Chapter 6

Friedrich Dessauer

(1881–1963)

"Fame has been blown away .... Names once frequently mentioned are no longer recognized .... The great champions of our congresses have become mere shadows .... What was once fascinating is now trivial .... Forgotten are the pursuits of yesterday and even today's art of research seems old." (1904)[135]

Friedrich Dessauer was born in Aschaffenburg, Germany, on 19 July 1881. He was the ninth child and fifth son of Elizabeth Vossen, of Aachen, and of Philipp Dessauer, scion of a family of industrialists who had founded the German cellulose and paper industries. Young Friedrich grew up near the oak-covered undulating hills of the Spessart, graduating from the Humanistisches Gymnasium of Aschaffenburg and attending the Institutes of Technology of Munich and Darmstadt. A man of remarkable versatility and devotion, a pragmatist with a philosophic bent, Dessauer was to become an important protagonist in the developing scene of radiotherapy (Fig. 6-1).

When he was only seventeen, Dessauer established in Aschaffenburg a shop for the manufacture of roentgenologic apparatus and devices and for experimentation with the newly discovered rays. In 1907 this enterprise expanded into the Vereinigte Electrotechnische Institute Frankfurt-Aschaffenburg (VEIFA Werke), an early commercial source of equipment located at 9 Wildungerstrasse in Frankfurt.[135] In 1909 Dessauer married Elizabeth Elhorst (1882–1976). For years, they made their home in Frankfurt am Main at 36 Streesemannallee and attended the Saint Bonifatius church.

Dessauer's interest in X-ray technology was part of a larger movement to refine apparatus in the field (Fig. 6-2). At the time of Röntgen's discovery, an abundant number of static generators were conveniently available to produce X rays. These generators had been made for electrotherapy and for various commercial purposes. After a period of controversy, induction coils were widely preferred. In order to use alternating current as an electric source, it was necessary to develop adequate interrupters. The electromagnetic interrupters were followed by mercury turbines and eventually by the electrolytic types. Dessauer contributed his own model of the latter. Tubes of good quality were needed, and among the numerous variations there were several Dessauer models.

In 1904 the initial observations of radiotherapy of superficial lesions were being extended to deep seated tumors. "Is it possible to deliver an effective deep subcutaneous dose of radiations without burning the skin and other interposed tissues?" asked Dessauer.[135] He answered his own question, emphasizing the importance of homogeneous irradiation.[140] As the logic of this point became recognized, others were credited with the originality of the view; among these was Georg Clemens Perthes (1869–1927),[B,323] but Dessauer's priority and deep understanding were easily demonstrated.[137,143] Gradually, Dessauer's principles of radiotherapeutic practice took the form of what was referred to as "Dessauer's laws of homogeneous irradiation."[145,146] These views were presented before the American Roentgen Ray Society in Washington, D.C., in September 1921, with Arthur Carlisle Christie (1879–1956) presiding.[151] Condensed (to four) and paraphrased, Dessauer's seven laws would read as follows:

(1) Different cells show different radiosensitivity to the same rays; differences in radiosensitivity are more marked for harder rays.

(2) Homogeneity of irradiation is required to take advantage of differences in radiosensitivity; when the non-homogeneity is greater than the difference in radiosensitivity, the advantage is lost.

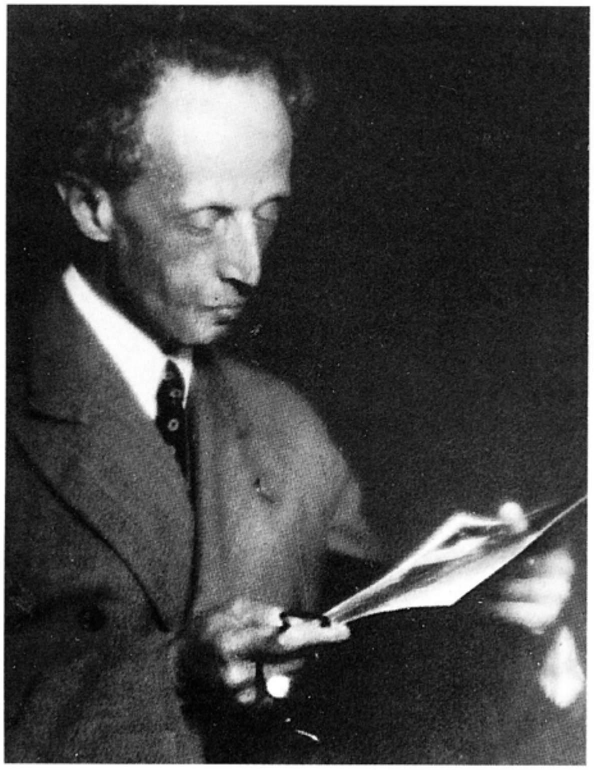

Fig. 6-1. Young Friedrich Dessauer.

He also participated in the development of stereoradiography.[138] Dessauer designed a water-cooled Röntgen tube as well as another with special features that proved to be the basis of a later development.[144] With a platinum sheet or window as part of its wall, this tube was the basis of the first contact-therapy unit twenty years later (" ... recently employed again, after twenty years of neglect, to further the development of radiotherapy," Dessauer would note).[147,160] He also pioneered in cineradiography by means of a device which permitted eight rapidly successive exposures per second.[159,537] "I will never forget that day, September 19, 1909," said Dessauer, "when Eykman and I documented for the first time the succeeding phases of the human heartbeat using the roentgen technique."[160] Hendrick Eykman (1862–1914) was a Netherlands radiologist from the Hague who pioneered X-ray cinematography. Dessauer also organized and taught courses in radiology (Fig. 6-4).

Dessauer's manufacturing interests did not interfere with his theoretical studies and research. In 1917 he received his Ph.D. from the University of Frankfurt am Main. His doctoral thesis was based on a novel method of generating high voltage direct current, an original concept in transformers that was to

(3) The aim should be to administer the same amount of radiations of the same quality throughout the diseased area.

(4) When qualitative homogeneity is fulfilled, the effects are strictly dependent upon the intensity of irradiation (dose and time).

Dessauer led growing numbers of general radiologists to recognize the importance of homogeneous irradiation of all tissues. He also emphasized the advantages of using hard, well-filtered radiations in order to preserve a margin of safety between the radiosensitivity of malignant and normal tissues.[136] The achievement of homogeneous irradiation was not a simple matter in view of the various geometrical forms and tissues and the insufficient penetration of rays. Dessauer designed appliances to permit the use of water-filled rubber bags, paraffin, flour, gelatin, etc. as boluses.[151]

Total body irradiation was being advocated for the treatment of leukemias and generalized radiosensitive neoplasms, but there was no equipment to carry this out satisfactorily. Dessauer proposed simultaneous irradiation from three different sources, a novel idea that has often been quoted (Fig. 6-3).[102,655] The radiodiagnostic demands for "instantaneous" radiography brought him to develop his *blitzapparatus* for one one-hundredth of a second exposures.[142]

Fig. 6-2. Advertisement of radiological equipment. The "System Dessauer," with typical turn-of-the-century *Jugendstil*. (Courtesy of Dr. Werner Schulze, Frankfurt.)

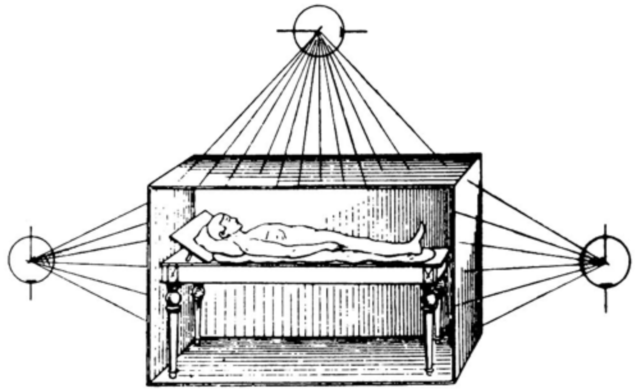

Fig. 6-3. Dessauer's scheme for total body irradiation.

Frankfurter Röntgenkurs

nach Art der Aschaffen-
burger Röntgen-Kurse

theoretisch u. praktisch

im

Städt. Krankenhaus Frankfurt-Sachsenhausen

gegeben von

Geh. San.-Rat Prof. Dr. **Rehn** u. Dr. **O. Frank,**
Professor Dr. **Schwenkenbecher** u. Dr. **W. Alwens,**
Professor Dr. **Herxheimer** und Dr. **Kollecker**
und
Ingenier **Friedrich Dessauer**-Aschaffenburg.

Beginn: 10. Oktober a. c.
Kurshonorar Mark 50.—.

Anmeldung mit der Aufschrift „Röntgenkurs"
an Professor Dr. **Herxheimer**
Städt. Krankenhaus, Frankfurt-Sachsenhausen.

Fig. 6-4. Announcement of early theoretical and practical course in radiology at the State Hospital of Frankfurt in October 1910. (Courtesy of Dr. Werner Schulze, Frankfurt.)

gain great importance in radiotherapy and was to become widely adopted.[137] "I solved this problem in 1915 and built up a transformer ... for 500,000 volts which voltage I could have raised indefinitely," he later remarked. The first unit of the cascade (or ladder) transformers had its secondary divided in two, its middle grounded and "related" to the primary of the second transformer (Fig. 6-5). The result was a rather elevated potential and a smaller transformer without insulating difficulties because the differential between primary and secondary was slight.[151] The patented principle was adopted by European as well as by American manufacturers of radiologic equipment. Dessauer hailed the introduction of the "hot cathode" tube by his American colleague and friend, William David Coolidge (1873–1976)[B] (Fig. 6-6).[149]

After World War I, Dessauer abandoned his industrial activities and became an Associate Professor of Physics of the University of Frankfurt. In 1920, he was promoted to full professor and accepted the directorship of the Oswald Foundation for the Application of Physics to Medicine (Institut fur Physikalische Grundlagen der Medizin). Thereafter, he devoted himself wholly to academic endeavors.[150] Practical radiotherapists utilized widely Dessauer's isodose charts ("equal intensity curves") that he and his associate, Vierheller, developed from water-phantom measurements (Fig. 6-7).[163]

In 1920 an historic meeting of the German Naturforscher Gesellschaft took place at Bad Nauheim, in the northern foothills of the Taunus, east of Frankfurt. At this event the leisurely spa hosted some of the most remarkable talent ever assembled, and became the scene of an interesting exchange. Most of what is known of the proceedings is due to Dessauer's presence and to his recounting of the event.[100,163] Some background on the participants is necessary to understand the heat of the scientific debate and its darker undercurrents.

Philipp Edward Anton Lenard (1862–1947)[B] was an ingenious professor of physics (Breslau) who did notable work with cathode rays. It brought him to the threshold of the discovery destined to be Röntgen's. Disappointment in himself and jealousy crippled

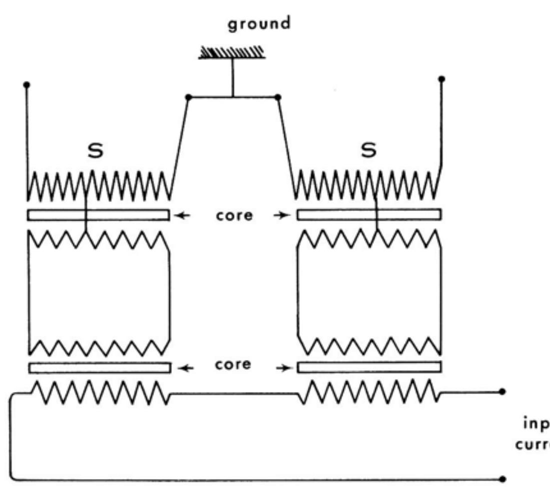

Fig. 6-5. Sketch of Dessauer's innovation to diminish the differential tension between primary and secondary induction coils.

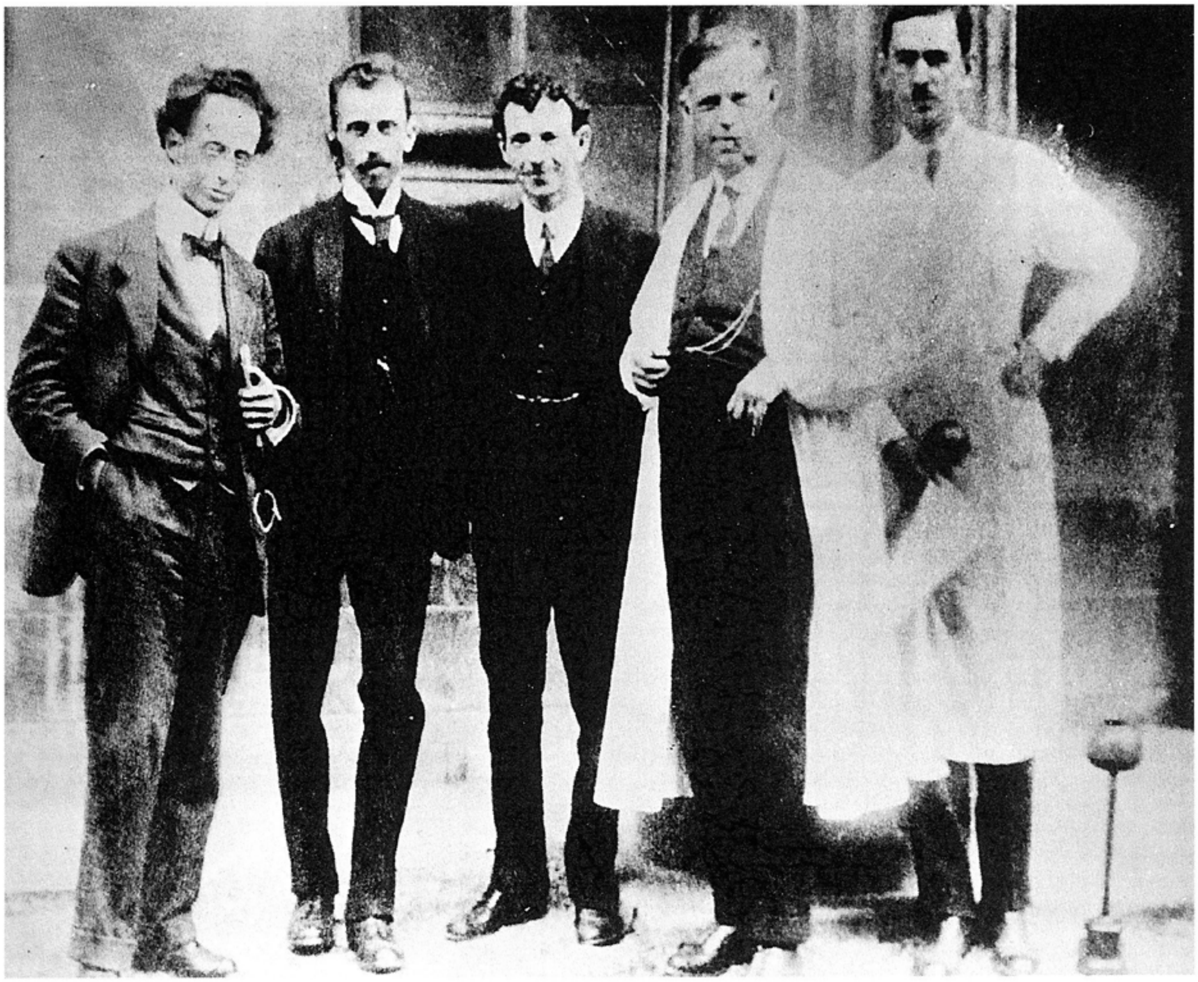

Fig. 6-6. Dessauer (far left), in the company of O. Seeman, William D. Coolidge, Walter Friedrich (1883–1968), and Otto Julius Alexander Glasser (1895–1964), with two of his early ionization chambers. Photographed at the Frauenklinik in Freiburg im Breisgau, August 1920. (Courtesy of the late Dale Trout, Sc.D.)

Lenard's character for life. Working with monochromatic light, he noted it was absorbed by strips of aluminum while electrons bounced off the metal. The number of electrons increased with the intensity of light but not their speed, whereas changes in color (frequency) of light did bring changes in the velocity of electrons.[415] These observations, not entirely explainable under the wave theory of light, proved to hold important implications in the development of nuclear physics and brought Lenard the Nobel Prize he had begrudged Röntgen and which he felt he deserved for his work on cathode ("Lenard") rays.[175]

Max Ernst Ludwig Planck (1858–1947) set out around the end of the century to solve a problem he had inherited: a discrepancy in the equilibrium of radiations and matter referred to as the "ultraviolet catastrophe," or the "mystery of the black-body radiation." Gustav Robert Kirchhoff (1824–1887), his predecessor at the University of Berlin, had devel-

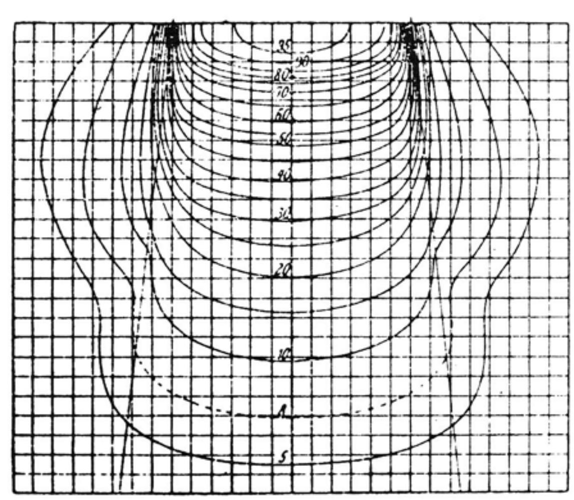

Fig. 6-7. Isodose curve showing depth doses in percentage of surface dose.

Fig. 6-8. Dessauer (far right), in the company of W.D. Coolidge and René Ledoux-Lebard (1879–1948), visiting the Adirondacks in 1928. (Courtesy of Gerhard Dessauer, Ph.D.)

oped a closed container with black inner walls (the black box) which, when heated to incandescence, allowed pure light to exit through a pinhole. Thus, it had become possible to measure minute variations of heat under the impact of specific wave lengths. Studies had noted discrepancies between the results obtained with high wave length by John William Strutt (1842–1909), third baron Raleigh, and those obtained with low wave length radiations by Wilhelm Carl Werner Otto Fritz Franz Wien (1864–1928). The discrepancy was solved as Planck postulated that light was not continuous, that it consisted of infinitely small discontinuous amounts that he called quanta, linking the frequency of the light with the size of the quantum (Planck's constant). This important contribution brought Planck the Nobel Prize.

Albert Einstein (1879–1955) furthered Planck's idea of light quanta in his 1905 paper on the photoelectric theory, for which he also eventually received the Nobel Prize.[172] He put forth the view that all radiations were emitted and absorbed as flying packages of energy (later called photons by Gilbert Newton Lewis (1885–1926)). Lenard's observations were now clearly understood as a transfer of energy between the light quantum and a conductivity electron. The 1920 meeting at Bad Nauheim, then, had been scheduled as a discussion of the relativistic theory of gravity (general theory of relativity), despite public attacks on Einstein and rumors of his departure from Germany. Lenard, then Professor at Heidelberg, lent respectability to the marked antisemitic undertones of the opposition to Einstein. As Lenard started his impassioned attack, Einstein sought to take notes and borrowed a pencil from Dessauer. In his riposte, Einstein was frequently interrupted, lost his temper, and was provoked into caustic replies.[160,162] Planck, presiding at the session, had difficulty keeping the heated debate within control. From the distance of time and place, this shabby display appears the result of primitive hostility camouflaged as righteousness. Dessauer's pencil was never restituted; he pondered to what better use it must have been put than if it had been returned!

A subject of controversy among radiobiologists was Dessauer's biophysical theory of the effects of radiations on living tissues.[323] His former assistant, Ernst Albert Pohle (1895–1965)[B] (subj. note 6.1), read an English version of Dessauer's views in Detroit before the Radiological Society of North America in December 1922, at the request of society president Al-

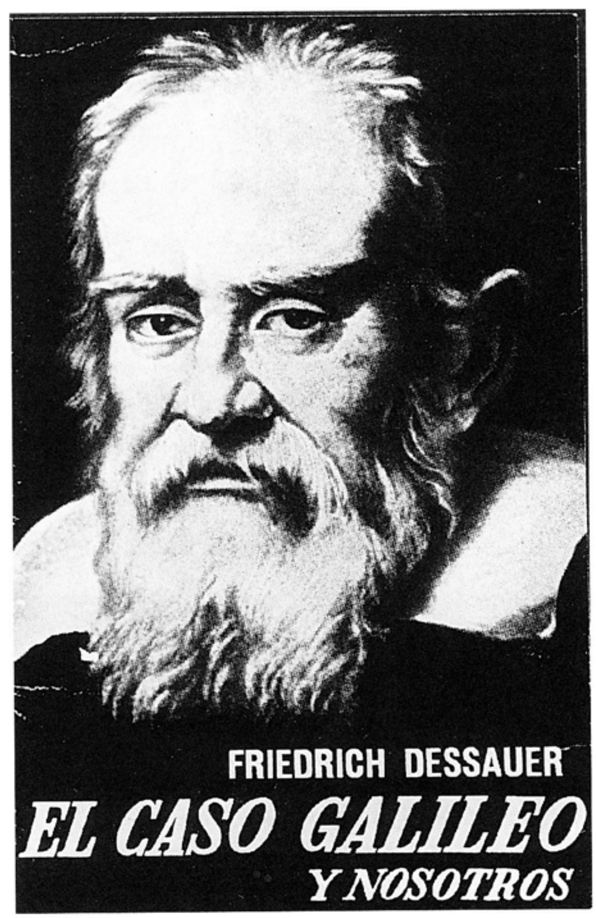

Fig. 6-9. Front cover of a Spanish edition of Dessauer's essay on Galileo.

Fig. 6-10. Friedrich Dessauer around 1950. (Courtesy of Gerhard Dessauer, Ph.D.)

bert Soiland.[152] According to Dessauer's hypothesis, the fundamental biological effects of radiations resulted from changes in the protein molecule resulting from the impact of electrons, the absorption of energy, and local elevation of temperature (*Punktwärmen*). His associates, Yoshida Nakashima and Boris Rajenwsky (1893–1974), studied the Brownian movements of coagulated proteins and made quantitative microscopic evaluations.[43,152,157] At the invitation of its president, Edwin Charles Ernst (1885–1969), an account of this research was read in Dessauer's stead at the fourteenth annual assembly of the Radiological Society of North America by his associate, Egon Lorenz (1892–1954)[B] at the Drake Hotel in Chicago in December 1928 (Fig. 6-8). Disputed by Hermann Holthusen, Dessauer's ideas led others to investigations of the hit-theory and the effects of discontinuous absorption (quanta).[155,158] Crowther studied the effects on protozoa, and Edward Uhler Condon (1902–1974) and H.M. Terrill on drosophila eggs.[127,102] Working with different unicellular organisms, Lacassagne and Fernand Holweck (1890–1941)[B] produced suppression of motility and reproduction, abortive mitoses, hereditary malformations, delayed growth or immediate death, depending on the site and importance of the cellular structure where the radiations were absorbed.[371]

Endowed with infinite curiosity, young Dessauer had liked to mix anonymously with the workers of his father's factory. As a student in technical school, he continued the practice, participating in conferences in mining districts, etc. The experience was to give him insight into the industrial worker's life. He found that they often had a mystical faith in progress as a source of spiritual sustenance, but they pondered not where this would take them. Metaphysics was a cause for laughs, even among the intellectually developed workers. Dessauer felt that they lacked a "spiritual fatherland." His keen sense of the sociological led him to write several books. In 1908 he wrote *Technological Culture*, and from 1926 to 1928, he developed his views on *The Philosophy of Technology*.[141,154] He also penned an *Apology of Technology* in 1931.[164] His philosophical excursions brought forth *Life, Nature and Religion* and *Man and the Cosmos*.

Dessauer's sociological interests led to his election to the Frankfurt municipal council. In 1924 he was elected to the Reichstag on the slate of the Catholic Centrum Party and became an active member of its committees (*Ausschuss*). For a decade, he lent his talents in the areas of his competence, in socioeconomics, labor relations, etc. Dessauer felt that there was a lack of cooperation between business and labor, producer and consumer, banker and entrepreneur. He conceived a new theory of economics to create the desired cooperation among the various elements. His

Fig. 6-11. Bronze head of Friedrich Dessauer by American sculptor Heinz Rosenberg.

1929 book, *Kooperative Wirtschaft*, has been reprinted posthumously.[156] In 1933 his political position led to his imprisonment and subsequently, to his departure from the country of his birth. He accepted an invitation from the newly organized University of Istanbul to develop a center for radiotherapy of cancer and moved to Turkey with his wife and two younger children.

Obliged to abandon the familiar abode and the cherished surroundings of his childhood, and to renounce the affectionate ties of old friendships and security, Dessauer, as exiles everywhere, had to seek new ways to make himself useful among strangers with different language, customs, religion, and ethics. With him he brought Erich Myron Uhlman, M.D. (1901–1964), Kurt S. Lion (1904–), and several other technical associates. With the enthusiastic support of Professors A. Tevfik Berkman and Muhterem Gökman, he was successful in organizing a modern cancer clinic in Istanbul. After three years, in 1937, he accepted the position of Professor and Chairman of the Department of Physics at the University of Fribourg in Switzerland. Here he was to live sixteen years in the ancient Catholic city on the Saane River, practically within hiking distance of the hills he had climbed in his youth. He maintained a lively interest in radiology, writing on such subjects as intermittent irradiation and rotation therapy.[166] On the fiftieth anniversary of the discovery, he wrote a biography of Röntgen with great feeling and insight.[161] With remarkable historical perspective and elegance, he summarized the developments of half a century of radiology of which he had been a witness as well as a protagonist.[160] Coinciding with these altruistic activities, he learned, at the close of World War II, of the destruction by war of his beloved city of Frankfurt. Even the gabled fourteenth-century burgher's mansions (*Romer*) had been reduced to rubble.

In 1953 after two decades spent in exile, Dessauer returned to Frankfurt to be reinstated as honorary director of his institution (which in the interim had become the Kaiser Wilhelm Institute of Biophysics) and to become Professor Emeritus. He had developed numerous carcinomas of the skin, face, and hands, had the usual conservative treatment approaches and the belated amputation of a hand. On 16 February 1963, he died from the secondary manifestations of radiation carcinogenesis (subj. note 6.2).[220,477,561,653]

As a prolific writer, Dessauer contributed numerous chapters to textbooks and published some four hundred papers and over sixty-five books and pamphlets.[359] In 1951, he authored an essay, "The Affair Galileo and Us," which has been translated into several languages (Fig. 6-9).[162] In it he reveals himself as a philosopher of science, analyzing the consequences of Galileo's trial and imprisonment in terms of its legacy in the animus of research. The natural sciences became emancipated, and the initiation of mathematical methods were recognized in research. In addition, Catholic countries lost their primacy in experimental science, and physics research left the circles of the Church.

A man of medium height and singular appearance, Dessauer had a large forehead crowned by a whirlwind of wavy brown hair. The searching stare of his small eyes was accented by his markedly aquiline nose. These imposing features de-emphasized his delicate lips and short chin. In his later years, the atrophic and diskeratotic changes of the skin of his face gave him an unnaturally pale appearance (Fig. 6-10). He was a graduate engineer, a Doctor of Philosophy, an Honorary Doctor of Theology and an Honorary Doctor of Medicine. He displayed his genius in a variety of ways and contributed a multiplicity of innovations that affected and speeded the development of radiology. Unlike other pioneers, he favored the pragmatic needs of radiotherapy. He was indefatigable in his efforts and honest in his credit to others. As a citizen he made his mark in the field of statesmanship, and as a thinker, in the realm of philosophy (Fig. 6-11).

Subject Notes

6.1 Several of Dessauer's associates emigrated from Europe and eventually settled in the United States. Ernst Albert Pohle, M.D., (1895–1965) became an assistant at the University of Michigan, then went on to become the first chairman of the department of radiology at the University of Wisconsin. He edited a book, *Clinical Roentgen Therapy*, published in 1938. Egon Karl Ferdinand Lorenz, Ph.D. (1892–1954) became an associate to William Duane in Boston and later, chief of the Radiation Branch of the National Cancer Institute. Erich Myron Uhlmann (1901–1964) was appointed radiotherapist at the Michael Reese Hospital of Chicago. Kurt S. Lion (1904–) followed him to Istanbul and Fribourg, and in 1941 became an associate in biophysics at the Massachusetts Institute of Technology. Yoshida Nakashima (1887–1971) returned to Japan and became the first professor of radiology at the Kyushu University. Boris Rajewsky (1893–) succeeded Dessauer as director of his institution, now the Max Planck Institute of Biophysics in Frankfurt, and became president of the International Congress of Radiology, held in Munich in 1959.

6.2 Dessauer was survived by his wife, who lived to be ninety-three. His eldest son, Gerhard (1910–), came to the United States, worked for General Electric and later for E.I. Du Pont de Nemours at the Savannah River Project in South Carolina. He is now retired in Charlottesville, Virginia. His youngest son, Christopher (1923–), served in the United States Air Force and retired as a lieutenant colonel. He now lives in Tucson, Arizona. Another son, Ottmar (1914–), became a priest and, like his sister Maria (1920–), remained in Germany. In 1969 Father Ottmar Dessauer spoke at the inauguration of a Catholic student center named for his father at the Darmstadt Institute of Technology. John Hans Dessauer, the son of Hans, an elder brother of Friedrich Dessauer, remained in the family business and came to the United States in 1929 for a business related visit. He met and married an American and remained. John Dessauer became one of the principal developers of the commercial Xerox process. Now retired in Pittsford, New York, Dr. John H. Dessauer and his wife, Margaret, sponsor a memorial lectureship in honor of their uncle, Dr. Friedrich Dessauer, at the University of Rochester, New York.