18. YAWS

Yaws, a non-venereal treponematosis, is one of the few diseases specific to the tropics. It occurs in the hot, humid tropical forest, although it is unevenly distributed. Moreover, it is a primitive treponematosis, persisting in the African pygmies and Asian aborigines alike.

The disease afflicts children and adolescents in particular. A less profuse variant is found in dry to arid tropical areas. It has unfortunately been called endemic syphilis. *It is found in its original form among the Bushmen of the Kalahari.*

It is a social disease, whose largest reservoir is found in Africa. Until 1950 it was the leading disease in Central Africa more common than hookworm, tropical ulcer, syphilis, leprosy, sleeping sickness, and even malaria.

An average of 200,000 to 300,000 cases were treated yearly in Zaire, requiring a total of 300 to 350 kg of neosalvarsan each year. Some 150,000 cases were detected annually in Ruanda-Urundi.

Organized efforts to control yaws helped to set up a remarkably effective mobile service. Swift but methodical action was needed to stop the transmission of endemic yaws in its foci. The objective was that the doctor should precede the disease, examine the entire population and treat all detected cases and their contacts in their villages.

The goal was to cure the patient rather than simply to mask the symptoms. This required a series of injections to be continued after the doctor had left the area. The mobile medical prospecting subunits took over at this point and helped to organize fixed and accessible treatment posts. The vertical programme gave rise to integrated horizontal coverage right from the start.

The results of this working method boosted the confidence of the population in Western medicine.

The sensitivity of yaws to penicillin made it possible to reduce its prevalence to a minimum through mass campaigns, leading to the erroneous impression that the disease had been eradicated.

Twenty years later, however, the disease reappeared in most of the West African and Zairean foci. This resurgence was even more dangerous in that health workers had completely forgotten it existed, and also because the new symptom complex was less classical.

Yaws is a serious social problem because the late phase, developing after a latent period, is disabling. Being a rural disease, occurring in remote areas, it can reach high levels before coming to the attention of public health officials.

Finally, penicillin is no longer an easy panacea, while substitute or adjuvant therapies are costly.

HISTORICAL BACKGROUND

1. Early observations

Yaws has such characteristic skin lesions that all communities where it occurs, recognize it and give it a vernacular name.

The first mention in medical papers appeared in *De Medicina indorum* by Jacobus Bontius, published at Leiden, 1642 by Hackius. He describes in chapter XIX the Ambonese spots (Amboynse pocken) occurring in the Molucca islands. These spots ulcerate and look like syphilis without having a venereal origin. They are ascribed to eating *sago*.

These observations were to be corroborated by Guigliemo Piso, physician among the attendants of count Joan Maurits van Nassau, governor of Brazil. Yaws are named *bubas* in his treatise *De medicina brasiliensi* (1648). The disease is classified as venereal although it is not caught by sexual contact.

From the XVIIIth century the observations become numerous in the Caribbean and in the West Indies. Father Labat (1722) calls those spots *epian*; Brickel (1737) uses the word *yaws*; Brother Boissier de Sauvages (1768) distinguishes between *yaws guinneensum* and *pian americanorum* or *epian*. The last author is the first to describe the typical lesions and he proposes to call them *framboesia*. G.W. Shilling (1770) draws the attention to the greater susceptibility of children. P.M. Nielen (1780) makes the difference between *lues venerea* or syphilis and *lues indica* or *epian* of the French physicians.

Yaws was identified in the XVIIth century both in Indonesia and in the West Indies, with further confusion in terminology. This appears clearly in the book *Contribution to the history of medicine* by K. Sprengel, who is disappointed by the grouping of pian and yaws under the name *framboesia* by Boissier de Sauvages. He tries to describe in details but without success, the characteristic signs allowing for specific diagnosis.

At the XIXth century de Rochas (1860) underlines that *lues* and *framboesia* are two different diseases but the famous dermatologist Hebra from Vienna (1862) refuses to accept yaws as being a separate disease. Charlouis (1881) was the first to use the expression *polypapilloma tropicum* and to describe the skin lesions precisely. He further draws attention to the fact that yaws disappears when one comes into a temperate climate.

It is generally admitted that yaws was introduced to America by the slave trade from Western Africa. This implies the occurrence of yaws in tropical Africa whithout confining there the primary focus. The occurrence of yaws in tropical Asia but the lack of data on migrations raise questions which are difficult to answer. In addition comes the problem of the interrelation between the different treponemal diseases.

Due to the lack of data it would be risky to make a choice between several assumptions such as the introduction of yaws in the far East by slaves coming from the East coast of Africa, including Ethiopia. Or its introduction in West Africa by Peuhl, Touareg or other pastoral groups coming from the East is also hazardous. The same is true for the emergence of the disease in America by groups of Asiatics crossing the strait of Behring. The occurrence of venereal or non-venereal treponemal diseases in the New World, proven by bone lesions likely to be due to syphilis, on remainders of the precolombian time, make the problem even more difficult.

The sudden appearence of venereal syphilis in Europe at the time that sailors disembarked in Barcelona from Christophe Colomb's caravels in March 1493 and after Louis XII went to Italy (1499-1500) is disconcerting. It is certain that syphilis was a newcomer at that period, as it would not have been missed by the practitioners of the Roman Empire, when corrupt morals should have resulted in a rapid extension of a sexually transmissible disease.

The occurrence of yaws, also called *framboesia*, was noticed at the time of the Congo Free State. In his report on the health status at the station of Leopoldville (November 1885-March 1887), *Mense* devotes a paragraph to this disease. He mentions its frequency among children and the satisfactory results attained by applying bismuth subnitrate to the swellings.

The discovery by *Castellani* in 1905, at Ceylan of *Spirochaeta pertenuis seu pallidula* in two patients of *paranghi* (yaws), shortly after *Treponema pallidum* by *Schaudinn* in a syphilis lesion, was an event that did not escape the interest of tropical practitioners.

2. Treatment trials

Clinical similarity between yaws and syphilis has encouraged trials with mercury and derived products to treat the disease. *J. Bontius* was already applying white precipitate on the lesions, as the apparently ordinary ailment at the beginning of the disease, could be followed by serious organic disorders. Mercury was used in its most various forms: mercuric chloride taken during one week with follow-up of saliva secretion control as its abundance was considered a sign of efficiency (Schilling); liquor of Van Swieten, called *aqua divina* in some areas of Latin America, was also used. The opinion on the efficiency of mercury remained very

divided. As a whole western treatment was no more efficient than the traditional one. The latter is very well described by *Van Nitsen* (1944).

Arsphenamine (*Salvarsan* or *606*®) discovered by *P. Ehrlich* (1907) is an active product against spirochaetal infections, relapsing fevers, trypanosomiasis, syphilis. It had given the hope that a *therapia sterilisans magna* was available, but it opened a new era in the fight against yaws. As soon as *Nichols* had shown at the Rockefeller Institute that *Salvarsan*® was active against *T. pertenue* inoculated in a rabbit, trials carried out on man proved to be successful. This was confirmed by *Alston* (1911), the impressive series of 700 cases treated at Paramaribo by *Flu* and *Koch* (1911), and the effect of the product on *patek* (yaws) in Indonesia as shown by *Kloppers* (1913).

Salvarsan® was used in the Belgian Congo by *Mouchet* and *Dubois* in 1911-1912. They considered the product to be a precious drug in daily practice for the population as the signs of the disease disappear in ten days or even less after administration. It is worth notice that these authors considered yaws to be widely spread over the whole population, particularly in children who are really covered by proliferations that are suppurating or are covered by crusts. This is in contradiction with *Broden* and *Rodhain* (1908) who consider in their detailed report on medical activities which were centred on Leopoldville that *framboesia tropica* was rare. This was based on their observations at the laboratory of the town.

When *Levaditi* and *Sazerac* (1920) demonstrated the efficiency of bismuth to treat syphilis, this drug was also used in many trials against yaws: various compounds were used in the vain hope of avoiding side effects – gengivitis, stomatitis, trigeminus neuralgia.

Miguens (1924) was to be the first to call upon bismuth subgallate or dermatol in oil (Method of Yernaux). The efficiency of this product was proven by *Mattlet* and many other practitioners, although its only real importance was the low cost of the drug.

Other products have also been used under well controlled trials. Mercury was ill tolerated by Africans and therefore it was quickly given up, except for an occasional use. Different salts of antimony, copper and gold had their period of use and also the inevitable potassium iodure. None of these products gave conclusive results.

3. Different varieties of treponematoses

The existence of different varieties of Treponematosis has not drawn much attention, especially as some of them were specific to a particular environment. Yaws flourishes in warm and moist climates, endemic syphilis of the Bejel type is prevalent in dry, arid or semi-desert areas such as the Sahel in the North, Kalahari and Botswana in the South. However a quite similar endemic syphilis was seen in temperate climates such as Norway, Scotland, and the Balkans, particularly the focus of Bosnia-Herzegovine (*skerljevo*) where the disease disappeared spontaneously or was eradicated by mass-campaigns with penicillin. These variants of endemic syphilis were grouped, rather simplistically in the same category as Bejel in the Middle-East. The main characteristic is the non-venereal transmission and its predominance in children. Clinical differences are also striking although it would be useful to examine the possibility of a modification of the symptoms in transitional areas between equatorial forest and the various types of savannah.

It is also impossible to separate the problem of yaws from that of syphilis. This is proven by the fact that medical conceptions changed over the years. There is also ressemblance if not identity of the pathogen, leading to further thinking.

The much debated question of whether yaws and syphilis are the same disease, or if they are two different nosologic entities, has passionately interested the medical corps. It is indeed not only a purely academic problem: it might be that, when yaws disappears, the field will be open to syphilis.

Opinions brought together by a survey conducted in 1930 by *Bruxelles-Médical* after the publication by *Calewaert* and *Gerniers* of an article arguing in favour of a possible or probable unicity are interesting to read. The same may be said of the papers reported to the *Cercle Médical* of Leopoldville in 1931. *Van Nitsen* has recorded an impressive list of data and observations showing a degree of relationship. The discussions underlined the fact that, depending on the speciality of the participant, the analysis of the data produced an average overall conception. Minor differences, which pointed to a marked tendency among biologists towards unicity, and practitioners towards a duality of diseases, were necessarily left out.

Clinical factors supporting the difference are impressive. The primary raspberry-like lesion of the skin is typical for yaws; it is not a hard *chancre* and is extragenital. Higher frequency in children and youngsters, early plantar hyperkeratosis with papillomas in the cracks, rheumatoid pain in bones, swellings near the joints, itching, strikingly quick clearing or cure of skin eruptions, negative serological outcome of spinal fluid, mild outcome if the patient is not treated, all these facts show the difference between yaws and syphilis.

In addition a number of signs commonly seen in syphilis are lacking – lesions in the mouth and on the lips (splits, patches, leucoplasia), iritis and iridochoroiditis, *syphilitic gummas*, cardiovascular lesions, late cardiovascular and neurologic lesions such as general paresis and tabes dorsalis, lack of hereditary transmission, etc.

In histopathology the lesions develop differently. *T. pertenue* keeps superficially to the surface and invades mostly the epidermis. *T. pallidum* tends to invade the organs and syphiloma are more deeply located in dermo-epidermis or viscera.

Despite this impressive number of unquestionable facts and the purely intertropical distribution of yaws, opinions remain divided.

As concerns the agent, it appears that *T. pallidum* cannot be differentiated from *T. pertenue*. To distinguish them on the basis of the number of spirals, thickness or staining properties, or on basis of typical lesions in the rabbit for *T. pertenue* (Castellani) or the specific sensitivity of *Cynomolgus philippinensis* to *T. pertenue* and the resistance of this monkey to *T. pallidum*, have only convinced the authors of these assertions.

Trials by cross-immunization have brought more contradictions than clarification. This is logical for experiments which are at the fringe of specificity but are facing the group-immunity that takes long to be induced – 7 to 10 months for laboratory animals and more than three years for men. Furthermore, immunity is unstable and does not always occur. It is in this context that the famous experience of *Charlouis* (1881) must be placed, when a Chinese prisoner was inoculated with syphilitic secretions to produce a primary lesion (*chancre*), and secondary stage damages. The same may be said of the failure of *Levaditi* and *Nattan-Larier* to transmit yaws to syphilis-inoculated monkeys, and when also others did similar trials. On the other hand it is possible to reinoculate yaws in a person having yaws. It is sufficient for the patient not to have reached the necessary degree of resistance or simply not to be able to become immunized by his first inoculation. The observations of *Turner* are very instructive in this respect.

The studies of *Mattlet* (1933) and *Vigoni* (1931) bring new elements. Vigoni has seen in an endemic focus of yaws in Kwilu (Lusanga-area of the oil producing *Huileries du Congo Belge*) that the recently introduced syphilis was increasing in frequency to the same extent that yaws were in regression. The author ascribed this not to the unicity of the agent but to the greater sensitivity of yaws to the applied treatment.

Mattlet thought a person well immunized against yaws to be resistant to syphilis, and that "yaws could be to syphilis what cowpox is to smallpox". This rests on the distinction by *Kolle* and *Prigge* between homologous and heterologous strains. Mattlet's opinion relies on his experience in Burundi where the population is heavily infected by yaws and where syphilis seems not to develop while gonorrhoea is currently making headway. The author underlines that his observations are not convincing directly as there is no clear-cut proof for unicity or duality of the agent. Deeper and more prolonged supplementary studies will be necessary to settle this puzzling question, fraught with serious consequences.

In addition, antigenic and genetic analyses of treponemas have led the taxonomists to group under subspecies the fundamentally identical *T. pallidum pallidum, T. pallidum pertenue* and *T. pallidum endemicum*, who have similar symptoms and development: primary lesion, and typical secondary symptoms for each sub-species, turning up in bouts of decreasing intensity with time and, after a latent period, late, sometimes destructive and mutilating lesions.

Treponemas are very sensitive micro-organisms which claim special environmental conditions. *In vitro* cultivation has not yet be done and it is difficult to keep the treponemas under glycerine or in cell culture. These organisms are very sensitive even to mild chemical antiseptics, soap being the first enemy.

It is not inconsistent to consider the specific symptoms as depending on constraints of the environment in its broadest sense. In a warm moist environment (tropical forest), the target of the treponema is the skin and the result is yaws. In a dry and warm sphere or in a temperate climate the favoured port of entrance will be restricted to external mucosa of the mouth, genitals and rectum. The distribution in West Africa suggests this dependence on the environment from the ocean up to the Sahel. In urban areas the problem of treponemal diseases amounts roughly to syphilis. In the coast area and in the forest one finds yaws with its papillomatosis, while in savannahs where temperature and moisture are lower, yaw lesions are located only on moist areas of the body. Finally in the desert endemic syphilis can be found.

It goes without saying that other factors such as lack of hygiene can have an effect. Syphilis might have undergone a period of extra-genital transmissions in the sixteenth century – *sivvens* or *sibbens* in Scotland (*sivvi* means raspberry in celtic language), *radesyge* in Sweden and Norway, button scurvy in Ireland, *skerljevo* in Yugoslavia, *spirocolone* in Greece, *syphiloide* in Jutland, *mal du chicot* in Canada. These terms can represent, according to the conditions, a combination of the two diseases.

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MAJOR CHALLENGES

Introduction

As said in the historical background, numerous terms are used to describe yaws: *pian* (French), *framboesia tropica* (Dutch, German), *buba* (Spanish), and *bouba* (Portuguese).

1. Epidemiology

1.1. *Agent*

The aetiological agent of yaws is *Treponema pertenue*. The disease is thus classified among the treponematoses. *T. pertenue* is morphologically identical to *T. pallidum*, the agent of venereal syphilis and endemic syphilis and *T. carateum*, the agent of pinta.

T. pertenue multiplies very slowly, dividing every 30 to 33 hours, and does not grow in artificial cultures. It can be inoculated in monkeys and rabbits (intratesticular route).

T. pertenue does not cross the placental barrier and therefore does not cause congenital infection. It attacks the skin, bones and cartilage, but other tissues and organs are spared.

1.2. *Reservoir of infection*

Children from 2 to 15 years of age and latent cases are the reservoirs for infection. The existence of an animal reservoir (monkeys) remains hypothetical, despite occasional mentions by Fribourg-Blanc *et al.* (1966), Mollaret and Fribourg-Blanc (1967), Baylet *et al.* (1970), and Paris-Hamelin *et al.* (1972). The high anti-treponeme antibodies levels found in various primates by FTA and TPI techniques – 75% of the baboons captured in Guinea, 47% of the baboons examined in Senegal, and 33% of the chimpanzees originating in Zaire – are open to various interpretations. On the other hand, the isolation of treponemes from the ganglia of 27.5% of 58 seropositive baboons merits further attention and research.

1.3. *Transmission*

Yaws is transmitted by direct, non-genital, person-to-person contact of abraded or lacerated areas of the skin with the exudates or serum of infectious yaws lesions. The spirochaetes do not penetrate unhurt skin, while the late bone or cartilage lesions are not infectious.

This direct transmission is facilitated by crowded living conditions, the lack of public and personal hygiene (lack of soap and water), and the absence of clothing and shoes. Household utensils, drinking vessels, and the mother's breast can all be sources of infection.

All children and teenagers living in regions where yaws is endemic will have come in contact with yaws lesions before the age at which they become sexually active. Consequently, yaws has very little chance of becoming a venereal disease. In addition, infection does not mean the automatic development of clinical signs of the disease. It is not unusual to find a 60-70% seropositive rate during mass surveys but clinical cases in only 10-30%, of which in turn only 2-3% are infectious.

The role of various insects (flies, etc.) has often been raised, never proven, and is highly unlikely, given the disease's focal distribution.

2. Distribution

The distribution of yaws is limited to the hot, humid tropical areas but is not restricted to the tropical forest, as it is found along the coasts as well as in the high plateaux. The clinical manifestations of florid yaws are seen more frequently in the rainy season.

Yaws used to be common in Burundi, Rwanda, and Zaire. Zaire has always had areas of high prevalence of yaws: Mayumbe (Seke Banza), Bas-Zaire, Bas-Kwango (Masi-Manimba), Tshuapa, Maniema, Kisangani, Nepoko, Lake Mobutu, Lake Edward, and Lake Kivu.

The role of anergizing and/or debilitating diseases (malnutrition, hookworm infection, measles, etc.) has not been sufficiently studied.

The disease is never uniformly distributed. Whatever the degree of endemicity of the focus (hyperendemic: > 10% recent evolving cases; mesoendemic: 5 to 10%; hypoendemic: 1 to 5% recent cases), it always includes pockets (*microfoci*) of greater prevalence. Yaws may also exist in valleys completely encircled by uninfected zones.

In 1938 there were 253,966 patients under treatment for yaws in Zaire and 150,146 in Rwanda and Burundi. The annual averages hardly varied until penicillin was introduced.

A FOREAMI report on Kwango District compared the 1945 statistics for a population of 700,000 with those obtained in 1954. The incidence (new cases) and prevalence rates (new cases plus old cases) of yaws were 0.21% and 0.24%, respectively, in 1945, falling markedly to 0.07% and 0.10%, in 1954.

3. Evolution of the disease

Yaws, like the other treponemal infections, develops in stages. The subdivision into primary, secondary, and tertiary phases, based on the analogy with syphilis, complicates the clinical evaluation. It is replaced advantageously by the WHO classification, as follows.

3.1. *Early yaws*

Early yaws is characterized by the development of a chancre after an incubation period of nine to 90 days (21 days on average). This primary lesion usually occurs at the site of a small cut or abrasion or at an insect bite on the skin; 80% of the time it is located on the lower limbs.

During the incubation period the treponemes multiply at the inoculation site, then enter the lymphatic system and the bloodstream. The lesion grows bigger, becoming a large, treponeme-rich lesion known as a mother yaw that persists from three to six months. The mother yaw may heal spontaneously before the appearance of the secondary papillomas.

These itching papillomas develop around the initial healed lesion or anywhere on the skin. Other secondary lesions develop on bones and cartilage. They spread through the body by autoinoculation or systemic dissemination. Very painful papillomas may develop on the soles of the feet, giving rise to the condition known as *crab yaws* related to the typical way of walking of the patient due to the very painful lesions.

Various forms of osteitis may develop. These include dactylitis of the first two digits, deforming the fingers of one or both hands, and goundou (or big nose by bilateral hyperostosis of the nasal bones due to involvement of the superior maxillae). These different secondary lesions may evolve over six months or longer.

In short, the infective recent yaws may take the following clinical forms: primary lesion (mother yaw papilloma), papillomas, macules, maculopapules, papules, micropapules, nodules, plaques, plantar or palmar hyperkeratoses, polydactylitis, and osteoperiostitis (nose and tibia).

3.2. *Latent yaws*

The secondary lesions improve and heal spontaneously. The disease then enters the non-infectious, clinically-negative latent period, which may last the patient's entire life.

The disease can then be detected only by serological tests. This latent period can be interrupted by relapses and the recurrence of infectious yaws. These relapses can occur as late as five years after infection and are usually located in the periaxillary and perianal areas. Yaws remains infectious for 12 to 18 months (recent yaws plus possible relapses), if untreated.

3.3. *Late yaws*

Late yaws develops after the papillomas heal in about 10% of the cases after a time interval that can reach several years. The lesions are often destructive and mutilating: gummas, painful deforming periostitis and osteitis as in tertiary syphilis, associated with destruction of the soft tissues and neighbouring joints; gangosa or mutilating ulcerous rhinopharyngitis that can lead to total destruction of the facial tissues; and painful palmar and plantar hyperkeratoses. These lesions contain few spirochaetes, but produce strong serological reactions.

3.4. *Attenuated yaws*

It has been observed that the clinical activity of yaws in low-endemicity foci tends to be low and the symptoms milder. This is due to the slowing down of transmission with its negative influence on virulence of the agent. It is interesting to underline that in Rwanda the population was aware that an infection at early age was protecting against a new infection and even against late yaws with its mutilating destructions. Indeed the people were even inoculating secretions of yaw lesions to their children to protect them against natural transmission (Mattlet, 1933; Lestrade, 1956). Inversely, the lesions tend to be especially exuberant in rapid-transmission or hyperendemic foci.

4. Diagnosis

The following diseases are often mistaken for yaws on the basis of clinical examination: impetigo, pityriasis versicolor, molluscum contagiosum, scabies, lichen planus, tropical ulcer, plantar warts, tungiasis (jigger fleas), cutaneous leishmaniasis, leprosy and psoriasis.

The biomedical means of diagnosis are the same as for all treponemal infections, namely, microscopy of the papillomas' secretions, histopathology of the lesions, and serological tests. Laboratory analyses do not differentiate between the different treponemas.

4.1. *Darkfield microscopy*

The pathogenic treponemas (6-20 μ in length, 0.3 μ in breadth) are found in the serous liquid of the mother yaw or secondary lesions. The serum is

collected by scraping and is examined fresh by an experienced laboratory technician against a dark background under a microscope equipped with a condenser. Avirulent treponemas may colonize the lesions, especially anogenital lesions, and must be differentiated from the pathogenic treponemas.

4.2. *Biopsies*

A biopsy will show typical histopathological changes and/or treponemas if stained by silver impregnation methods. Biopsy is not a suitable field technique.

4.3. *Serological tests*

The serological tests are of two types:
a) the non-treponemal lipid antigen tests such as the VDRL (Venereal Disease Research Laboratory), RPR (Rapid Plasma Reagin), Kline, Kahn, Bordet-Wasserman, and Kolmer tests. These tests are also called reagin tests. The VDRL or RPR are preferable because they are more standardized and reliable.

Laboratories express the results of reagin tests, for example, the VDRL, by a semiquantitative index (0, +, ++, +++, or ++++), also by the labels: reactive serum = positive, unreactive serum = negative, and weakly reactive serum.

A positive reaction must be followed up by a quantitative assay. The positive serum is diluted serially and the greatest dilution that still gives a positive reaction gives the titre (VDRL 1/16 means that the serum remained reactive to a sixteenfold dilution).

b) of the treponemal antigen tests, only the TPHA (*T. pallidum* Haemagglutination Assay) and FTA-ABS (indirect fluorescent treponemal antibody assay using serum diluted in a "sorbent") deserve our attention. They have comparable levels of sensitivity and specificity. The TPHA is easier, quicker, and more economical. The serological tests do not become positive until the beginning of the secondary period and remain positive for a long time after. However, they do not distinguish between the different treponematoses. The differential diagnosis must be established on the basis of the clinical examination and questioning.

A positive reagin test in the absence of clinical lesions and without the subject's remembering symptoms of treponematosis may mean one of the following:
- latent syphilis,
- latent yaws or endemic syphilis, or
- a false-positive reaction, a rather frequent occurrence with lipid antigen tests. In this case, the quantitative test usually will not exceed a 1:4 dilution. A treponemal antigen test, as TPHA, will be negative.

A strongly positive seroreaction is an indication for penicillin therapy.

A slightly positive reaction without clinical symptoms and remaining stable may be considered a serological scar with no effect on the subject's health, or a biological false-positive reaction for which no treatment is needed (except in the case of expectant mothers, who should be treated in either case).

It has been established that a population contains three-four seropositive individuals for every clinical case. This is equal to positive reaction rates of the order of 60% or higher in hyperendemic areas, 20 to 40% in mesoendemic areas, and less than 10% in hypoendemic areas.

Serological surveys on treponemal infections have complemented the informations on epidemiology of yaws by retrospective analysis. It is indeed possible to recognize a yaws infection that occurred during youth, even if the meaning of positive tests is difficult to establish. The tests are giving quite different results for populations who have other behaviour or personal hygiene (Biemans *et al.*, 1971; Widy-Wirsky *et al.*, 1980).

5. **Treatment**

The aim of treatment is to stop the progression of the disease. While the lesions of early yaws are reversible, the destructive lesions of late yaws leave sequelae.

At the beginning of this century patients were treated with arsphenamin or *Salvarsan*®, and with different formulae of bismuth salts.

The now recommended course is benzathine penicillin G injected intramuscularly in a single dose of 600,000 units for children under ten years and 1,200,000 units over ten. This regimen applies to evolving early or late yaws, latent cases, and contacts. In no case should the short action benzylpenicillin sodium be used.

Pencillin-resistance in the treponemas has not been proven. Patients treated with longer-acting penicillin preparations (benzathine penicillin G) become noncontagious in 18 to 24 hours. However, one must be aware that penicillin therapy can have side effects and even trigger an anaphylactic reaction (an emergency kit containing adrenalin, cortisone, and an antihistamine should be on hand at all times).

6. Mass campaigns and prevention

Prevention relies on treatment of early cases in order to reduce the infectious reservoir.

Education and improved personal and general hygiene will help eradicate the disease. Only sporadic cases are now observed in the cities.

The mass campaigns use long-acting penicillin preparations, benzathine penicillin G or procaine penicillin G aluminum monostearate (PAM) administered as single doses.

These campaigns are conducted in several phases. The first one is the *attack phase*, which lasts as long as the prevalence of recent cases in the area exceeds 5%. This phase is carried out by mobile units. The strategies chosen will depend on how prevalent active clinical yaws are:

a) treatment of the entire population (total mass treatment or TMT) if the prevalence rate is above 10%;
b) treatment of all clinical cases and all children under 15 years of age (juvenile mass treatment or JMT) if the prevalence is between 5 and 10%;
c) treatment of the clinical cases and all of their contacts (selective mass treatment or SMT) if the prevalence is less than 5%.

The *consolidation phase* begins as soon as the prevalence of recent yaws falls below 2%. Yaws control is continued and integrated into the rural health services. The health centres then become responsible for yaws surveillance in their catchment areas. The families, fellow villagers, schools, and all possible contacts of cases presenting for consultation or diagnosed at home will be investigated and an SMT strategy applied by treating all clinical cases, their family and other contacts with slow-acting benzathine penicillin G as indicated above.

A recrudescence of yaws is possible and has been noted in certain African countries (BMJ, 1980)

Therefore adequate surveillance remains necessary to detect the last cases, instaure selective mass treatment and ultimately eradicate the disease.

7. Points for further study

Fresh strains of *T. pertenue* should be isolated for study of their antigen compositions and possible resistance to penicillin.

The existence of a simian reservoir must be proven or ruled out on scientific grounds.

The serological diagnosis of latent yaws calls for objective assessment of the meaning of positive sero-reactions, especially in children apparently free of any clinical signs.

The roles of nutritional status and intercurrent debilitating diseases must be elucidated.

The presence of *endemic syphilis*, Bejel, should be sought in the dry savannah regions.

A search for dermatotropic strains should be undertaken.

Longitudinal family studies of the development of immunity, especially of cell-mediated immunity, are needed.

The length of time that post-treatment monitoring is required must be determined.

A. Meheus

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EXAMENS B

DUBUY L. (1924), *Contribution à l'étude clinique et au traitement du pian*, 20 p.
LAURENT R. (1936), *Contribution à l'étude clinique et au traitement du pian au Ruanda-Urundi*, 22 p.
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HACKETT C.J. (1980), Yaws, in: SABBEN-CLARE E. et al. (Eds.), *Health in tropical Africa during the colonial period*, Clarendon Press, Oxford, pp. 82-93.

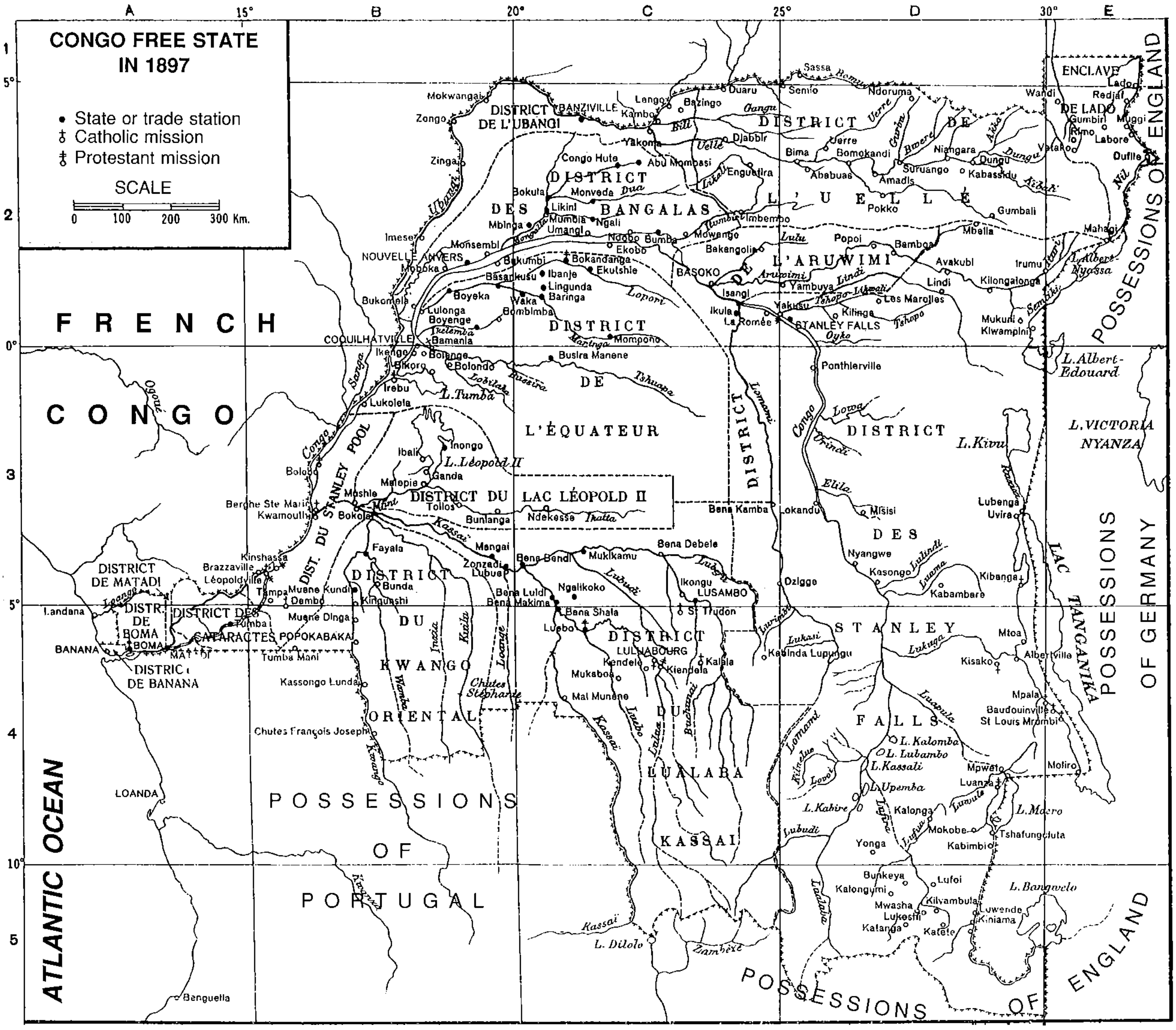
The author follows developments in knowledge of yaws in Africa and the organization of control measures based on the administration of bismuth, then neoarsphenamine, and finally (after World War II) penicillin. The WHO and UNICEF sponsored eradication campaigns are mentioned, as are their main promoters in the French- and English-speaking countries of Africa.

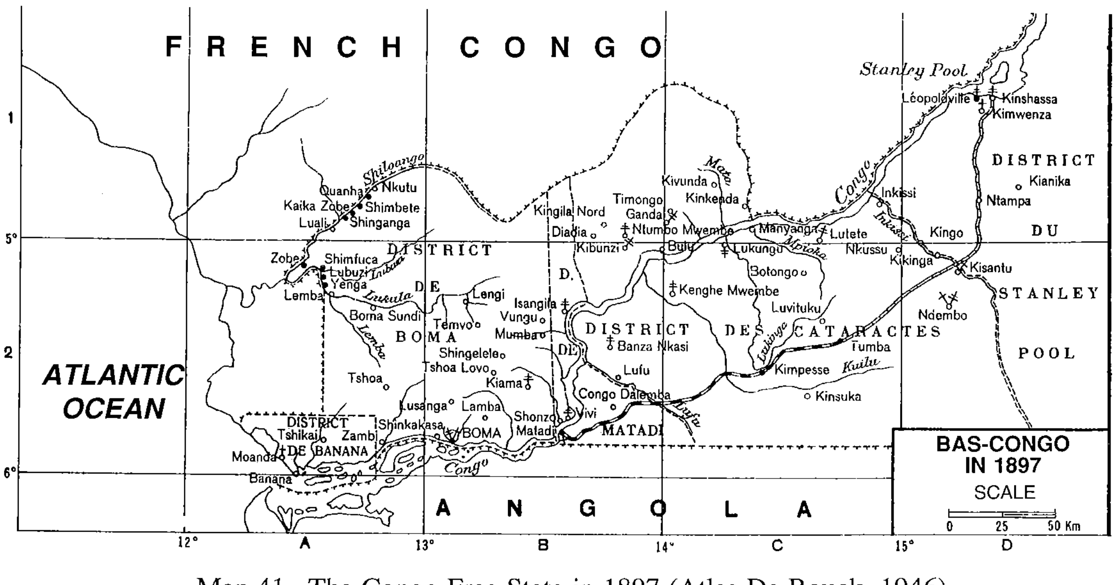
MEHEUS A. (1982), Le pian, in: MEHEUS A. et al. (Eds.), *Santé et Maladies au Rwanda*, ACGD, Bruxelles, pp. 474-480.

After defining and reviewing the clinical particularities of yaws the author relates the history of the disease in Rwanda, supplemented by some epidemiological data. He concludes that whilst yaws was originally hyperendemic, it eventually became relatively rare in Rwanda, although it has not yet been eradicated. The author also describes the mass yaws control campaigns that have been conducted in Rwanda.

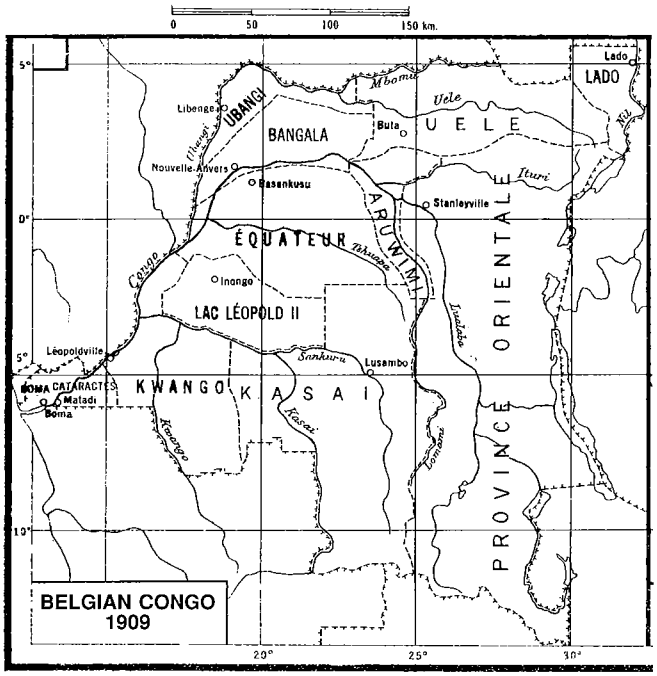
VAN NITSEN R. (1944), Le pian, – *IRCB, Sect. Sci. Nat. Méd., Mém.*, 13, 92 p.

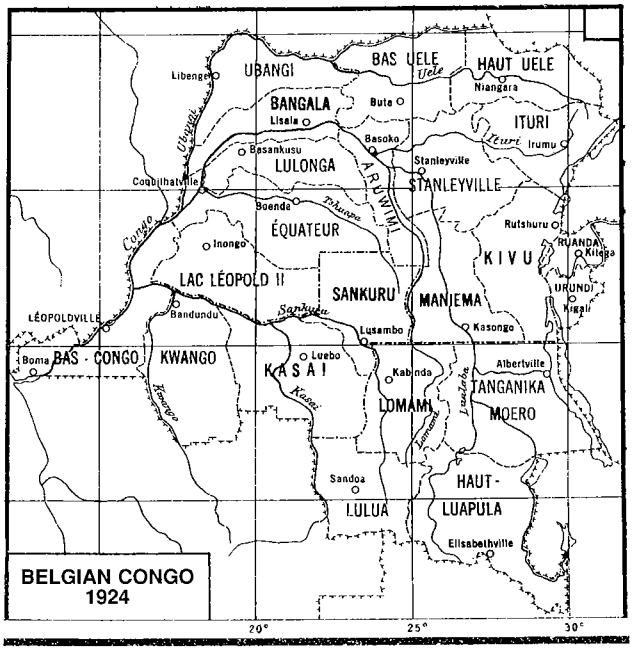
The author starts with an overview of the geographical distribution of yaws in the various provinces of the Belgian Congo, Rwanda and Burundi, then singles out various clinical considerations discussed in publications about Central Africa. He studies the arsenic compounds, bismuth compounds, and other miscellaneous drugs (potassium emetic, copper salts, potassium iodide, mercury, etc.) used to treat yaws as well as the effects of courses of sterilisation. Native therapies are also analysed. He then reviews the various Belgian publications that tried to answer the burning question "Are yaws and syphilis the same disease?" that was raised in the early thirties. The study ends with an analysis of the various preventive methods used to date and a few remarks concerning living conditions.





Map 41 –The Congo Free State in 1897 (Atlas De Rouck, 1946)





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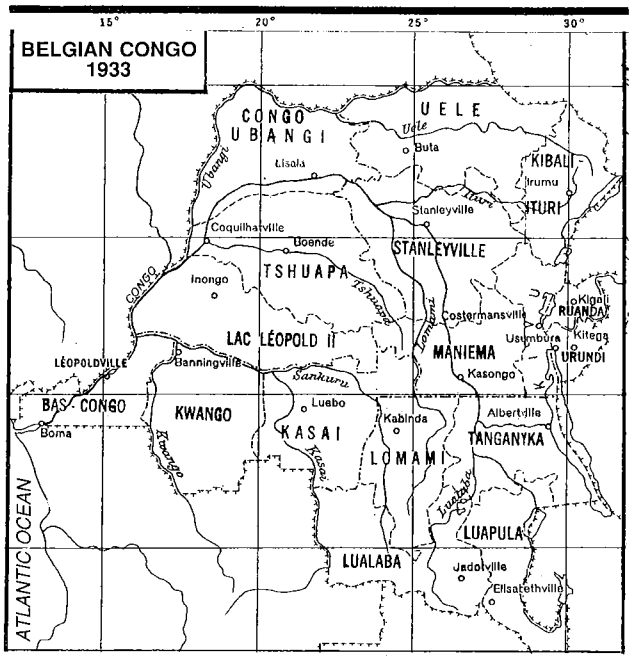

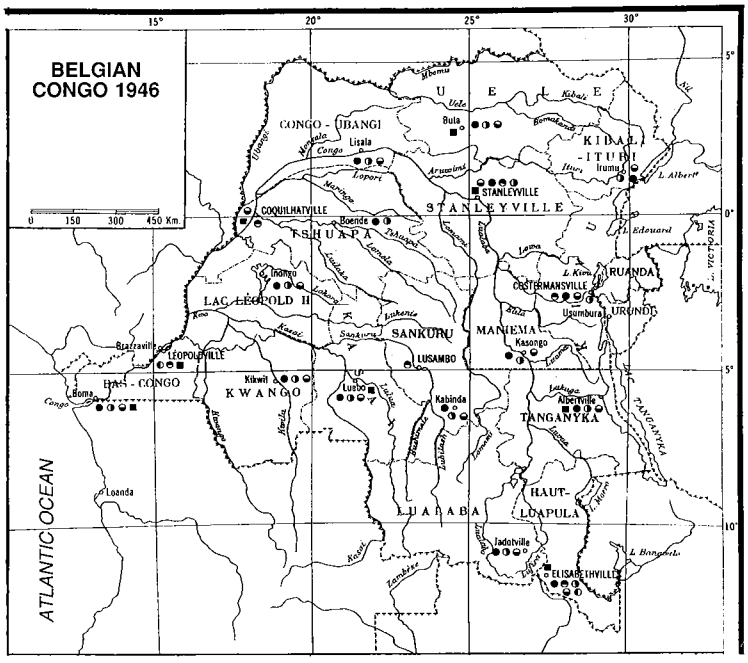

Map 42 – Administrative divisions of the Congo at different periods (Atlas de Rouck, 1946)

With map 41, these maps allow to locate an event
according to the period at which it occurred or was reported.