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RADIATION ONCOLOGY IN SPAIN: HISTORICAL NOTES FOR THE RADIOLOGY CENTENNIAL

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THE ORIGINS OF RADIOLOGICAL SCIENCES AND CANCER MEDICINE: THE EARLY SOCIOPOLITICAL AND PROFESSIONAL SCENARIO

Cancer started to forge as a visible disease in the first third of this century (1). This means that it began to be considered as a conceivable illness by society, and above all, a concern for doctors. They were the social agents to persuade public and states of cancer curability. The lay reality was colonized by medical discourse, and individuals were assigned to be the assistants of doctors in the ideal frame of an industrial healthy society (2). This new medical mentality about cancer was a result of the professional commitment with social change, the improvement of surgery, and the perception of radioactive remedies as innovative therapeutical hopes. The process was linked to medical profession dynamics directed at the autonomization of radiotherapy as a new medical discipline.

In western societies the concern about cancer and the rise of radiotherapy as a medical speciality was a process with common steps in its devolopment (3). In Spain, the therapeutic use of x-rays and radium was incorporated with a similar celerity to other countries. In the 30s the presence of radiological devices and instruments was significant in private practice medicine. According to the Spanish Medical Catalog (Anuario Médico de España), from 1927 to 1931 the number of radiologists tripled (from 223 to 571) (4). This extraordinary increase did not mean a specialized type of radiological practice. Several medical specialists (surgeons, gynecologists, dermatologists) used radiological apparatus, particularly radium, due to its simple manipulation in clinics as an auxiliary therapy or, above all, as diagnostic methods. The practice of Radiotherapy as it is defined today lasted to be generalized, and for decades radiological medicine combined the practice of diagnostic and therapeutic use of this technology. In 1936, with the beginning of the Spanish Civil War, there was no regulation of the radiology practice, although in 1935 (Primer Congreso Promédico Español) it was decided to name a Commission to study the legal implications and present a regulatory proposal to the health authorities.

It was not until the 1930s when the health authorities of the Spanish government had a project to fight against cancer. Until then, some benefic cancer institutions, including individuals of the medical and social elite together with members of the government, were helped occasionally with financial support. These initiatives defined their objectives with the criteria of the doctors involved and in general were directed more toward the adquisition of radioactive material and its instrumentation requirements, more than to solve public education on the incurable problem.

In 1909, the Comité Central Contra el Cáncer [Central Committee Against Cancer] and the Asociación Nacional Contra el Cáncer were founded. Also the main proposals of campaigning were discussed, but following foreign experiences, difficult to carry on. The unique achievements for this period were the national enquiries (1902 and 1909) to know clinical cancer incidence, etiology, medical services available, and doctors knowledge about the disease. But the reply obtained was insignificant: 20.000 enquiries and 298 replies (1902) (5). The decline of international initiatives due to the war had a negative effect on Spanish institutions. In fact, except for the creation of a modest laboratory for cancer research at the Instituto Rubio (Madrid, 1909) and the discussion about radiumtherapy in the cancer campaign, nothing more was done.

In 1914 the Sociedad Benéfica Radium-Barcelona arose, as a nonprofit institution, to provide radium to pri-

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Fig. 1. Cèsar Comas (1874–1956). The first Spanish Roentgenologist who initiated the empirical period of radiotherapy.

vate clinics and hospitals (6). Ten years later the Lliga Catalana Contra el Cranc was founded, essentially with the same goal (7). El Patronato Catalan Pro Hospital Asilo de Cancerosos (1925), a medical initiative, was concerned with the social problem of the so-called "incurables" (8). In 1927, both institutions joined and were affiliated with the Liga Española. The denomination and the union achievement could not avoid the descatalanizadora policy of the institutions that Primo de Rivera's dictatorship propitiated.

In 1924 the Liga Española Contra el Cáncer (LECC) was created (9). The Liga contributed to the founding of the Instituto Nacional del Cáncer (INC) and to supply hospitals with x-rays and radium. But the task was obstructed by the lack of a budget and the difficult alliance of benefactors and doctors' interests. La Junta de Damas (Ladies Committee of the LECC) collected donations and helped the clinical routines of the INC. The ordinances linked the LECC to the aristocracy and monarchy. Such a coalition became an obstacle during the republican period.

At the end of the 1920s new initiatives spread around the whole country, prompted by the Reglamento de la Sanidad Provincial (new provincial council medical care regulation). The resources and the goals did not follow the same pattern. In 1928 and 1929 the Liga anticancerosa emerged in Guipuzcoa, Galicia, Valencia, and Sevilla. The Instituto Radioquirúrgico de Guipuzcoa (1933, surgery and radiotherapy), the Dispensario anticanceroso de Valencia (1930, radiumtherapy), and the Oncology Department of the Hospital Civil de Alicante seemed to be the unique places were the provincial Liga achieved hospital services. Resources came from benefactors, Provincial, and Local Councils, and particularly in Valencia from specific metropolitan taxes.

During the 1930s theories more than achievements defined the cancer campaign. Several structural options were discussed in the frame of a reshuffling State. Options combined professional interests (to foster Oncology) and reorganization of the Spanish Health Services. Between 1931 and 1936, three Committees were designated to plan a national scheme. Up until then the cancer campaign had been comprised of a sequence of benefactors and medical elites initiatives far from a government general strategy. However, the change did not take place because of the lack of any resolution to fund the campaign, any definite structural option, and any real plan to establish a National Health Service to transform the charity system (Beneficencia) into something more suitable for the ideal of a modern state. In summary, the central government scheme (1934) followed the French pattern and inserted the campaign in the national health network: Instituto Nacional del Cáncer, Institutos and Centros Regionales or Provinciales and Dispensarios. There was no agreement about the task of the Dispensary defined as monovalente (confined to cancer) or polivalente (directed to some public health programs).

In Spain, during the first 40 years of this century, cancer patients began to receive radiological treatments in three different hospital institutions: (a) the university hospitals, attached to the medical faculties and funded by the Ministry of Education; (b) the specialized hospitals partly financed by charity; and (c) the National Institute of Cancer, a specialized national center, mainly funded by the State.

As you will see below, the introduction of radiological technology resulted in different institutional organization in the Hospitals we analyzed.

A proper evaluation of the cancer campaign can be done following one of its main goals: measuring the medicalization in terms of public demand of oncological services. In this sense, it cannot be said that demand of public or private radiotherapy services experienced a substantial expansion in Spain before the Civil War.



Fig. 2. Agustí Prió (1873–1929). Cousin and co-worker of C. Comas.

The Barcelona University Hospital was a pioneer in introducing radiotherapy practice. César Comas (1874–1956) (Fig. 1) and Agustín Prió (1873–1929) (Fig. 2) performed the first x-ray experiments in 1898 at the Photography Laboratory [Gabinete fotográfico] (10). In 1907, this Laboratory, which was the embryo of the Radiological Department, was attached to the Therapeutics Chair headed by Valentí Carulla Margenat (1864–1923). Three years later the faculty invested more funds in radiological equipment prompted by the celebration in Barcelona of the International Congress of Electrology and Radiology (11).

In 1912, new x-ray machines were installed (Unipuls and Ortoscop). One year later an implantation radium unit was set up within the Electrotherapy Section. This service allowed the treatment of eight patients and four sessions a day. In 1914, the Hospital Clínico contributed to the founding of Sociedad Benéfica Radio-Barcelona. Consequently, the hospital became one of the first Spanish hospitals that had radium available.

At the end of the period on which we focus our analysis (1935), the Gabinete Terapéutico comprised electrocoagulation and six roentgenotherapy apparatuses, 500 mg of radium, 37 beds, an outclinic, and laboratories (12).

In this hospital the number of radium implantations tripled in 1911 and was maintained at about 1000 per year up until 1919. The following year the radium insertions were cut by half. The number of patients grew from 95 in 1916 to 554 in 1920, which meant a decrease in the number of implantations per patient. The roentgentherapy treatments quadrupled in 1914 (from 406 to 1637) and remained at around 2500 up until 1923. Radiodiagnoses gradually increased.

In 1922 the Department separated into two radiological sections: therapy and diagnosis. Vicens Carulla Riera (1895–1971) took over the responsibility of radiotherapy, leaving diagnosis to Comas. After these arrangements (in 1923 and 1924), the number of patients treated by roentgentherapy decreased and the number of radium treatments barely decreased. From 1923 to 1924 the number of applications of roentgentherapy went from 2466 to 1224 and radium from 2248 to 1403. Before the Civil War 353 new cancer patients visited the section, which was adscribed to the Chair of Therapeutics (Cátedra de Terapeútica). The Autonoma University of Barcelona (founded in June 1933) promoted an independent professorship for cancer medicine.

In 1907, The Radiology Clinic of the Medical School of Granada (Gabinete Radiológico) joined together the practice of Spain, Electrology, and Radiology (13). During the first two decades several factors restrained the development of radiotherapy: scant concern paid by doctors to radiology, technical obstacles in handling devices, low economic support, instability of staff, and low professional status given to radiologists by their colleagues. From 1907 to 1917 radiodiagnosis was the sole radiological service. In 1918 the faculty acquired new radiological apparatus. However, the radiologist José Sequera, in charge of the Radiology Clinic, estimated that there was an inadequate supply of equipment to practice radiotherapy. Under these conditions, the dean of the faculty commissioned an enquiry to inspect the radiological unit. Finally, Sequera resigned and the ENT professor, Federico Oloriz, took his place. This year, Oloriz appealed for the official recognition of radiologists, additional radiological equipment, and a large budget. After 1921, the stability of staff and benefactor López de la Cámara's economic support consolidated radiotherapy. The new radiological unit (Radiosilex, Lilienfeld tube), donated by López de la Cámara, was used for diagnoses and therapy and was kept functioning during the 1930s. In 1929, the Hospital purchased a deep x-ray therapy unit (Stabilivolts, Siemens) for more efficient gynaecological treatments.

The diagnostic use of radiation carred more weight than therapy regarding the consolidation of the Gabinete Radiológico. In fact, between 1930 and 1931, the number of x-ray plates increased 15 times compared to 10 years earlier (1921–1923) but radiotherapy treatments dropped by half (from 646 treatments to 81). The radiodiagnoses expansion could be explained by the agreement reached with the Provincial Council (Diputación Provincial) that increased the recruitment of patients. However, the decline of Radiotherapy treatments can hardly be justified. Patients suffering from tuberculosis (TBC) and epithelioma were the most significant group treated during the early 1920s and 1930s.

There was a constant demand for more funds. In spite of the efforts to reduce expenses, the economical shortage would be severe because in 1923 the Ministry of Education was informed about the possibility of closing the Gabinete. The Ministry rejected the request and it did not seem likely that their political position would change in the following years.

Towards the end of the 1920s only a few radiological units in University Hospitals had radium available. The national enquiry of 1927 revealed that Barcelona University Hospital had, in relative terms, the best equipment. Granada, Valencia, and Zaragoza possessed adequate supplies for diagnoses and therapy, while Salamanca and Valladolid only had radiodiagnoses equipment. In Cádiz, Madrid, and Sevilla, the radiological services were being reformed. However, none of the university hospitals had radium available (4). The lack of central government funding, the Provincial Council's nonfulfillment of the 1902 Act of Organización de las Enseñanzas Clínicas, and the sparse development of charity in Spain meant that radium could not be supplied in these hospitals. As the gynecologist Otero said, only "a few rich or enthusiastic doctors and tradesmen" could acquire the precious radium (15).

Up until 1935 the Radiology Department of Granada could not afford the purchase of 180 mg of radium, thanks to the economical support of the Gynaecology Department by the Ministry of Education (72.500 pesetas). The impact

of the radium purchase was visible in the clinical activity. The number of radium treatments (47) exceeded the hysterectomy (40). After 1921 the Radiological Department was linked to the Gynaecology Department but remained beneath it. In this way, the organization of services did not cause any dispute between the specialists. Radium was used by gynecologysts and roentgentherapy by radiologists (16).

The Hospital of Santa Cruz y San Pablo (HSCSP) was built in 1902 and funded by Benefactors legacies, the city Council and the Catholic church. In 1930, 27 wards were functioning. The 1100 inpatients were attended by 500 members of staff (17).

The same technology (radiological devices) engendered different structural patterns in the hospitals we have analyzed. Institutions practicing radiotherapy endorsed its monopoly on cancer and the division between radiodiagnoses and radiotherapy.

Both were practice in the Servicio Central de Radiología (Central Department of Radiology, CDR) of the Hospital Santa Cruz y San Pablo (Barcelona). The administrative regulation of 1930 favored the rise of Oncology and segregated by diseases the uses of the same remedy. The patients affected by benign diseases received roentgentherapy in the Radiology Central Service and cancer patients were treated in the Cancer Pavilion also named Oncology Department [Pabellón de Cáncer]. Roentgentherapy was managed in the Roentgen Section and radium in the Radium Clinic and mainly used in cancer. Oncology remained at the same level as the other medical specialities but the Radiology Central Service was included as an auxiliary service similar to the Pharmacy and Laboratories.

Here, the x-ray treatments only accounted for 20% of the clinical activity. Such arrangements favored the Oncology Department and so that same year its medical staff tripled from three to nine. Electrology was not linked to these departments and was practiced in the Neuropathology Clinic [Dispensario de Neuropatología]. The upsurge of radiotherapy under the protection of surgeons, a consolidated professional group, bestowed its consolidation and the access of the new therapies to the hospital scheme. The process in which the pathologist and gynecologist Lluis Guilera (1896–1969) was a key person culminated with the creation of the OD, pioneer in the Spanish hospital scene.

The Cancer Pavilion was constructed during 1928 and 1930. The project foresaw to recruit 100 patients coming from all over the country. In this way this building had the same status as other specialized ones in which the number of beds ranged from 60 in the TBC and Gynaecology Pavilions to 24 in the Ophthalmology Department.

In the Santa Cruz Hospital, radiotherapy stemmed from the gynecology service that used the 200 mg of radium supplied by the Sociedad Radio-Barcelona (1913–1921).

In 1921, the new head of the Gynaecology Department, Adolfo Pujol Brull, donated his own radium and purchased a new deep x-ray unit to be used, exclusively in the clinic. Guilera, just arrived from the German Gynaecology Clinics, took charge of the Gynaecological Cancer Physics Therapy Section. Two years later, this section remained joined to the Gynaecology Department, although it provided services to the rest of the hospital.

In 1925, Guilera and Pujol promoted a campaign to purchase more radium. The medical staff supported the campaign and, finally, 685 mg of radium were purchased. The renamed Radiological Therapy dispensary included six beds, histology and serology laboratories, a deep x-ray apparatus, and the administrative section for renting and managing the radium. The future of the Cancer Pavilion was established, in its embryonic stage, and was foreseen as "a true anticancer Physics Therapy school, eminently catalanian" (1925) (18).

On May 4, 1930, the Cancer Pavilion was inaugurated, thanks to being funded in part by the Patronato de Cataluña pro Hospital-Asilo de Cancerosos, the Provincial Council, and benefactors.

Patients suffering from different cancers came from other departments or clinics or were recruited directly to the dispensary. This hospital space was designed to recruit patients following the Cancer Pavilion medical staff criteria and to release the new therapists from their dependency on other doctors. The criteria to select the patients varied from the scientific, clinical cases of medical concern, to their social conditions.

In the Roentgentherapy Section, deep x-ray therapy was prescribed in terminally ill papients with very large neoplasia and also in benign illnesses. The radium was reserved for curable conditions. The therapeutic schedule was first of all surgery, secondly, and sometimes as a first option, radium, and, finally, roentgenotherapy.

The oncological service mainly focused on radiotherapy and progressively embodied other treatments such as electrocoagulation and cauterization. Also, some new drugs were used to complement radiotherapy or were tested on hopeless patients. In this way the institution hospice function was justified by the experimentation on terminally ill patients of unproved treatments.

In the Radiotherapy Section the number of patients attended increased by 100 between 1929 and 1930, and then the number remained at about 300 up until 1933, after which it progressively decreased. Approximately 150 patients were treated with radium falling to 113 in 1934. Radium results in cervix cancer patients treated in 1930 showed a curability rate comparable to that reported in the international literature. Guilera analyzed his results following the recommendations of the Subcommission of the Cancer Committee of the United Nations, which was an original contribution to scientific results publications. The curability rate was of 25.8% (19).

The proportion of Cancer Pavillion inpatients to the total number of admissions per month fell from from 8% (1930) to 5% (1936).

The National Cancer Institute [Instituto Nacional del Cáncer, INC] took 20 years to consolidate due to diffi-

culties in funding and the lack of a definite institutional structure. State, Diputación [Council], charity, and paying patients supported the project. Finally, the center was built in the Moncloa (Madrid). In 1924, thanks to the League Against Cancer funding, the number of beds increased from 28 to 142. Laboratories were equipped and researching tasks started (20).

The practice of surgery, radium, and roentgentherapy had a similar number of procedures, with an estimation of around 1000 cases treated with each modality. Medical activities in the period 1929–1930 were performed in the three pavillions under the direction of José Goyanes Capdevilla (1876–1964). Surgery and radiotherapy were performed by the surgical team of Goyanes, while roentgentherapy and radiodiagnosis were done in the section of roentgenology directed by Ratera and Carlos Gil. The divisions of the therapeutic modalities at the INC confirms the control by surgeons of the new remedy in this particular institution.

The republican government nationalized the institution but the unstable political situation, the dismissal of staff (party purges), and the scarcity of resources avoided to continue with the same institutional structure or to devise another. In fact, the number of beds available decreased to 60 in this period. It seems during this period that research was pushed. Some facts confirm this idea: INC was part of the Centro Nacional de Investigaciones Científicas (National Research Centre), the researcher Rio Hortega (1882–1945) was named director, and the new center scheme divided into two departments: Basic Research and Clinical Research.

During the more productive period of INC (1929 and 1930), 2330 patients were admitted. This was a low rate to a referring national center that had to afford a mortality rate of 16,000–22,000 deaths/year (72.4 annual deaths/100,000 inhabitants). The amount of inpatients did not increase during the short period in which the institution published its results (133/month in 1929 and 116/month in 1930). The average of patients treated per month with radiotherapy fell from 73 in 1929 to 49 in 1930.

Radiotherapy was initially taught into the subject of therapeutics [Terapéutica] (21). In 1928, reform of universities allowed teaching of radiotherapy, electrology, and new medical specialities as suplementary or optional subjects. In 1932, the revision of curricula foresaw transforming electrology into a doctorate subject but, except for the Madrid and Granada faculties, it did not come into force. Electrology combined the teaching of hidrology, electrology, and radiology in the Andalusian Faculty.

In 1935 (Primer Congreso Promédico Español), there was a proposal of teaching new medical specialities in the last year of the curricula and medical physics in the preclinic period, following the teaching scheme of the Universidad Autónoma de Barcelona. But the new government's medical education program (1936, Frente Popular) only approved the teaching of electrology as an optional subject in the clinical period.

The early creation of the doctoral Chair of Electro-Radiología in Madrid (1920) was linked to the personal endorsement of Professor Celedonio Calatayud Costa (1880–1931) (22). But his individual achievement did not prompt the rigid Spanish university structure. Calatayud's enterprise was bonded to establish boundaries between radiology and electrology. He outlined radiology as a subspeciality of medical electrology. This profited radiology, because it provided it with a corpus of doctrine and specific technology to move away from medical specialities and extramedical professions. The Faculty of Madrid was a well-defined scenario of the confrontation between gynecologists and electroradiologists to obtain the monopoly of radioactive remedies. The similar hierarchy (professorship) of Calatayud and Sebastián Recaséns (Chair of Gynaecology), the most influential gynecologist at that moment, allowed the antagonism.

At the Faculty of Barcelona, radiology was taught early on by the Therapeutics Chair. In 1908, radiotherapy was instructed as part of the Fisicoterapia, later segregated from electrology (1908–1915) and radiodiagnosis (1923). At the Medical School of the Hospital de la Santa Cruz y San Pablo Radiotherapy became a component of the oncology program.

The institutionalization of radiotherapy instruction consolidated the offer of this new medical community. It was a means of endorsing the training of specialists and spreading its knowledge about to general practitioners whose collaboration was essential to recruit patients.

In the first third of this century three professional societies arose enlisting 250 members (total number). The Spanish Medical Electrology and Radiology Society (Sociedad Española de Radiología y Electrología Médicas; 1914–1922) was founded by Calatayud and supported by 76 doctors who practiced electroradiology, radiotherapy (x-rays and radium) or physiotherapy (23). The new devices were a pretext to attach professional interests when the tasks were not delimited yet. The Society self-defined as a medical (no technical) association, stressing its clinical and particularly therapeutical concern.

The control of the Society was under doctors, although nonmedical members were accepted (engineers and manufacturers). They could only be adjunct members [miembros adjuntos], penalized with a costly admission fee, and with no right to vote.

The second attempt to group was the Spanish Society of Medical Radiology and Electrology (Sociedad Española de Radiología y Electrología Médica, SEREM; 1930s) (24). It enlisted 84 members, and radiology, instead of electrology, had a prominent position. The expansion of radiotherapy under the cancer campaign and most of all of radiodiagnosis pushed by TBC campaign was determining. Another contemporary attempt was the Society of Diagnosis and Physiotherapy (Sociedad de Diagnóstico y Terapéutica Física), focusing on radiotherapy (25), but the weakness of this medical group and the restrictions raised by SEREM hindered its progress.

The first endeavor of a Catalan association of radiologists (1927) was frustrated by the Primo de Rivera antinationalistic politics. In 1930, the Sociedad Catalana de Radiología y Electrología was established, joining 54 members (26). Its creation (sustained by scientific aims) was justified by the nonentity of any society covering the whole country, the prominent number of Catalan radiologists, and the nationalism reappearance. As in the Spanish society, the radiodiagnosis facet was highlighted. The creation of prizes and the edition of journals aimed at external promotion. Journals were the mouthpiece of professional interests. La Revista Española de Electrología y Radiología Médicas (1912–1919), first published in Spain, was founded by Calatayud following the goals of SEREM, and the Archivos de Radiología y Electrología Médica (1934–1936) published by SEREM. The short life of these journals indicates the lack of a strong professional support.

Radiological societies became a mechanism to dignify the new medical specialities fighting against doctors' individualism and defending some corporate measures (formal training, diploma, struggle against intrusivism, retirement, pensions for injured by radiations, legal radiological protection, regulation of charges, hospital equipment, staff supply, etc.). Furthermore, they were the scenario to gain the therapeutic monopoly. Social acknowledgement was guaranteed by institutions and medical elite and defending patriotic ideals.

It is noteworthy that any society was interested in radiumtherapy. Plausibly that was due to societie's policies of avoiding confrontation with other medical groups that could hinder the association. Another remarkable fact is the null participation of these medical corporations such as in the cancer campaign.

Last, but not least, it should be emphasized what Spain seems to have in common with other countries. At that time any institution was developed to control such dangerous technologies or to protect the patient's rights. Acquiescence of doctors to an undiscerning practice of radiotherapy was granted by the professional interests brought into play and social routines. On the other hand, the absence of public representation in the areas where clinical uses were discussed (academies, professional societies, congresses, journals) hindered any restriction to the therapeutical program. Charity and the state funded medical initiatives, disregarding their role as public mediators.

PRACTICE OF RADIATION MEDICINE AND CLINICAL ONCOLOGY UNTIL THE SPANISH CIVIL WAR (1895–1936)

Medical sciences in the 19th century

Medical sciences, in the last 30 years of the 19th century, endured a period in which the laboratory had attempted to substitute theoretical labor; at all levels what had been speculative had given passage to what was empirical, especially in biological topics. This assumed, along with physics and chemistry, that scientific projects received maximum influx. Medicine was characterized by microscopic observation, providing knowledge of three basic entities: the cell, the microbe, and the atom.

Discoveries were made by various people such as C. Bernard (1813–1878), T. Billrroth (1829–1894), P. Reel (1824–1880), J. M. Charcot (1825–1893), C. J. Davaine (1812–1882), P. Flourens (1794–1867), R. Koch (1843–1910), L. Pasteur (1822–1895), and others. As part of their work, procedures were applied with the intention of finding out about the unknown and improving the known. It was the birth of specialities that produced disciplines that were converted into sciences, an abundant bibliography, meticulous proceedings, and subtle techniques. Branches of Hippocratic science were developed, thanks to the physics and chemistry. Microbes were important in the study of the structure of the human being, the approximation of germs as a cause of illness, the knowledge of the action of the toxins, and the configuration of the immunity concept (27).

In these years microbiology and antisepsis were consolidated. Surgery had become faster, safer, and cleaner through the contributions of anesthesia, antisepsis, and the improvements in surgical utensils. The work of authors such as X. Bichat (1771–1802), L. Aunbrugger (1722–1809), T. Addison (1793–1860), R. Bright (1789–1858), J. N. Corvisart (1755–1821), T. H. Laënnec (1781–1826), K. von Rokytansky (1804–1878), J. Skoda (1805–1881), and W. Stokes (1804–1878), in the area of clinical and anatomical medicine, placed the disease in the anatomical injury, resulting in symptoms and a clinical table advocated to the doctrine of the cellular pathology of Virchow. It was sought, through clinical methods, to locate the injury.

The signs of percussion and auscultation were classified with the data from the laboratory and the knowledge of the electrical phenomena studied by W. H. Erb (1840–1900), F. Ghilarducci (1857–1924) and G. B. A. Duchenne of Boulogne (1806–1875). Sensibility disorders, motility, and language showed signs and symptoms that helped in the localization of the injury. Electricity was used in diagnosis and treatment from which electrology was born.

The introduction of roentgenology in Spain

On November 8, 1895, W. C. Roentgen (1845–1923) discovered x-rays. Radiodiagnosis was initiated fulfilling the desire of the clinical anatomists to have direct vision of the injury. Radiology revealed changes that produced the disease once as variances in position, form, contours, or structure of an organ that make changes in the density of the different parts of the body. Radiological images permitted the vision in a plan that is a volume, through which absorption variances the structure alterations condition the x-rays.

The introduction of roentgenology in Spain was in Catalonia, which was living a social-scientific recovery period in a society, open, receptive, and a vehicle of innovations (28). It is interesting to note the relationship between photographs and x-rays and the impression of the radiographic plate as a characteristic of x-rays. This analogy explains the public demonstrations that were made with the photograph.

On February 10, 1896, in the "Real Academia de las Ciencias y Artes" of Barcelona, a seminar on x-rays took place, presented by Lozano y Ponce de Leon, showing three x-rays, taken by E. Fontsere (Fig. 3) and A. Bofill (29).

On February 24, another session took place in the amphitheater of the Faculty of Medicine in Barcelona. In this one, nine x-rays taken between February 10 and 21 (30) were presented, giving way to the accomplishment of an x-ray plate (Fig. 4). The author, C. Comas (1874–1956), described time exposure and distance between the object and the x-ray tube.

Comas was a medical student in charge of photography at the Faculty of Medicine since 1892, thus explaining the ability in obtaining better images than Fontsere and other colleagues. The latter, recognizing their historical priority, did not continue with the management of the x-rays, as opposed to Comas, who because licensed in Medicine in June 1896, continued cooperatively in that field with A. Prió (1873–1929).

A little more than a year after the first public demonstration on x-rays, on May 17, 1897, Dr. L. Pombo y Sanchez presented his doctoral thesis in the Faculty of Medicine of Madrid about "Roentgen Rays: Applications to Medicine and Surgery" (31). Skin injuries after excessive exposure were mentioned. Four years later, in Valladolid, Dr. A. Miquel y Ramon presented his doctoral thesis on "X-Rays: Applications to Medical Sciences" (32).

The development of roentgenology in Spain (1897–1903)

In 1897, in Madrid, the first public radiographical cabinet was opened by A. Espina y Capó (33), and thereafter by F. Pujol (34). In June 1898, Comas and Prió set up a radiological cabinet in Barcelona. During the following year they presented five communications on diagnosis: bone injury of a foot (35), renal and vesical calculus (36, 37), and location of foreign bodies (38, 39).

In 1899, a publication on roentgenology was presented at a conference in the "Real Academia de Medicina y Cirugía de Barcelona" (RAMCB) on the "Current state of Radiology. Its value in Medical Sciences" (40). Knowledge of the technological evolution of x-rays was demonstrated from the units of production of electricity to radiographical tubes. Results obtained in the treatment of cutaneous illnesses such as lupus, chronic eczema, acne, and so on, were described.

Thus, the first therapeutic application using the x-rays in Spain was made in 1899 in a cutaneous lupus (41), which was published in 1900. In this case, a total of 56 sessions were made that emphasized the meticulousness in the procedure as well as in the clinical application. In the same year there were also communications on the diagnosis of the aneurism of the thoracic aorta (42, 43). In the area of development, an exhibition about clinical and anatomical exposition of Roentgenographies took place in the "Ateneo Barcelonés" in Barcelona (44). In November 1900 (45), "Diagnosis of renal calculus by Roentgen rays" was published, defending the safety and profit of this technique. Several x-rays were made to compare and better interpret the results. They found the technique to be limited in three areas: excessive weight of the patient, small size of the calculus, and transparent nature of the stone. The two last publications in 1900 dealt with Roentgen rays (46) and vesical calculus (47).

The inaugural session of the year 1900–1901, of the "Instituto Médico-Farmacéutico de Barcelona" (IMFB), was carried out by Prió(48). He emphasized the synthesis capacity of the stated bibliography, emphasizing the projects of German, English, French, Italian, and American groups. French terminology gave the name radioscopy and radiography to the diagnostical techniques of x-rays and radiotherapy in its therapeutic application. The radiodiagnosis showed two phases: reproduction of the image, and interpretation. Once the existence of a phenomenon was established, it was necessary to interpret its significance. Clinical experience as well as the comparative study would permit specific conclusions. Because of this, specialized training was preferred that permited the valuation of observed phenomena. This demand on physicians with specialization who practiced radiodiagnosis represents a historical priority. It emphasized the advances in the location of foreign bodies and in processes of the neuroskeleton, making a special reference to studies about the diagnosis of tuberculosis.

The clinical training in radiotherapy was evident as much in the description that was made in the indications as well as the historical approximation on the observed secondary effects. This fact was attributed to an individual susceptibility and/or to prior applications. It described radiodermitis phases and cutaneous susceptibility of women, children, and fair-haired people. It remarked as factors, to avoid complications, the "hardness" of the x-ray tube, the proximity of this to skin, and the duration of exposure.

Division of the dosage was preferred, raising the number of sessions and reducing its duration, continuing the indications of Freund, which advised evaluating the intrinsic susceptibility of the skin of a patient with a test session of 5 min, the x-ray tube at a distance of 10 cm from the area to be treated, and protecting the healthy areas with a screen or a lead mask.

The First International Congress of Electrology and Radiology described the most meaningful contributions, especially the presentation of two cases of cutaneous cancer cured through x-rays by T. Stenbech and Sjogren. Be-



Fig. 3. Eduard Fontseré (1870–1970). Author of the first Spanish radiograph (first days of February 1896, before the 10th).

tween this last communication in 1901 and the end of 1903, Comas and Prió presented 11 communications, two of them at Congresses (49, 50). A predominance of diagnostic themes (51–56), as opposed to therapeutic (57–59), existed in these communications.

The contribution of dermatologists in the development of Spanish roentgenology, the introduction of radium, and the III International Congress of Medical Electrology and Radiology in Berlin (1903–1908)

In April 1903, P. Vilanova (1868–1953) presented a work about the role of radiotherapy and phototherapy in dermatology (60), the first communication by a specialist on the subject of x-rays. In it, criticism of the results is shown as a consequence of the harmful effects that can be produced. Knowledge of the technique is shown, indicating the necessity to control quality and quantity of the x-rays through measurement methods (Villard osmoregulator, Benoist radiochrometer, or Holznecht chromoradiometer). He defends the success of x-rays in the treatment of cancer and dermatosis in general, even though he does not consider them the selected treatment. In the second communication by a dermatologist on radiotherapy, dated 1905 (61), P. Umbert showed aseptically the case of a nasal wing epithelioma treated with a single session, which he called intensive. He attributed perfect cosmesis to this method. Thus, we find a second discrepancy between dermatologists and roentgenologists with respect to the use of radiotherapy in cutaneous processes: the fractionation.

In the same year, Vilanova published the results of a scientific stay in radiotherapy centres in Paris (62), emphasizing those of Dr. A. Sabouraud (1864–1938) and Dr. Béclère. In this communication, as opposed to the previous one, he cited himself as a devoted supporter of radiotherapy listing its possible symptoms. This change of attitude on the use of radiotherapy by Vilanova is not conceptual. In the defense of radiotherapy, through the exhaustive enumeration of the symptoms, he implicitly underlined the message of the helpfulness that this therapy based in correct symptoms. Symptoms, in a logical way, that only the dermatologist can and should diagnose. Umbert is clear in the claim that all therapy in cutaneous diseases must depend on the dermatologist (63), being declared critical with radiotherapy. In a vast and interesting article, in its clear definition of attitudes as well as its content, Umbert considers that in spite of radiotherapy, incurable cutaneous diseases continue being so and the successes represent isolated cases, concealing failures and complications. Umbert lists the possible indications of radiotherapy, considering that in the cutaneous cancer radiotherapy should only be used in cases of relapse, advanced injuries, or inoperables ones. The radiotherapy used is at the election of the dermatologist.

This partial radiotherapy rejection by the dermatologist is not extended to the utilization of radium. On the contrary, its introduction is due to such authors as Umbert, Vilanova, or Peyrí, though relatively late, in dermatological treatment. Though in some instances its employment was of simple application, progressively it required small surgical intervention, which explains the technical appropriation that the dermatologist made to the detriment of the roentgenologist. Regarding the introduction and development of treatment by radium by the specialists in surgery, the contribution of R. Botey is also emphasized, who, in 1908, had already published a work about the applications of radium in otorhinolaryngology (64).

In this period of disagreement of dermatologists regarding radiotherapy and the introduction of the radium therapy, Comas and Prió continued with the exclusive cultivation of radiodiagnosis and external radiotherapy. In 1904, they presented six communications to the IMFB (65–70), and three communications (71–73) to the "Ac-

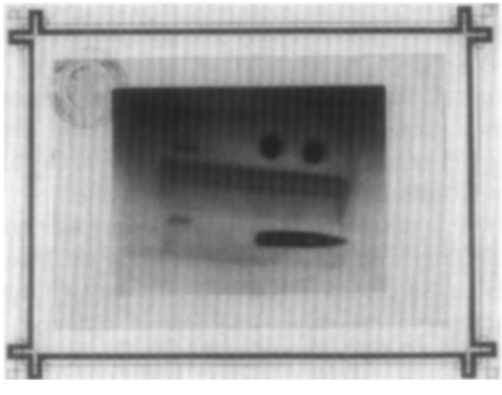


Fig. 4. A photographic copy of one original x-ray picture showed on February 24th, 1896, at the anatomic amphitheater of "Facultat de Medicina de Barcelona" by C. Comas (made on February 17th, 1896). It shows a leather case with a celluloid comb and a steel small plumelet. The exposure time used was 40 min and distance at Crookes tube was 8 cm.

ademia y Laboratorio de Ciencias Médicas de Cataluña'' (ALCMC).

In 1905, they attended the III International Congress on Electrology and Medical Radiology in Berlin, presenting their experiences in the treatment of cutaneous cancers with an analysis of 65 cases. In this work they outlined the radical, palliative, and postoperative radiotherapy concepts (74) as is relinquished in the following transcription:

''... in nonoperable neoplasias, as the last hope of cure rarely used, or as irreplaceable palliative (disappearance of the pain and of the sanious secretion, partial cicatrization of the ulcerated parts, limitation of the progressive course of disease), always procuring to avoid the determination of intensive reactions. In recent relapses of operated cases, frequently managing to detain them or to make them disappear. Consecutive operative scars on the removal of a cancer, though the action of the Roentgen rays is not sufficiently checked in these cases, we believe that in this way relapses must be reduced ...''

Approximately 80 communications presented in this congress on x-rays (15) were emphasized for their therapeutic application.

At this congress the coming of age of roentgenotherapy was proclaimed, defending its separation from electrology, whereas in France they were counting on common applications. In Spain, they were separated due to the Comas and Prió sole dedication to x-rays. The indications of radiotherapy as of an absolute empiricism were noted, and the difficulty in interpreting results was as a consequence of an absence of accurate measurement methods, which prevented the reproduction of the facts or the comparison among authors.

In Spain, advanced theoretical contributions by Comas and Prió, included new radiotherapy indications, but had technical limitations due to the greater dedication to the diagnostic issues. In the same year, 1905, Comas and Prió presented two communications on a case of deep postoperative irradiation in a uterus neoplasm (75, 76). The importance of these based the world precedent of intraoperative irradiation. It was applied to a 33-year-old woman who was suffering from a locally advanced cervix neoplasm that affected the bladder. A total abdominohysterectomy, a pelvic lymphadenectomy, and a partial cystectomy until up to a centimeter of the ureters were carried out. The gynecologist, A. Raventos, proceeded with a pelvic and iliac fossa tamponage, leaving the abdominal cavity open to proceed with the irradiations that were initiated on March 11, 1905, practicing seven sessions on alternate days. The same gynecologist, in 1913 presented a communication at the ''Congrés de Metges de Llengua Catalana,'' where he remarked that the patient continued being well and was free of disease (77). Between 1905 and 1906 a further seven communications were presented on radiological diagnosis or radiotherapy treatment (78–84).

Between September 20–23, 1906, the III International Congress of Electrology and Medical Radiology took place in Milan, with the participation of Italy, France, Germany, England, Belgium, The Netherlands, Austria, Russia, Spain, Portugal, Greece, Switzerland, Canada, Mexico, Argentina, and Brazil. The French and Italians emphasized the use of radiumtherapy. The Spanish participation was the responsibility of Comas and Prió, who presented the case of intraoperative irradiation, and the electrologists Xercavins and Cirera. At this Congress, new indications and neoplasia cures were communicated that stressed even more the Spanish contribution with respect to international radiotherapy, as was relinquished by the Comas and Prió communications in radiodiagnosis and cutaneous radiotherapy (85–104), in the following 2 years.

The V international congress of electrology and medical radiology in Barcelona (1910)

The development of the deep radiotherapy in the treatment of gynecological neoplasms (1909–1915). In the first decade of the 20th century radiotherapy included as a means of diffusion in Spain two journals in which Comas and Prió were participants. The first of them, ''Revista General de Roentgenología,'' since 1903 constituted a section in the ''Revista de Ciencias Médicas de Barcelona,'' which from 1897 dealt with topics related to roentgenography. The second, ''Therapia,'' was edited for new ideas in therapeutics.

The ''Facultad de Medicina de Barcelona'' (FMB), emphasized the priority on academic training because the professor of Therapeutic, V. Carulla i Margenat (1864–1923), included in the course (from 1907–1908) eight theoretical-practical conferences on roentgenotherapy by Comas and Prió, and electrology given by E. Cirera. This education continued until the course of 1910–1911, which suffered a short lapse, and was reopened in the course of 1914–1915 (105).

In 1908 the IV International Congress took place in Amsterdam in which there was a Roentgenology predominance against Electrology (106). To this fact it is attributed (107) that Barcelona was proposed as the headquarters for the next International Congress, with the address of a worldwide recognized electrologist.

In December 1910, the V International Congress of Electrology and Medical Radiology took place in Barcelona, under the presidency of L. Cirera. After the inaugural speech and presentations, respectively made by Cirera and Doumer, the Congress started. It was structured into eight consecutive sessions, with a closing session given by C. Comas (108). In the first session 17 communications about electrology and/or some others physical therapeutics were presented. The second session was devoted to roentgentherapy treatment. Comas and Prió discussed nonmalignant cutaneous processes (109). A weighted introduction in technological progress was balanced with correct clinical applications. The clinical empiricism modulated the indications of techniques as consequences of limitations in the dose measurements proceedings (Benoist, Benoist-Walter, Wehnelt, Kienböch, Sabouraud, Noire, and others). Also, it was noted to be taken into account the characteristics of the patient such age, sex, and their general

status. Comas defended the fractionated irradiation against intense, even though he recognized that this depended on the different radiosensibility of the tissues. He presented 121 cases in his statistics.

In the second communication, F. Carrizo presented a keloid cured with radiotherapy (110). The third communication, "Clinical results of Roentgentherapy in the treatment of malignant illnesses (its curative, palliative, and preventive value)" by Comas and Prió (111), showed the state of the art of radiotherapy cancer treatment: in superficial cases it can be a curative treatment; in those of deep location or nonoperable cases it is considered palliative, and the postoperative relapses can be prevented with irradiation or by combating them once established. Fouveau de Courmelles, from Paris, presented radiotherapy treatment of myomas (112), a technique that was communicated, for the first time on January 11, 1904, and which would constitute the beginning of gynecologist's interest for deep radiotherapy. Finally, among the Spanish authors, in the last communication of the day about internal radiotherapy, V. Peset, of Valencia, defended the integration of radiumtherapy within generical radiotherapy (113). In this way, the Electroradiological School of Valencia represented by C. Calatayud (1880–1915), was one of the inventors of the use of radium in Spain, sharing stardom with the dermatologists already mentioned.

In the third session, 10 communications were presented by neurologists and physiologists about physiological processes (114). In the fifth session, the nine communications dealt with the electrical treatment of cancer (115), while the content of the sixth session was mixed (116). Special attention was paid to the study of radiotherapical treatment development in Spain, in the communication by Vilanova (117) about "Comunicación sobre irradiación total intensiva y ultrapenetrante en el tratamiento del nevus vascular." Through a process of filtration taken by Dominici, ultrapenetrating irradiation, or using a crossfire technique, the cure of large-size nevus is managed without any cutaneous reaction (118). In the sixth session, 17 communications were presented that dealt with the therapeutic application of electricity, as well as of its antiinflamatory action. In this report, the participation of Calatayud was emphasized (119). The seventh session was devoted to x-rays, with the exception of the Guilleminot communication about filtration in radiotherapy (120).

The closing speech, as it has been commented, was made by Comas. The success of the congress for the Catalan medical society was owed not only to the importance of the event but also to the fact that the Spanish Government withdrew the economic support upon which it had formally agreed at the beginning. According to Piquer (121), this sponsored the inscription of the majority of the catalan physicians, many of them who until then had very little interest in this type of therapy. In the same year, as a result of the reaction to the Congress in Barcelona, another one was held in Brussels, in which radiology dominated. Also coinciding with the celebration of these congresses, an International Congress in Physical Therapy took place in Paris.

The state of roentgenology in Spain is made clear by the article by J. Ratera (122), which was published in November 1911. It falsely attributed the priority of the first x-rays in Spain to Espina y Capó, recognizing, nevertheless, his early relation with the same Roentgen for the best knowledge of the technique. In that period all the public hospitals in Madrid were counting on facilities for Roentgen projects, signalling a certain diagnostic predominance above the therapeutic. Ratera only signalled two appliances devoted exclusively to roentgentherapy in "Hospital de San Juan de Dios" and one for J. Decref. In reference to Barcelona, Comas and Prió were recognized for their universal prestige as roentgenologists. It stated "Hospital Clínic i Provincial" (HCP) as the only public facility and among the 70 unofficial, emphasizing especially those of Comas and Prió, Darder, and Torres y Carreras. The facility of Calatayud is mentioned as the one in Valencia. In Sevilla, two public facilities and two private ones are mentioned being the responsibility, respectively, of Lopez-Carmona, Muga, Carriazo, and Puelles. In the case of Salamanca, the two installations in the "Facultad de Medicina" and the private one by F. Villalobos were devoted preferentially to radiotherapy. In Galicia, marked facilities existed in Santiago, Coruña, Ferrol, Lugo, Pontevedra, Orense, Vigo, and Redondela. Special mention is given to the case of Oviedo, specifically a facility by J. Geonondern for radiotherapical use. In the province of Valladolid there were three facilities devoted to a mixed way to use of diagnostic and therapeutics.

From the doctoral thesis by L. Zugazabeitia (123), special reference was made to the "Hospital de Basurto;" in Vizcaya in 1909 it had used x-rays on over 100 patients. Nevertheless, this center would develop its radiotherapeutic work after 1914. Ratera made an interesting disquisition about the relative abandonment that the official Roentgenology facilities would suffer due to the disinterest of the official institutions, a comment of absolute validity in Spain. In most of the Spanish cities radiodiagnosis was almost exclusively practiced. Until 1911, Comas and Prió had considered themselves experts in radiotherapy, and Calatayud, combining the use of electrology and radium, and Azua and Villalobos had begun treating some patients in the previous 5 years. These data show the lack of interest by the Spanish radiologist for radiotherapy in the first decade of the 20th century, when internationally its indications and results were beginning to be made evident. This fact explains the delay in the incorporation of deep radiotherapy, a process in which the gynecologists acquired stardom.

On the other hand, the Coolidge tube, which, from 1913 would permit greater possibilities in deep radiotherapy, was not introduced in our country until 1917 in the private Torres Carreras facility (124). From 1910–1912 Spanish

specialists such as Azola, Garmendia, Conill, Guilera, and other, would attend European centres to complete their training. V. Conill (1886–1970) would represent the introduction and development of the deep radiotherapy in Spain. After a 3-year stay in different private German hospitals he returned to Spain. In May 1914 he published "Hypothesis about the different action of the cathodic rays (sic) in the uterine myoma." He confirmed that radiotherapy was the chosen treatment for this disease and its application was exclusive to the gynecologist: ". . . many are the errors that are shown in the diagnosis, so assorted the nuances of the tributary aches the radiotherapy" (125). A few months later, S. Recasens (1863–1933) gave a communication on his experience in the treatment of the uterus cancer by radium and mesothorium (126), defining the conservative intention of radiotherapy against surgery as an mutilating treatment:

"... a truly conservative era has begun with the entrance in therapeutic of a series of means that permits us to cure many sick women without the necessity in the past of one who performed the most operations was the best we will soon arrive at a point where the most important will be the one who obtains most cures with the vast number of operations ...."

He considered radiotherapical treatment the choice in myoma, with hemorrhages, granting protagonism to emanated radiations from radium and the mesothorium. From the description of the 19 cases treated from January of that year a technique was implemented requiring the dose (12,000 mg/h of application) and the combination with external radiotherapy to achieve a more effective action at ganglionic level and in periuterine tissues. The article ends with the petition to the Spanish Government to provide a center for radium or mesothorium. Recasens started strong debates in connection with the defense of radiation in treatment of the gynecological processes. Primarily with A. Pulido, representative of one of the surgeons who had carried out most operations (127), and later with Calatayud, roentgenologist themselves, such as the first Professor of Radiology and Electrology in the "Facultad de Medicina de Madrid," against which the control of gynecological radiotherapy was disputed (128).

Conill, in 1915 presented another communication (129). Without any posology of internationally accepted administration, using the indirect relation between quantity of "X" administrated and the cutaneous change produced, Conill emphasized the importance of the filtration (developed by Perthes and Dessauer) as a means of advancing in the possibilities of deep radiotherapy:

"... to benefit of the filtration of the focal x-rays, we are able to arrive at a certain point for example in the case of an ovary, we put a considerable dose but without exceeding the limit sanctioned by practice and that is estimated at 10 units of X; as the external abdominal region provides a large surface, we can arrive at the point of the interior that we are trying to irradiate only by different points of this surface by only changing the concentrator and the burden of the blister each time the irradiated area has achieved its 10 units. Continuing this procedure, which we call convergent irradiation, it is possible to incorporate into the external genitalia a dose of 130–150 × on the Kienböck scale ...."

In the January issue of "Therapia," A. Terradas published an article in the RACMB, dated November 30, 1915 (130), in which he presented the physics of radium, by invitation of the gynecologist M. Fargas promotor of "Sociedad Benéfica-Radio," that in a short time would make available a decigram of radium salt. Of the gestation of such Society we will occupy ourselves in the chapter designated to the importance of sanitary campaigns against cancer in the development of radiotherapy.

One month later Conill published an article about gynecological radiotherapy read in the FMB (131). In a beautiful introduction it glossed the advances in the knowledge of the human body provided by physiology, where each organ had its own purpose in relation to itself and to the whole body. From this vision he defined the physical gynecological therapy as a conservative gynecology that seeks the cure of the processes through radioactive bodies, heat, massage, and electricity. He insisted on the possibilities provided by filtration emphasizing the superiority of the intense dose with respect to the separated dose:

"... if the secret of the success of gynecological radiotherapy consists of administering a valid dose, the secret of the success is supported by the fact that the administration takes place within the shortest time possible, the intense incorporation and the dose accumulation. 100 units of X administered within 24 hours are of a therapeutic value much greater than the same doses given over the period of a week ...."

It was supported by the influence of the German school in Freiburg, a defender of the single dose and creator of the convergent technique that was using up to 21 ways of fields in addition to the vaginal route using a speculum. He emphasized the use of radiotherapy in uterine tumors and as an analgesic. In April 1916, M. Fargas y Raymat published his experience with radium in gynecological neoplasms (132). He maked an epidemiological introduction about the incidence of uterine cancer in Spain in relation to Germany and emphasized radium as the best palliative treatment. He presented his personal experience with 22 cases (133). After the description of the first eight cases we must emphasizing his conclusion without coherence by palliative qualification:

"... the effect produced by these cases, more than being read ought to have been followed in its natural course to see the radical changes in the organism injury and in the spirit of the sick person which radium generates. It is enough to say to finish that it is undoubtedly the best means of treatment of the inoperable cancer as we know it today ...."

The same author presented his doctoral thesis titled "Roentgentheraphy in the treatment of uterous myomas" (134), in which he considered deep Roentgentherapy as: "... a procedure that has soared to the highest limits of gynecological therapy ...." From an experimental study of abdominal ovary irradiation in rabbits and later historical testing, Fargas showed the difficulty of procuring ovarial sterilization in a single session, in addition, emphasizing the possible movement of the ovary where the myomatosa uterus was of large size, a fact that would hinder its correct irradiation. He comments that the chronological application of this therapeutic and attributes to Calatayud the publication in August 1912 of 9 first cases treated in Spain. He describes later the used technique;

through 5 anterior ports of entry, 5 posterior and one vaginal. Technique is in agreement with the French school, in contraposition with the intense or convergent dose of the German school defended by Recasens and Conill.

Garmendia (135) attributes to the German Gynecological Congress of Halle celebrated in 1913 the great development of the gynecological radiotherapy that Conill also mentioned (136). As corollary to the role of the gynecologist in the development of the radiotherapy as well as the wide ownership that arrived to reach in deep radiotherapy, it is adequate to emphasize the published work of Recasens and Conill in 1918, without any doubt, one of the European handbooks of great interest in its class (137).

The sanitary campaigns in the fight against the cancer and their influence in the development of radiotherapy.

The cancer pavilion of Hospital de la Santa Creu i Sant Pau in Barcelona. Radiotherapy in the period previous to the Spanish Civil War (1918–1936). In 1864 Medina had placed the remotest antecedent in the anticancerous struggle (138). In her doctoral thesis she signalled to the Spanish Medicine Congress the need to create a study commission of cancer. Continuing with the same bibliographical source we emphasize the participation of A. Pulido in the collection of statistics on the incidence of cancer in Spain (139). It was urged to establish international statistics about cancer to unify struggle strategies. We centered on tumoral location as the key in the sanitary campaigns against cancer, and in a secondary way in the development of radiation therapy treatment in our country. We emphasized a communication of Guilera in 1905, whom we presumed was a relative of Guilera i Molas (1896–1969), a decisive figure in the struggle against neoplastic diseases in Spain, made a call in favor of the prevention in the gynecologic cancerous diseases. A "crusade" against cancer was considered necessary in the same way as was made for tuberculosis. In the treatment of cervix carcinoma four basic principals were emphasized, which by their absolute validity, will be transcribed totally:

"... 1st. In more than 95% of cases postmenopausica metrorrhagia however slight, it may show the existence of malignant neoplasia. 2nd. Every woman who has hereditary characteristics of carcinosis, in those who present numerous related illnesses, neuro-arthritis or rheumatic ones extreme control must be given according to the critical age. 3rd. Each woman who consults a doctor about a genital disorder (hemorrhage, pain, leucorrhea, etc), must think about the possibility of a neoplastic process, especially those over 35 years of age. 4th. Nowadays only a precocious diagnosis permits a truly radical treatment ... "(140)

As other authors remarked (141), gynecological cancer was the one that caused most worries. In 1907, in the inaugural session of RACMB, M. A. Fargas Roca (1858–1916), Professor of Obstetrics and Gynecology at FMB, remarked on the mortality rate caused by this cancer. In Europe and Spain, about 100,000 and 5000 cases, respectively, per year were reported.

He considered radium therapy, the roentgentherapy and serumtherapy as: "... tested means are better desire than good results..." (142).

The surgical techniques developed by Freund and Czerny for abdominal and vaginal hysterectomy produced high rates of morbimortality and relapses. Fargas emphasized a general survival level at 5 years between 33 and 45%. They insisted on the necessity of an early diagnosis to achieve a greater surgical efficiency. The problem of the fight against uterus cancer was reduced to: first, suspicion of the fact that it could spread; second, clinical exploration; and third, a historical check in case the previous one was not enough.

The concept of recovery had to be abandoned soliciting greater training by the general doctors than those that attended at the beginning.

Capella and Craven-Bartle (143) emphasized this struggle against cancer using the masterful inauguration of the 1908–1909 course by A. Morales about "Cancer as a social plague." Less technical than his predecessor, he granted influence to social and environmental causes. He emphasized the diagnosis delay as a handicap for the surgery, the shortage of adequate attendance centers, and social rejection that the disease produced, given the prevalence of the infectious theory in the development of the illnesses.

In 1909, the Central Committee for the Study of Cancer was created in Madrid under the direction of E. Cervera (1855–1916), responsible for the Laboratory of Cancerological Investigations at the "Instituto Rubio" joining itself to the International Committee in 1910. The first World War meant the relative disappearance of the International Association as well as the Spanish one. Continuing with Capella's article, we should emphasize the hygienist E. O. Raduá (1864–1928), through the statistics section of the "Instituto de Higiene Urbana de Barcelona," especially in a publication of 1911 (144), where cancerous terminology appears. Even though the general mortality had decreased between 1897 and 1908 from 25.1 per 1000 inhabitants to 24.45, the mortality rate in cancer patients had increased from 2.25 per 3.9 for 100 deaths. More than to establish curative solutions of the disease, prevention was proposed as a scientific instrument of knowledge and intervention with regard to the statistics and the reality, and the use of data from the "Registro Civil" with demographical and sanitary means, which had been started in Barcelona in 1910. The merit of Raduá was to show the statistics as a means that contributed to the study of pathogenesis of the neoplasias, emphasizing the importance of social-environmental factors, an innovative concept in its time.

In 1913 the second "Congreso de la Sociedad Española de Ginecología y Obstetricia" was held in Valencia in which not a single article about radiation therapy was presented. In the Spanish Congress, a commission for uterus cancer was created. In that same year, the delegate in Catalonia, F. Terrades, was defending (145) surgery as the only therapeutic cure. He insisted on prevention and early diagnosis, granting

some stardom to the medical education campaigns. On the other hand, in 1913, impelled by Fargas Roca, Carulla, Bartrina, and Peyrí, the "Asociación Benéfica Radio-Barcelona" was created in Barcelona with the object of purchasing radium. With a fund capital of 100,000 Spanish pesetas, 138 mg of radium-element was acquired, which as we have seen before, was available from 1915. Two days per month radium was offered at the Hospital Clínico, the Casa de la Caridad and the Hospital de la Santa Cruz y Sagrado Corazón; the rest of time, it was hired.

Coinciding with the development of the Radium Beneficial Association the article by Recasens on irradiation in gynecologic diseases was published, as it has been already commented. In that article, Recasens made a call to the Government to provide radium and mesothorium to the hospitals. That call would be repeated in the "V Congreso de la Asociación Española para el Progreso de las Ciencias," which took place in Valladolid in 1915, without any success.

In 1917, in the "Segon Congrés de Metges de Llengua Catalana" (146), the gynecologists Pujol i Brull (1874–1932) and Ribas i Ribas (1878–1935) added to the early diagnosis concepts and social sanitary education the necessity to create research centers in the fight against cancer. They defended the fact that roentgentherapy and radiumtherapy had to be combined, and the urgency to divulge their curative effects to convince people of the necessity to deposit them in hospitals and public welfare asylums. The preoccupation to constituting an institutional net in the fight against cancer was outlined at a lecture on "La Lucha Social contra el Cáncer" by Ribas y Ribas, in 1923. In this they tried to divulge among the population some elemental knowledge about cancer, especially about the symptoms, to initiate a campaign of diagnosis and early treatment. On April 30, 1924, the same academy opened a subscription in all Catalonia, to finance the creation of an Institute of Cancer.

In that period, the first associations in the fight against cancer were created. On September 17, 1925 "La Lliga Catalana contra el Cranc" was formed, presided over by Ribas i Ribas. Three commissions were highlighted: "Comisión de Investigación Biológica", "de Tratamiento", y "Hospitalización y de Propaganda" (147), the last one being the most active. They were made up of a series of lectures directed by Guilera in Barcelona, Reus, Poble Nou, Lleida, and Vilafranca, seeking to stimulate medical consultations by patients before suspicious signs appeared. The campaign was also routed to provide funds for the purchase of radium and radiotherapy appliances for Catalonian hospitals.

On March 8, 1924, "La Liga Española contra el Cáncer" was established, its need being justified by an increase in the mortality rate caused by cancer. The fight would be supported by two basic rights: the prevention against toxic agents such as alcohol and tobacco, and the fight against the diagnosed disease. The "Liga" was born as an association affiliated to the French-English-American League against cancer and the Belgian League. The beginning was difficult, highlighted by a short beneficial contribution by private people, with collaboration, private as well as Governmental, being guaranteed. The actions of the Ladies Commission were emphasized, that in addition to raising funds, also took charge of income management in the National Institute and collaborated in the elaboration of the clinical charts of the patients.

A task also existed in reporting through lectures and propaganda. Nevertheless, an initial centralist vision prevailed that was slightly revised in 1927 with the holding of "Comité Científico" with members from other Spanish cities (148). In 1925 "Patronato de Cataluña pro Hospital-Asilo de cancerosos" was emerging in Catalonia, as a division of Conill's League for initiative based on the procedures of the League at a national level. An asylum-hospital and an investigation hospital were created. This initiative was accepted by the aristocracy and the Catalonian upper middle classes. The differences in criteria with respect to the "Lliga" were often reflected in the press of that period, because this second one asked for reenforcement of the already existing centers. In 1927 these two processes converged in the fusion of the "Lliga" with the "Patronato de Cataluña pro Asilo de Cancerosos," adopting the name of "Sección Catalana de la Liga Española contra el Cáncer," a group in agreement with the decataloniasized policy of the dictator Primo de Rivera.

The funds raised along with a campaign intended for Catalonian children, directed the initiation of work on the "Pabellón del Cáncer" in the "Hospital de Sant Pau i de la Santa Creu de Barcelona" (HSPSCB) in 1928. According to Capella, on June 29, 1929, the first stone at the Pavilion was placed, depositing in its foundations the remains of thousands of money boxes from children of Catalonia. The Pavilion would be inaugurated on May 4, 1930, being one of the first modern oncological hospitals of the time, apart from "Dispensario de Terapéutica Radiológica del Hospital de la Santa Cruz de Barcelona" (HSCB). In 1917, Pujol i Brull, Ribas i Ribas, and Guilera managed to buy 1 mg of radium. Another key person in the development of the Cancer Pavilion was Guilera, who after a stay in various German clinics was commissioned by the "Sección de Terapéutica Física del Cáncer Ginecológico," to provide thereafter a histological diagnostic laboratory (149), in which the first Spanish experimental projects on carcinogenesis (150).

In 1925, the charitable association of radium was dissolved, relinquishing the radium to Pujol and Guilera, who put under way a campaign for the purchase of radium acquiring 1 g of radium sulphate. The "Dispensario de Terápeutica Radiológica" (DTR), consolidated itself with six beds, a laboratory for serological and histological analysis, an office for administration, rent, and supply of radium, and complementary material and a deep radiotherapy section.

In those years, treatment with radiotherapy was used exclusively on patients with benign diseases or cancerous

processes in which other therapeutic processes had failed. Progressively indications increased, based on the multidisciplinary management of the patient. Irradiation was associated to surgery for cancer of the uterus, breast, bladder, etc., replacing the method of German irradiation in massive doses to the split pioneered by the French School. It was interesting to highlight that finally an eclectic fractionation was opted for the nearest to the French system, but dependant on the availabilities of the Service.

In 1931, out of 325 patients treated in the Cancer Pavilion 47% came from other Spanish provinces, given an acknowledgement of the prestige that it had achieved. This fact reiterated the petition of the collaboration of the Central State in its financing as was happening with the "Instituto de Madrid" (151). We will not stop detailing the relationships referring to the treatment of certain malignant processes in the Pavilion with other services of the hospital, but we consider of interest the relationship maintained with the "Servicio Central de Roentgenología," directed by Comas and Prió. The Central Service had attended 351 patients in 1923, reaching the figure of 1752 in 1929. Already in its new location as HSCSP, in the following year it duplicated the number of patients (152), a figure that would be maintained until 1936. The percentage distribution between diagnosis and treatment was in those years 89% for the former and 11% for the latter. The approval of a new law on June 9, 1931 (153), drove the Central Service to occupy itself exclusively with diagnostic and physical treatment in non neoplastic processes.

Cancerology remained within the specialties and roentgenology stayed within auxiliary services such as laboratories and pharmacy. This consolidation of the speciality was centered in the figure of Guilera, whose clinical, histological, and radiotherapical training could be summarized in the definition made by Buschke about a modern radiation oncologist:

"... while the patient is under our care we take full and exclusive responsibility, exactly as does the surgeon who takes care of a patient with cancer. This means that we examine the patient personally, review the microscopic material, perform examinations and take a biopsy if necessary ..."

The development of the fight against cancer in other spanish provinces

The evolution of the "Instituto Nacional del Cancer" (1922–1936): Radiotherapy in the period previous to the spanish civil war (1931–1936). 1927 began a project to be outlined to create an "Instituto Contra el Cáncer" in Bilbao, under the protection of the "Liga," impelled by Guimón and Rey Baltar (154, 155). These last presented chilling statistics, affirming that 96% of the patients with uterus cancer were arriving to the specialist in an inoperable state. The general practitioners were urged to carry out gynecological explorations and to take histological material (156).

In 1928 the "Liga Anticancerosa de Guipuzcoa" was established under the presidency of Queen María Cristina, local authorities, and Goyanes, the Director of the "Instituto Nacional contra el Cáncer," being impelled by the "Instituto Radioquirúrgico de San Sebastian."

The "Liga Gallega Anticancerosa" was formed in 1928, sponsored by Montes Nájera. It established the need to encourage diagnosis and treatment of the neoplasias through laboratories and attendance centers. The Spanish League continued to be the source of finance along with a number of members, private donations, and help from official Institutions. Nevertheless, in 1935, the Institute had still not been built, in spite of the placement of the first stone in an official inauguration ceremony in the city of Vigo in 1929.

In the Valencian area, apart from initiatives from 1914 in sanitary training in the prevention and early diagnosis of neoplasias of the uterus, a Cancerology section existed since 1926, that favored the organization of a municipal anticancerous service and the foundation of the "Liga Provincial" in 1930. The financing came from local taxes. A "Dispensario Anticanceroso Municipal" was created, which counted from the beginning with 160 mg of radium. It also developed a course on Cancerology and Brachitherapy organized in 1932, providing cancerological training to general practitioners. In 1931, in Alicante, official campaigns provided the "Hospital Civil de la Beneficiencia Provincial" with 100 mg of radium and a deep radiotherapy facility.

In Mallorca the creation of anticancerous centers remained mere proposals.

In 1928, in Andalucia, the creation of the "Liga Provincial Anticancerosa de Sevilla" was emphasized, and a little later in Málaga, it was thought to improve the radiological facility of the "Hospital Civil" and to organize an area for sick cancerous patients.

In Zaragoza, the plan by Horno Alcorta emerged, who in 1930 began negotiations to establish the Aragonese section of the League, initiating a course on cancer.

One of the first initiatives that emerged in the campaign in the fight against cancer was the creation of the "Laboratorio del Cáncer del Instituto Rubio" in Madrid, which we have referred to before. Nevertheless, the initiative did not achieve financial aid and the building was not finished until 1917. Nonscientific problems postponed its inauguration until 1922. José Goyanes would take charge of its development, providing the center with a modern roentgentherapy facility. Financing was covered through a payment by the patients themselves, being welfare beds, the cost of which was aided by the Queen. In 1924, after the constitution of the "Liga," the center remained under its control. On May 5, 1929, the inauguration of two new Pavilions took place in the "Instituto Nacional de Oncología."

The work of the Institute was performed in the form of attendance, investigation, and publications, numerous courses, and lectures being imparted and favoring the attendance of national and foreign congresses. One of the most important was the I International Congress of the Scientific

and Social Fight Against Cancer, which took place from October 25–30, 1933. Various people from the world of Cancer took part presenting 25 reports, four of them from the Spaniards Covisa, Pittaluga, Carulla, and Rio Hortega, this latter being then director of the "Instituto Contra el Cáncer." One of the main achievements was the approval of the foundation of the International Union Against Cancer. The reports dealt with the biology of the cancerous cell, early diagnosis, tumors of the central nervous system, statistics, and the organization of the fight against cancer, anticancerous education, etc. (157).

The proclamation of the Republic had repercussions on the National Institute of Cancer, minorly related to the monarchy and the Spanish aristocracy. In 1931, Goyanes was dismissed for not very clear reasons.

In 1936 professional instability, inconclusive management of the center, and controlled changes in national government diminished the attendance capability of the Institute, that would show its work gravely affected by the Spanish Civil War.

The scientific cancerological situation was going through some years of development in Catalonia. The HCP radiation therapy school consolidated under the figure of V. Carulla, who was sharing stardom with the modern direction of "Pabellón del Cáncer". In 1931 the "Societat de Radiologia i Electrologia de Catalunya" (SREC) was formed. The records of electrological association had begun between 1915–1916 at the hand of Calatayud and Comas, being officially inaugurated with the name of Spanish Society in February of 1917. The Association counted on the "Revista Española de Electrología y Radiología Médica" as a diffusion agency that Calatayud had previously established in 1912 in Valencia. The Society was emerging as an organization responsible for the development of the specialty and to avoid the intrusion of other specialists, carrying out their activities until the middle of 1920.

In 1931, the need to associate for the defense of interests was clear again (158); a group being designated "Sociedad Española de Electrología y Radiología Médica" (SEREM), thus reflecting the importance of x-rays. Although at the beginning it tried to embrace all the fields within its group name, progressively it hypertrophied the diagnostical flow in detriment to the therapeutic, a trend that would last until its disappearance in 1939.

In a contemporary way it was replaced by the previous named SREC, responding to the importance of the scientific nucleus of Catalonia, that from its beginnings counted with more than 50 associates (159). First, the "Revista de Diagnóstico y Tratamiento Físicos," directed by Carulla, was converted into the unofficial voice of its actions, until 1934, when the magazine "Medicina Física" was established. Written exclusively in Catalan, it reflected the nationalistic development favored by the Republic and it showed from the beginning a clear therapeutic direction. In the first issue, October of 1934, it emphasized an article by T. Pinós, about the choice of surgery or radiation therapy in the treatment of uterine myomas (160) and another on the irradiation for hypertrophy of tonsils by Torres Carreras and Bosch-Solà (161). The second issue of the magazine, in January of 1935, was of interest because of two of its articles. In the first one, for its defense of the necessity of specialization in radiology (162), and the second for the review of the IV International Radiology Congress that took place in Zurich in July 1934 (163). Some importance was given to the organization of the fight against cancer, articles being presented on its development in various countries. C. Gil y Gil of the "Instituto del Cáncer" of Madrid presented in French "Organisation de la lutte contre le cancer in Espagne," where he showed with an abundance of facts and figures the burden of cancer in our country, as well as the evolution of its mortality in the last few years. Finally, he talked about the anticancerous organizations that existed in Spain.

The Spanish participation was important in the congress, articles having been presented by Torres Carreras, Bosch-Solà, Carulla, Sanchiz, Llorens, Gil y Gil, and Martínez Crespo. The congress was structured into two sessions on radiology, two on radiotherapy, one on radiobiology, one on radiophysics, and another on electrology and heliotherapy. An indirect sign, as much to the level as to the development in the field of radiotherapy reached by the Spanish group, was represented by the attendance of the meeting of the International Radiology Committee of such people as Carulla, Martín-Crespo, Gil, Téllez-Plasencia, and Canalejas. At that meeting Spain was voted one of the five nations that would form part of the committee until the following congress took place. In the issue of October of 1935, about treatment of breast cancer, Guilera (164), the surgeon M. Corachan (165) and Carulla (166), participated, devoting themselves, respectively, to brachitherapy, surgical, and radiation treatment of the disease; a reference monograph in the study of the evolution of the treatment of the breast cancer. The synthesis of the last publications and techniques at world level coexisted with reviews and articles provided by our authors in the treatment of the disease.

Finally, in the last two issues, which appeared in 1936, radiation therapy treatment was hardly dealt with at all.

RADIOTHERAPY IN POSTWAR SPAIN: REORGANIZATION OF THE SCIENTIFIC SOCIETY (1945)

The beginning of the modern chemotherapy: the early cobalt units (1940–1970)

The Spanish Civil war put a hold on the whole action and development with regard to the fight against cancer. The recovery was slow due as much to the technical problems as to external problems because of the international blockade. One example was the evolution of the Radiology Service of the "Hospital de Sant Pau i Santa Tecla" (HSPST) in Tarragona in the years after the Civil War. This Service had its origins in 1928 at the height of the Spanish fight against cancer, providing specific appliances

Table 1. Situation of radiation oncology resources in Spain (1991–1992): public vs. private hospitals

Parameters	Public	Private	Total
No. of institutions	55	22	77
Specialized professionals			
Radiation oncologists	245	46	291
Physicists	93	16	109
Technologists	341	67	408
Installations/equipments			
^{60}Co Units	63	21	84
Linear accelerators (ph)	5	1	6
Linear accelerators (ph + e)	34	6	40
Total megavoltage units	102	28	130
Orthovoltage devices	18	1	19
Superficial ± contact RT	38	5	43
Simulators	42	3	45
Computerized planning	52	14	66
Brachytherapy units	35	8	43
Radioprotected beds	141	17	158
No. patients per year	31.468	8.056	39.524

for deep radiotherapy as well as 75 mg of radium. The people responsible of the Service were Drs. Torres Carreras, Bosch-Solà, and L. Delclós. Given the growth of the Service, a modern unit of radiotherapy was acquired in 1931. The Service was organized in four sections: brachytherapy, electrotherapy, physiotherapy, and roentgentherapy; it was the only anticancerous center in the province of Tarragona. In 1939, the radiotherapy appliances were destroyed and the radium from the Hospital disappeared, reappearing in the HSCSP (167).

The Radiology Service of the HSPST did not begin to recover itself until 1941. That same year the German consulate in the city donated a new tube for the radiotherapy appliance, which did not arrive until almost 2 years later. Upon attempting to connect it, it was observed that its size did not coincide with the previous one. The hospital, due to the urgency, asked the supplier for a new one directly. After 3 more years, a further administrative bureaucracy, the tube arrived in Tarragona in 1946. Treatments did not begin again until 1947.

In 1940, Delclós presented an interesting publication on a colpostat of his invention with a device that avoided the tamponage and consequent infections (168).

In the centers with greater infrastructure the restarting of activities was faster, such as HCP with Carulla as new professor since 1941, HSCSP with Guilera, and the "Instituto del Cáncer" of Gil y Gil.

The SEREM was refounded in 1945 under the same name. A year later the magazine "Radiológica-Cancerológica. Revista Ibérica de Ciencias Médicas" was presented. As the new form of communication it was made available to the medical field and was devoted to the study of radiological and cancerological problems of the whole Iberian Peninsula. There was a continuous series of articles that appeared in the magazine between 1946 and 1950, data that is a direct document of the evolution of the radiotherapic treatment in the years previous to the introduction of megavoltage in Spain. In the first issue a predominance of topics about radiology in relation to cancerology were observed (8 to 3), whether of an experimental, therapeutic, or statistics nature, a proportion that would be maintained until the disappearance of the journal. It is of importance to emphasize the principal participation of C. Gil, key figure in the maintenance of the speciality in Spain. Thus, in the first two issues he presented four articles (169–172), the devotion to "Significación del Cáncer en España," being of special interest, where he produced evidence regarding the national backward in relation to the focus of neoplastic pathologies. In the January–April issue of 1947, out of a total of 10 publications, only 2 were dedicated to radiotherapy, being of interest an article submitted by Guilera on breast cancer (173). He declared himself a supporter of the utilization of radiotherapy in this disease because it improved surgery results, as much in preoperation in advanced cases, as in postoperative cases. He considered brachytherapy of value in relapse treatment. Finally, he commented on the good results obtained from male treatment, citing his own experience.

The last issue of 1947 includes an experimental article on modifications of glutationemia in cancerous diseases experienced in relation to treatment (174), reporting a group of 65 sick people. Carulla describes an extensive summary of his experience in the treatment of giant cells bone tumors (175). In 1948, the few articles related to cancerology were by Guilera (176) and Gil (177). In 1949, Gil y Gil published the results obtained in the treatment of the mammary cancer (178), an article that he presented in the form of a conference at the "Curso Monográfico Nacional sobre Cáncer de Mama" organized by HSCSP of Barcelona in April of 1949. It summarized its educational facet, characteristic of that center, which still continues to the present day.

The May–August issue in 1949 showed the impact that it had on Spanish oncology the article by Gilman and Philips in 1946 (179), about nitrogen mustard. J. G. Zarandieta made a first inspection of the published projects on the new therapy (180) and Gil, presented his experience in the treatment of 22 patients affected by Hodgkin's disease, treated with radiotherapy and nitrogen mustard (181). The analysis of the results of the mixed treatment of the patients, treated between June 1948 and December 1949, was very cautious. In general, it showed some surprising results, though of short duration, between moderated and intensive hematological toxicity. He especially emphasized two cases: one in a young patient, of excellent prognosis, that died after a few days of the administration of exclusive chemotherapy treatment; on the other hand, a patient in a very compromized state, with general health problems remained sluggish after the administration of the mustard and the later radiotherapy. Coinciding with P. Botet, he was commited to the Pedro-Pons School (182), that this

treatment must be reserved for refractory or advanced forms of radiotherapy. Nevertheless, Gil was the first Spanish doctor, who, towards the end of 1946, moved to the United States to observe the new therapy.

The last issues, dated around 1950, comparative studies between chemotherapy and radiotherapy (183) were reported, as well as Spanish articles presented to the International Radiology Congress in Stockholm; the first since the end of the II World War. There were 10 articles by Spanish authors where emphasis was placed on one by Gil on radiobiology (184) and on another by J. W. Otte, on the treatment of breast cancer with radiosensitizing chemotherapy (185).

At the beginning of the 1950s, when cobalt therapy unit began to show its possibilities in the treatment of deep neoplasias, Spanish radiotherapy specialists lacked of their own expression organ, until 1955 when the "Boletín de la Sociedad Española de Radiología y Electrología Médica" appeared. The first cobalt therapy unit that came to Spain went to the private "Clínica Ruber" in Madrid, in 1957. The following year, two new units were also acquired by nonpublic centers in Madrid and given to the responsibility of Dr. Arce and Dr. Gil.

The first public hospital in Spain to have a unit of this type was the HSCSP in Barcelona, as a consequence of the negotiations between Guilera and a young collaborator, A. Subias, who was added in 1950. That happened around the end of 1958.

At the beginning of the 1960s, polychemotherapy archieved its first success in the treatment of Hodgkin's disease (186), and progressively, interest by Spanish radiotherapist in chemotherapy was reduced. New specialists emerged from internal medicine. This process was initiated in Spain, in the 1960s by Subias in HSCSP, generating a new specialty: medical oncology.

In 1963 the journal "Radiología" was published as a continuation of the "Boletín" that has been commented on previously. The follow-up of the articles from this publication gave a set of guidelines for the Spanish specialists. It should be emphasized an article that appeared in 1963 about the treatment of gliomas with an innovative coaxial convergent arc technique (187), by M. Badell. The following year HSCSP presented the follow-up of the patients irradiated with ^{60}Co between 1959 and 1960 (188).

Of special interest was the monographical summer issue of 1965 by M. Badell in homage to the retirement of his mentor V. Carulla. The reading matter attempted five articles (189, 190), that showed us a specialist with vast radiobiology and dosimetry knowledge with his own proposals and conceptions. He is one of the pioneers in our country of isocentrical techniques of irradiation. He was a perfectionist in the correct definition of target volume in the isodose distribution. In 1966, he gained access to the vacant professorship of Carulla at the HCP, initiating a period marked by his personality and training, probably more technical-physical than clinical. To him were owed the first published projects in Spain on the incorporation of computerized dosimetry (191), as well as the optimization of immobilization devices in the treatment of patients (192).

Another key figure at that time was Otero Luna, from 1964 Head of Radiotherapy Service at the "Hospital Puerta de Hierro" in Madrid, known since its foundation as "Centro Nacional de Investigaciones Médico-Quirúrgicas." Otero published a text on Telecobalt therapy in 1962 (193). The book introduced the clinical and dosimetrical experience of the author with three different cobalt therapy units, in which he worked intensively in Spain and abroad. This book, a classic in the Spanish bibliography on radiotherapy, was only comparable to that of Recasens and Conill on deep radiotherapy and radium, already mentioned. In spite of the existence of some outstanding professionals in the radiotherapical field, trained in French, North America, British, and German centers, Spanish radiotherapy around the end of the 1960s and the beginning of the 1970s was characterized by a progressive accumulation of poor infrastructure, as a consequence of poor govermental sanitary planning. We have an example of this in the delay of the first Spanish center with a complete equipment radiotherapy, that is to say, a cobalttherapy unit, brachytherapy facilities, and an accelerator (betatron type), which was the "Instituto Nacional del Cáncer" in Madrid. It was 1967 (194).

TECHNOLOGICAL DEVELOPMENTS FROM 1970 TO 1995: RADIATION ONCOLOGY AS A MEDICAL SPECIALTY, PRE- AND POSTGRADUATE EDUCATION, AND THE CONSOLIDATION OF A SCIENTIFIC SOCIETY

An expansive period (1970–1995): Technology and resources

In 1995, a second edition of the White Book of Oncology in Spain compiled the oncological resources devoted in the country for cancer medicine and analyzed the status of pre- and postgraduate education, scientific oncological societies, cancer prevention and epidemiology, early diagnosis, research, and oncology medical practice (195). The new edition updated the initial effort done in 1988 to review the scenario of Oncology in Spain (196). Data concerning the status of radiation oncology resources in the period 1991–1992 is shown in Table 1. A comparative analysis between the radiation oncology resorces in public hospitals in 1986 and 1991–1992 shows increments in all the parameters evaluated, except for orthovoltage devices. It is important to remark the significant increments in radiotherapy technologists (66%), dosimetrists (79%), linear accelerators (112%), simulators (68%), computarized planning systems (62%), and brachytherapy units (52%) observed in that period (Table 2). An expert reading of the real numbers expressed in Table 2 will inmediately give the impression that the actual progress in technology and coordination of human and institutional resources in

Table 2. Analysis of radiation oncology resources in public hospitals: evolution from the status in 1988 and 1991–1992

Parameters	1988	1991–92
No. of institutions	50	55
Specialized professionals		
Radiation oncologists	177	245
Physicists	75	93
Technologists	208	341
Dosimetrists	19	34
Installations/equipments		
Cobalt units	57	63
Linear accelerator (ph)	3	5
Linear accelerator (ph + e)	15	34
Megavoltage units	75	102
Orthovoltage devices	32	18
Superficial ± contact RT	37	38
Simulators	25	42
Computerized planning	32	52
Brachytherapy units	23	35
Radioprotected beds	94	141
No. of patients per year	25.722	31.468

Spain has been delayed compared to other countries of the European Union.

In Table 3, the status of radiation oncology resources in Spain in the period 1991–1992 is compared to the accepted standars for the specialty practice in developed countries (197). The need of further investment in radiotherapy technology is evident and should be recognized by the health authorities.

The foundations and reality of a medical specialty

Physicians using ionizing radiation for therapeutic purposes, and particularly for cancer treatment, required a progressive degree of training and acreditation. The legal regulation of medical practice in recent times, includes the recognition of medical specialties and their representation at the Ministers of Health and Education. Each specialty has a National Commission (with members named by the scientific society, College of Physicians, Universities, National Health System, and residents) and the Presidents of the Commissions meet at the National Council of Medical Specialties. The role of these representative organs is exclusively of consultive nature for both Ministers, in the supervision of the development of medical specialization, contents of training programs, requirements for acreditation of centers, and titles (degrees) expedition. In the period 1970–1978, the official specialty title required for cancer treatment with ionizing radiation was electroradiology. In 1978, the medical specialty of radiotherapy was recognized, separated from the previous clinical practice frame that included the general medical use of radiation and other agents of physical nature. Finally, in 1984 the National Council for Medical Specialties established a definitive terminology with the expression Oncología Radioterápica (198) (radiation oncology), which is a valid term up to the present. At the present time oncology in Spain has two different medical specialties legally recognized: medical oncology and radiation oncology. The contents of the Training Program in Radiation Oncology was updated in 1994.

Pre- and postgraduate education

Radiation oncology is a component of the teaching program of Radiology and Medical Physics given at the pregraduate university level. Theoretical and practical credits are given in third year of medical school (Introduction to Radiation Oncology) and in sixth year (radiotherapy in the treatment of the different tumor sites, oncologic emergencies, etc.). The University Department of Radiology and Medical Physics coordinates the pregraduate education in Radiodiagnosis, Nuclear Medicine, Radiation Oncology and Medical Physics. At the same time the University Department is responsible for the supervision of the doctorate programs that are based on postgraduate educational credits, the degree of research adequacy, and the defense of an original research project (Doctoral Thesis).

In addition, postgraduate education in Spain includes the training process in medical specialization, which is done under the responsibility and supervision of the Ministers of Health and Education, through the National Council of Medical Specialties, and particularly the Spanish Commission of Radiation Oncology. The present number of Teaching Units acredited for the specialty of Radiation Oncology is 34. The program includes a 4-year training period, including 13 months of rotations in medical and surgical departments, and 3 months in physics and dosimetry. It is recommended that there is an increasing level of responsibility of the residents in patient care, clinical, and therapeutic decisions and scientific activities.

Table 3. Compared analysis between the status of radiation oncology resources available in Spain to the international standard recommendations (Spanish population in 1991: 38,872,279)

Parameters	Spain 1991–1992	International Standards
No. of institutions	77	83
Specialized professionals		
Radiation oncologists	291	430
Physicists	109	179
Technologists	408	780
Dosimetrists	41	195
Installations/equipments		
Cobalt units	84	89
Linear accelerators (ph)	6	39
Linear accelerators (ph + e)	40	78
Megavoltage units	130	206
Superficial ± contact Rt	43	505
Simulators	45	83
Radiation beam analyzers	38	60
Brachytherapy units	43	55
Radioprotected beds	158	190
No. of patients per year	39.524	77.800

Qualification does not require examination, and the Book of Resident is not yet implanted at the present time (199). The recent analysis published by the European Union of Medical Specialties (200) shows a panoramic view of the status of specialized training in our continent. Spain is in the lower range of training duration, is one of the six countries (out of 17 analyzed in total) without examination for qualification, and has the highest number of residents in training per year (42 positions available in 1995 for first year residents).

The consolidation of a scientific society

Since the constitution of the Spanish Society of Electroradiology in 1919, radiotherapy has been an integral part of the development of radiological sciences for a large portion of this century. The technological development in the last two decades, the emergence of cancer as the most relevant disease of modern medicine, and the need for highly specialized training in clinical oncology (a field of accelerated changes and achievements) slowly moved the professionals primarily (and, in most cases, exclusively) involved in radiotherapy and cancer treatment to establish a section of radiotherapists in the Spanish Society of Medical Radiology (SERAM). This section was named Spanish Association of Radiotherapy and Oncology (AERO) (1985). In 1987, the Spanish Federation of Oncological Societies (FESEO) was founded, which impulsed the segregation of AERO from the radiology society seeking legal independency and freedom to join FESEO in equal conditions than the rest of oncological societies already present in the Federation: Medical Oncology, Surgical Oncology, Pediatric Oncology and Cancer Research. The Spanish Association of Radiotherapy and Oncology (AERO) was refounded in Barcelona in 1988. At the present time it has 298 members, publishes a periodic informative bulletin, has a national independent meeting every 2 years, and shares with the Spanish Federation of Oncological Societies the journal Oncología as the scientific vehicle of expression.

The presence of Spanish radiotherapists physicists and technologists in the European Society for Therapeutic Radiology and Oncology (ESTRO) has grown progressively. The 1995, ESTRO membership directory records 194 Spanish members belonging to 61 different institutions and 33 cities. Granada was selected for the 1994 ESTRO meeting.

The Spanish Association of Radiotherapy and Oncology is a consolidated reality, respected in the oncological and radiological national medical scenario. Nevertheless, radiation oncology in Spain faces a challenging future in which the scientific society is expected to play a major role in subjects such as the mandatory investment in radiotherapy technology to approach the international standards, the concerning increase of unemployment in recently trained radiation oncologists, the changing times and rapid evolution of medical pre- and postgraduate education, and the budget restrictions in medical politics and economics.

History will continue, and new generations of colleagues will face the responsibility expressed by Pérez and Brady in the dedication of their masterpiece book: "To our trainees that will advance the field further."

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