

## (Gerhard Henrik Armauer Hansen (1841-1912))

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In Europe during the 19th Century Norway was the nation which had the highest prevalence of leprosy and the most advanced knowledge of the disease.

Bergen, the cradle of modern leprology, was the oldest city in the kingdom. It was founded by the king OLAF KYRRE between 1070 and 1075 with the name of Dorf-Gora along the port of Vaagen and the Pudde fiord on the Atlantic coast near the Isle of Askoe.

The existence of leprosy in Norway goes back to the most ancient times, the 7th and 8th centuries according to MELSOM, and probably was carried from Great Britain and Ireland by the Vikings, the Scandinavian sailors. EHLERS also estimates that it was known before the 11th century. ZAMBACO PACHÁ nevertheless thinks that it appeared after the Crusades in the 13th Century. H. P. ELLINGSTON LIE confirms the opinion of MELSOM and EHLERS that leprosy was known in Norway before the 11th century, because in this epoch laws existed designed to protect the people against this cruel plague.

In Norway, as in the rest of Europe, the disease developed in mediaeval times, decreased during the 14th and 15th centuries, and later increased again, so that there were 2,850 patients at the middle of the 19th century. The population then was 1,500,000 and the index of prevalence can be calculated as 17.20 patients per every 10,000 healthy persons.

In 1859 the Norwegian Government invited R. VIRCHOW to study the existing endemic, and he found that the areas most affected corresponded to the narrow coastal girdle of the western provinces. Existing foci included Nord Bergenhus where the incidence was one patient for every 113 inhabitants. Other foci showed incidences of one patient for 71 healthy, and one patient for every 47. It was natural that all these high indices worried the health authorities very much, and they tried to carry out all the measures they knew to halt the disease. Between 1830 and 1840 the anti-leprosy campaign intensified, giving rise to the creation of the 'J. J. HJORTS' medical team to assist the campaign. In 1836 the first leprosy census was carried out, and in 1837 the Royal Commission was created which had the chief aim of directing the intense fight against the disease which would be carried to its conclusion in the whole nation. In 1838 a committee in Parliament proposed the erection of four hospitals, which were constructed between 1850 and 1860, namely two at Bergen, one at Molde, and one at Frondheim, besides the ancient St. Jörgen which already existed in Bergen since about 1300. Thus in 1861 Norway possessed five great hospitals with capacity for 800 patients.

We can think of leprosy as the chief health problem, requiring urgent solution, which the Norwegians had to face. They faced this problem with great decisiveness, so that the studies of leprologists increased markedly. The famous works of DANIEL CORNELIUS DANIELSSEN contributed greatly to the enthusiasm. He was a young doctor, the son of humble artisans and during his childhood worked as an apothecary's apprentice, and after brilliant studies succeeded in graduating in medicine in 1838, and after taking a course in skin diseases at the University of Oslo, began to work in the St. Jørgen Hospital in 1839.

When DANIELSSEN came to St. Jørgen he radically changed the scientific environment of the establishment, and from the languid and indifferent way in which it carried on its activities, succeeded in converting it into the world centre of leprology. It reached the climax of its fame when CARL WILHELM BOECK, who later was professor in the Faculty of Medicine at Oslo, began to collaborate with DANIELSSEN, and between the two of them, in 1847, published the monumental work 'OM SPEDALSKHED' which in 1855 gained them the Monthyon Prize which is given by the Academy of French Medicine. According to VIRCHOW their work represented the beginning of biological knowledge in leprosy.

DANIELSSEN was the first to describe the typical cells of lepromatous leprosy, which he called 'the brown element', due to the colour which the cells showed, and which he thought was characteristic of the 'tuberous form'. He said that in microscopic studies 'they seemed to be formed from a fundamental diaphanous mass, of bright yellow colour, split in all directions, and surrounded by a fine fibrillary net, where small granules can be seen which are difficult to clear away with water'. These same cells are those of R. VIRCHOW, in material which he collected in Norway and studied in Germany using staining techniques which did not exist when DANIELSSEN discovered the cells and described them under the name of 'Lepra cells' in 1864, or 'vacuolated cells', or 'foamy cells'. We consider the famous 'VIRCHOW cells' pathognomonic of lepromatous leprosy, and in the previous century they were known under the name of 'VIRCHOW leprosy,' which is synonymous with tuberous leprosy of the classification of DANIELSSEN - BOECK of 1848. In the same way the anaesthetic leprosy of the classification was known as 'DANIELSSEN leprosy'.

DANIELSSEN, BOECK, and their colleagues systematically carried out *post mortem* examinations of all patients who died in the Norwegian leprosaria. They accumulated such an amount of knowledge on the clinical aspects of leprosy, knowledge completely unknown until then, that with justice they are apt to be called 'the fathers of modern leprology'. They beat out the path which the leprologists of the 20th century would have to follow later.

Coinciding with the growing interest which had been awakened in Norwegian cultural circles by the study of leprology, and the crusade against the disease being in full career which had been begun years before, in the year 1859 a young man of 17 years of age, GERHARD HENRIK

ARMAUER HANSEN matriculated in the Faculty of Medicine at Oslo in order to begin his medical studies. He was born in Bergen 29 July 1841.

The father of Armauer was Claus Hansen. He was a business man of repute who carried out his wish of building an honourable hearth, where he and his wife, ruled over a cheerful family of 15 children, 10 of whom were male. The childhood of Gerhard Henrik passed in the average habitual environment of the rest of Norwegian families belonging to the middle class. His first studies and secondary education took place in Bergen. His successful first studies and his course in medicine must have been influenced by the labour of the leprologists of his country, awakening in him the vocation for leprology, and perhaps causing him to dream of graduating in medicine, which he did in 1866 at 25 years of age.

On leaving the University he worked for a year as intern of the Rigs-hospital in Oslo, and afterwards as medical officer of the Government of the fishing company of the Lofoten Islands, an archipelago of 720 km. in length, which also includes the Vestersaaden Islands, situated inside the Arctic circle in the glacial Arctic Ocean. HANSEN had an extremely hard task which we can appreciate if we take into account that the fishing industry, especially concerned with cod, herring, salmon, crustaceans, and molluscs, was one of the most ancient means of subsistence for the Norwegians, and that at the end of last century 80,000 fishermen on the average worked scattered in the forty fishing centres possessed by the industry. HANSEN had to look after them with very little assistance.

HANSEN had an eager temperament for study which he could not adapt to the routine work of the fishing industry, far from scientific centres where constantly they acquired new knowledge in all branches of medicine as the result of research, of interchange of knowledge, of trial of new techniques, of study, application, and practice of new therapeutic procedures, and the fraternal rivalry which was apt to arise among the young men, and the studious doctors of the hospitals, whether from desire not to be relegated to secondary status, whether from desire to raise the level of their knowledge to that of their most outstanding and enlightened colleagues, perhaps to arrive at the highest scientific strata to which their learned and wise professors had attained.

Choosing between riches and glory HANSEN preferred glory. Choosing between Lofoten, one of the world centres of the fishing industry, and Bergen, famed world centre of leprology, the decision of a recently graduated doctor, with a world of aspirations before him, and the desire to feel the warmth of fame and glory binding his temples with the symbolic laurel crown, could not be in doubt. He returned to Bergen, the City of his birth, and commenced by his own efforts to prepare the soil where he would find the germ which much later would open for him the gates of immortality.

The St. Jörgen Hospital, under the direction of DANIELSSEN, the famous leprologist whom all the world admired, whom the most related medical celebrities recognized as the most qualified in the subject, to whom those

doctors wishing to unveil the mysteries of leprosy had recourse from the most remote places of the land, opened its doors to him in 1868. In this year HANSEN began to work alongside DANIELSSEN. From the first moment the student, by his devotion to the study, conquered the heart of the famous master, whose character was extremely kind and good.

DANIELSSEN incorporated HANSEN in his duties as doctor to the hospital and the latter nobly responded by working intensely and always trying to establish by means of autopsies that which clinical experience was teaching him. He gave the greater part of his time to the research laboratory. There was no skin, nervous, or visceral lesion which HANSEN failed to study exhaustively in order to understand the 'why' of its pathology. In the study of anatomical specimens, or in the histological sections, for which he had a great vocation, he passed long hours. He wished to take in everything, to study everything, to unveil every unknown, and he saw such an unexplored field before him and had such a burning desire to tackle every field rapidly, that he hardly knew where to begin. For him everything was important and deserved the same attention. In his diary he tells us 'It is so oppressively wide the field of that which has to be done, that I am always concocting plans of work, but never get enough time for everything'. HANSEN, doubtless, would wish that the days never ended.

Such was the amount of work to be done, and so short the time available to do it that rest times did not exist for him. HANSEN showed himself very irritable when he was interrupted in his investigations or when he had to dedicate part of the time to matters other than the study of leprosy. As an implacable and pertinacious martinet the Hippocratic aphorism would echo in his mind *ars longa vita brevis*.

The work of HANSEN quickly began to yield results. In the year following his entry to St. Jörgen, he presented at the University his first paper on leprology, which unfortunately was not printed, and for which he was awarded the royal gold medal.

The problem of the etiology of leprosy was one of his first and deepest preoccupations. HANSEN thought that a causal agent of the disease existed, and did not agree with the theory of heredity of which DANIELSSEN was a tenacious partisan, which gave rise to heated discussions between the master and his disciple when they dealt with this point; although the spirit of DANIELSSEN was flexible and young (according to the phrase used by HANSEN himself) he was not pleased when his works were criticized, although he was a severe critic of others. In spite of all this HANSEN was glad to present to DANIELSSEN his study plans and show him his experiments so that they could discuss them between themselves and amend any errors which may have crept in, thus trying to clear the road which would lead to the conquest of scientific truth.

The marked progress which he had gained in his histological studies and the enthusiasm which he had for them, qualified him for obtaining a travel bursary and widening out his knowledge in foreign parts. He went to Bonn and later to Vienna, assiduously attending for a year the theoretical

and practical classes given by the most famous histopathologists of those cities. During this journey he became acquainted with the work of the celebrated English physiologist C. R. DARWIN, and was converted into an ardent defender of the theory of evolution of species, which he undertook to popularize.

The cost of this bursary granted to HANSEN was borne by the managers of the MONTHYON cash prize. As we have said previously the prize was awarded to DANIELSSEN in 1855, and donated by him to the university to strengthen the travel bursaries fund.

On his return from Bergen with the wealth of knowledge acquired, HANSEN redoubled his efforts as far as possible, trying to clear up the origin of leprosy. He revolved the theory in his mind on which DANIELSSEN was mistaken. He thought this theory was not well founded. DANIELSSEN was his master, and his friend, and he was worried with the thought that he could not undeceive him. Many times he discussed the question with him in an effort to make him see that the theory of heredity was based on very weak foundations. DANIELSSEN always answered him with asperity and showed that he was annoyed with a daring young doctor who had the temerity to discuss that which the best-endowed medical brains accepted without hesitation.

'This is insolence' said DANIELSSEN.

'DANIELSSEN is mistaken', murmured HANSEN.

DANIELSSEN, in order to give convincing demonstration that the theory of heredity was true and that leprosy was not a contagious disease, inoculated himself and some of his co-workers many times with leprotic material, and the result of these experiments was always negative.

HANSEN recognized that DANIELSSEN had worked much and strongly to reach the position which he occupied in scientific circles. Indeed he was much admired there, and he would find it very hard to retract his error, an error which HANSEN considered to be the result of reaching rapid conclusions without beforehand submitting them to a careful critical examination. The bitter discussions which he underwent with DANIELSSEN stimulated him more and more in his investigations, and after the discussions he passed whole days in the laboratory in front of the microscope without giving the least sign of tiredness. At the beginning of each investigation he hoped at least to find the longed-for key, and when he failed in having within reach of his eyes the feared organism which caused leprosy, the failure made him abandon the work begun, and on only the next day begin another new search with greater enthusiasm and hope, and so without failing in his intention, HANSEN constantly repeated his arduous labour.

Meanwhile he continued attending to the patients whom he had under his care. He was interested in all problems concerning them, especially on the social side. He carried on long and animated conversations in which he entered intimately into the life of the patients, and the moral sufferings which afflicted them because of the fear which they caused in the healthy population, and the family anxieties due to the erroneous concept of

heredity. This caused them much trouble because it stigmatized them. He gained much information from the immense riches of medico-social knowledge which can be provided best by the patients themselves. He consulted the patients and heard their thoughts on the most intricate scientific problems, on his studies, projects, and investigations, and we see how this great and good man meditated and knew how to assay the opinions of those who (lacking a scientific training, as probably amongst the patients) discussed these involved matters with him. He said, 'I spoke with one who was strongly in agreement with my idea that leprosy was due to a specific cause, and not due to mode of living nor to heredity'.

HANSEN was not likely ever to belong to the chorus of mediocrities who lived as parasites on the great celebrities and never dared to discuss problems with them or go against the current thought which they directed. One day he started to analyse the classification of DANIELSEN. He did not think it right, and simply to the master, explained his thoughts on it, discussed it with him, made constructive criticism of it, and although DANIELSEN was annoyed, he firmly pressed his points and tried to expound them.

DANIELSEN classified leprosy into Tuberous, Anaesthetic, and Mixed, or maybe a combination of the first two. HANSEN was not in agreement with this and said that skin lesions were met with in both forms, therefore rendering the mixed form unnecessary. He added for a tuberculous patient to become anaesthetic, it is all a question of the patient having a sufficient length of life to permit the evolution of the disease. He made his own classification known under the name of 'Classification of HANSEN', in which he pointed out two forms, the Tuberous and the Maculo-anaesthetic. The first is an affection of the skin and nerves, with an eruptive tuberculous syndrome. The second is an affection of the skin and nerves with an eruptive macular syndrome. In fact, to make this classification, it is necessary to base it on clinical and morphological criteria, two forms only are distinguished, and the validity of macular lesions is emphasized for the first time.

Finally success crowned the persevering and patient labour of HANSEN, and in the year 1871, or about that time, he was able to see in unstained and fresh stained specimens some little rods which strongly attracted his attention and which later he observed in routine examinations of all tuberculous lesions or infiltrated lesions in his patients. HANSEN had discovered the causal agent of leprosy and he gave a perfect account of it. Now, in order to be able to demonstrate it before the scientific world he tried to cultivate it and inoculate it into experimental animals, in order that no doubt at all would remain about his important discovery, which, according to JEANSELME, overthrew every hypothesis then existing about the disease in its etiological aspect, and reduced to secondary, auxiliary, or favouring causes all those factors which were considered preponderant. HANSEN was not able to cultivate the bacillus which he discovered, nor reproduce it in animals by experimental inoculations, and this was the

chief reason why he did not publish his brilliant exploit for several years.

In order better to comprehend the merit of HANSEN it is necessary to study the place and time in which he made his discovery, and so grasp better its greatness and value.

In that epoch bacteriology was in swaddling clothes, and the belief that some diseases could be caused by micro-organisms was in its infancy, and the means of research were rudimentary.

Our illustrious master, Professor A. CURBELO, to whom we are most grateful for his wise and educative teaching, told us that towards the middle of the 19th century infectious diseases were known as miasmatic, contagious, and miasmatic-contagious. In some places leprosy was considered miasmatic and, according to that archaic belief, could be acquired by breathing the air which surrounded the patients. At other times it was attributed to divine origin, and was the consequence of some fault committed, or was a test to which the gods submitted us. In other places leprosy was thought to be of dyscrasic nature, that is, through changes in the body humours. The predominant theory in scientific circles from the 15th century was the hereditary theory, of which, among others, DANIELSEN was a decided defender. The basis of this theory consisted chiefly in the rarity of conjugal contagion, the absence of leprosy observed in animals, the presence of leprosy in several generations of patients, and the failure of transmission to healthy personnel who worked in leprosaria, and other factors which today we think are of small importance.

Up to then there had only been observed some fungi, anthrax, and pyocyanus bacilli, but the pathogenicity of them was not proved until many years after the HANSEN discovery. The origin of bacteria was unknown and it was not known whether they came from the animal or vegetable kingdom. Some thought they were produced by spontaneous generation by the vegetative force, and there were even some who thought they were products in auspicious moments of inorganic bodies. SPELLANZI was the champion of those who asserted that microbes were born of microbes.

Bacteriological classification comprised a veritable chaos. The works of LINNAEUS, begun in 1773 and continued by MÜLLER in 1786 perfected this sort of knowledge. Almost a century afterwards F. COHN classified bacteria as a vegetable sub-kingdom and NÄGELI called them schizomycetes.

We take the opportunity of saying that BUCHANAN of the American school classified the causal agent of leprosy as follows:

Kingdom			organic
Sub-kingdom	..	..	vegetable
Type	..	..	cryptogama
Sub-type	..	..	cellular
Branch	..	..	talophytes
Class	..	..	fungi
Sub-class	..	..	schizomycetes
Order	..	..	actinomycetals

Family ..	..	..	mycobacteriaceae
Genus ..	..	..	mycobacterium
Species ..	..	..	leprae
Variety	..	..	<i>Mycobacterium leprae</i>
Common name	..	..	bacillus of Hansen

Also the methods of staining were very defective, and not until after 1871 did the German professor CARL WEIGERT first of all and ROBERT KOCH later create, perfect, and make general the staining techniques and fixation which allowed bacteriologists to examine microbes in a better way with the aniline derivatives.

Now we already have a wide view of the scientific environment which surrounded GERHARD ARMAUER HANSEN when he saw for the first time the famous acid-alcohol-resistant rods he thought to be the causal agents of leprosy. As he himself pointed out, the means at his disposal were very scanty.

As Professor A. CURBELO indicated, the work of LUIS PASTEUR and the emotion aroused by it, was what led to the first levels of thought being occupied by the micro-organisms and stimulated profound research on them by the scientific investigators of the day.

Perhaps this enthusiasm was the decisive factor which influenced the mind of HANSEN and led him to his final triumph.

We said that HANSEN had delayed the publication of his discovery while he tried to cultivate the germ and inoculate animals, and it is about that time that he tried to apply the ideas of HENLE on the conditions which should be met by a germ so that it could be considered a specific causal agent of any disease.

GUSTAV HENLE maintained that these should be

1. To find the germ present always in the same disease;
2. To be able to make a pure culture of the germ and reproduce the disease by inoculation in experimental animals.

These ideas were those which later influenced R. KOCH in 1882 to publish his famous postulates.

We think that these ideas must have influenced HANSEN, because in his paper 'Spedalskhedeus Arsager' (Causes of Leprosy) which he published in 1874, a paper which has been translated into English by GEORGE L. FITE, he says that 'it is beyond doubt that bodies in form of little rods exist in the leprotic nodules'. He tried to culture them but did not succeed, although he tried very many times. They did not satisfy the conditions which HENLE demands so as to be considered as the microbial causal agent of leprosy, and therefore in the paper we have quoted he says 'the results are still uncertain, but I have continued the research and not published it, because I think it inopportune when so many things remain for me to resolve before I am able to show convincingly that this is the specific germ of leprosy'.

Great and bitter have been the troubles suffered by HANSEN. He saw the bacillus in all his preparations, he was convinced of its causal relation

to leprosy, and lacked the scientific means to be able to demonstrate it. MEISOM was right in saying that he was unfortunate in discovering a micro-organism which up to this day no one has been able to cultivate.

While HANSEN continued his experiments, DANIELSSEN his master and friend, scoffed at his bacilli and the studies which he was carrying out. HANSEN who admired and loved DANIELSSEN sincerely, often visited him in his house, where he was so greatly appreciated for his great virtues. He fell in love with Fanny, daughter of the master, got engaged to her, and a little while after, on 7th January 1873, they were married. This marriage had a very short life, since the young wife contracted pulmonary tuberculosis, and died as a victim of it 25th October of the same year. DANIELSSEN also suffered from this disease, and it carried his four sons to the tomb.

The fact of being son-in-law of DANIELSSEN was of no value to him to the extent of the latter's helping him in his sensational studies. On the other hand, he criticized them more, and HANSEN relates that this was the best spur which he could have been given, in order to stimulate him to the point at which he could demonstrate the truth of his theory. Thus it can be seen that the stubborn father-in-law had right on his side!

Battling against the incomprehension of DANIELSSEN and other colleagues, the years passed without HANSEN, whose store of leprologic knowledge had increased considerably, being able to advance in what could be called the second stage of his discovery, namely culture and inoculation of the bacilli.

How many times he would reflect if he had the truth or not? No, said HENLE, to consider a germ specific it needs to be cultured and reproduced in animals.

What was it that HANSEN saw then? Would VIRCHOW, considered the greatest authority in the world in medicine, be right when he said that the bacteria seen by HANSEN were nothing else than crystals of fatty acids?

G. FITE says that today it is not easy to understand the opposition which HANSEN had to face when he tried to introduce the idea of the contagiousness of leprosy, and later when he wanted to gain comprehension also of the decisive importance in the etiology of the disease of the thousands of little rods which he daily saw on the stage of his microscope. HANSEN continued working ceaselessly, examined a great number of nodules, reduced them to small pieces and made smears with them, expressed and examined the sera from them, scraped the base on which they had been seated, or examined the product which was extracted below the scales which are formed on ulcerations. He examined the lymphatic glands, liver, spleen, kidneys, lungs, testes, stomach, and intestines. For him nothing lacked value; he investigated everything, and before his scrutinizing eyes, at one time or another passed his histological sections or bacterial preparations, and always there appeared those bodies in form of little rods, rectilinear or slightly incurved, in which he noted oscillatory movements. These were the germs which produced leprosy, but he could not demonstrate it as the laws of HENLE demanded.

They also saw the cells discovered by DANIELSSEN, and within them his little rods, isolated, or in bundles, or in packets, crossing over each other or forming sharp angles. He observed attentively the chestnut-coloured bodies or 'brown bodies' under covering objects, and drew attention to the fact that if one compresses the fragile cover-glass, these bodies untwine and then appear to be a great quantity of bacilli. Without doubt, they are the 'globi', described later by NEISSER, which separate under pressure and remained as scattered bacilli. HANSEN examined them in fresh preparations and also after breaking down the tissue fragments in 1 per cent osmic acid solution, allowing the solution to act on the tissues and examining them at 24 and 48 hours, finding that the bacilli stained dark and were very easy to detect. The chestnut-coloured bodies appeared to his sight as dark brown to black colour. He was convinced, as we have said, that they were bacterial rods, and said 'To distinguish if the little rods are bacteria and the brown cells are cells which could include masses of zoogloea, is another matter'. He also showed that the little rods and the brown bodies are not attacked by potassium lye.

GERHARD ARMAUER HANSEN later married on 27 August 1875 the distinguished lady JOHANNE MARGARETHE GRAN, belonging to a distinguished family, and of this marriage had only one child, who was baptized with the name of DANIEL CORNELIUS, in compliment to his master and friend.

DANIEL CORNELIUS ARMAUER HANSEN, with the passage of time also became a leprologist, being assistant to DR. H. P. LIE when the latter was chief doctor of the Norwegian Leprosy Service and Director of the Regional Control of Leprosy No. 1 in Bergen, and was there in 1926 when DR. H. C. DE SOUZA ARAUJO visited the Scandinavian countries among other nations.

In 1875, on the death of CARL WILHELM BOECK, HANSEN was raised to the rank of Chief of the Leprosy Service, a charge which he carried out for 37 years.

Thanks to the efforts of HANSEN, on 26 May 1877, the law was promulgated in Norway for the protection and medical assistance to leprosy patients, which later, in 1885 was amplified to include active prophylactic measures. This amplification was very much opposed, because it was thought that it attacked human rights, and that the patients would be pursued as if they were criminals. This was a terrible error which spread around the world. Some interpreted this law, especially those outside Norway, in the sense that hospital isolation was indispensable for all patients. The spirit of the law never had this intention, as BASOMBRÍO clearly pointed out when he heard the paper of R. MELSOM at the Rome Congress in 1956 on 'Defence and Rehabilitation of the Leprosy Patient'.

REIDAR MELSOM, who also was Chief of the Norwegian Leprosy Service said that patients were never isolated under severe conditions, were free to receive visits, to visit their homes, walk through the city streets and also sell products of their manual work. The patients complied with the law if proper treatment was carried out in their own homes. As is logical, they

were obliged to take precautionary measures of separation from family relations and neighbours and carry out some required prophylactic measures in their houses. These measures were laid down for them. Marriages between healthy and patients were not dissolved, if the maintenance of the conjugal union was the wish of the partners. A body of inspectors was charged with the duty of fulfilling the existing prophylactic rules, also on isolation and treatment, for those who stayed in their own homes. If the medical authorities considered the law vulnerable in regard to the danger of propagating the disease, in the case of a grave form of leprosy, then certainly there was isolation.

That the law was not so rigorous as some suppose, can be seen if we take account of the fact that the five Norwegian hospitals had capacity for 800 patients, and there must have been many more.

The law was essentially humane, protecting the patient by obliging him to take treatment, and at the same time protecting the healthy from contagion.

With these humane measures, Norway was able to eradicate leprosy. The consequences would have been otherwise, and disastrous, if isolation had contained the cruel factors which some authors, not very well instructed took upon themselves to recommend.

From 1875 to 1879 HANSEN continued his investigations, besides guiding the fight against leprosy, and he employed the spare time which his many occupations allowed to him in reading the works of DARWIN, or increasing the great knowledge which he had as a naturalist. He was an eminent zoologist, so that in 1894 he was chosen president of the Bergen Museum of Natural History, one of the most important scientific centres of the country, highly regarded in Europe for its valuable collections of archeology and of Natural History, its rich library, and its biology centre.

HANSEN was always ready to show the results of his works to as many doctors as came to him. He was highly pleased and flattered when they paid attention and above all when they interested themselves in his experiments. Openly, without false courtesy, he told them what he knew, told of the labour he had carried out, and offered them material sufficient for identical attempts to his. The noble and benign spirit of HANSEN could not imagine that anyone would wish to swindle him of the product of his long watches.

As HANSEN progressed towards the conviction that he possessed the truth and the right road to final success, the criticisms of DANIELSSEN grew more severe, and he even tried to scoff at him when some doctor visited him, asking with an ironic smile 'Has Hansen already shown you his bacilli?'

In the year 1879 the outstanding German bacteriologist, ALBERT LUDWIG SIGMUND NEISSER, then 24 years of age, made a journey from Breslau to Bergen, accompanied by his colleague E. LESSER, with the object of studying leprosy, and perhaps with additional intentions to see the bacilli so discussed of HANSEN, although he did not openly discuss his

intentions. However we should not forget that NEISSER was an authentic hunter of microbes.

In Bergen he was amiably received by HANSEN who without reserve showed him what he had done in the field of experimental leprology. He was cheered by the visit of NEISSER, thinking that perhaps as he came from the land of C. WEIGERT and R. KOCH he would be able to assess it by the new staining techniques, and he was interested in hearing details of the work carried out by them, since, although HANSEN had tried the said techniques he had never succeeded. We cannot be sure if NEISSER was ignorant of them, or knowing them did not want to teach them to HANSEN; it is only certain that HANSEN was disappointed, and said that NEISSER did not know more of it than he himself knew.

HANSEN gifted to NEISSER a great quantity of material extracted from nodules and leprotic tissues, with which the latter returned to Breslau.

Meanwhile, HANSEN wrote to R. KOCH and interested himself in the new staining methods, and began to try them without hastening to publish the results which he was obtaining, which were quite hopeful as HANSEN himself relates.

As soon as NEISSER arrived home he made use of the material supplied by HANSEN, stained the specimens by the new techniques, and was able to demonstrate the bacilli, as HANSEN still had not been able to do. He wrote a paper which in October 1879 he read before the Silesian Society for Natural Culture and published in the same year. It is true that in this paper NEISSER speaks of the investigations which HANSEN had done, but as GEORGE FITE asserts 'He did so rather to discredit them than to recognize their merits.'

In this paper NEISSER relates the controversy which existed for centuries over the etiology of leprosy saying that while some attributed its causes to climatic factors, others thought it was due to social factors, and while some leprologists defended the theory of heredity, others broke lances in favour of contagion.

There was no unity in judgement of the cause of leprosy, and he said 'the most outstanding contemporary experts, DANIELSSEN and HANSEN, both studying identical material, maintain opposed points of view. DANIELSSEN denies infection and pronounces in favour of heredity, while HANSEN thinks it is a purely contagious disease and rejects heredity.'

Of all the works on leprosy which had been completed up to that time, such as those of CARTER, KLEBS, and HANSEN, NEISSER found those of HANSEN were the most interesting, and related how the latter saw a great number of motile little rods in fresh preparations, and also, possibly, zoogloea groups, but he had failed in his attempts to cultivate and inoculate them in animals and that 'he does not seem to have been able to reach the conclusion that he had found the germ of leprosy'. In his paper NEISSER continued the story of his visit to Norway, what he did there, and how, on his return to Germany, began his experiments rapidly, using the method of KOCH for staining, and that his surprise was limitless when he found a

great number of bacilli in all the pieces of tissue examined by him, in which material was included extracted from nodules, lymph glands, skin, cornea, testes, liver, and spleen. He continued 'These little rods seemed to be something previously unknown. The singular appearance of them awakens the hope that wider investigations can clear up this obscure problem.'

The reply of HANSEN was prompt. He published his paper in his own language, Norwegian, and for the first time in languages other than his own, English, German. This paper under the title '*Bacillus leprae*' was published in 1880. It was translated into English by DR. FITE, and of this translation we reproduce some paragraphs here. In it said HANSEN 'I had not intended to publish my investigations on this matter, but now I am obliged to describe my work on this infectious germ. A few years ago I showed my preparations and gave my opinion on the parasitic nature of leprosy to the Swedish DR. EKLUND. In a recent work, called 'Om Spetalska' he refers to the causal agent of leprosy as something which he himself has discovered in the form of a micrococcus. In addition, DR. NEISSER of Breslau, who spent part of last summer in Bergen, in order to study leprosy, has recently published the result of his investigations of the preparations which he obtained here. He also finds them full of bacilli which he thinks are the specific causal agent of leprosy, and the bacteriologists F. COHN and R. KOCH share this view.

'I make this report, in part in order to maintain my priority in this matter not only before the Scandinavian public but the world, and in part in order to adduce more details from those I offered in the paper of 1874 presented before the Oslo Medical Society'.

As we see, HANSEN feared that the priority of his discovery could fall into the hands of other investigators who were not the first to see *Mycobacterium leprae*, and to whom he had shown fully without reserve the products of his studies.

After this paper, when NEISSER needed more material for his tests he obtained it from the 'San Lazaro' Hospital of Granada in 1880.

In 1881 NEISSER replied sharply to HANSEN and said he had never claimed the priority of the discovery, and the bacillus discovered or reported by HANSEN in 1874 apparently lacked importance because it had not been satisfactorily reported; that his investigations were viewed with little or no value by his own colleagues, while he had reported a specific type of bacterium etiologically connected with all leprosy lesions.

His article continued distilling bile, and added that DANIELSSEN mocked at HANSEN that they spoke little or nothing of bacilli and techniques of culture media and staining in the hospital where the famous discoverer worked.

Thus it seemed that NEISSER wished that HANSEN knew nothing about bacteria. The anger of NEISSER was clearly reflected in the following paragraph from his paper in which he literally said 'And all in order to obtain the priority which I had conceded to him in two places in my article,

which itself consisted of eight pages; definitely I gave considerable space to discussing HANSEN and his publication.'

This episode in the life of HANSEN, little reported, is known under the name 'Controversy between HANSEN and NEISSER'. Some authors such as CZAPLEWSKI and RICHTER have tried in vain to wrest the glory of the discovery from HANSEN and give it to NEISSER. Some partisans of NEISSER less passionate, only support that the bacillus be baptised with the name of both, namely HANSEN-NEISSER bacillus, as it was known for many years in Germany.

There is no doubt that NEISSER studied, confirmed, and extended the observations of HANSEN, but the latter was the discoverer, the first man who saw the bacilli; the first who related them to the cause of leprosy. It could be that he was not a great bacteriologist, but beyond a doubt was a sagacious observer, a clever investigator, an exceptional leprologist, a character which did not bow to anyone in his scientific convictions, whether his opponent was DANIELSSEN or VIRCHOW, and in order to establish his proposals had to conquer an infinity of failures.

NEISSER had great success in describing the bacilli, and described them more fully than HANSEN and also described the agglomerations of bacilli which he called 'globi'. He said that in fresh preparations he had difficulties in recognizing these minute organisms which nevertheless appeared brightly stained with the use of fuchsin and gentian violet. He strengthened the work of HANSEN rather than belittled it, and the wise Norwegian had no need to use stains to make sure that he was facing the causal agent of leprosy.

Many authors think that NEISSER used too much time in belittling the work of HANSEN instead of recognizing it, and perhaps this has influenced the fact that the work was not recognized, or recognized very inadequately, as work which had true value, and beyond doubt it was of first importance. NEISSER was hurt that his due participation in the discovery was not recognized, although his fame with posterity will rest on the discovery of the micrococcus which bears his name and which is the causal agent of gonorrhoea. This polemic, which at the beginning harmed the friendship which existed between the great men, later was forgotten. HANSEN when he wrote his memoirs treats the matter briefly without showing animosity against NEISSER. The chief thing was the bacillus of leprosy was discovered, and the controversy contributed to spreading the discovery in European scientific centres, especially in Germany and France; in Germany thanks to NEISSER and in France with the scientific reports in favour of the bacillus made by BROCC, LEOIR, and BESNIER. In America also the discovery of HANSEN was recognized and spread. In Cuba, in August 1882 when a discussion arose in the Academy of Medical Sciences over an article published in a scientific review, which dealt with leprosy contagion, also our wise and great CARLOS J. FINLAY said 'Concerning leprosy, thanks to some recent work, opinion is turning more and more in favour of the contagion of this disease. I was one of the first to uphold this for academic discussion.'

For HANSEN a great stretch of time had to pass before his finding was fully recognized. Still he had to battle much so that his bacillus and his theory on the infectious-contagious nature of the disease should be accepted, since the acceptance of this theory implied a violent change in the concept of that which existed. In spite of the bacilli being met with in almost all lesions, the anti-contagion group gave no value at all to any cause which was not the hereditary. The confusion was enormous. It was not possible to arrive at an agreement. The health authorities seemed unable to act through fear of falling into manifest injustice. When HANSEN was still a medical student, in the year 1862 The Royal College of Physicians of London began an enquiry among all doctors to make certain aspects of leprosy clear, and especially its method of propagation. This enquiry ended in 1865 and after long discussions the majority conclusion was that leprosy was not contagious.

As the judgement of the committee charged with the investigation to which we refer was not unanimous, doubt remained.

Seven years later, when HANSEN had already seen the bacillus in 1872, another committee, this time presided over by the Prince of Wales, later King Edward VII, and DR. TILBURY FOX and T. FARQUHAR participating, began another study enquiry into the hygienic and social problem, very important to leprosy in the Indian Empire. The committee appointed included DRS. BEAVEN RAKE, BUCKMASTER, KANTHACK, BARDY, and THOMPSON, helped by the laboratories of Simla and Almora. The work lasted two years. Doctors consulted were 66, and of them 45 declared against contagion, 12 did not vote, and only 9 pronounced in favour of contagion. The report was edited and declared that latitude, humidity, neighbourhood of the sea and atmospheric temperature did not seem to exercise a great influence on the development of leprosy, which was always met with, without regard to telluric indices, or climatic or hygienic factors, and nevertheless improvement in social state and nutrition coincided with the diminution of the disease. They concluded by affirming that 'contagion does not play a role of great importance in the etiology of the disease.'

In 1876 in a memoir published by DRS. TILBURY FOX, FARQUHAR, and VAN DICK CARTER, they said that 'DR. HANSEN of Bergen maintains that lepra is propagated chiefly by contagion. This opinion is fully wrong, and there is no reason why leprosy patients should not be admitted to general hospitals.'

When discussions on the contagiousness of leprosy were very warm, our Academy of Medical Sciences in 1879-1890 also tried to clear up this question with a symposium directed by the General Benevolent Council under the Governor General. In our scientific environment also the opinions were very divided. DR. FINLAY took part, and when he showed himself a partisan of contagion and someone refuted what he had said and faced him with the conclusions at which the Royal College of Physicians had arrived, he replied saying 'Scientific truths are not demon-

strated by means of voting, and the only legitimate deduction in the matter is the question which is not yet resolved in a definite manner.' 'The opinion of the Royal College of Physicians in London was answered by 66 medical specialists in India and the West Indies. Of these 45 declared against contagion, 9 in favour, and 12 did not wish to decide. It is better to consider that one single example of positive contagion, properly observed by a competent judge of such, suffices in itself to annul many negative arguments from the anti-contagionists. It follows that the result of those opinions which seem to have been given, only means that 45 of the experts never had occasion to observe any case proving evident contagion, and on this they based themselves for rejection of the validity of other observations, whose authors were perhaps more fortunate than they, or were better placed for gathering the indispensable data, which are always difficult to collect.'

In other discussions of these memorable sessions, FINLAY again intervened, and answering one of the partisans of the hereditary theory 'There is a world of difference between saying that the Royal College of Physicians in London had declared that leprosy was not contagious and relating that this was the majority opinion, but a very appreciable minority accepted contagion, the question being undecided by others. Scientifically it is not shown that leprosy is not contagious.'

The theory of heredity was reinforced by the fact of encountering leprosy at times in the same family over several generations.

When in Norway the law was approved of Protection and Medical Assistance to Leprosy Patients in 1877 and amplified in 1885, the law of which we have spoken, 156 leprosy patients who did not agree with this law emigrated to the USA, and HANSEN, with the object of studying and observing the development which had taken place, and especially the health state of the descendants in regard to leprosy, decided to visit them in 1888. He went to the USA and visited the states of Minnesota, Wisconsin and Iowa, where most of the patients had settled down. Of the 156 refugees, hardly 14 lived, without presenting symptoms of active disease, and he could not find a single patient among the descendants, though he had the chance of examining three generations of the emigrés. Once more he could convince himself that leprosy was not hereditary and so reinforce his theory of contagion. He explained the absence of leprosy among the descendants to the improvement of standard of living in general, of habits and health conditions.

In the year 1894 DANIEL CORNELIUS DANIELSSEN died at 79 years of age, when he was carrying out the duties of Lungegaards hospital. This decease deeply affected HANSEN because of the strong spiritual bonds which united him to the famous master of leprology, for whom he felt a great devotion.

HANSEN, in 1895, in collaboration with CARL LOOFT published a lengthy work called 'Leprosy in its clinical and pathological aspects'. In it he defines leprosy as a chronic disease produced by the leprosy bacillus, in spite of the bacillus not having been experimentally proved.'

Reading this paper we can take note of the profound knowledge of leprosy which HANSEN had. He began by criticizing the classification then existing of DANIELSSEN-BOECK, of which we have spoken, and afterwards described in a masterly manner nodular leprosy and its ocular complications and in the mucosae of lips, tongue, gums, uvula, soft palate, and pharynx. He treats with mastery of the subject the infiltrations of the vocal cords and the rough or hoarse voice which develops as a result of them, later on refers to laryngeal stenosis, tracheotomy, and gland infarcts especially in the axillary, cervical and inguinal glands. He says that in the static period of this type of leprosy the diagnosis is very easy, and there is no other skin state existing which could be confused with nodular leprosy. If it were necessary, search for the bacillus would clear up all doubts. He calls attention to how little leprosy in itself affects the life of the patient. He says that leprotic symptoms of the central nervous system have never been observed by him, because there was never a patient with maniacal attacks who was brought to a sanatorium for lunatics and left cured.

He wrote extensively on the morphology of the bacilli and of the granular ones which he estimated to be degenerative residua. He thought that the bacillary multiplication took place in the cells themselves, without the bacilli ever penetrating into the nucleus. He made wide use of his histo-pathological knowledge, describing renal, splenic, hepatic, nervous, ocular, testicular, and glandular lesions.

He was just to NEISSER saying that the rounded groups of bacilli which he called 'globi' were correctly designated, because of the globular form shown in the microscope. In the present age this form of grouped bacilli are called 'globi of NEISSER'.

When dealing with the maculo-anaesthetic form he said that it was described for the first time and very well by DANIELSSEN. This passage allows us to discern the affection which HANSEN felt for his father-in-law, because this form was described for the first time by him, when HANSEN criticized classification of DANIELSSEN - BOECK. DANIELSSEN simply called it the anaesthetic form, explained the nervous connections of this form and said that the prominent feature of the disease was the neuritis, and explained how the thinnest peripheral branches could be palpated and fine thickenings detected in the nerve cords.

And so we arrive at 1897 which was to be memorable in the annals of contemporary leprology on celebrating in Berlin the First International Congress of Leprology, in which an account was given of the work and of the advances attained in what could be called the first 50 years of the scientific era of leprosy, which, in our view, began in Norway with the work of DANIELSSEN and BOECK and the discovery of the leprosy bacillus by HANSEN.

This first congress was presided over by VIRCHOW who as PAUL DE KRUIF said 'was the most eminent of the German pathologists, an astonishing wise man who knew a great number of subjects, more than can be known by two scientists together.' In a few words, RUDOLPH VIRCHOW was

a kind of Dalai Lama of German medical sciences. 'He had arrived at that stage of life when men thought he knew everything, and there was nothing left for him to discover.'

Of course in this Berlin Congress they debated thoroughly the thesis about the hereditary transmission of leprosy, as well as the contagion theory, and the finding triumphed for those who maintained the opinion of contagion, the very point of view sustained by HANSEN since he began his leprologic studies. In this Congress the majority recognized: (1) *bacillus leprae* exists in all cases of leprosy without regard to race, country, or climate, (2) the propagation of leprosy takes place from man to man, (3) persons cannot become leprosy patients without contact with them, (4) man is the only cause of leprosy and of the foci of leprosy, (5) leprosy should be classified among infectious-contagious diseases.

The opinion maintained by HANSEN triumphed, and the final conclusions as edited by A. NEISSER thus were 'Because of the individual and social damage caused by leprosy, as well as the results obtained in Norway thanks to the legal methods of isolation, the Congress, basing itself on the principle of contagion in leprosy, adopts as definite conclusions the following propositions of HANSEN. (1) In all countries where leprosy forms foci or extends widely, isolation is the best means of impeding the propagation of the disease. (2) Obligatory notification, supervision and isolation, such as was carried out in Norway, should be recommended to all nations whose municipalities are autonomous and possess the sufficient number of facilities. (3) It is necessary to leave to the administrative authorities the task of arranging the prophylactic measures in accord with the social conditions of each country.'

These conclusions provoked sharp criticism from the anti-contagionist group, beginning with VIRCHOW himself who declared, 'They have tyrannically imposed a dogma without demonstration: no member here present has produced a fact which demonstrates contagion.'

ZAMBACO PACHÁ, declared 'The conclusions of the Congress bring disastrous consequences which will cause prophylactic knowledge of leprosy to recede by several centuries, and patients will be persecuted as in the 12th century. They have exaggerated the facts so as to terrorize the people, trying to make a flea into an elephant.' Straightway he added 'The Congress has imposed an authority not backed by clinical experience. The majority voted an ukase, a majority not formed of leprologists, but by theorists who have based their arguments on microbiology, and on comparisons and forced analogies with other infectious diseases.'

Great criticism was made of the German government for being the first to order obligatory declaration of the disease. Also Britain was criticized for accepting on 4 February 1898, the agreements of the Berlin Congress and declaring leprosy an infectious disease. For the same reason the critics said that the measures introduced in the USA were cruel and unworthy. Also the French Academy of Medicine received a broadside from the

partisans of the theory of heredity when on 5 April 1898 it voted the obligatory declaration of leprosy.

In the end the HANSEN theory triumphed and the discovery of the specific bacillus was recognized as the causal agent of leprosy. He ought to have had infinite satisfaction when 26 years after its discovery almost all his colleagues met in an international meeting accepted his assertions as proved.

The 2nd International Leprosy Congress was celebrated in Bergen in 1909. This meeting was presided over by the illustrious GERARD HANSEN, and still under the influence of his work, was more explicit than the former Congress, and established obligatory notification and isolation, examination of contacts, assistance to the children of patients, study of the transmission of leprosy by blood-sucking insects, and search for a specific treatment as the indispensable complement of prophylaxis.

In this Congress great eulogy was made of the Norwegian leprologists, and PROF. E. MARCHOUX years afterwards, on the occasion of the 3rd International Congress at Strasbourg in 1923, said that Norway was the leading country, the most distinguished in the study of leprosy.

On the 12th February 1912 world medicine was saddened by the loss of one of its most famous sons. While carrying out a journey of inspection of leprosy hospitals, he being doctor-in-chief of the Department of Leprosy since 1875, HANSEN felt unwell and was transferred to Bergen, where he died. He died as he had lived since he graduated as a doctor, among leprosy patients.

R. MELSON says that in common with other great brains who have laboured hard to clear up deep scientific mysteries which acted as a brake on the advance of science, and kept the human race at the mercy of chance, without possible means of clarifying the evils which decimated it, HANSEN received severe criticism from his opponents in payment, and failure to recognize his merits, but he had the joy of seeing before he died, that his discovery received the solemn approval of the most qualified scientists of his epoch, in the two International Congresses, and later in all the scientific centres of the world.

The glorious exploit of ARMAUER HANSEN had no precedent in those days and he can be considered as one of the pioneers among the discoverers of pathogenic germs.

He was an exceptional investigator whom study, not luck, carried to the discovery of the causal agent of this thousands-of-year-old disease. He worked without rest since he began to practise in Bergen in 1868 until the very moment of his death when he was 71 years old and had 44 years of uninterrupted labour in the field of leprology.

He did not have the pleasure that the bacillus which he discovered can be grown in culture media or reproduce itself in experimental animals (as is the case even up to today), such as happens with other micro-organisms, and therefore he had to spend a great part of his precious time in trying to clear up this mystery, which always deeply preoccupied him.

Defining leprosy in his work of 1895, with what great pain he must have written those lines when he writes 'although the bacillus has not been experimentally proved.'

The highest virtues adorned this exemplary man, who will live eternally in the History of Medicine, as symbol and pattern of what human intelligence can produce when it is well directed, goes with capacity for hard work, tenacity, and goodness (which he always had for his inseparable companions of the way).

When HANSEN died the leprosy endemic in Norway had decreased markedly and only about 300 patients existed.

Other eminent leprologists were proud to continue the task which he began, and did not cease their noble efforts until leprosy was practically eradicated from Norwegian soil.

To lead the task which HANSEN had undertaken the very eminent leprologist H. P. LIE, Secretary General of the 2nd International Congress and assistant to DR. DANIELSEN in 1893 was designated. Leprosy continued its victorious march, and the Trondjheim hospital closed in 1921, as formerly already had been closed the Lungegaardshospital of Molde and the Leprosy Control Unit No. 1. Thanks to the precautionary measures which they took, the decline of leprosy was so steep that HANSEN himself during the 1st International Congress of Berlin, prophesied that according to his calculations, if the descent of curve suffered no interruption, Norway would see itself free of leprosy by the year 1920. This prediction was not fulfilled, for in this year 166 patients existed in Norway, but most authors agreed that the cause of the prolongation of the endemic, was the great number of **fishermen** and Norwegian navigators who were continually in contact with patients resident in areas of high endemicity, where at times they lived several years, and later returned infected to their homeland.

Now the disease has disappeared, almost completely, from Norway and the last Chief of the Leprosy Department which existed there was DR. REIDAR SHOYEN MELSOM, who gave up his charge 28 February 1957 when he estimated that for the seven perfectly controlled patients who existed in the country his job was unnecessary.

REIDAR MELSOM is at present in Tanganyika, Africa, directing there an anti-leprosy campaign under the auspices of the Norwegian society for the protection of children ('Save the Child' or 'RED BARNA').

O that with this modest paper that we have just written, we may have accomplished our purpose of rendering homage and exciting admiration, respect, and sympathy, for the memory of the wise master, GERHARD HENRIK ARMAUER HANSEN on this year of anniversary of the 50th year of his death!

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