. Darrach W. Report of the Dean of the School of Medicine for 1930: 86. See also: Jordan EO. Food poisoning. Porto Rico Rev Public Health Trop Med 1929;4:517-537 (Portions of the Gordon Bell Memorial Lecture, Winnipeg, Manitoba); and Smillie WG. Field Studies of Acute Respiratory Disease. Porto Rico J Public Health Trop Med 1929;5:3-7, lecture delivered at the STM, May 10, 1929.
45. See: Ramírez de Arellano, Francis William O'Connor. In: Mayo Santana, Ramírez de Arellano, Rigau Pérez (eds.). A Sojourn in Tropical Medicine. Ramírez de Arellano asserts that: "Even before the school had opened in Puerto Rico, the International Health Board had agreed to give Columbia the sum of $8,000 to support visiting professorships at the fledgling enterprise, thereby encouraging the intellectual cross-pollination to which the Foundation was committed": 128-129. Both O'Connor and Taliaferro visits were supported by the Rockefeller Foundation.
46. Ashford BK. Liver extract in the treatment of the anemias of sprue. Preliminary note. JAMA 1928;4:120-127. This trial of a combination of diet and liver extract was unsuccessful: the pernicious anemia remains and 'no patient with secondary anemia' responded positively to liver extract. See also: Ashford BK. Liver extract in the treatment of the anemias of sprue. Porto Rico Rev Public Health Trop Med 1928;4:78-80. According to Hanes FM (Ashford's bibliography of sprue. PR J Public Health Trop Med 1938;13:427-459), Ashford's research on tropical sprue dates back from 1913 - with one article on a local journal (Bol Asoc Med PR) and two papers on external venues (Am J Trop Dis & Am Soc Trop Med); and from 1915 to 1923, Hanes bibliography shows two papers in the same local medical bulletin and seven in external journals.
47. Ciferri R, Ashford BK. Two strains of Pullularia Pullulans (De Bary), Berkhout isolated from the human skin. Porto Rico J Public Health Trop Med 1929; 5:188-195. According to the authors, the results of their observations were that two fungi, Montoyella nigra and Cladosporium Mansoni, associated as causes of certain 'bizarre' pigmented mycotic affections of the skin (i.e., the tropical disease of "black pinta," a treponemal infection), grouped under the term "carate," can readily be confused with Pullularia Pullulans, "which is either a contaminating organism or which may be a harmless saprophyte": 195.
48. Kesten BM. Observations on skin diseases in Porto Rico. Porto Rico J Public Health Trop Med 1929; 5:185-187. Carrión AL. Observations on dermatomycosis in Porto Rico: Report on the fungus commonly associated with foot dishidrosis. Porto Rico J Public Health Trop Med 1930; 5:278-282. Carrión AL. Observations on dermatomycosis in Porto Rico: Report on epidermophytosis of the general surface of the skin. Porto Rico J Public Health Trop Med 1930;6:217-220.
49. McKinley EB. Encephalitis. Proc Soc Exp Biol Med 1930;27:436-440. McKinley EB, Douglas M. Encephalitis. J Infect Dis 1930;47:511-522.
50. Lambert, Review of research carried out in first two years 1926-28: 107. This comment on the nutritional deficiencies in the common diet will be common for decades to come.
51. Rappleye W.C. Report of the Dean of the School of Medicine for the period ending June 30, 1931. On entomology, the report mentions the following: "In the field of entomology the collection of mosquitoes has been continued and eventually a monograph will be prepared on the mosquitoes in Porto Rico": 41. See also: Rappleye W.C. Report of the Dean of the School of Medicine for the period ending June 30, 1935. This report mentions a monograph on Culicoides, a genus of biting midges: "In this connection the Department [Parasitology] is cooperating in the preparation of... Culicoides of the Western Hemisphere, by Drs. Root (deceased) and Hoffman": 54. Another publication by Hoffman on Culicoides and filaria is: Hoffman WA. Culicoides filariferus, new species. Intermediate host of an unidentified filaria from Southwestern Mexico. PR J Public Health Trop Med 1939;15:172-174. On publications of mosquitoes in P.R., at the time, see for example: Tulloch GS. The mosquitoes of Puerto Rico. J Agric UPR 1937;21:137-168. Weathersbee AA. A note on the mosquito distribution records of Puerto Rico and of the Virgin Islands. PR J Public Health Trop Med 1944;19:646-648.
52. There is no article, in local or external venues, by Hoffman on a serological test for Fasciola hepatica during this epoch or later. The McKinley's Review of research during the third year 1928-1929, states the following: "Fasciola hepatica is a common fluke infection of cattle in Porto Rico. Furthermore, it is known that man occasionally serves as the definite host for this species. Dr. Hoffman has succeeded in developing a serological test for this parasite though the precipitins reacting specifically against antigen prepared from this fluke are demonstrable only in low dilutions": 315. There is an article by Hoffman on the intermediate host of this parasite: Hoffman WA. The intermediate host of Fasciola hepatica in Porto Rico. Porto Rico J Public Health Trop Med 1930; 6:89-91. In this article, Hoffman corroborates the finding of H.L. Van Volkenburg of the 'Porto Rico Agricultural Experiment Station' at Mayagüez who identifies the snail Lymneacubensis as the intermediate host of Fasciola hepatica in P.R. There is an indirect reference of a presentation by Hoffman in 1928 in the proceedings of the American Society of Parasitologists on a "Ring Test or Precipitin test" in Fasciola hepatica: The Journal of Parasitology 1928;15:135-149. The historical difficulties of finding an adequate diagnostic test for Fasciola hepatica infestation in cattle is evident, as the following recent article shows: Mazeri S, Sargison N, Kelly RF, de C Bronsvoort BR, Handel I. Evaluation of the performance of five diagnostic tests for Fasciola hepatica infestation in naturally infested cattle using a Bayesian no gold standard approach. PLOS One 2016;11:e0161621; the authors say: "The clinical and economic importance of fasciolosis has been recognized for centuries, yet diagnostic tests available for cattle are far from perfect": abstract.

53. McKinley, Review of research during the third year 1928-1929: 316. See also: Pomales Lebrón A. Bacteriologic study of normal throats, pathological throats and tonsils removed at operation in Porto Rico (A preliminary report). Porto Rico J Public Health Trop Med 1929;5:196-210. This report was offered in partial fulfillment for an MA Thesis.
54. McKinley, Review of research during the third year 1928-1929: 314. See also: Morales Otero P, McKinley EB. Experimental measles in monkeys (Macacus Rhesus). Porto Rico J Public Health Trop Med 1929;5:36-39. On the controversial experiments performed by Morales Otero see: Morales Otero P. Experimental infection of Brucella abortus in man: Preliminary Report. Porto Rico J Public Health Trop Med 1929;5:144-157. Morales Otero P. Further attempts at experimental infection of man with a bovine strain of Brucella abortus. J Infect Dis 1933;52:54-59. In the 1929 article, Morales Otero reviewed a study carried out in Michigan of another experimental infection of B. abortus of the bovine type in humans with five hundreds persons ("equally divided into males and females, of all age groups") also exposed through an infected milk supply, which showed a low human susceptibility of infection (p. 145). Orr FP, Hunddleson IF. Symposium on undulant fever. Am Public Health Ass 1929.
55. Darrach W. Report of the Dean of the School of Medicine for 1930: 87. Three research fellowships: 1) the B.K. Ashford Fellowship; 2) the Committee for Relief in Belgium Educational Foundation; and 3) the Rockefeller Foundation support of P. Morales Otero for study in the U.S. Two research grants: 1) the Ella Sachs Plotz Foundation of Boston granted a fund for the study of fungus diseases in P.R.; and 2) the Matheson Encephalitis Commission granted compensation for two laboratory assistants who were also students in the School.
56. Rappleye W.C. Report of the Dean of the School of Medicine for the period ending June 30, 1931: 38. The transfer of J.H. Axtmayer was financed in part by the Rockefeller Foundation, who would become a permanent faculty member of the School in 1933. Axtmayer got a BS in P.R. and a MA (1926) and PhD (1927) from Columbia. STM Announcement, 1931-32: 3.
57. Koppisch, Report of the Pathology Department, 1929-1930: 336-338. Specifically, cases with infestation with parasitic helminthes were: trichuriasis (23), uncinariasis (21), schistosomiasis (10), and ascariasis (5), and cases of other "tropical conditions" were: sprue (5), malaria (4), filariasis (4), and leprosy (3). Diseases of more general distribution that were fatal: lobal pneumonia in 11 cases, lobular pneumonia in 7, typhoid fever in 6, and epidemic encephalitis in 1. Tuberculosis was found in 15 cases in different forms. Of 1,316 cases examined, there were: 187 malignant tumors (mostly carcinomas and sarcomas) and 130 benign tumors.
58. Darrach W. The object and outlook of the School of Tropical Medicine: 4.
59. Lambert RA. Escuela de Medicina Tropical de la Universidad de Puerto Rico. Bajo los auspicios de la Universidad de Columbia. Oficina Sanitaria Panamericana; 925-929: 926.
60. Jobling, Report on the School of Tropical Medicine: 3.
61. Lambert, Review of Research Carried Out in First Two Years 1926-28: 109-110.
62. Lambert, Review of Research Carried Out in First Two Years 1926-28: 109. Darrach W. Report of the Dean of the School of Medicine for 1930: 90.
63. Lambert, Review of research Carried Out in First Two years 1926-28: 107. A prototype such as the one established by Ashford with Sprue, was an extension of the research carried out by him at the ITMH, or that schistosomiasis attracted Hoffman's attention due to some interesting biological fact (or even that other worm infestations were more prevalent, such as uncinariasis and ascariasis), or by the technical chemical development of a diagnostic serum precipitin test.
64. McKinley, Review of research during the third year 1928-1929.
65. Rappleye W.C. Report of the Dean of the School of Medicine for the period ending June 30, 1931. These health conditions were: filariasis (O'Connor), sprue (Ashford), pernicious anemia (Ashford & Pons), leprosy (Epidemiology), skin affections (Carrión), undulant fever (Morales Otero, Veterinary), general nutrition (Chemistry), schistosomiasis (Parasitology), or in the case of Pathology, through collaboration with other departments (experimental mycotic infection in monkeys, acute rheumatic fever, schistosomiasis), or bacteriological studies on hemolytic staphylococcus infections with the Presbyterian Hospital.
66. Jobling, Report on the School of Tropical Medicine. Lambert, Review of research carried out in first two years 1926-28. McKinley, Review of research during the third year 1928-1929. Darrach W. Report of the Dean of the School of Medicine for 1930. Rappleye W.C. Report of the Dean of the School of Medicine for the period ending June 30, 1931.
67. Rappleye W.C. Report of the Dean of the School of Medicine for the period ending June 30, 1931: 41.
68. STM Announcement, 1934-35: 5
69. Rappleye W.C. Report of the Dean of the School of Medicine for the period ending June 30, 1940: 37.
70. Faust EC. Investigations in Puerto Rico on Manson's blood-fluke infection (Schistosomiasis mansoni). Science 1933;78:62-63. Faust EC. Studies on Schistosomiasis mansoni in Puerto Rico. I. The history of schistosomiasis in Puerto Rico. PR J Public Health Trop Med 1933;9:154-161.
71. Faust, Investigations in Puerto Rico: 63.
72. a) Faust, Investigations in Puerto Rico: "It also occurs in Puerto Rico, where it was first reported by González Martínez in 1904, three years before the species was differentiated...": 63. b) Faust, The history of schistosomiasis: "In the light of this documented evidence the present writer feels that the honor of first studying intestinal schistosomiasis in the indigenous population of the Western Hemisphere without question belongs to González Martínez": 155-156. In the above reference 27, I mentioned Hillyer's comment, The rise and fall of bilharzia in Puerto Rico: 225, on the priority of P. Manson in "identifying a new parasite": "Manson had described in England a single case of intestinal bilharziosis from a patient from the Caribbean island of Antigua finding oval eggs with lateral spines." Nevertheless, the assertion made by Faust on González Martínez being the "first studying intestinal schistosomiasis in the indigenous population" is still correct. See: Manson P. Report of a case of bilharzia from the West Indies. Br Med J 1902;2:1894-1895: "I made an examination of his faeces and discovered the ova of bilharzia. In this case, as so often happens in bilharzia ova from the alimentary canal, the spine is placed laterally": 1894. However, bilharzia historian J. Farley, in terms of Manson description, clarifies that "in the past, such eggs [laterally spined eggs] had been assumed to be those of Schistosoma haematobium," the classic Bilharz African schistosome species - I add, not the 'second species' described by Sambon (S. mansoni, 1907) and González Martínez (1904). Farley J. Bilharzia: A History of Imperial Tropical Medicine, 1st paperback ed.; Cambridge; Cambridge University Press, 2003: 55. Also, Manson did not seem to make any credit on priority - except by being eventually in agreement with Sambon that there were two species - as Faust, Investigations in Puerto Rico, mentions a J. Catto (15 Dec 1904) letter of acknowledgement to González Martínez who said: "I have shown your worms and papers to Sir Patrick Manson and he is also very interested": 155.
73. Faust, Investigations in Puerto Rico: 159-160. The list makes reference to seven studies, but I have been unable to find the seventh (i.e., VII. Preventive aspects of schistosomiasis mansoni in Puerto Rico). Hillyer, The rise and fall of bilharzia in Puerto Rico: 225-226, mentions the sixth by E. Koppish as the "8th and last article," and is correct, however, in that it was the last of the series. See: Koppish E. Studies on Schistosomiasis mansoni in Puerto Rico. VI. Morbid anatomy of the disease as found in Puerto Ricans. PR J Public Health Trop Med 1941;16:393-455.
74. Mayo Santana, The Puerto Rico Journal of Public Health and Tropical Medicine: 184.
75. a) On the survey of animal and human parasites, see: Rappleye W.C. Report of the Dean of the School of Medicine for the period ending June 30, 1940: 38. b) On trichinosis research, see: Bachman GW. A precipitin test in experimental trichiniasis. J Prev Med 1928;2:97-101. Bachman GW. An intradermal reaction in experimental trichinosis. J Prev Med 1929; 2:513-523. McNaught JB. Trichinosis. Calif West Med 1938;48:166-172: 169. Oliver-González J. The in vitro action of immune serum on the larvae and adults of Trichinella spiralis. J Infect Dis 1940;67:292-300. Oliver-González J. The dual antibody basis of acquired immunity in trichinosis. J Infect Dis 1941;69:254-270. Note: Overall, the majority of experimental articles will be addressed in the last era (1941-1949).

76. STM Announcement, 1931-32: 5. The other research assistants in Chemistry were Trinita Rivera (BA Columbia 1927) and Carlos L. Cintrón (BS Porto Rico 1920); and Assistant in Bacteriology, Margaret Douglass (BA Cornell 1927).
77. On the nutrition series see, for example: a) Cintrón CL, Cook DH. Nutritional studies of the food stuff used in the Porto Rican dietary. II. Proximate and ash analyses. Porto Rico J Public Health Trop Med 1931; 7:435-441. This study analyzed 22 plants (see list, p. 438). In general, the study shows: (i) that the foods are low in protein, (ii) "all but aguacate are low in fat," (iii) no plants were specially rich in calcium, (iv) most of them contain little iron, and (v) "some of them contain notable amounts of vitamin A": 437-438. b) Axtmayer JH, Silva S. Nutritional studies of the food stuff used in the Porto Rican dietary. III. The vitamin G (B_2) content of the ripe plantain (Musa paradisiaca, L.) and the pigeon pea (Gandul), (CajanCajan, L.). PR J Public Health Trop Med 1932; 8:1-4. This study, that used the rat growth method (i.e., Sherman & Smith), found that the vitamin B_2 content of the gandul is four times that of the ripe plátano. The authors mention that their experimental results compare favorably with those from other sources. c) Cook DH, Axtmayer JH, Dalmau LM. Nutritional studies of foodstuffs used in the Porto Rican dietary. VII. A comparative study of the nutritive value of three diets of frequent use in Puerto Rico. PR J Public Health Trop Med 1940;16:3-13. The purpose of this important study was to evaluate through rat grow feeding the chemical composition and nutritive values of "typical diets... consumed by three large groups of people living" in P.R.: "natives of the U.S." (Continental diet); "large groups of families" who buy their food from "caterers" (i.e., from restaurants, hotels, or private homes) (Caterer diet); and "representatives... of the poorest country families" (Country Family diet). The cost in cents per person of each diet was: 0.85, 0.15, and 0.08. The method used was: aliquot weighs or volumes, mixed and grounded into a homogeneous part duly samples in total moisture and vitamin A determination. The general results were: "the poor quality of the protein in the County Family Diet is responsible in part for the poor growth response of the rats receiving it as the only source of food deficient": 12. In conclusion, the County Family diet "has been shown to be deficient in various essential factors": 13.
78. Rappleye W.C. Report of the Dean of the School of Medicine for the period ending June 30, 1940: 36. The report also states that the Rockefeller Foundation grant will expire this year. The evaluation of the work done was that it "has been of great value since it is concerned with the food habits, welfare, and general health of the public": 36.
79. Bachman GW. Memoria del Director de la Escuela de Medicina Tropical de la Universidad de Puerto Rico bajo los auspicios de Columbia, en el Curso Académico de 1934-35. Archives & Special Collections. A.C. Long Health Sci. Library. Columbia University: 42. (Note: from now on, the "Memorias del Director" will be referenced as: Name of Director. Memoria del Director STM, academic year.)
80. These three phases of the nutrition-chemistry research program at the STM were formulated based on faculty publications in the STM Journal: a) The foundational phase (~1927-1931), the D.H. Cook &Trinita Rivera series, starts with Cook, Vitamin studies in Porto Rico, of 1927, and run continuously up to the year 1931, with Cook and Rivera, "Note on the effect of feeding raw and cooked tubers" (Porto Rico J Public Health Trop Med 1931;6:341-345); b) The second phase (~1930-33/1940) goes from J.H. Axtmayer, "A study of the vitamin B complex of yellow yautía (Xanthosa sagittae-folium) and of plantain (Musa paradisica L)" (Porto Rico J Public Health Trop Med 1930;6:229-233), passing trough Cook and Axtmayer, "Nutrition studies of foodstuffs used in the Puerto Rican Dietary. VI. The vitamin A content of pasteurized milk and native cheese" (PR J Public Health Trop Med 1933;9:90-92) and ending in 1940 with Cook, Axtmayer and Dalmau, "Nutrition studies of foodstuffs used in the Puerto Rican Dietary. VI. A comparative study of the nutritive value of three diets of frequent use in Puerto Rico" (PR J Public Health Trop Med 1940;16:3-13); and c) The last long standing phase (~1935-1948) of C. Asenjo and L.M. Dalmau, starts in 1935 with Asenjo, Dalmau and Axtmayer, "The vitamin content of West Indian shark liver oils. II. The vitamin D content of the liver oil of the small blue shark" (PR J Public Health Trop Med 1937;12:358-362) and ends in 1948 with J.A. Goyco and Asenjo, "Studies on edible yeasts" (PR J Public Health Trop Med 1948;23:471-502).
81. O'Connor (1927), Filariasis in association with infection of Filaria bancrofti. O'Connor (1929), An experiment in the treatment of filarial lymphangitis. O'Connor, Burke (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. O'Connor FW. Filarial periodicity with observations on the mechanism of the migration of the microfilariae from the parent worm to the blood stream, Porto Rico J Public Health Trop Med 1931;6:263-272. O'Connor, Hulse (1935), Studies in Filariasis. I.
82. Mayo Santana R. Scientific representations at the UPR School of Tropical Medicine. I: Images of Science: Table 4.
83. Tampi MK. A study of filariasis in Porto Rico. Porto Rico J Public Health Trop Med 1931;6:435-441: 438.
84. See for example: Cartwright FF. Disease and History (In collaboration with MD Biddis); New York; Thomas Y. Crowell, 1972. Ch. 5. The impact of infectious diseases: 113-136. Faust, Russell, Graig and Faust's Clinical Parasitology: 46-48, 394. Harhay MO, Horton J, Olliaro PL. Epidemiology and control of human gastrointestinal parasites in children. Expert Rev Anti Infect Ther 2010; 8:219-234. King CH. Parasites and poverty: The case of schistosomiasis. Acta Trop 2010; 113:95-104. López Piñero JM. Breve historia de la medicina; Madrid; Alianza Editorial, 2000/2012: Cap. 1. Enfermedades y sociedad: 13-46. Pullan R, Brooker S. The health impact of polyparasitism in humans: are we underestimating the burden of parasitic diseases? Parasitology 2008;135:783-794. Zimmer C. Parasite rex: inside the bizarre world of nature's most dangerous creature; New York; Atria Paperback, 2000/2014.
85. An example of publications in each area of research are: a) (Tuberculosis) Morales Otero P, Koppisch E, Axtmayer JH. Influence of dietary factors upon the resistance of the white rat to experimental tuberculosis: I. Vitamin A deficiency. PR J Public Health Trop Med 1934;9:314-320. b) (Recurrent tropical lymphangitis) Morales Otero P, Pomales-Lebrón A. Immunological response of cases of recurrent tropical lymphangitis to haemolytic streptococci and their products. PR J Public Health Trop Med 1936;12:43-66. c) (Biology of pneumococci) Benítez C, Morales Otero P. PR J Public Health Trop Med 1940;15:252-262. d) (Streptococcus) Pomales-Lebrón A. A study of hemolytic streptococci as found in the tropical island of Puerto Rico. PR J Public Health Trop Med 1940;16:66-133. e) (Brucella abortus) Morales Otero P, Monge G. Las pruebas de alexina y aglutinación en las infecciones ocasionadas por el Brucella abortus. PR J Public Health Trop Med 1932;8:201-204. f) (Endameba histolytica) Poindexter HA. The Puerto Rican strain of Endameba histolytica. PR J Public Health Trop Med 1933; 9:31-36. g) (Surveys) Rodríguez Pastor J, Morales Otero P, Payne GC. Tuberculosis surveys in Puerto Rico: I. Study of a coast and a mountain municipality. PR J Public Health Trop Med 1935;10:451-479.
86. Mayo Santana, The Puerto Rico Journal of Public Health and Tropical Medicine: 184. Mayo Santana, Scientific Representations at the UPR School of Tropical Medicine. I: Images of Science: First, P. Morales Otero (bacteriologist) with 9 articles; second, D.H. Cook (chemist) with 7, and third G.W. Bachman (parasitologist) with 6; followed by: J.H. Axtmayer (chemist) (5), R. Rodríguez Molina (medical parasitologist) (5); then four other with 4 each (A. Pomales Lebrón, J. Oliver-González, W.A. Hoffman, and L.M. González).
87. Bachman GW. Memoria del Director STM, 1935-36: 37.
88. Bachman GW. Memoria del Director STM, 1936-37: 40. The special permits were granted to the following external researchers: Dr. R. Ruiz Nazario, Srta. C. Benítez, Sr. L.M. Laugier, Sra. M. del C. de Fernández.
89. Rappleye W.C. Report of the Dean of the School of Medicine for the period ending June 30, 1940: 35.
90. a) First survey: Rodríguez Pastor, Morales Otero, Payne, Tuberculosis surveys in Puerto Rico: I. b) Second survey: The second survey was a "preliminary report" of a study carried out in two urban communities (i.e., urban sections of San Juan and Bayamón), again using a tuberculin test. The results showed the widespread dissemination of the infection with

the higher prevalence of the fibrous-caseous type of pulmonary tuberculosis. Rodríguez Pastor J, Morales Otero P, Payne GC, Ramírez Santos R, Silva E. Tuberculosis surveys in Puerto Rico: II. A study of two urban communities. Preliminary report. PR J Public Health Trop Med 1935; 10:514-522. c) Third survey; This survey of four slum areas in San Juan was considered unreliable due to the use of an inadequate methodology (selection of cases by house visits, clinical identification, and medical examination). Arruza J, Payne GC, Rodríguez Pastor J. Tuberculosis surveys in Puerto Rico: III. A survey of slums in San Juan. PR J Public Health Trop Med 1935;10:533-537.

91. Rappleye W.C. Report of the Dean of the School of Medicine for the period ending June 30, 1934: 35. Rappleye W.C. Report of the Dean of the School of Medicine for the period ending June 30, 1935: 51. Bachman GW. Memoria del Director STM, 1937-38: 40. However, no papers were published in the STM Journal or in external venues of these studies on tuberculosis in the needlework and tobacco industries.
92. Rappleye W.C. Report of the Dean of the School of Medicine for the period ending June 30, 1940: 80. See: Pomales-Lebrón A. A bacteriological study of normal throats, pathological throats, and excised tonsils, made in Puerto Rico. PR J Public Health Trop Med 1936;11:512-532. Morales Otero P, Pomales-Lebrón A. Biological characteristics of hemolytic streptococci isolated in Puerto Rico. PR J Public Health Trop Med 1936;12:3-20.
93. Bachman GW. Memoria del Director STM, 1936-37: 46.
94. The series of five articles on the health and socioeconomic studies were: Morales Otero P, Pérez MA, Ramírez Santos R, et al. Health and socio-economic studies in Puerto Rico. I. Health and socio-economic conditions on a sugar cane plantation. PR J Public Health Trop Med 1937;12:405-490. Morales Otero P, Pérez MA, Ramírez Santos R, Espino R, Marrero M. Health and socio economic studies in Puerto Rico. II. Health and socio-economic conditions in tobacco, coffee and fruit regions. PR J Public Health Trop Med 1939;14:201-289. Morales Otero P, Pérez MA. Health and socio-economic studies in Puerto Rico. III. Physical measurements of agricultural workers. PR J Public Health Trop Med 1939;14:450-474. Morales Otero P, Pérez MA. Health and socio-economic studies in Puerto Rico. IV. Physical impairments of adult life among agricultural workers. PR J Public Health Trop Med 1940; 15:285-313. Pérez MA. Health and socio-economic studies in Puerto Rico. V. Second survey of the Lafayette area. PR J Public Health Trop Med 1941;16:547-615. This series will be evaluated in a future article on the compelling presence of public health at the STM.
95. Rappleye W.C. Report of the Dean of the School of Medicine for the period ending June 30, 1934: 39. See: Morales Otero, Koppisch, Axtmayer, Influence of dietary factors upon the resistance of the white rat to experimental tuberculosis: I.
96. Rappleye W.C. Report of the Dean of the School of Medicine for the period ending June 30, 1934: 39. Morales Otero P, Koppisch E. La aspergilosis en el pollito. Estudio preliminar. (Sociedad Argentina de Patología Regional del Norte, Santiago del Estero, 2-3 Oct 1933) STM Collected Papers (v.4, 1931).
97. Rappleye W.C. Report of the Dean of the School of Medicine for the period ending June 30, 1934: 39. Koppisch E. Tuberculosis in Puertoricans (sic). A review of 628 autopsies. PR J Public Health Trop Med 1936;11:492-502.
98. Thompson R, Koppisch E. Studies on B.C.G. I. The pathogenicity of B.C.G. PR J Public Health Trop Med 1936;12:209-215. Thompson R, Koppisch E. Studies on B.C.G. II. Vaccination of guinea pigs. PR J Public Health Trop Med 1936;12:216-225. Koppisch E. Studies on Schistosomiasis mansoni in Puerto Rico. IV. The pathological anatomy of experimental Schistosomiasis mansoni in the rabbit and albino rat. PR J Public Health Trop Med 1937;13:154. Koppisch E. Studies on Schistosomiasis mansoni in Puerto Rico. VI. Morbid anatomy of the disease found in Puerto Ricans. PR J Public Health Trop Med 1941;16:395-435.
99. On Koppisch herpes virus and other virology studies results see comments in the following reports: Bachman GW. Memoria del Director STM, 1935-36:51-52. Bachman GW. Memoria del Director STM, 1936-37:55-56. Rappleye W.C. Report of the Dean of the School of Medicine for the period ending June 30, 1939: 71. Rappleye W.C. Report of the Dean of the School of Medicine for the period ending June 30, 1940: 81. In this last report, a negative result in a three-year study to isolate virus of equine encephalomyelitis was taken as a demonstration that the disease was nonexistent on the Island.
100. Rappleye W.C. Report of the Dean of the School of Medicine for the period ending June 30, 1934: 36.
101. Bachman GW. Memoria del Director STM, 1936-37: 48-49. Rappleye W.C. Report of the Dean of the School of Medicine for the period ending June 30, 1939: 23 24.Rappleye W.C. Report of the Dean of the School of Medicine for the period ending June 30, 1940: 75.
102. The Hospital review of research was based on several yearly academic reports: Rappleye W.C. Report of the Dean of the School of Medicine for the period ending June 30, 1934 (pp. 36-37), 1935 (pp. 52-53), 1939 (pp. 23-24), 1940 (pp. 75-80). Bachman GW. Memoria del Director STM, 1935-36 (pp. 43-45), 1936-37 (pp. 48-50), 1937-38 (pp. 43-46).
103. Rappleye W.C. Report of the Dean of the School of Medicine for the period ending June 30, 1934: 38-39; on Ashford's illness: 38. On Ashford's death, see: a) Rappleye W.C. Report of the Dean of the School of Medicine for the period ending June 30, 1935: 52-53. b) Bachman GW. Obituary. Bailey Kelly Ashford. Science 1934;80:516-518.
104. Rappleye W.C. Report of the Dean of the School of Medicine for the period ending June 30, 1935: 52-53. Bachman GW. Memoria del Director STM, 1934-35: 46-48. Bachman GW. Memoria del Director STM, 1935-36: 48-50. According to some authors: "In 1935, Carrión in Puerto Rico described the third aetiological agent of CBM–Hormodendrum compacta. Puerto Rican fungus had all three methods of sporulation characteristic of Hormodendrum, but also demonstrated individual features so that it could be recognized as a different species. In 1936 Pablo Negroni proposed a generic name Fonsecaea, which was accepted as correct. It has been used until now." In: Krzyściak PM, Pindycka-Piaszczyńska M, Piaszczyński. Chromoblastomycosis. Postepy Dermatol Alergol 2014;31:310-321. Accessed 7 Aug 2018. Published online 2014 Oct 22. doi: 10.5114/pdia.2014.40949. Carrión AL. Chromoblastomycosis: Preliminary report on a new clinical type of the disease caused by Hormodendrum compactum, nov.sp. PR J Public Health Trop Med 1935;10:543-545. Carrión AL, Emmons CW. A spore form common to three etiologic agents of chromoblastomycosis. PR J Public Health Trop Med 1935;11:114-115. Carrión AL. Chromoblastomycosis: A new clinical type caused by Hormodendrum compactum. PR J Public Health Trop Med 1936; 11:663-682. Emmons CW, Carrión AL. Hormodendrum pedrosi: An etiological agent in chromoblastomycosis. PR J Public Health Trop Med 1936;11:639. Carrión AL. Chromoblastomycosis in Puerto Rico. PR J Public Health Trop Med 1938;14:37-55. Carrión AL. Observation on dermatomycosis in Puerto Rico: Further report on the etiology of epidermophytosis. PR J Public Health Trop Med 1935;10:255-261.
105. Bachman GW. Memoria del Director STM, 1936-37: 50-52. Bachman GW. Memoria del Director STM, 1937-38: 61-63. Rappleye W.C. Report of the Dean of the School of Medicine for the period ending June 30, 1939: 70-71. Rappleye W.C. Report of the Dean of the School of Medicine for the period ending June 30, 1940: 80. Carrión AL. Actinomycosis in Puerto Rico. PR J Public Health Trop Med 1938;13:367-382. Carrión AL, Ruiz Nazario R, Hernández Morales E. Mal del Pinto en Puerto Rico. Bol Asoc Med PR 1941;33:104-106.