Chapter 3

Guido Holzknecht

(1872–1931)

"As long as we are unable to weigh and measure the remedy, we shall be unable to get an exact knowledge of its biological effects." (1923)[330]

Guido Holzknecht was born in Vienna on 3 December 1872, the son of Ludovica Elizabeth Sievert and of Guido Evarist Holzknecht, an industrialist whose ancestors had come from the Tyrol. Young Guido attended the Gymnasium in Seitenstetten (in Lower Austria) and later the Theresianum, a very reputable Viennese school operated for sons of the aristocracy. He obtained his secondary school diploma by the skin of his teeth in 1893.[651] His study of medicine began in Strasburg and continued in Königsberg. In the youthful enthusiasm of his undergraduate years, Holzknecht dreamed of becoming a psychiatrist, but Röntgen's discovery of the "new light" provided him with fresh inspiration. The medical promise of the newly discovered rays, ably presented to him by Professor Ludwig Lichtheim (1845–1928), of Königsberg, offered exciting and unusual opportunities of which he was to take advantage. He would later remark on many occasions: "I always obey my inner urge when at this point I thank my respected former teacher, the honorable Professor Lichtheim."[651]

He completed his medical education at the University of Vienna, receiving his diploma of *Doktur der gesamten Heilkunde* in July 1889. An indefatigable and resourceful worker, Holzknecht was to make important contributions to the medical utilization of the roentgen rays. In the short span of his fruitful life, he became a world leader and champion of the new medical specialty, a sought after lecturer, and the beloved teacher of a pleiad of brilliant radiological stars. Few, if any, of his contemporaries attained equal fame and following.

On New Year's day, 1896, Röntgen mailed copies of his papers and prints of his first radiographs to a few of his friends and colleagues. Franz Serafin Exner (1849–1926), a physicist in Vienna who had been Röntgen's classmate in Zürich, claimed to have been given the information earlier. Serafin is now credited with making three radiographs in December of 1895. One of these shows a foot with a double great toe and another a retained gunshot in a forester's hand. Within three weeks, several roentgenograms had been shown to the Vienna Medical Society, including a post-mortem angiographic study of the hand.[652] Gustav Kaiser (1871–1954), recently graduated from medical school, participated in these efforts. Kaiser was to become Vienna's first radiologist, developing a radiologic service in the "second" medical department of the University. It was there as a medical student that Holzknecht was initiated in radiology under Kaiser's guidance.

Hermann Nothnagel (1841–1905), Professor of Medicine at the University of Vienna, offered Holzknecht a position in his department in October 1899. He was given a room with an X-ray unit discarded by another department. In December 1899, Holzknecht presented his first paper and observations on bronchial stenosis and the expiratory shift of the mediastinum (*mediastinalschnellen*).[316] Working diligently, he dedicated himself to the exploration of the chest, pointing at the usefulness of oblique views in the study of the aorta and esophagus.[317] In 1901 he published a monograph of 229 pages with 68 charts and 50 figures on the roentgenologic diagnosis of diseases of the chest.[318] This work, published as one of a series under the editorship of Heinrich Albers-Schönberg (1865–1921), was hailed by Béclère as a fundamental work worthy of consideration and as an historical complement to Laennec's celebrated *Traité de l'auscultation mediate.* Subsequent observers have

emphasized Holzknecht's exceptional gifts as revealed in this early work.[702]

At the beginning of this century, the Allgemeine Krankhaus consisted of 20 departments and 14 institutes and clinics, housed in a dozen interconnected quadrangular buildings, each one enclosing a beautifully landscaped court: a total of 250 acres within stone walls. The rapidly increasing demands of Holzknecht's rather limited roentgen station made it a financial liability to Nothnagel's department. Meanwhile, a Röntgen Institute had been developed at the hospital under the jurisdiction of the chair of dermatology. In 1901 Kaiser, who had done his work there, was obliged to retire because of radiodermatitis of his hands. As his previous place of work was abolished, Holzknecht was promoted and asked to take over this "roentgen room." The new situation enlarged his interests to include other areas of diagnostic research and offered opportunities for radiotherapy of a variety of dermatoses. He studied in detail the various degrees of skin reaction and applied himself to the use of radium.[321,199]

At the second International Congress of Medical Electrology in Berne in 1902, Holzknecht presented his chromoradiometer, the first device invented for the dosimetry of radiations.[319] The measuring scheme was based on the photochemical effect and consequent changes in color of a mixture of sodium carbonate and potassium chloride. Holzknecht estimated the amount of radiations necessary to produce a light skin reaction and arbitrarily designated this amount as a normal dose, giving it the value of three units (3H). The Holzknecht unit, or H unit, was used widely for over three decades until the advent of the roentgen. The chromoradiometer underwent several model changes (Fig. 3-1), and since color could also be affected by heat, a provision was made for a control (subj. note 3.1). Holzknecht later adopted the barium platinocyanide pastilles of Sabouraud-Noiré as more satisfactory for the chromoradiometer's purposes.[559]

In 1903 Holzknecht and his Viennese contemporary and friend, Dr. Robert Kienböck (1871–1953),[B] made a vigorous plea for radiology to be recognized as a new medical science and specialty, not merely the use of an ingenious tool.[335] Considering that only seven years had elapsed since Röntgen's discovery, and in view of the chaotic circumstances that had accompanied its use, their early efforts were decidedly foresighted. Holzknecht and Kienböck were rewarded by the University of Vienna when both were appointed *privat dozents*. Also receiving the appointment with them was Leopold Freund (1868–1943),[B] who had made the first trials of substance in therapeutic radiology. Holzknecht was promoted to director of the Institute in 1904. By then it was already providing six thousand roentgenologic examinations and two thousand roentgen- and curietherapeutic applications a year.

In 1905 an independent laboratory of roentgen diagnosis and roentgen therapy was established at the Allgemeine Krankhaus. Holzknecht succeeded in making it a Central Roentgen Institute, but physical impediments and competition from other departments led to the creation of smaller radiologic services throughout the hospital. Although Holzknecht favored centralization, he also understood the value of subspecialization.[566] He opted to accept the opportunity to train the young radiologists who went to

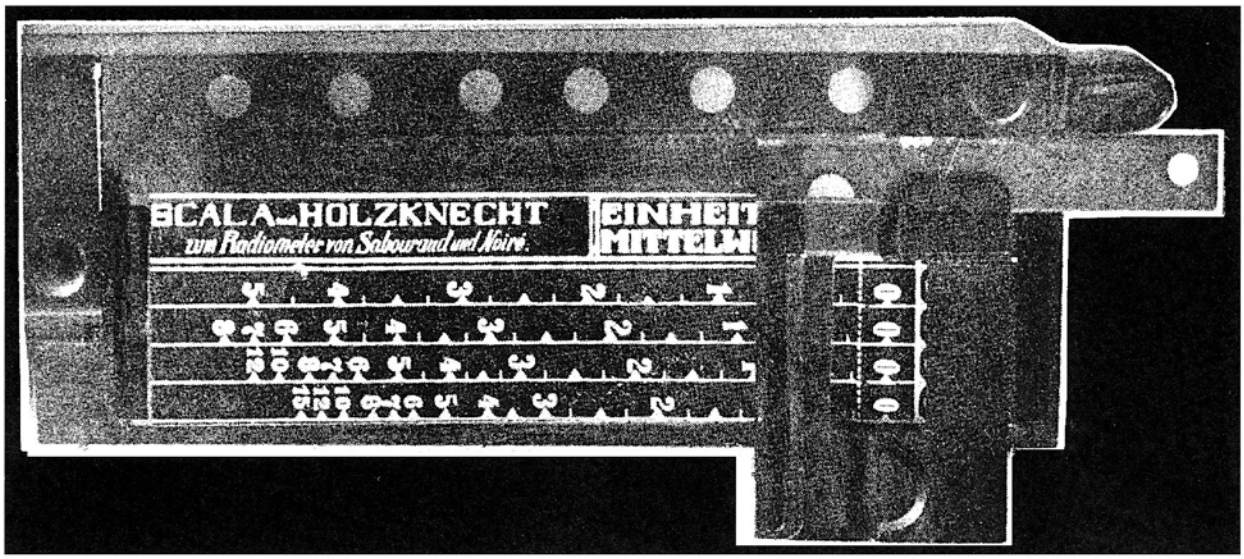

Fig. 3-1. The chromoradiometer. This later model used pastilles of Sabouraud-Noiré and provided a control for changes of color due to heat.

serve the various subspecialties. It was his strong feeling that subspecialization encouraged the mastery of all aspects of anatomy, physiology, pathology, and clinical manifestations in a narrow sector, thus facilitating more original contributions to the interpretation of radiologic images. He was also among the first to recognize and accept the physical foundations of radiotherapy.[323]

During the period of his most intense dedication, Holzknecht and his associates embarked on a vast study of the radiodiagnostic possibilities of the exploration of the normal and diseased gastrointestinal tract. Such a concerted effort by members of the Viennese school was unmatched anywhere else. Their efforts greatly stimulated the factorial consideration of symptom-complexes in relation to function and image, and enhanced appreciation of the role of fluoroscopy. Innumerable neologisms still in use (duodenal bulb, haustrations, etc.) were created in the course of their pioneer efforts. Holzknecht is credited with being the first to diagnose cancer of the stomach by radiologic means.[322] With Siegfried Jonas, he wrote a thorough work on the diagnosis of gastric and extragastric tumors.[334] Martin Haudeck identified his name with the study of peptic ulcers.

In World War I, Holzknecht served in the Austrian Army with the rank of lieutenant colonel. He gave himself completely to the organization and development of radiological services and to the solution of medical and surgical problems encountered in warfare.[325,336] Numerous contributions made by Holzknecht in the design of equipment and devices are inextricably embedded in the historical metamorphosis of radiology.[324,327] He also pioneered in the training of radiologic technologists.

Eugen Steinach (1861–1944), a Viennese biologist previously concerned with cephalopods, became interested in feminizing tumors and in homosexuality.[600,602] He developed the theory of a "puberty gland," supposedly restrained in adulthood by the gonad's reproductive function, but which could be revivified in the aged by the simple suppression of the gonadal external secretion.[601] The vasectomy, called "Steinach's operation," became popular and was widely advocated as a "rejuvenating" procedure.[77] The idea arose that the radiotherapeutic suppression of residual ovulation could result in rejuvenation in middle-aged women. Steinach and Holzknecht made experiments on guinea pigs, reportedly producing the desired results.[599] In an appeal for endowment of the Biological Laboratory of the University of Vienna, Holzknecht aroused public interest in Steinach's work.[320] In New York in 1923, Paul Kammerer,[B] a visiting lecturer and former collaborator of Steinach,

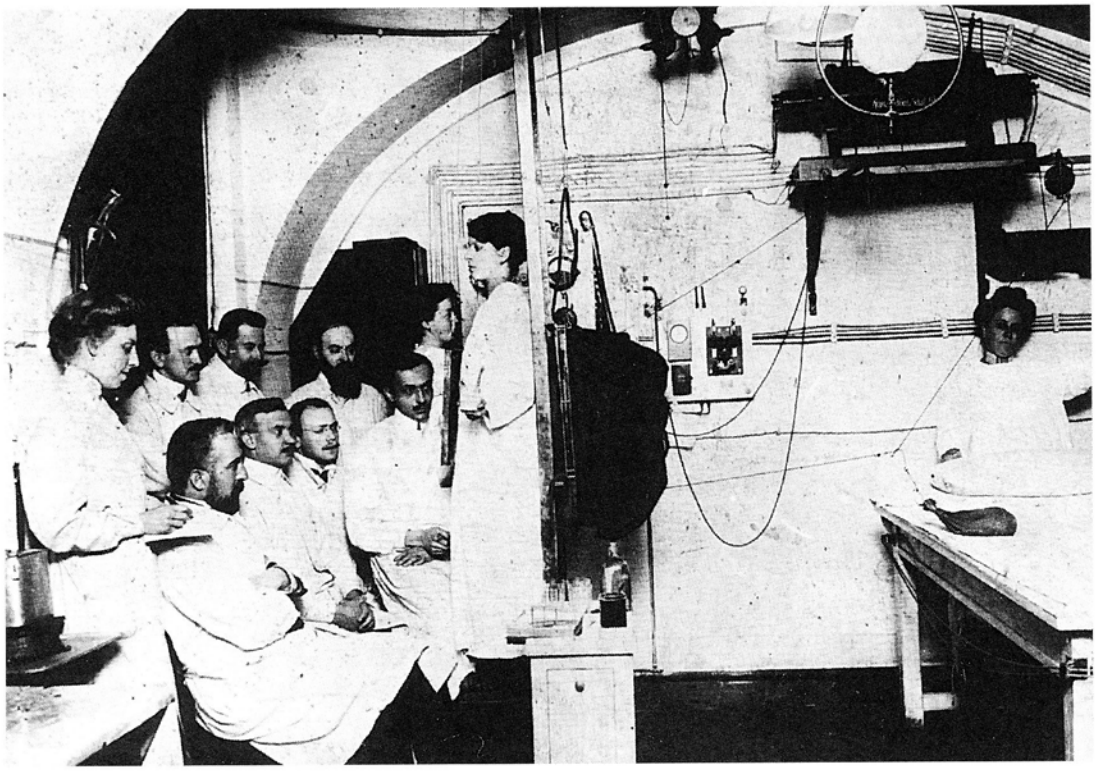

Fig. 3-2. Holzknecht and a group of early associates behind the fluoroscope. Seated second from left is Martin Haudek. (Courtesy of Prof. L. Psenner, Vienna.)

credited Holzknecht with having observed "remarkable rejuvenations" incidental to the irradiation of ovaries for benign conditions.[346] Others also contributed similar testimonials (subj. note 3.2). The inevitable publicity, discussion, and consequent professional reactions brought embarrassment to Holzknecht and led to at least one poorly documented posthumous disclaimer.[345]

Relentlessly, Holzknecht gave his best effort to the task of teaching radiology, to the diffusion of its applications, and to the instruction of converts.[326] He wrote a thoughtful essay on attitudes on roentgenology which has been frequently quoted for the soundness of its views.[329] He influenced the development and practice of radiology everywhere. His foreign disciples were innumerable; among them Russell Daniel Carman (1876–1926) of the United States, Padamanur Rama Rau (1899–1956) of India, Massimiliano Gortan (1873–1938) of Italy, and dozens of others. His Viennese disciples were legion (Figs. 3-2 and 3-3): Ludwig Brauner, Fritz Eisler (1885–1936), Albert Fernau (1879–1934), Felix G. Fleischner (1893–1969), Joseph Freud (1882–1925), Martin Haudeck (1880–1931), Siegfried Jonas (1874–1926), Alfred Jungmann (1872–1914), Robert Lenk (1885–), Ernst Georg Mayer (1893–1969), Joseph von Palugyay (1890–1953), George Politzer (1898–1956), Fritz Pordes (1890–1936), Karl Presser (1899–1958), Hugo Rössler (1899–1961), Arthur Schuller (1874–1957), Gottwald Schwarz (1880–1959), Max Sgalitzer (1889–1974), and many others who also contributed to the development of radiology (subj. note 3.3). Although they learned to protect themselves and avoided the fate of their mentor ("Holzknecht's spoon"), many shortened their lives by their dedication. Among Holzknecht's students, only Jonas Borak (1893–1949)[B] chose to practice radiotherapy exclusively. Gottfried Spiegler (1891–1970) was a physicist.

At the twenty-third annual meeting of the American Roentgen Ray Society in Los Angeles in 1922, Holzknecht reviewed the status of what was being called "deep" roentgentherapy. He pointed out that biological dose units had been found wanting and decried the concepts of "stimulating dose" and "carcinoma dose." He welcomed the practice of expressing depth dose as a percentage of surface dose and favored the spectrometric measure of beam quality. Having experienced failures in the control of certain forms of cancer, he said: "It is dignified to acknowledge our inability and to confess that we are confronted by a biological barrier over which to leap is not in our power."[330] He understood the need for new approaches and sought to develop the art of radiosensitization.[332] In Cairo on the centenary of the Egyptian School of Medicine in 1928, he spoke eloquently

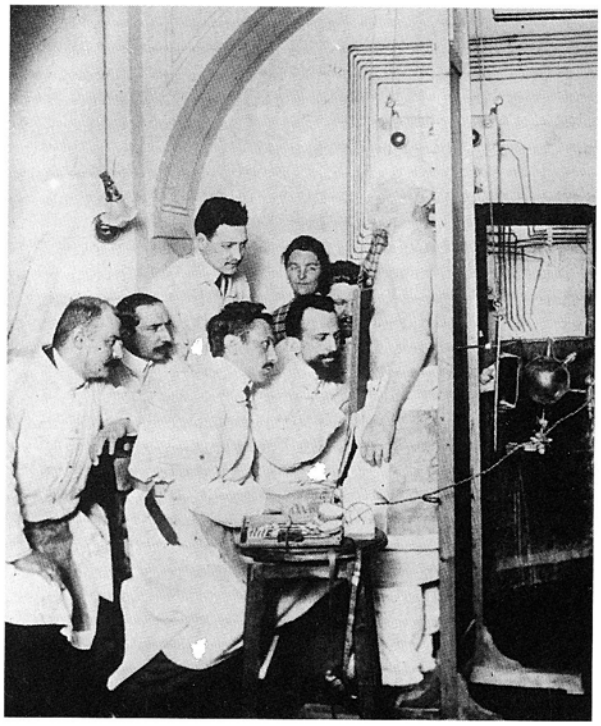

Fig. 3-3. Close-up of fluoroscopists. Standing in rear is Gottwald Schwarz. Holznecht is third from left in front. (Courtesy of Prof. L. Psenner, Vienna.)

of and illustrated graphically the progress that had been made since Röntgen's discovery: "Medicine has made important advances in the last century," he said, "but there is no other example of total transformation ... of enrichment ... of enlargement of truth such as brought about by the roentgen rays in all segments of medical sciences .... What extraordinary consequences resulted," he exclaimed, "from the sudden conception and dedicated work of a loner!"[333]

In 1922 Holzknecht wrote a 24-page booklet intended as a guide for indications and practice of roentgentherapy in a variety of diseases.[323] It was translated into French, and was reproduced as a chapter on dosage formulae in *The Principles and Practice of Roentgentherapy*, published in New York by Isaac Seth Hirsch (1880–1942).[281] The tables give details of technique for eight groups and sub-groups of diseases. These details include intensity of irradiations, size and number of fields, kilovoltage, quality of radiations, filters, distance, protection, dosimetry, fractionation, intervals, etc. Dosage levels are categorized in eight different levels from minimal through moderate to maximal. Over 125 conditions are given in which radiotherapy may be indicated, including 15 malignant neoplasms. Forty-two dermatologic conditions are listed, including acne, tinea, lupus, and psoriasis, in addition to carcinoma, mycosis fungoides,

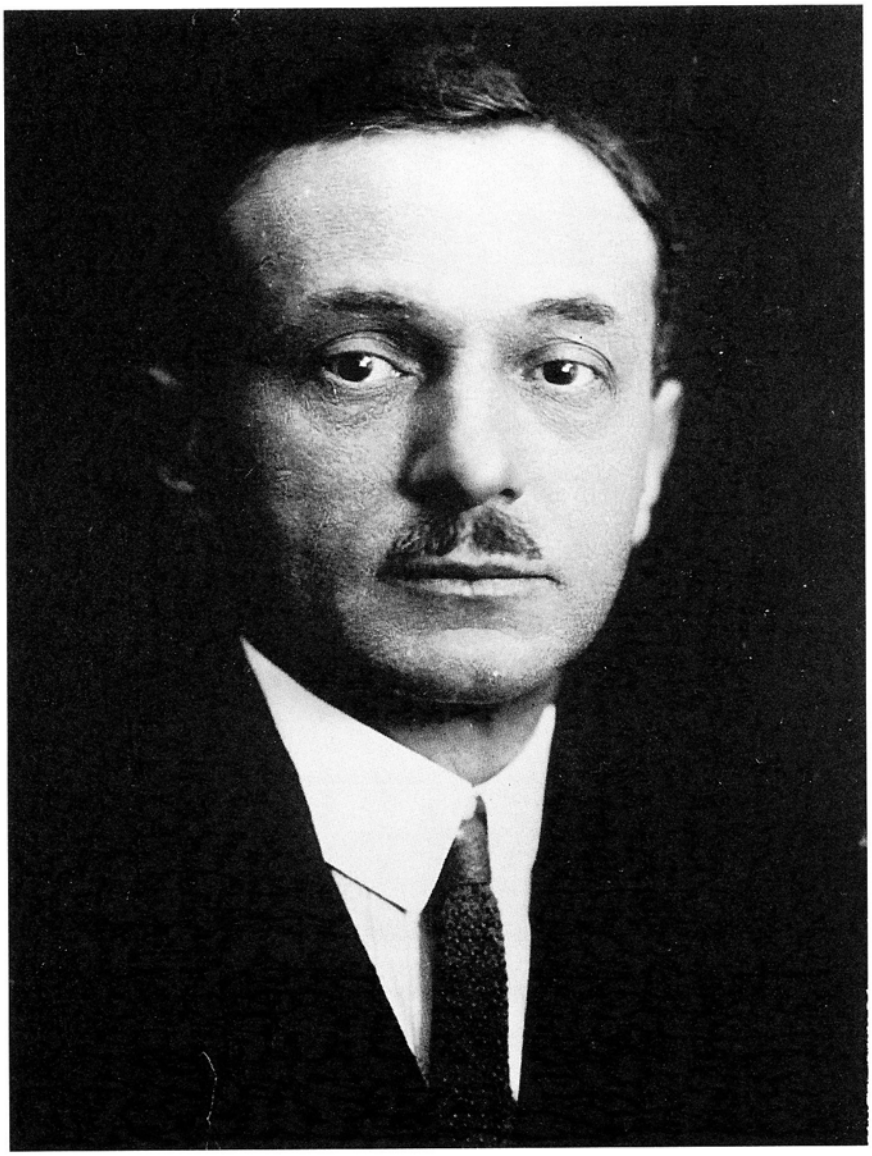

Fig. 3-4. Holzknecht around 1925.

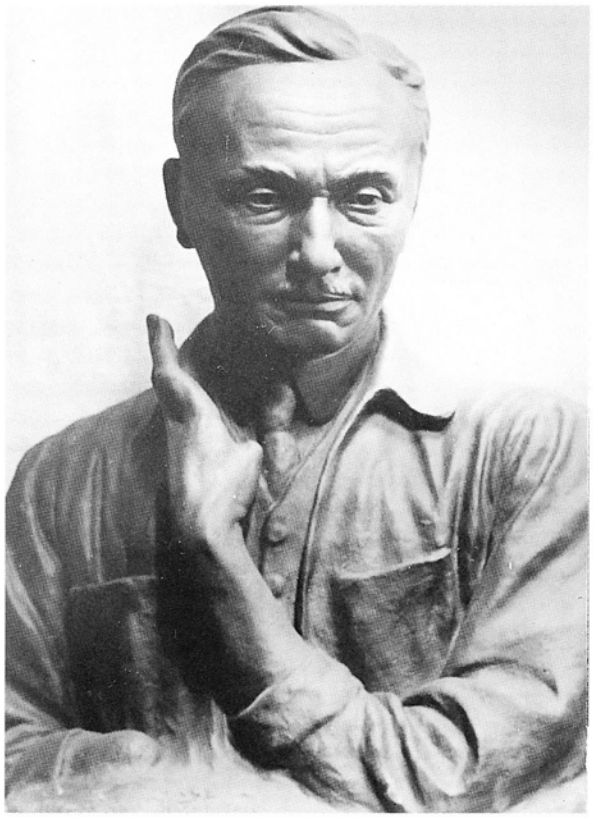

Fig. 3-5. Sculpture of Holzknecht showing stump of amputated right hand. Parts of the left were also missing. (Courtesy of Prof. L. Psenner, Vienna.)

and rhinoscleroma. Among the gynecological conditions listed are dysmenorrhea, leiomyoma, kraurosis, pruritus, hypertrichosis, and metrorrhagia, in addition to carcinoma. The medical conditions are also numerous, from vertebral arthritis, hyperchlorydria, exophthalmic goiter, parotitis, polycythemia, angina pectoris, and also lymphogranulomatosis. A variety of ophthalmic, laryngological, pediatric, surgical, and urological diagnoses also appear in these tables. Malignant tumors are not given any special connotation; they are, in fact, de-emphasized.

There can be no doubt that because of its prestigious source, the authoritative treatment of the subject, and the wide variety of conditions listed, this short work had great influence on the practice of radiotherapy seventy-five years ago. Unquestionably, however, this rather condensed, purely technological simplification contributed to wide and enthusiastic applications of roentgentherapy. In the following decades, the serious life-saving practice of radiotherapy of cancer had to be disassociated from these empirical excesses which brought radiotherapy into disrepute.

Holzknecht had a magnetic personal charm that made him popular as well as respected (Fig. 3-4). He was stubborn but friendly, and he relished controversy. Early in his life Holzknecht married a traditional *midinette,* but the union was not successful and ended in divorce. Later he wed Carola Dittmar and adopted her daughter, Margarethe. Holzknecht's eagerness to expand his experience and his preference for fluoroscopy were dearly paid for: he developed numerous dyskeratotic lesions of the skin which eventually developed into carcinomas. He irradiated some of his own skin lesions, but later submitted to repeated surgical interventions.[326] After dozens of lesser excisions, he suffered the loss of his right hand and also part of the left (Fig. 3-5). Eventually, he developed axillary metastases. A proud man, Holzknecht suffered his mutilations and their consequences stoically without ostentation. On 30 October 1931 he had his final rendezvous with fate: he died alone in what must have been desperate agony from mesenteric thrombosis. His passing was genuinely and widely lamented.[57,250,353,365,416,428,472]

Fig. 3-6. Memorial bust of Holzknecht. Now standing in the Arne-Karlsson Park, Vienna.

By everyone's reckoning, Holzknecht was the leading figure of clinical radiology in the first quarter of this century. He made the Viennese school the brightest beacon in the world. Distinguished pioneers of every country paid him respectful homage. "The new generations of radiologists," said Forssell, "could hardly imagine how far ahead of his time were Holzknecht's work and ideas."[239] "Medical radiology was raised to a high place by the work of many," said Béclère, "but no one contributed more to this progress than Guido Holzknecht by his research, his teaching, his apostolate." And the venerable French patriarch, himself an example of selfless dedication and sacrifice, went on to say of Guido Holzknecht: "No one brought more passionate ardor and inspiration in the pursuit of a good and high ideal, no one had a deeper zeal, was more indefatigable, had more courage, dedication or selflessness." A monument to his memory was erected in the Arne Karlsson Park of Vienna (Fig. 3-6).

Subject Notes

3.1 The chromoradiometer was eventually replaced by Kienböck's quantimeter, which utilized strips of paper impregnated in silver bromide and measured X-units.[351,352] Later, Gottwald Schwarz proposed a different system based on the precipitation of calomel from a solution of mercury bichloride in ammonium oxalate.[564]

3.2 In the same year that Kammerer's book was printed and from the same publishers, a fictional account of rejuvenation became a best-selling novel. *Black Oxen* told the story of an American widow who, having received treatments at the Steinach clinic in Vienna, was delighted at the return of youth or "to achieve its simulacrum."[14] The author, Gertrude Franklin Atherton, née Horn (1857–1948), a widowed Californian, later recounted that the novel was a result of her own experiences. When sixty-five years old, Mrs. Atherton was irradiated at an office on Park Avenue West in New York. Shortly afterwards, she felt "as though a cloud had lifted" from her mind. Ideas gushed forth, and she finished her novel in record time, expressing lyrically her own feeling of rejuvenation "of mind and body." Treatments for Mrs. Atherton were arranged by Dr. Harry Benjamin (1885–) and carried out by Dr. Thomas Scholz of New York. The details of technique had been obtained in Vienna from Holzknecht through an introduction by Steinach. In later years, Benjamin became an authority on trans-sexualism and wrote a book on the subject.[77,78] At ninety-two, with his sight failing, he remained in perfect control of his intellectual faculties. He remembered Holzknecht as a very kind gentleman.

3.3 Freud and Lenk went to Israel. Fleischner, Presser, Sgalitzer and Schwarz came to the United States. Mayer lived in exile in Argentina during the second World War, then returned to Vienna. Among the Americans who followed Holzknecht's work closely were James Thomas Case (1882–1960), Ross Golden (1889–1975), and Leo George Rigler (1896–1979). Many others went to Vienna for summer courses given by Holzknecht and his associates and organized by the University and the A.M.A.