

HUMAN INOCULATION EXPERIMENTS IN HAWAII  
INCLUDING NOTES ON THOSE OF ARNING AND  
OF FITCH

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On November 1, 1884, Dr. Arthur A. St. Maur Mouritz, who had come to Hawaii from England in the previous year succeeded Dr. G. L. Fitch as the fourth of the succession of resident physicians at the Leper Settlement on Molokai; and he continued in that position until January 1888, after the revolution which had made conditions of the position unsatisfactory to him. Obviously much interested in leprosy and its problems, he did not content himself with merely fulfilling the routine duties of the position but made independent observations, although Arning was the special investigator at the time.

Many years later, avowedly in order that the history of leprosy in Hawaii should not be forgotten but also in order to set forth his personal views against "inoculation infection" in favor of "mouth infection," he compiled his own experiences and those of others in a quaint book entitled, "The Path of the Destroyer"; a History of Leprosy in the Hawaiian Islands, and Thirty Years Research into the Means by Which It Has Been Spread. Published in 1916 and long since out of print, I do not recall seeing it referred to until attention was called to it by Dr. H. L. Arnold, Jr., of Honolulu, when he recalled that Mouritz had made a series of human inoculations on nonleprous (*kokua*) volunteers at the Settlement, and had also made over 100 attempts to produce fresh foci by inoculation in early leprosy cases, all without success.<sup>1</sup>

<sup>1</sup> The book printed by the Honolulu Star-Bulletin Press, Inc., 1916, was copyrighted by its author. The copyright had expired a few years before his death, without heirs in 1944, according to Dr. Arnold who loaned me his copy, and his inquiries—extended even to the Library of Congress—have failed to reveal evidence of renewal of the copyright.

Mouritz' account of his experiments with kokuas<sup>2</sup> is of such interest that it seems a pity it has not long since been made known to leprosy workers, and there is also interest in the revealed background of conditions in the Settlement at that time. Very brief mention is made of similar experiments—understandably never published—by Fitch, who had ideas of his own about the disease; and also an account of Arning's famed experiment, in which as much space is given to Keanu's crime and trial as to the inoculation and its outcome.

To make this information available, the greater part of Chapter 3 of Part II of the book, and one bit of a later chapter, are presented here in the manner in which Tombs made available the first scientific record of the use of chaulmoogra as a folk medicine for leprosy.<sup>3</sup> However, much of this material is too detailed and verbose to justify reproduction in full, so it has been condensed in varying degrees in different sections but, so far as possible, with retention of the author's own phraseology. A center head or two have been introduced, and there has been a little rearrangement to bring under one of those heads what was said of attempts to inoculate actual cases. The following section is from pp. 140-151 of the book.

#### INOCULATIONS OF LEPROSY PATIENTS

In the incipient stages of leprosy, it is natural to conclude [assume] that it would be possible to start fresh foci of disease in uninfected parts of the body of a leper by inoculation. If we could successfully accomplish this, we could learn much about the etiology, the inoculability, the period of incubation, etc., and also about the cycle or life history of the bacillus.

This is one of the first snags I encountered in investigating the pathogenic features of leprosy; the creation of "fresh foci" of leprosy infection in the leper cannot be accomplished. My many experiments to produce this "leprosy reinfection" all ended in failure.

To end this chapter [this paragraph being moved up from the end] I repeat the very significant fact that fresh areas of

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<sup>2</sup> The term *kokua*, now officially defined as "a voluntary helper to a patient with Hansen's disease," signifies a healthy person—spouse, blood relative or other—who accompanied a leprosy person to the Settlement and lived there with him supposedly to take care of him.

<sup>3</sup> MOUAT, F. J. Notes on native remedies. No. 1. The chaulmoogra. With an introduction by J. WALKER TOMBS. THE JOURNAL 3 (1935) 219-222.

infection cannot be produced in the incipient leper, nor when the case is advanced. Fresh areas of infection can be started in the syphilitic, in the primary and secondary stages of the disease, by inoculation, and also in tuberculosis in animals. [But] I have made over one hundred attempts to inoculate new areas of the disease in leprosy, in mild cases of the nodular form, and never once succeeded.

Whilst the failure to produce new infection centers weakens the probability that certain local lesions are of purely local origin, it by no means negatives the position maintained by some leprologists that, in certain lepers, leprosy has well defined local foci which, if eradicated by excision, will lessen or stop general systemic infection.

#### INOCULATIONS OF KOKUAS

In the early 1880's the greater number of the 225 healthy kokuas, male and female, living in the Settlement were ready and willing to be experimented on by any means likely to induce leprosy, hoping to obtain board and lodging as lepers for the remainder of their lives without working. I was pestered and annoyed daily with requests to examine purposely caused lesions of the integument, generally wounds which had been allowed to fester and become ulcerated, aided and aggravated by various irritating substances. Feigned pains, aches, paralyses and anaesthesia were all made to order. To imitate the leprous alopecia of the supraorbital ridge, plucking out and burning of the eyebrows was resorted to. Counterfeit leprous ulcers of the plantar surface of the feet were also common.

A splendid field for experimental work was at hand and, stretching all questions of professional ethics, I did not hesitate to avail myself of the opportunities afforded me for testing the inoculability of leprosy. My chief regret is that I have so little to offer in results obtained on this much debated question. Over a period of three years I selected ten male and five female kokuas, suitable in every respect as subjects for experimental inoculation. A preponderance of cases of leprosy developing between the ages of 20 and 35 years, indicating an apparent susceptibility at this period of life, the fifteen selected subjects fell within that age period.

Daily, the dispensaries at both Kalawao and Kalaupapa offered abundant supplies of leprous serum from burn vesicles due to thermal anesthesia and steam scalds, and patients applying for remedies to dress these injuries furnished this fluid from blisters.

These vesicles yield varying amounts, from a teaspoonful to several ounces or more, of a blister serum rich in bacilli.

Hawaiians have a marked dislike for hypodermic injections, and I rarely could persuade anyone to submit to the use of the syringe to administer leprous serum. However, in one or two instances I succeeded in doing so.

The [following] records of the fifteen kokuas inoculated with leprous fluids show that every case was a failure and produced no results.

#### INOCULATIONS OF MALE KOKUAS

CASE A.—Hawaiian, 31 years old, free from leprosy, had resided four years at Kalaupapa with his leper wife, her disease of six years standing. He claimed that various sores on his arms, body, and legs were due to *mai pake* (leprosy) and demanded that he be registered as a leper. The wounds were obvious self-inflicted with hot tobacco ashes, salt and kerosene oil being rubbed in, although the man stoutly denied any malingering practices and claimed his skin lesions were truly leprous; and he could produce witnesses to prove it. I informed "A" I would use certain measures to decide his case. Stipulating against hypodermic treatment, he agreed to submit to any other medicines I might see fit to use.

In December 1884 I scarified three centers for inoculation: inner surface left forearm, base of neck near sternal end of left clavicle, and left side of abdomen near umbilicus. Leprous serum was thoroughly rubbed in with a lancet. The sores on his arms, legs, and body were cleansed with warm creoline solution, and afterwards dressed with borated vaseline to each ounce of which had been added 4 cc. of blister serum; the patient was to dress his sores twice a day, the morning dressing being made by my dispenser.

After eight weeks the three points of inoculation had healed, were barely visible. Some of the old ulcers had lessened in area while others showed no improvement; and so the case progressed from month to month. One year after inoculation there were no signs of leprosy. Shortly afterward I again inoculated two foci on the pectoral muscles. Up to 1895, when he died of acute nephritis resulting from alcoholic excesses, no sign of leprosy had appeared.

CASE B.—Hawaiian, 28 years old, took care of his mother, leprous for five years. He claimed he had leprosy because most of the integument of his body, limbs, and face was affected with the psoriatic change produced by drinking *awa*. Patches of tinea versicolor were scattered on the neck and dorsum. I explained that his skin trouble was not leprous, and he admitted his desire to acquire leprosy to avoid being ejected from the Settlement as an undesirable (which he was) on the death of his mother.

In December 1884 I scarified a patch the size of a quarter dollar over both lumbar regions, and rubbed in a liberal supply of vesicle serum and blood obtained from a young leper woman. After two months the inoculated foci showed a little discoloration. Small blisters induced by cantharides collodion gave vesicle fluid devoid of any leprosy bacilli. "B" left the Settlement in 1902, after a residence of 18 years, and is alive today (1914) with no signs of leprosy.

CASE C.—Hawaiian, aged 24 years, living with his leper wife. In December 1884 I performed the same operation on him as on "B," inoculating a sore in the web between the finger and thumb of the left hand with blister serum and leprosy blood. The wound healed at the end of two months. No sign of leprosy ever appeared. In 1908, 24 years after inoculation, he died on Maui of cardiac disease.

CASE D.—Hawaiian, 31 years of age, living with his sister, a leper of eight years duration. At his own request, and to refute his claim of being a leper, I inoculated four foci with leprosy serum in December 1885. The spots were: inner surface of each thigh, base of Scarpa's triangle, and both inguinal regions. "D" married a leper woman, lived 24 years at Kalaupapa, and then moved to Honolulu. He never developed leprosy.

CASE E.—Hawaiian, 25 years old, wife leprosy for four years. Because of rheumatic pains and patches of leucoderma on his hands, feet and neck he claimed he had leprosy. He had lived one year in the Settlement, and had been examined by several physicians, amongst them Dr. Arning, who failed to find any bacilli.

In April 1886, at his own request, I inoculated him over the left pectoralis major, in a pigmented area of tinea versicolor. A scarified patch size of a half dollar was thoroughly coated with leprosy serum and saliva furnished by his wife. In April 1887 a section of the scar failed to reveal any bacilli. On this date I inoculated him the second time, with blood and blister serum, on the inner surface of his left forearm.

Fifteen years afterwards, in 1901, he showed no signs of leprosy. He had had two leper wives, and on the death of the second he left the settlement and I lost track of him.

CASE F.—Hawaiian, 29 years old, whose leper wife had died in 1880. In September 1885 he appeared at the dispensary at Kalawao with gonorrhoea, multiple soft chancres, and inguinal buboes. He was anxious to contract leprosy, and several times he requested me to enter his name on the leper list, but he was not a leper.

With his permission on two occasions, at intervals of a month, I administered hypodermic injections of 4 cc. of leper blister serum, making the injection intramuscular, into the right buttock. After the second injection he refused any more, although those given had caused no inconvenience. During the time he used my favorite application in such cases—borated vaseline with blister serum added.

Up to January 1888, and later—20 years and 23 years after the injections—"F" showed no trace of leprosy. He had married three leper women, and when the last one died he was sent out of the Settlement because of gambling and illicit alcohol distilling.

CASE G.—Hawaiian, aged 26 years, went to reside at the Settlement in 1884 with his leprosy sister. A confirmed *awa* drinker, he presented a most repulsive appearance—purulent ophthalmia, thickening and eversion of the eyelids, bright scarlet conjunctivae, his entire body a mass of *awa* scale-patches, in places of rupia formation, and foul ulcers. He informed me that he was a confirmed leper and that the Settlement people thought me a very poor doctor because I failed to recognize him as such. There were weekly repetitions of his tirade, and finally I told him that I would find out if he was a genuine leper.

I shaved and cleaned both axillae—the only apparently normal dermal surface remaining—and scarified two foci in each axilla, thoroughly

rubbing in about 2 cc. of leprous serum. The points of inoculation readily healed, and sections of skin from them taken twelve months later revealed no bacilli. The inoculation was made in May, 1886, and the man died a nonleper in 1897, eleven years later, of acute alcoholism.

CASE H.—Caucasian-Hawaiian, 31 years old, segregated in 1883 as a leper. Ten months later he was pronounced a doubtful case and then was liberated as a nonleper. Six months later he was re-declared a leper and again sent to Molokai. (There are many similar cases.) The only pronounced signs of leprosy were atrophy and paralysis of the interossei muscles of the left hand, wasting and paralysis of the forearm extensors, extreme flexing of fingers on palm, ectropion with constant lachrymal discharge, and destruction of the phalanges of the right large toe. No bacilli could be detected.

"H" requested me to determine if possible the absence or presence of leprosy, and to this end I inoculated him in February 1887 with leper serum on a surface about the size of a half dollar over each lumbar region. Six months afterwards only a discolored area indicated the seat of operation. He died in 1901 at Kalaupapa of acute dysentery. There had been no active development of his latent leprosy.

CASE I.—Hawaiian, 24 years old, whose leprous wife had been resident for three years. "I" was affected severely with tertiary syphilis, and had ulcers on the anterior tibial surfaces of both legs, necrosis of the nasal bones, and perforation of both the hard and soft palate; he had been treated with potassium iodide with benefit until the drug was discontinued, when all the symptoms would break out again. Like all the cases I have previously related, "I" was eager to get leprosy or to have his syphilis called leprosy, and expressed his desire to undergo any treatment which would accomplish this end.

In October 1885 I made two centers of inoculation the size of a dollar in areas level with the umbilicus and three inches external therefrom. Watched until 1888, no signs of leprosy appeared. He died in 1897 of cerebral hemorrhage, and the physician who had watched the case had detected no manifestations of leprosy.

CASE J.—The tenth and last male subject on which I performed inoculation was a Hawaiian who had resided six years at Kalaupapa. In January 1887, at his own request, to decide if he was a leper, I inoculated him between the shoulder blades and in the lumbar regions; the three foci were scarified deeply. Thirteen months afterwards sections of skin from the points of inoculation were examined independently by two physicians, and both pronounced them free of bacilli.

#### INOCULATIONS OF FEMALE KOKUAS

CASE O.—Hawaiian, 28 years of age, husband three years a leper and a very bad case. This woman used *awa* to excess, and also alcohol, and was a prostitute with gonorrhoea, chancres, and venereal warts. She strenuously insisted she had leprosy, and accused me of prejudice against her and of favoring other kokua women whom I listed as lepers. This case was an excellent one to determine whether the vagina was a permanent seat of the leprous bacillus, but never once did I succeed in finding any though all her many consorts were lepers.

"O" made no objection to the use of the hypodermic syringe, and I gave her 1 cc. injections of vesicle serum every month. Also, after her

chancres had been cleaned and disinfected, I had her use borated vaseline with leper serum as in previous cases.

Watched for two years, she showed no signs of leprosy. Shortly afterward, in the interest of law and order, she was ejected from the Settlement. Examined for leprosy in 1898, she was not a leper.

CASE P.—Hawaiian, aged 25 years, husband a leper for five years. This woman was very uncleanly, her entire skin was scaly, with extensive patches and crusts, mostly due to scabies, and large ulcerated surfaces on the nates, and inguinal regions (with buboes) and front of the thighs. She loudly asserted whenever she saw me that she had the *mai pake* and clamored for rations, as she and her husband had to exist on his one ration. Previously she had been declared a leper but this declaration had been revoked. Under treatment she improved much to her displeasure since the prospect of rations vanished. After the cause of a profuse and fetid leucorrhoea had been relieved I repeatedly searched the vaginal secretions for bacilli, but never could find them.

With her consent I freshened up old chancres of both mucous and dermal surfaces of the labia majora, and rubbed in leprosy vesicle serum and blood. Four times I so inoculated "P" at intervals of four months. No leprosy developed from 1887, date of inoculation, to 1900 when she died of fever. Her first husband died in 1890, and she married a second leper who survived her.

CASE Q.—Hawaiian, 35 years of age, had lived fourteen years at Kalawao and had had four husbands and three children, all of whom had died of leprosy. Husband No. 2, who had been a kokua, developed leprosy two years after his marriage to "Q" and died shortly afterwards. Husband No. 3 was also a clean kokua who became a leper one year after his marriage to "Q," and he died three years after the disease showed itself. Husband No. 4, a mere youth, developed leprosy within one year and died eighteen months afterwards. She decided she had had enough husbands, and thereafter made her living by doing washing, sewing, and making hats and mats. She feared deportation because, during the fourteen years of residence, all her friends and relations outside had died, and she was perfectly willing to acquire leprosy if that could be brought about. She was perfectly indifferent as to the ultimate result if she could gain her chief desire of life-long residence, food and lodging.

The speedy way in which her husbands became lepers had naturally caused considerable comment and gossip, and she was examined by many physicians and all pronounced her not leprosy. She was petite, comely and graceful, and very clean and neat in person; her skin was free from blemish; and she neither drank alcohol nor smoked. I searched her nasal secretion, saliva, blood, feces and vaginal secretion, and had them examined by other physicians, but no bacilli could be detected.

At one period of my residence at Kalawao I had difficulty in getting my wearing apparel laundried, and engaged her to wash for me. Father Damien came racing along to my house and begged and implored me not to employ "Q," offering to obtain the services of another kokua washer-woman. He recounted her past history, all of which I knew. I did not discharge her as I felt no fear of getting leprosy through her laundry work.

I may say here that Father Damien was most careless and reckless in his associations with lepers, seemed perfectly indifferent as to whether he

fell a victim to leprosy or not. I repeatedly scolded and rebuked him for having leper cooks and servants, but he turned a deaf ear to all my remonstrances; yet he displayed genuine concern and alarm when he thought I was taking an undue risk by employing "Q" to wash my clothes.

Acceding to the importuning of "Q," on two occasions at intervals of four months I injected 2 cc. of leprosy vesicle fluid into the lumbar regions, 1 cc. into each flank. On the second occasion the injections were made between the shoulder blades and also into the abdominal muscles below the ribs in the mid-axillary line. Alone in my experience with injections of this vesicle serum, "Q" then had a marked reaction. Headache, chills, fever of 103.6°F., bodily pains, nausea, and profuse sweating, all followed the injections for four succeeding days. This reaction scared her; she thought I proposed to kill her right off, and any further injections were declined. She lived for fifteen years after being inoculated, but leprosy never appeared.

CASE R.—Chinese-Hawaiian, aged 24 years, husband a leper, had resided at Kalawao since spring of the year 1883. In March 1885 she came to the dispensary for relief of skin troubles, consisting of eczema, impetigo, scabies, ulcers of legs, warty condylomata on labia and around the anus, and ulcerating inguinal buboes. She claimed she had leprosy and *pala* (syphilis), with which I could not agree. Her genital passage was free from disease and from bacilli, which I was always seeking in order to confirm or eliminate the vagina as a permanent seat of the leprosy bacillus.

This woman, anxious to obtain rations, wished to be listed as a leper. After her skin troubles improved the large ulcers were dressed daily with borated vaseline containing leprosy vesicle fluid. Afterward I lost sight of "R" and forgot all about her case. When I last saw her, in 1898, she had to remind me who she was, so great was the improvement in her appearance. Her freedom from leprosy was only too apparent.

CASE S.—Hawaiian, 26 years of age, was born at Kalaupapa on holdings but practically speaking she was one of the Settlement residents.<sup>4</sup> She married a *kokua* who developed leprosy four years after their marriage. She claimed to be a leper on very poor evidence, for she had no desire to leave the place. Her hands and feet were devoid of sensation, but there were no changes in the skin, muscular structure, or blood vessels. She was addicted to alcohol (home-made) in excess, and had gonorrhoea, cystitis, and ovarian and uterine disease. She had been examined repeatedly in Honolulu for leprosy, the decision always being in the negative.

She being a frequent visitor to the dispensary at Kalaupapa, I inoculated her on different occasions, at intervals of four months, on the arms and back with blood and serum obtained from facial lepromas of her husband. The first inoculations were made in November 1886, and when in 1895 she was examined by a medical commission no leprosy was in evidence and she was ordered deported with other *kuleana* holders on the

<sup>4</sup> These original residents (*kamaainas*) continued to live unmolested alongside the leper homes for 29 years, when their holdings—homesteads (*kuleanas*) previously outside the control of the Board of Health—were condemned and the dwellers thereon were expelled from the reservation. There were 38 or 39 of these *kamaainas*, male and female, and none of them ever developed leprosy though some are said to have taken inmates into their houses to live and a few even married inmates.

condemnation of their homesteads. In 1904 she was still not a leper. She had lived, altogether, over 35 years in contact with leprosy.

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#### A CELEBRATED CASE

Having registered the foregoing evidence that leprosy is not contracted by inoculation of the dermis by ordinary methods, Mouritz went on to point out that two events had "caused the eyes of the world to become focused on Hawaii," giving the islands unenviable notoriety. These were, first, "the successful inoculation or alleged inoculation of Keanu, the Hawaiian murderer," and, second, the infection of Father Damien. His account of the former event (pp. 152-155), under the heading which appears above (but listed as "The Alleged Successful Case of Keanu" in the table of contents), is condensed severely as regards details of the crime and the trial, less so in the second part.

I will now [he went on] give a brief history of the case of Keanu, the Hawaiian murderer, whose death sentence was commuted to imprisonment for life with the proviso "that he submit to inoculation with leprosy." Under no circumstances was he to be pardoned and given his freedom, as has been stated in certain mainland publications.

#### KEANU, THE MURDERER

In the gray dawn of the morning of February 16, 1844, on a lonely part of the Kohala-Waimea road in the district of Kohala, Island of Hawaii, Keanu with a wooden bludgeon beat in the skull of "Charlie," a Japanese of diminutive stature and feeble strength. This Japanese was married to Kamaka, a Hawaiian woman, and a clandestine liason between Kamaka and Keanu led to the premeditated and unprovoked murder. Keanu was 48 years old at the time; in physique he was massive, broad-shouldered, and of erect carriage, about 5 feet 10 inches tall, and his weight at least 250 pounds. Suspicion pointed to him, and Kamaka gave damaging evidence against her paramour.

Before Chief Justice A. F. Judd on July 9, 1884, Keanu was arraigned for murder in the first degree and pleaded not guilty, his counsel being Kaulukou and Poepoe. The trial lasted for two days, and the jury brought in a verdict of guilty as charged. Keanu's counsel moved for a new trial, which was unanimously denied by the Supreme Court on July 18. Keanu was sentenced to be hung on October 28, 1884.

Chief Justice Judd was an excellent and competent Hawaiian scholar, and for Keanu, if he had the slightest possibility of proving his innocence, no better judge could have sat on the bench.

#### INOCULATION OF KEANU

I have not been able to get access to all the documents in the case, but I was informed by the late Dr. George Trousseau, "that the Board of

Health petitioned the late King Kalakaua's Privy Council of State to commute Keanu's death sentence to life imprisonment, and for the advancement of science he (Keanu) was to submit to inoculation with leprosy." The Privy Council acceded to the petition and its terms.

Keanu was confined in Oahu jail, and on September 30, 1884, he gave his written consent to Dr. Edward Arning to inoculate him with leprosy. Dr. Arning excised a leproma, about the size of a small hen's egg, from the cheek of a young leper girl,<sup>5</sup> and transplanted and embedded this leprous flesh into an incision which laid bare the belly of the supinator radii longus muscle of Keanu's right forearm, suturing it in position.

Twenty-five months after this operation, in October 1886,<sup>5</sup> Keanu showed the maculation of nodular leprosy all over his body, and the nerves and lymphatic glands near the seat of the wound also showed implication. The infection in the various selective seats of the body peculiar to leprosy (ear lobes, helix, cheeks, forehead, supraorbital alopecia, etc.) became apparent in 1887. In the fall of that year, some three years after inoculation, Keanu was a confirmed and apparent leper. I examined him in February 1888, at the request of the United States Minister, G. W. Merrill, at the Oahu jail; the details of this examination were forwarded to Washington.

All through 1888 Keanu's leprosy progressed rapidly. He became a menace to the prisoners in the jail, and he was finally removed to the Leper Settlement on February 6, 1889. He died at Kalawao on November 18, 1892, eight years and fifty days after his so-called inoculation with leprous tissue, then aged fifty-six years. Twenty-five years ago the average duration of life of a Hawaiian affected with nodular leprosy was about eight to ten years, so that Keanu's tenure of life was about that of the average leper.

Dr. [S. B.] Swift, who resided for four years (1888-1892) at the Settlement, made known the fact that Keanu's relatives were affected with leprosy, and that he (Keanu) had lived in the same house with these leper relatives. This discovery raised the question whether Keanu was a leper previous to his inoculation.

Most old residents of Hawaii know well that the Hawaiian family relations are described in a very loose and careless fashion; and they have such appellatives as cousin-brother, cousin-sister, brother-cousin, and sister-cousin. A man may have plural wives; or he may live and cohabit with the married wife and her sister; and the reverse situation, a wife with two husbands, is even more common (*punalua* is the term used in these cases).

In the case of Keanu his maternal cousins, so-called, had leprosy before he did. They may have been in reality his own brothers and sisters, viewing the matter in the light of the

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<sup>5</sup> Cf notes from Arning's report, below.

peculiarly loose and bewildering family relations and associations maintained in Hawaii.

All the data and features connected with Keanu's case cannot determine the question of the inoculability of leprosy in man. By no such method as was employed in his case could the average person accidentally become infected with leprosy. Transplanting and imbedding leprosy tissue into the healthy person cannot by any manner of means be termed inoculation, as I define that term. It is an extraordinary method of infection; it is of no value to determine the manner of average, every-day infection; and it cannot possibly meet the issues that face us on the inoculation question.

In view of all my own experiments, of those of others, and of my general knowledge of the cause of the spread of leprosy, I assert and claim that leprosy cannot be inoculated in man or animals on any dermal surface by ordinary methods. I also assert that the chief cause of the spread of leprosy is not by inoculation. . . . Absolute proof of the inoculability of the disease has yet to be demonstrated.

Just before describing the murder, Mouritz stated (p. 152) that the case of Keanu failed to carry conviction regarding the absolute inoculability of leprosy, because the operation was not one of "legitimate inoculation" but "transplantation of leprosy flesh." The infection of Father Damien, he held, "illustrates what may happen to anyone who is careless and imprudent in contact with a contagious disease. . ." He set forth (p. 155) the conditions essential for the successful invasion of man by the leprosy bacillus, namely, (a) a receptive system, (b) a mucous surface, (c) the presence of a ferment at the point of entry, and (d) the presence of "leprogen" in the tissues. The bacilli, he speculated, might call forth a "fermentogen" from the tissues of man, and the ferment into which it is converted causes the tissues to liberate "leprogen," a pabulum which man alone possesses—which would explain the immunity of animals. In another place (p. 116) he concluded that: "The bacillus leprae, in order to infect a healthy person, must enter the digestive tract through the mouth; from thence a general systemic infection occurs through the mucosae of this tract." Hence, he said (p. 124), his selection of the name of the monograph, "The Path of the Destroyer."

It will be noted that in the above account of Keanu's condition the first observation mentioned is ascribed to October 1886, 25 months after the operation. No mention is made of Arning's

own report of the case,<sup>6</sup> which gives details of the operation—differing in certain respect from Mouritz' account—and of his observations of Keanu up to June 5, 1886, just prior to his departure from Hawaii. After that, because of the political disturbance which ended in a revolution the following year, the first report which he could get was one written from memory early in 1889 of an examination made late in 1887, a little over three years after the operation, when Keanu already presented a well-established case.

One point of interest in Arning's description is that the donor was a 9-year-old girl with marked nodular leprosy who had just recovered from an attack of lepra fever. Another is that the inoculation attempt was a two-phase one. First, bacillus-rich material from an ulcer on the donor's chin was injected into an induced blister on the right forearm, and rubbed into the freshly scarified left earlobe. Second, the implantation was of "a piece of clean (not ulcerated) skin from the arm [not cheek] of the child..." implanted with five sutures into the 3-cm. incision in the left [not right] forearm.

The implantation wound became an ulceration which took nearly three months to heal, after which there was a keloid scar; and in the meantime the subject complained of rheumatoid pains in the left shoulder and then in the other joints of that arm, while there was a "painful swelling of the ulnar and median nerves" of the left arm only. In the course of the next six months the neuritis subsided, and there appeared (first recorded on February 15, 1885) in the scar of the inoculation site a "lentil-sized waxy yellow granulation tumor" which when examined a month later yielded a smear "colossally rich in lepra bacilli, often found singly as beautiful, long, vigorous individuals, but mostly in thick sheaves in large epithelioid cells, partly also in smaller cells of the size of white blood corpuscles"; some of the bacilli lay in vacuoles in these cells, others in mucoid (*Schleim*) clumps. "It seems open to question," Arning wrote as of March 19th, "whether, since recent enlargement of the granuloma cannot be verified, we have here in reality a new development of a leprous nodule or the elimination of a part of the healed-in leprous tissue." However, the lesion was described as a nodulation and not an ulceration, although it was crusted for a time after the bacteriological examination. It was still present on June 18, but a smear made on April 25 had shown only "sparse but well-stained bacilli"; one from the keloid itself had shown none. By July 11th the little nodule had disappeared. At the time of the last examination, on June 5, 1886, the arm was free from pain, the nerves were not painful on pressure, there was no disturbance of sensibility, and the keloid was unchanged; no lepra bacilli were demonstrated in the secretion (*im Secret lassen sich Leprabacillen nicht nachweisen*). "In that condition I left Keanu."

If in October 1886, four months later, there was evident and

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<sup>6</sup> ARNING, E. Eine Lepra-Impfung beim Menschen (etc.) Verhandl. deutsch. dermat. Gesellsch., Prog. 1889; Wien, 1889, I, pp. 9-25.

generalized leprosy, the onset must have been acute and progression rapid indeed.

#### FITCH'S INOCULATION EXPERIMENTS

To return to Mouritz' book, in a later section (pp. 382-389) there is reproduced a report by Dr. G. L. Fitch, written in late 1884 while he was still the resident physician at the Settlement, devoted to the thesis that leprosy is not contagious or communicable "except by heredity," although Mouritz states (p. 146) that Fitch claimed leprosy to be the fourth stage of syphilis. Although, curiously, Fitch held that "no person with a disease as loathsome as leprosy has any right to be at large in a community," his conviction that leprosy was not "a contagious or infectious disease" was so strong that according to the following verbatim passage from Mouritz (p. 398) he made some inoculation experiments on persons evidently not of the kokua class.

The late Dr. G. L. Fitch, subsequent to his leaving the service of the Board of Health, made some experiments on his Hawaiian patients. With blood and serum obtained from scarified leprosy nodules he inoculated some thirty males and females on the upper arm, similar to the usual method pursued in vaccination.

The Doctor claimed that all these cases had syphilis, and he proposed to demonstrate that leprosy could not be successfully inoculated, because it is or was modified syphilis in a fourth stage, hence not inoculable nor contagious. Whether this assumption is correct or not, it however furnished to my mind fresh evidence of the noninoculability of leprosy, for no development of that disease took place in any of these inoculated people within the four years subsequent to the performance of the operation.