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Mária Telkes and Changing Female Roles in Academia in Hungary and the United States in the Interwar Period

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Abstract: The early years of Mária Telkes' exceptional career have received less scholarly attention despite their significance in her future achievements and the insights they provide into the social context of the interwar period on both sides of the Atlantic. The paper provides an overview of Mária Telkes' life and times during this early period, divided into two parts: her education in Hungary from 1914 to 1925 and her first years of employment in the US between 1925 and 1937. These phases of Telkes's career are significant when considering contemporary gender roles. At a time when few women had access to higher education in the 1920s and female engineers remained rare in the 1930s, Telkes secured positions at prestigious institutions. What were the social and cultural tendencies that shaped the Hungarian educational system of the interwar period? What kind of American work environment did Telkes face upon her arrival? Based predominantly on primary sources discussed for the first time, the paper introduces a case study by tracing the story of the joint scientific endeavor of Mária Telkes and Amy Rowlandat the Cleveland Clinic. These two women made a genuine contribution to breaking down social stereotypes and patterns of their times.

Keywords: *Mária Telkes, Amy Rowland, Cleveland Clinic, women in science and engineering; interwar women's education*

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Mária Telkes, the Hungarian-born scientist and inventor, also known as the Sun Queen, gained her fame for her inventions related to the utilization of solar energy. She embarked on her professional career in America precisely one hundred years ago, in early July 1926. In her first position, at the Cleveland Clinic, she worked as a research associate until 1937. Her achievements were largely linked to her colleague and friend, Amy Rowland, who not only supported Telkes in her research but also in her private life, by helping her obtain American citizenship. Rowland brought her into contact with the Clinic in 1926. Later, they collaborated on research projects, presented a professional exhibition of the so-called "autosynthetic" cells in 1931, and published several papers between 1928 and 1932. The success they attained working together was particularly remarkable during an era when few women had the opportunity to earn a reputation in research and

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engineering. Her tenure at the Cleveland Clinic allowed Mária Telkes to establish a professional career. Her innovative insights and research findings encouraged her to develop her ideas and implement her original goal in the field of solar energy utilization. When she left the Clinic in September 1937, she shifted her focus to exploiting solar energy. Her subsequent innovation, a method of transforming solar radiation into electric energy, aroused the interest of the Westinghouse Electric and Manufacturing Company in Pittsburgh. She continued her research in their laboratories, where she filed her invention of the "Thermoelectric couple" in March 1937, for which she received her first patent in 1941.[1] Over the years, Telkes achieved international recognition for her work at MIT, New York University, and in the business world at companies such as Curtiss-Wright, Cryo-Therm, and Melpar. Among other achievements, she was credited with the construction of the Dover Solar House,[2] the development of the solar stove, solar distillers, various solar-related insulating materials, and numerous other devices.

Before arriving in America, Telkes studied in Hungary during a particularly volatile era. In addition to Hungary's massive territorial losses in the wake of the Versailles peace treaties following the Great War, the public and higher education systems went through a major transformation. Although a royal decree promulgated in 1895 had enabled girls to enroll in certain university faculties in very limited numbers, the gates of the Budapest University of Technology, for example, remained closed to them (Palasik 2002: 26). Then, almost exactly 100 years ago, the "Girls' Secondary School Act" of 1926 finally remedied the situation by reforming the educational system, allowing girls to obtain the necessary high-school graduation certificate to enter higher education.

Mária Telkes completed her higher education during these turbulent and transitional times that characterized interwar Hungary. She graduated in 1918 and earned her doctoral degree in1924. Her situation was fraught with challenges not only because of her interest in engineering, an overwhelmingly male profession at the time, but also because of her Jewish identity. Although it did not directly affect her academic progress, she had to face the consequences of the *numerus clausus* legislation introduced in 1920 due to her having come from a converted Jewish family on her paternal grandfather's side.

The change of girls' education system in the interwar period in Hungary—an overview

To better grasp the social context of female enrollment in the secondary and higher education system in Hungary, a closer look at the background is in order. The very first *gimnáziums*[3] began admitting girls as early as the 1870s, initially offering six years of secondary education following four years of elementary schooling. The rationale behind this school type was to "to provide girls with an education that prepares them for their role in the family and society and equips them with general literacy (Csorba 1989: 6). In 1895, a royal decree made it possible for women to continue their studies at the university in the humanities as well as in medicine and the pharmaceutical sciences. Starting in 1896, further courses were organized to prepare female high school students

[1] Patented on January 21, 1941, no. 2,229,481, and assigned to Westinghouse Electric and Manufacturing Company.
[2] For further details about the Dover Sun House project see: Rédey 2023.
[3] In Hungarian the word *gimnázium* is equivalent with the American high school, and *leánygimnázium* is used for the American "girls' high school" which is used later in the paper.

for university. These later evolved into the institution known as the independent girls’ *gimnázium* (*leánygimnázium*). A national regulation adopted in 1916 distinguished three different types of girls’ high schools in Hungary: 1. high school for girls, which offered three years of education; 2. trade high school for girls (also three years); and 3. The girls’ *gimnázium* (*leánygimnázium*), which offered four years of education. The first two types were intended for girls who did not contemplate further studies or a professional career as earners. As the royal decree put it: “…in view of women’s special calling and their role in society and the family, this secondary school model is intended for girls who do not wish to pursue university studies” (Csorba 1989: 9). Only the third type, the *leánygimnázium*, left open the possibility of subsequent university studies. This system was changed and further enhanced to broaden opportunities for young women exactly a hundred years ago. Act XXIV of 1926 established three high school types: 1. girls’ *gimnázium* (*leánygimnázium*) 2. girls’ *lyceum* and 3. *leánykollégium* (girls’ high school) (Act 1926: 4). The first two, both eight-year schools, offered specific education in preparation for university studies, focusing on subjects like classical Latin language and literature,[4] the third type continued to provide education for women who did not wish to attend university.

Despite the increasing number of high schools for girls, the *gimnázium* (both for boys and for girls as well) remained the school type preferred by and accessible only to a select wealthy few, accounting for approximately 10% of the total number of high-school students in the 1910s. Statistics from 1912–13 show that there were around 6,800 students in girls’ high schools and 1,070 in girls’ *gimnáziums* in Hungary (Nagy 2003: 5). By contrast, in 1914–15, enrollment in the thirty-eight high schools in Budapest amounted to 16,000 students in total. The growth trend continued until 1929–30, when forty-six high schools were attended by 21,356 students. Of this large number, only seven were girls’ *gimnáziums* (with 2,907 students) and another seven boys’ *gimnáziums* (with 3,482 students) (Frank 2009: 58).

Scholars agree (Karády 1997:59 and 63; Frank 2009: 58; Marx 1994: 163) that the above-mentioned elite system became available mostly for the children of wealthy families, often with Jewish origins. Whether a family could afford to send their children to a *gimnázium* in Hungary was primarily a financial issue. After graduation, these children typically went on to study at universities either in Hungary or abroad in cities like Berlin, Vienna, Zurich or in other European countries. “Jews produce the greatest number of geniuses. The education of Jewish girls, both at the secondary and higher levels, is greater than that of Christian girls, all the more so because, with the appropriate financial means at their disposal, they can still easily attend colleges in Germany, Vienna or Prague, while the world is closed to the poor Hungarian girl if she is excluded from Hungarian universities” (Kornis 1925: 11). This is how Gyula Kornis[5] assessed the situation in 1925 referring to the *numerus clausus* legislation introduced in Hungary in 1920. Although the ethnicity-based enrollment quota was amended in 1928, the law especially affected and shrank the

[4] According to the report of the school including Telkes’ grades in 1918, she received results in the following subjects: Religious studies, Hungarian, Latin, German, Greek languages, History, Quantity, Natural science, Health science, Humanities, Sports and Behavior (Report 1918: 37).

[5] Gyula Kornis, a philosopher and university teacher. According to Telkes’ grade book Korniss taught Telkes in subjects: logic, ethics, philosophy, and psychology between 1920 and 1923 at the university. Later Kornis became Secretary of State of the Ministry of Religion and Education (between 1927 and 1931) and president of the Hungarian Academy of Sciences (between 1945 and 1946).

opportunities of female students at universities. The phenomenon was not unique to Hungary in the 1920s and 1930s. There were cases even in America, such as described by Rossiter: "Anti-Semitism was enough of a problem in academia in these years to merit occasional mention. Libbie Hyman had intended to study botany at the University of Chicago but found enough anti-Semitism in that department to make a transfer to zoology necessary" (Rossiter 1982: 373).[6]

Among the girls, educational opportunities perhaps correlated even more closely with a denominational approach than among boys. Statistics show that, in 1910–11, 21.2% of male high school graduates and 30.0% of female high school graduates affirmed their Jewish identity (Nagy 2003: 6 and Karády 1997: 59, 63). By 1930–31, the ratio of Jewish attendance had decreased but the split between the sexes in the group had remained mainly unchanged (16.1% Jewish boys, 26.2% Jewish girls). The University of Budapest, during the first ten years after opening its doors to women in 1895, reported that Jewish female and male students accounted for one half and one third of the total enrollment, respectively.

Economic and financial-related statistics corroborate these enrollment figures in terms of distribution by family background during the same period. In 1913, upper-class Jews had filled fifty-one out of the seventy-nine senior positions in the banks of Budapest. By 1935, their participation in the sector had decreased to holding only twenty-six out of ninety-eight banking positions.[7] Indeed, these numbers (both in education and economics) may be seen as underrepresentative of Jewish participation considering the wave of conversion among Jewish families. "The choice by many Jewish students (or their parents) to attend various Christian high schools of various denominations in the early twentieth century was related to the phenomenon of religious conversion. Though these schools were of exceptionally high quality, Jewish enrollment in them expressed a willingness to assimilate" (Frank 2009: 57). Notable cases of conversion included for example Leó Spitz (born in Budapest on February 11, 1898) whose family changed its German surname to the Hungarian Szilárd in 1900, or Kornél Löwy (born in Székesfehérvár in 1893) whose father Magyarized his family name to Lánczos in 1906 (Marx 1994: 163 and 239).

The "Magyarization" of Jewish names was promoted enthusiastically by Simon Telkes, the paternal grandfather of Mária Telkes. Born in Szeged in 1845 as Simon Rubin, in 1881 he changed his family name to Telkes and converted from Judaism to Unitarianism in 1883 (Telkes 1897).[8] Simon Telkes was a respected public servant of the Hungarian Statistical Office and later other governmental agencies. In 1907, the emperor honored his services by conferring on him the noble

[6] Rossiter mentions another example as well. „Although Helen Tracy Parsons thought The John Hopkins „as essentially Jewish" when she was there in the early 1920s, Elmer V. McCollum complained to the Rockefeller Foundation officials that he could not get his assistant, Elsa Orent (later Keiles), a Russian Jewess, on the payroll at Hopkins in 1936 and again in 1938: "Both because she is a woman and because she is Jewish it will be difficult to place her elsewhere, but McCollum says that she is the most useful and valuable research assistant he has ever had" (Rossiter 1982: 373).

[7] In his work *Jewish Nobles and Geniuses in Modern Hungary* William O. McCagg mentions the Telkes family as an example of not only the capitalist imitation of the court banker ideal in Hungary, but also the formation of Hungary's scientific geniuses (McCagg 1972: 42, 67–68).

[8] Simon Telkes established the Central Name Hungarianization Society [Központi Névmagyarosító Társaság] in 1881 to promote Jewish families for "Magyarization". (Konrád 2024: 304)

title of "Kelenföldi de Telkes." The title was passed on to Simon's son Aladár (Mária's father) and to Mária herself, although she never used it.[9]

Mária Telkes' education in Hungary (1910–24) and her arrival in America (1925)

Mária Telkes was born on December 12, 1900, in Budapest as the first child of Aladár Telkes and Mária Lábán. By 1911, her father, a bank official later appointed to the helm of the United Budapest Savings Bank ("Egyesült budapesti fővárosi takarékpénztár"), had the means to purchase property in an elegant neighborhood, under 43 Gellérthegy Street, where the family used to live together.[10] In their home in Budapest, Mária witnessed all of her father's business ventures, and these memories later influenced her in America. In 1924, Aladár Telkes registered a manufacturing company under the name of *Hidrophyl Vatta és Kötszergyár Rt* ("Cotton and Bandage Factory Inc.") which he proceeded to list on the stock exchange as well. In those days, however, years after the Great War, the bandage market was decreasing, even as demand for his products was never high to begin with. In another attempt, Aladár Telkes set out to promote Hungarian folk art in America. *The Orsó és Rokka Háziipari Szövetkezet* ("Reel and Spindle Home Industry Cooperative") focused on selling Hungarian folk-art embroidery in the US with the help of Ernő Ludwig, Mária's maternal uncle, who served as the consul in Cleveland.[11] Apart from supporting the family business, Ludwig was to play a key role in Mária's life later on when he invited her, in 1925, to build her professional career in the US.

Telkes was among the first female students to be admitted to the girls' *gimnázium* (*leánygimnázium*) Sophianum Sacre Coeur in Budapest, established in September 1914, reserved female enrollment to two grades (1 and 5 in a system of eight grades). Telkes was one of the thirty-one girls who graduated in 1918. According to a school report (Report (b) 1917–18), all of them intended to continue their studies in higher education: thirteen in the humanities, seven in medicine, one in pharmaceutical sciences, and six in teacher training. The remaining fourteen female students were either indecisive or eyed a career that was yet unavailable for women at the end of their high-school years. Given her special interest in engineering, Mária Telkes was probably among these girls. The increase in the number of female students in Hungarian higher education was remarkable starting in 1918, when Telkes earned her high-school diploma. Female acceptance in universities was mostly because *leánygimáziums* had opened their doors in the early twentieth century in Hungary.[12]

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[9] Telkes never used the prefix "de" in her family name. We can only meet the noble "de Telkes" prefix in correspondences with some official persons who addressed Mária in this way.

[10] The same address is indicated on Mária Telkes' university grade book between 1918 –24 and also on the migration documents to the US in 1925. The title to half of the property was transferred to Mária in 1926, the year after she left for America.

[11] This business also failed due to the dissolved painting during washing of the textiles in America and the venture was closed in 1928. The family stories were told by Lászlóné Ducz, granddaughter of Mária Lábán, Mária Telkes' mother (Búza 2009: 15).

[12] Among others, special *gimnáziums* for girls were the Calvinist "Baár-Madas", which opened its doors in 1907, the Hungarian Royal National "Erzsébet", which opened in 1908, or the Budapest "Zrínyi Ilona" which opened in 1917 (Bácskai 1970: 45).

Telkes was much more interested in engineering and, given her abilities and proclivities, the faculty of chemical engineering at the Budapest University of Technology would have been the ideal academic environment for her. However, it was offlimits for female students in 1918, as enrollment remained a male privilege until 1924. Although feminist organizations in Hungary, such as the Organization of Feminists or the Association of Hungarian Women Organizations, had grown increasingly influential since the early twentieth century and eventually achieved political gains, opportunities for women remained limited. They had to fight long and hard to win equal admission opportunities for women at all universities, including the University of Technology, demanding the same conditions as men.[13] They achieved success only in 1924, when the Rectoral Council of the Technical University resolved to admit women up to 5% of the total enrollment, as long as men did not already exhaust the permitted capacity. Prior to 1924, the only way for female students to study natural sciences or chemical engineering, including laboratory privileges and advanced analysis, was under the auspices of humanities faculties. Pázmány Péter University of Budapest was among the first institutions in the country to admit women, among them Telkes, to its chemistry and physics programs, supplemented by experimental sciences.

Year	Field of education				
	Humanities	Medical	Pharmacist	Accountings	Engineering[14]
1896/97	3	3			
1899/1900	14	17			
1900/01	57	24			
1905/06	131	41	2		
1910/11	172	110			
1914/15	293	220	13	56	
1918/19					10
1920/21	504	303		9	4
1923/24	533	89	35		
1924/25	471	17		4	

Figure 1. Number of female students in different fields available for girls in the higher education in Hungary between 1986–1925 (number of accepted female students in the academic years). Source: Kornis 1925 and Palasik 2002: 168.

[13] See *Figure 1* for detailed numbers of girls in the Hungarian higher education of the period (Palasik 2002: 168).

[14] The 1918–19 year's female engineers were accepted according to the short-lived state First Hungarian Republic's (Hungarian People's Republic) decision, which for the first time in the Hungarian history allowed women to earn engineering diploma at the Budapest University of Technology. With the fall of the civic democratic regime, at the beginning of the fall semester of 1919, women students were banned again at the University. Source: Palasik 2002:169.

Having graduated from a high school in Budapest[15] on June 29, 1918, Mária Telkes embarked on her university studies in physics and chemistry at the Pázmány Péter University of Budapest, Faculty of Humanities, in the autumn of the same year. [16] After completing eleven semesters, she received her "absolutorium" and earned her doctoral degree on October 11, 1924, *cum laude*, both in her major of chemistry and her minor subjects of experimental physics and mineralogy.[17] More than a student of excellence, she was also active in civil life during her university years. At the thirteenth national Catholic conference, held in October 1920, she delivered a speech about the tasks facing female university students of the day (General assembly 1920: 3). After her university years, Telkes also spent some time in Germany in a position with her postgraduate work,[18] which was made possible by the wealth of her family. Early on, she distinguished herself by her aptitude for invention and passion for new discoveries. She filed her first patent application in Hungary in 1923, while still at university.[19]

After reading a paper about future energy sources by Kornel Zelovich, an engineer and university teacher at the Budapest University of Technology, Telkes's interest turned towards the utilization of solar power. The paper described experiments in solar energy going on mostly in the United States of America. This idea so strongly motivated Telkes that she decided to move there. Her uncle, Ernő Ludwig, had been living in the United States with his wife, Edith, since 1909, and they invited Telkes to join them in 1925. Arriving in Cleveland in September 1925 with a PhD in experimental physics and chemistry, Mária Telkes faced massive challenges in finding a job as a female engineer or research associate. The obstacles loomed large even though her supporter, Ernő Ludwig, wielded considerable influence in Cleveland as a consul in office since 1909. He was able to help her through his connections, at least initially. One of her first attempts was at doing business with the family folk-art embroideries. Soon after her arrival, in November 1925, she showed some of these items at an exhibition curated by the Federation of Women's Club in Cleveland. "A collection of beautiful handwork, Hungarian, Italian, German and Czecho-Slovakian, was exhibited by Dr. Marie Telkes," the *Cleveland Plain Dealer* reported on the event (Glasier 1925: 17).

As regards her own profession, there were no female engineers working in the United States in the 1920s, and the situation had barely changed by 1938: when Telkes arrived in America, the total number of female scientists in physics and chemistry stood at twenty-one (4.7% of the total workforce) and twenty-eight (6.5%), respectively. By 1938, these figures had climbed to sixty-

[15] Telkes started her high school studies in 1910 at the "Angolkisasszonyok Sancta Maria Római Katolikus Leánygimnázium Budapest" [Budapest English Ladies' Sancta Maria Roman Catholic Girls' High School] changed in 1914 and graduated from the „Budapesti Szent-Szív-Szerzetesnők Katolikus Leánygimnázium – „Sophianum" [Budapest Catholic Girls' High School of the Sacre Coeur Nuns – Sophianum] with excellent results (she had only excellent grades in all her subjects) in 1918 among the thirty-one female students.

[16] See the University Report of Philosophy Doctorates in year 1924–25 (ELTE 1924–25).

[17] The title of her thesis was: Investigation of "Walden's" law in isosmotic aqueous solutions of non-electrolytes (A "Walden-féle" törvény vizsgálata nem elektrolytok isosmotikus vizes oldatában) (ELTE 1924–25).

[18] As it is mentioned in her biography written in May 1952 (Telkes papers 1952: 15).

[19] The title of her patent application was: "Method and apparatus for repairing consumer goods, food and perfumes using electricity" under file no. 550.T.3509. date: October 23, 1923. Source: *Report of the Hungarian Patent Office* in 1925. (Accessed by Arcanum.hu on December 11, 2024) Unfortunately there is no further information available about the application and development of this idea.

three physicists (3.3%) and 163 chemists (8.5%) (Rossiter 1982: 136). In the United States of the 1920s and 30s, a female engineer was such a rare phenomenon that the press picked up on the few mavericks instantly, labeling them "invaders" of the male-dominated fields of engineering. As Rossiter points out, "these women were so few, however, as to remain exceptions or examples of the outer limits of women's employment in science in these years rather than evidence of a broad movement" (Rossiter 1982: 260). The Women's Engineering Society was founded in 1919 in Great Britain to protect women's jobs in general and to promote female careers in engineering in particular. In the U.S., similar associations, specifically targeting the engineering sector, were established around the same time. In December 1918, a budding sense of camaraderie and shared professional goals inspired a group of women from the University of Colorado to establish a national organization for female engineers and architects (Bix 2013: 38). The Women's Architectural Club of Chicago was one of the first such societies to be founded later, in 1928. The formation of the American Society of Women Engineers and Architects was announced to serve women by offering them engineering training courses at five American universities, including Michigan, Kansas, Ohio State, Illinois, and Texas. Although this society never grew into a major national organization, some of its founding members, notably Elsie Eaves and Hilda Counts Edgecomb, continued to encourage female engineers and, after World War II, helped promote the creation of the Society of Women Engineers (SWE), which still exists today (Bix 2013: 39). Some decades later, in 1952, Mária Telkes became the first woman to be awarded by the newly founded SWE prize for her meritorious contribution to engineering in the utilization of solar energy.[20]

Changing paradigms: vocational guidance and the "human touch" of scientific management

What were the socially accepted female roles when Mária Telkes arrived in America in 1925? What other challenges did she face at that time? She certainly did not come to the New World to get married and start a new life as a housewife or find a job as some sort of "household engineer" concerned with home economics. However, these must have seemed realistic options in the 1920s and 30s, when stereotypes strongly determined workplace positions. As Sharon H. Strom observes, "engineering remained the most difficult of all the professions for women to enter through the twentieth century, and without access to engineering women were essentially excluded from the material development and managerial structuring of the corporate process" (Strom 1992: 77). Outright discrimination was the most likely explanation for the almost total paucity of women in that field. This attitude characterized the job market for women who tried to pioneer and break the patterns. Low and negative expectations became even more discriminatory when compared to management's strikingly different attitudes toward the employment and advancement of young male scientists in the 1920s and 1930s. During this period, young male scientists were viewed as the saviors of the scientific industry, in contrast to women at all levels who were often seen as presenting "problems" for management. Frank B. Jewett, president of Bell Telephone

[20] Despite the controversial relation between Mária Telkes and Hoyt C. Hottel at MIT in 1952–53, MIT also acknowledged the award and Mária Telkes's efforts. Her award was mentioned twice in the *President's Report Issue MIT Bulletins*: first in Volume 88, October 1952, and second in Volume 89, November 1953. The 1953 issue also mentioned Telkes and her award in the "Personnel and administration" introduction section as the only female awardee.

Laboratories, and Willis R. Whitney, director of research at General Electric Company, frequently emphasized the industry's need to recruit and motivate these highly sought-after male employees. Their lofty discussions on this topic became a common theme in grandiose articles during the 1920s and 1930s. According to this perspective, the talents of these individuals were considered so rare and valuable that the industry felt justified in providing every incentive and inducement to keep them engaged in research within an industrial setting (Rossiter 1982: 256).

It was in this spirit that job advertisements and products were announced in the engineering magazines sponsored by the largest and most advanced technology corporations. Women were portrayed as pinups in tight sweaters or swimsuits, glamorizing men's pursuit of sexual conquest (Bix 2013: 24). Established in 1919 in New York City, the Bureau of Vocational Information (BVI) sparked the vocational guidance movement, an initiative to tackle the stereotyping and discrimination of women in the workforce The agency's role was to conduct groundbreaking studies on women in various occupations, including fields such as chemistry, employment management, department store management, and statistical and secretarial work (Strom 1992: 119). The home products industry was identified as one of the sectors with the greatest potential of success for female scientists. Companies hired women professors of home economics to develop new products or new markets. Mary Barber, formerly a member of Teachers College at Columbia University, gained recognition in the 1930s for her work with the Kellogg Company in Battle Creek, Michigan, where she developed foods and served the first in-flight meal on an airplane (Rossiter 1982: 258).

Early in the twentieth century, the ideal candidate for a career in engineering was invariably male in the eyes of the adherents of "scientific management." Implementing the main aspects of Taylorism, the focus was on increased productivity, the rationalization of tasks, and the effective use of technology. Although psychology, vocational guidance, and welfare work were all experiencing significant growth among teenagers, these fields continued to be viewed with skepticism in business and engineering circles due to their perceived "soft-hearted" and effeminate connotations (Strom 1992: 125). Especially after the death of Frederick W. Taylor in 1915, a new approach to scientific management materialized, with an emphasis on the human factor. With the aim of understanding and helping each other, and educating management, a new professional specialization in industrial relations was formed. Members of the Taylor Society, such as the efficiency expert Lillian M. Gilberth and the industrial sociologist Mary van Kleeck, took the lead in embracing the new attitude, bringing the "human factor" or "feminine touch" to the corporate enterprise.

In 1926, these women were dispatched as delegates to the Women's Industrial Conference sponsored by the Women's Bureau, where they stood up for women's protective legislation (Strom 1992: 128). Later, they also served on the Industrial Code Committee and contributed to the drafting of a document endorsing reforms, including the standardization of the eight-hour workday and the banning of nighttime work, especially for women. General attitudes began to change slowly, and the reform efforts eventually won social recognition for the single woman who feels it is her duty to work outside the roles of being a housewife and mother and to build a professional career. The idea that "all girls were simply looking for an interim job between school and marriage" began to be seen as a misperception.

A case study of two "invaders": Mária Telkes and Amy Rowland at the Cleveland Clinic

In the early twentieth century, Cleveland, one of America's most rapidly developing industrial cities, showed increasing attention to gender issues and the changing roles of women in urban society. Mary Barnett Gilson, economist and later professor at the University of Chicago, was invited to Cleveland in 1913 to be the employment director of Joseph and Feiss Clothcraft Shops. The reforms in employment management she introduced at this company helped to implement the "human factor" for the factory. With a significant number of women workers and a management approach that focused on personal interaction, Clothcraft took on a parental role for its young female employees, a characteristic seen only in selected firms. By 1915, Clothcraft had established an employee cafeteria, a medical department, a thrift bank, recreational facilities, a factory orchestra, a choral club, and a branch of the Cleveland Public Library (Strom 1992: 133).

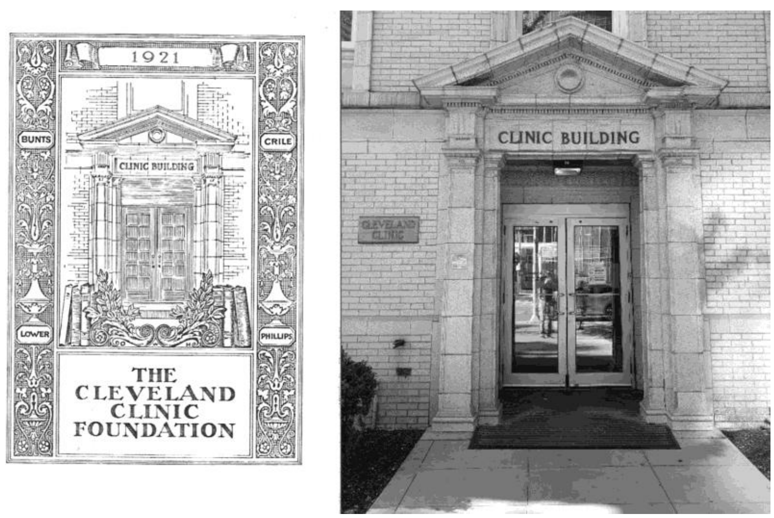
In 1919, a survey entitled *Opportunities for Trained Women in Cleveland Factories* found that many women held leading positions, particularly in accounting, among the 125 factories surveyed. Four women headed cost accounting, and several oversaw payroll departments (Strom 1992: 91). The municipal government was also sensitive to issues of women at work. In the 1920s, Cleveland was one of the few places in America where female participation in the workforce was acknowledged in the professional fields. The Board of Education in Cleveland hired four women psychologists, which was the second-highest number of female employees in a national ranking.[21] Miss Linda A. Eastman, director of the Cleveland Public Library, was the first woman to head a metropolitan library system in the United States, from 1918 to 1938 (Morton 1972). The present main building of the library opened during Eastman's presidency, in 1925, the same year Mária Telkes arrived in Cleveland.

George Washington Crile, one of the founders of the Cleveland Clinic, was among the innovative physicians of his age. After finishing his medical studies at Western Reserve University in Cleveland at the end of the nineteenth century, Crile developed an interest in research and experimental medicine. "Crile performed one of the earliest laryngectomies; he performed radical neck dissection, invented a spring clamp to temporarily occlude the carotid artery, and continued his experiments on the origin of shock" (Loop 1993: 76). He established the first school of nurse anesthesia at the Lakeside Hospital in Cleveland, where he achieved significant results. He reduced the mortality rate from 6.8% in 1898 to 1.9% in 1912 with the help of improved intraoperative monitoring and anesthetics. Crile considered Amy Farley Rowland as a woman of extraordinary accomplishment in her age (Taylor 1982: 150). Rowland graduated from Mount Holyoke College, Massachusetts, in 1893. Her alma mater conferred upon her the honorary degree of Master of Science in 1921 in recognition of her scientific research. She began working with Dr. Crile in 1914 as his secretary, editor, and research assistant. During the Great War, Crile was asked to organize the "Ambulance Américaine" military hospital for the American Colony in Paris. "I selected my group from among my immediate associates and operating-room staff at Lakeside Hospital, with an additional member for special research." (Crile 1947: 250) Amy Rowland, mentioned by Crile as a researcher, was a member of his staff during the war. The other members of this cherry-picked

[21] Board of Education, Department of Health, and other courts and hospitals had ten female employees in New York City, being the first city in the national ranking of governmental female positions in 1938 (Rossiter 1982: 245).

group included several other women, including anesthetists and operating nurses. Following three months of treating casualties at Neuilly, close to the front lines, the group returned, and Crile organized a base-hospital unit (Bunts and Crile Jr. 1971: 7).

Later, after the war, the experience of the military hospital led the founders to establish their own hospital, the Cleveland Clinic Foundation. In 1921, when the Clinic was established, Amy Rowland was appointed head of the Editorial Department. She edited numerous technical volumes by Dr. Crile and his associates and coauthored some of their subsequent papers (Taylor 1982: 151). After helping to establish the Cleveland Clinic, Amy Rowland began to claim a part in Crile's research projects as well. "In the studies of electric conductivity of animal tissues under normal and pathologic conditions which Miss Rowland and her group had conducted, the following findings were of special significance: In every adult animal studied, the conductivity of the cerebrum was higher than the conductivity of the cerebellum" (Crile 1947: 370). Rowland established such a reputation as a skilled relief organizer that she was sent to take charge of the relief work following the Lorrain tornado disaster in Cleveland in 1924. Later, Rowlandwrote the first history of the Clinic (1938)[22], where she worked until 1942 as the executive secretary of the Research Department. "Amy Rowland played a very important part in the history of the Clinic," recalled Alexander T. Bunts, the son of one of the founders of the Clinic, in 1970, before the publication of *Acting as a Unit – A history of the Cleveland Clinic* — a volume he co-compiled with Crile (Bunts papers 1970).[23]



Picture 1. The main entrance of the Cleveland Clinic as presented on the front cover of Amy F. Rowland's book published in 1938 by The William Feather Company, Cleveland Ohio, the building and the same entrance still existed in 2025. Sources: Amy Rowland, *The Cleveland Clinic Foundation* (1938), Photo by the author (2025)

[22] See Picture 1. for the cover of the book published in 1938.

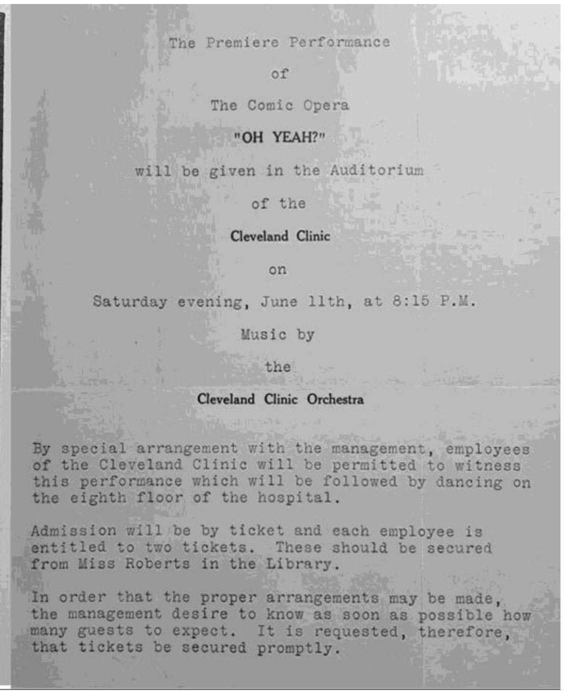
[23] The book "Bunts: *To Act as a Unit"* mentions Mária Telkes's contribution in Chapter XIII – "The history of the division of research": "Dr. Hugo Fricke and Dr. Maria Telkes measured the thickness of cell membranes and showed their relationship to electrical charges in the cells. These were widely recognized as pioneering contributions to this complicated field." (Bunts 1971: 122)

The Cleveland Clinic Foundation, a non-profit organization, was established in 1921 by four founders: Frank E. Bunts, George W. Crile, William E. Lower, and John Phillips. It had four divisions: the Cleveland Clinic, the Cleveland Clinic Hospital, the Research Division, and the Frank E. Bunts Educational Institute. The Research Division was coordinated by Crile and focused on biophysics from the beginning. According to Rowland's description, the Cleveland Clinic had been characterized by an interactive relationship among doctors, nurses, and scientists, aided by the structure of three divisions responsible for clinical issues, research, and education. "The inflow of new knowledge to every member of the staff seemed to offer an ideal set-up" (Rowland 1938: 16).

The procedure adopted by the Clinic aimed to practice medicine in surgery as in all other specialties; to perfect the application of existing knowledge; to find new knowledge by scientific research, and to train young medical graduates. The founders agreed that one-fourth of the net revenues had to be devoted to research. The Clinic was formally opened on February 26, 1921. Later it was augmented by an art department, an editorial department, a library, a mechanical-engineering shop, and a print shop. The employees' family-like atmosphere was well demonstrated in their regularly organized choir and theater performances.[24] The work of the Art Department has included making of drawings for the illustrations of medical papers and books, photographs of patients, of anatomical specimens and of drawings, lantern slides, transparencies for exhibits, wax models of pathological specimens and of various organs and tissues. The Editorial Department, headed by Amy Rowland, was responsible for publishing books and articles.

Picture 2.

[24] See Pictures 2 and 3 for the invitation cards and posters of the Cleveland Clinic plays.



The Premiere Performance

of

The Comic Opera

"OH YEAH?"

will be given in the Auditorium

of the

Cleveland Clinic

on

Saturday evening, June 11th, at 8:15 P.M.

Music by

the

Cleveland Clinic Orchestra

By special arrangement with the management, employees of the Cleveland Clinic will be permitted to witness this performance which will be followed by dancing on the eighth floor of the hospital.

Admission will be by ticket and each employee is entitled to two tickets. These should be secured from Miss Roberts in the Library.

In order that the proper arrangements may be made, the management desire to know as soon as possible how many guests to expect. It is requested, therefore, that tickets be secured promptly.

Pictures 2 and 3. Front covers of the invitation cards of the Cleveland Clinic Theater comic spectacles from 1926, 1927, and 1932. Source: WRHS Cleveland History Center, Crile Papers

The Research Department was supported personally by the founders, among other donors, with Crile contributing $5,000 of his own funds annually. By 1938, the Clinic had accumulated contributions to research valued at over $1,000,000. Laboratories were furnished in the newly built Research Building, equipment purchased, skilled personnel employed, and a shop was installed for the manufacture of scientific instruments and apparatus. Having pursued research in biophysics from the start, the Clinic branched out into biochemical research in 1930.[25] Amy Rowland had been among the first researchers and the only female scientist at the department until Mária Telkes was recruited. Rowland specialized in the thermoelectric aspects of temperature variations in animal tissues, in particular the brain and the liver, in collaboration with George Crile and S.W. Wallace. In 1927, Otto Glasser, a pioneer in radiology and radium therapy, was appointed head of the department.

During the spring or early summer of 1926, Telkes literally walked into her new job with Crile by her side at the Cleveland Clinic.[26] “While escorting her on a tour of the Clinic laboratories, Dr. Crile learned that his young visitor had just won her Doctor of Philosophy degree from Budapest

[25] One of the first researchers invited by Crile was Hugo Fricke, the Danish American physicist from Harvard University, who studied the effects of X-ray and invented during his Cleveland years the “Fricke dosimeter” which was named after him.

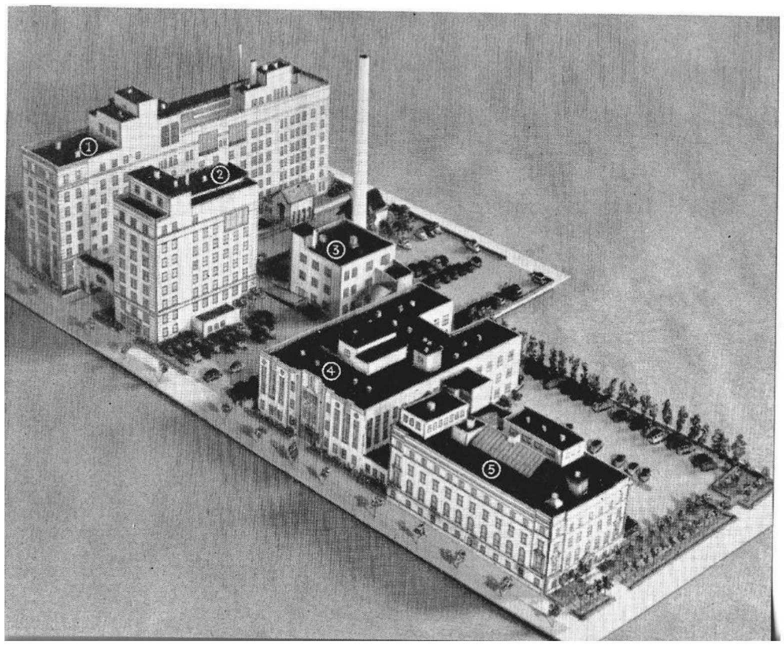
[26] Though unsupported by direct evidence, the most likely hypothesis is that Mária Telkes and Amy Rowland first met at the earlier mentioned Hungarian folk-art exhibition organized by the General Federation of Women’s Club in Cleveland 13 November 1925. Mária attended the event to present her Hungarian needlework. The event was organized by the Club where Amy Rowland was the president during that time. Probably it was Amy Rowland who introduced Mária Telkes to her boss, George Crile.

University in electrobiology, the very subject in which Dr. Crile was beginning to take an interest" (Leacacos 1937: 2). So it happened that, at the age of 26, in the summer of 1926, Telkes started working at the Research Department of the newly founded Cleveland Clinic. During her first weeks on the job, Dr. Crile — "The Chief" to his family and closest friends — happened to be away on a hunting expedition in Tanganyika. During his vacation, between July 15 and September 1, 1926, Amy Rowland reported regularly to the professor, updating him on Telkes' research progress. In her first report, dated 13 August 1926, Rowland stated that "Dr. Telkes' work is going on with the rats received from the Crocker Institute. The tumors in those which received the lead colloid were smaller than in the other rats, and the gross appearance of sections from tumors from the treated rats was different from sections from the untreated rats" (Crile papers 1926). Shortly after she started working at the Clinic, Telkes achieved promising results between January and March 1927. Rowland's subsequent reports gave enthusiastic accounts about Telkes' research in detail. "Dr. Telkes is now having an electrode made with which she feels the measurements from which she can calculate specific capacity and conductivity. We shall then have a true basis for comparison. She has been having a good deal of trouble with her cell for the measurement of the ameba as it is so very small that it has been almost impossible for her to get constant measurements. By using the de Khotinsky cement, she has at last succeeded in getting a constant cell, and tomorrow morning I hope she will make some measurements" (Crile papers 1927).

Just a few days later, Telkes managed to take measurements of the ameba, and further experiments were awaiting the completion of the necessary micrometer screws. Rowland also reported on an experiment Telkes performed on rabbits for Dr. Lower. Rowland hired an assistant (a girl from Oberlin) to relieve Telkes of some of her workload, allowing Telkes to concentrate on the more intricate parts of her research. On March 12, Rowland mentioned that "Dr. Telkes has been able to put an electrode into the jugular vein, her second electrode being in the liver. By this means, when the technique is perfected and when we have secured a sufficient number of controls, we shall be able to know exactly what part of the effect of the injection of an electrolyte is due to the presence of the electrolyte in the circulating blood and what to change in the tissues in the different organs. It seems to me that this is an exceedingly important step" (Crile papers 1927b).

Early on, Rowland came to regard Telkes as a very skillful operator and a perfectionist physical chemist. At a certain point, Telkes voiced a critical opinion about previous research related to the capacity and conductivity of the sodium chloride solution. "Of course, it has long been known that that is the law in the case of electrolytic solutions," Telkes commented, obviously implying that the previous measurements could not be correct (Crile papers 1927c). Rowland continued to praise Telkes's research results subsequently as well. Her name is mentioned among scientists who joined the Research Department of the Clinic, including well-known professors of the time such as Hugo Fricke or Otto Glasser, both of whom studied biophysical phenomena at the X-ray department. "Pursuant to the investigations on the use of colloidal lead solution by W. Blair Bell of Liverpool, Dr. Marie Telkes has succeeded in making a stable colloidal lead accompanying reprint" (Crile papers 1927d). In her last report summarizing research activities for the Board of Directors, Rowland stressed the progress made by Telkes, highlighting her achievements in biophysical research before commending her performance at the X-ray and clinical research departments (Crile papers 1927e).

Before long, it became obvious that the expansion of the Clinic's research activities, especially in biophysics, would require more space for the Research Department. The solution was to construct a new, eight-story Research Building in 1928 between the Hospital and the Clinic Building.[27] The new research facility, like the other buildings of the hospital, was immediately occupied to full capacity as soon as it was inaugurated. "The Research Building was planned in such a manner that neither the Hospital next door—also an eight-story building—nor the Clinic Building, which was separated by a lot, has ever experienced any annoyance" (Rowland 1937: 23). Unfortunately, just the opposite happened a year later, in 1929.



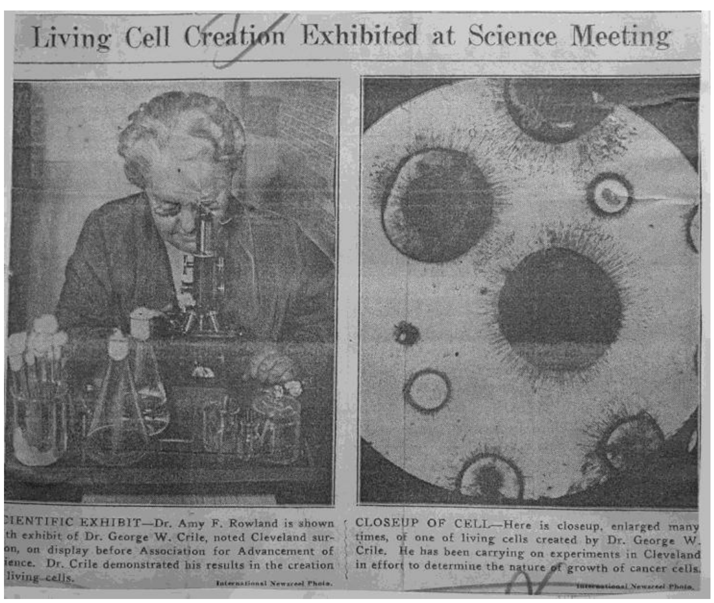
Picture 4. Model made to scale of Cleveland Clinic Foundation buildings in 1928. 1. Hospital; 2. Research Building; 3. Power Plant; 4. South Wing, Clinic Building; 5. North Wing, Clinic Building. Source: Rowland 1938.

Mária Telkes, busy at work in the Research Building, even witnessed the disaster that happened at 11.00 am on May 15, 1929, when several explosions shook the Clinic Building, killing 123 people, including one of the Founders, John Phillips. Amy Rowland, herself, barely escaped. "Miss Amy Rowland, assistant to Dr. George W. Crile and editor of all his publications, had left the Clinic Library on the fourth floor, until a month ago her own office, less than five minutes before the disaster came yesterday" (Cleveland 1929: 7), the *Cleveland Plain Dealer* reported on May 16. The investigation concluded that the fire was caused by the slow decomposition of nitrocellulose X-ray films, liberating deadly nitrogen peroxide gas in the basement storage place.[28] "The nitrous fumes were converted to nitric acid by contact with moisture in the lungs, causing acute rupture of the alveolar walls and pulmonary edema" (Loop 1993: 79), Floyd Loop said, explaining the high

[27] See Picture 4. of the model of Clinic buildings in 1928.
[28] Only after the Cleveland Clinic disaster did the manufacturers of the X-ray films become aware of this fire danger and started to print warnings and safety instructions on the containers of the films.

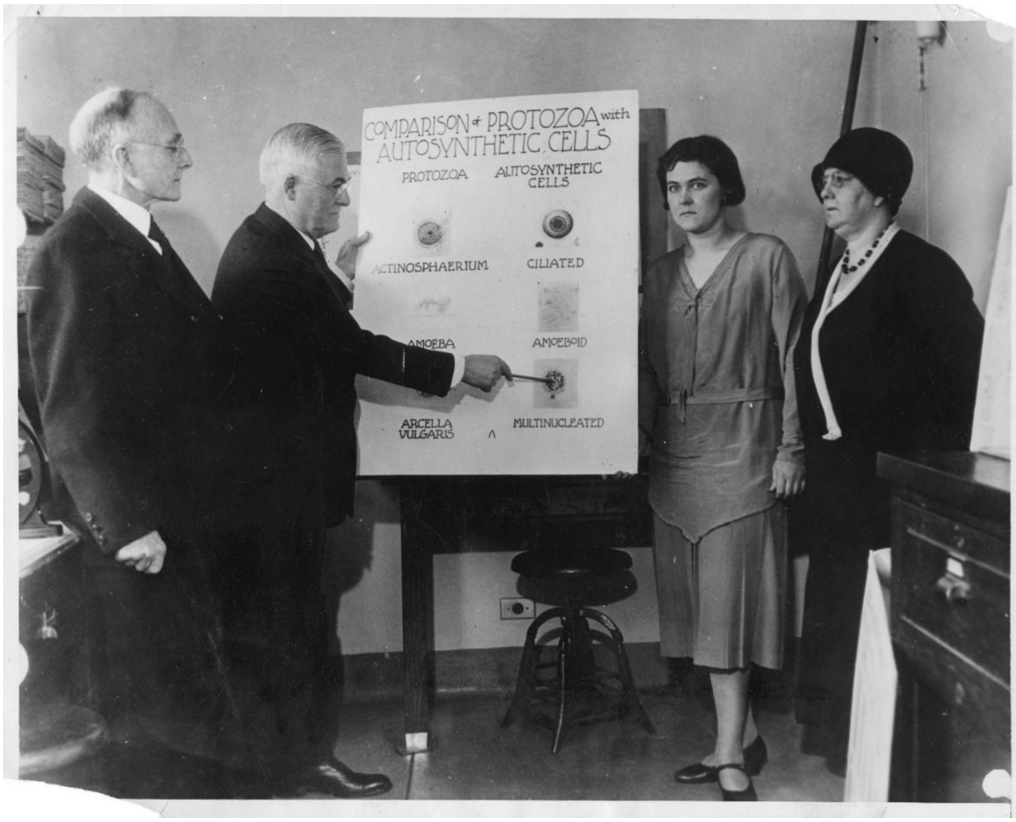
number of severely injured victims. Letters of sympathy arrived from all over the world. The disaster caused damage appraised at $4 million, but the Clinic itself survived the tragedy. The new Clinic Building was completed in 1931.

The disaster encouraged Crile to venture into new fields of research. He stated, "[our laboratory study of nitro-explosives to ascertain what caused the death of the victims of the Clinic disaster brought the conclusion that an analogous arrangement of nitrogen and carbon compounds would seem to be present in protoplasm, and that all animals, plants, bacteria, like nitro-explosives, are nitrogen and carbon compounds, linked together" (Crile 1947: 440).. Telkes and Rowland contributed to the new research project. "I embarked, with the assistance of Dr. Telkes and Miss Rowland on a study of the spectrum of the living state, including bio-chemiluminescent radiation and with Dr. Glasser on a study of mitogenetic radiation" (Crile 1947: 441), Crile recalled. For a few years to come, especially between 1929 and 1933, Rowland and Telkes actively worked together on this project. They reported on the progress they made at the Research Department's Laboratory of Biophysics from January 1, 1929, to December 31, 1930, focusing on the study of the physical characteristics of cancer cells. They summed up the results as follows: "In the course of these investigations it was found that when the lipoid extracted from the brain was mixed with the proteins extracted from the brain or any other organ in electrolyte solution cell-like structures were formed which have been named autosynthetic cells" (Crile papers 1931a). The several publications that followed[29] typically focused on explaining how the cells exhibited traits of a live organism: "They move, they grow, they divide and have a determinable respiratory rate" (Crile papers 1931b).



Picture 5. Amy Rowland is investigating the cells at the exhibition on December 29, 1930, at the convention of the American Association for the Advancement of Science held in Cleveland.
Source: Crile 1931c.

[29] See Picture 5, 6 and 7 for the publications of the exhibition presented by Amy Rowland and Mária Telkes.



Picture 6. Dr. George Crile, director of the Cleveland Clinic, visits Philadelphia and explains the functions and construction of his autosynthetic cells before a large and distinguished audience of medicos. Photo shows (left to right) Dr. Chevalier Jackson, Dr. Crile, Dr. Mária Telkes, and Amy Rowland after the lecture at the Jefferson Hospital. February 6, 1931 [original description on photo verso]. Source: Cleveland Public Library/Photograph Collection

The experiments leading to the creation of a living cell raised Albert Einstein's interest. He expressed his desire to meet Crile and see the autosynthetic cells for himself. Crile was asked to board the train in Cleveland that had left from Chicago bound for New York Central, as Einstein was on that train on his way from Pasadena, California to New York. On March 4, 1931, Crile and Einstein had the opportunity to talk face to face on the train between Cleveland and New York City. "I was glad to have the opportunity of meeting such an authority as Einstein," Crile remembered, "and to have him go over all our data. He proved to be an intense interlocutor. I was impressed with the ease and flexibility of his mind, his simple mode of reasoning and his obviously great power of concentration" (Crile 1947: 467).

For several years after this meeting, Rowland and Telkes coauthored several papers with Crile describing the results of their joint research effort.[30] In 1936, these studies were abridged and published in Crile's book *The Phenomena of Life* (Crile 1936), edited by Amy Rowland. The book contained two studies by Telkes[31] and referred to the device she invented. "By means of

[30] See Appendices.
[31] See Appendix on Telkes's publications.

micromanipulator—a device whereby, by means of fine needles, particles of organisms of microscopic size can be moved about on the stage of microscope—Dr. Telkes was able to introduce one electrode into the nucleus of an autosynthetic cell and the other electrode into the cytoplasm and thus to measure directly the potential difference between the nucleus and the cytoplasm" (Crile 1936: 51). As late as in 1934, papers reported widely on Telkes's research achievements at the Cleveland Clinic, bringing her a popularity that proved essential in her election as a member of the 1934 All-American Team of Women.[32]

Still with the staff of the Crile Clinic in the spring of 1937, Telkes suddenly saw life accelerate around her. "An attractive young Hungarian girl today appears on the horizon as one who may in the future turn the world's whole economic structure upside down, be instrumental in the conversion of solar heat to electricity" (Crile papers 1937a). Telkes now revisited the idea which had originally attracted her to America: the utilization of the power of the sun. She developed an instrument which harnessed sunshine and turned it through a metal alloy into electrical current, with a potential efficiency of twenty percent. Her invention raised the attention of industrial companies after she presented it at a conference. Crile supported Telkes in her personal career and wrote the following enthusiastic words to her: "Dr. Telkes possesses an inventive as well as a philosophical mind, an unusual combination, and is extraordinarily well trained in the field of physical chemistry. She has written several articles of her own as well as others in collaboration with me. She reads and speaks several languages. In her work, she is accurate and industrious. In dealing with people, I have found her to be even-tempered, comprehending, and co-operative" (Crile papers 1937b). Finally, in 1937, after eleven years at the Clinic, Telkes moved to Pittsburgh after she accepted the position at the Westinghouse Research Laboratories as a biophysicist.

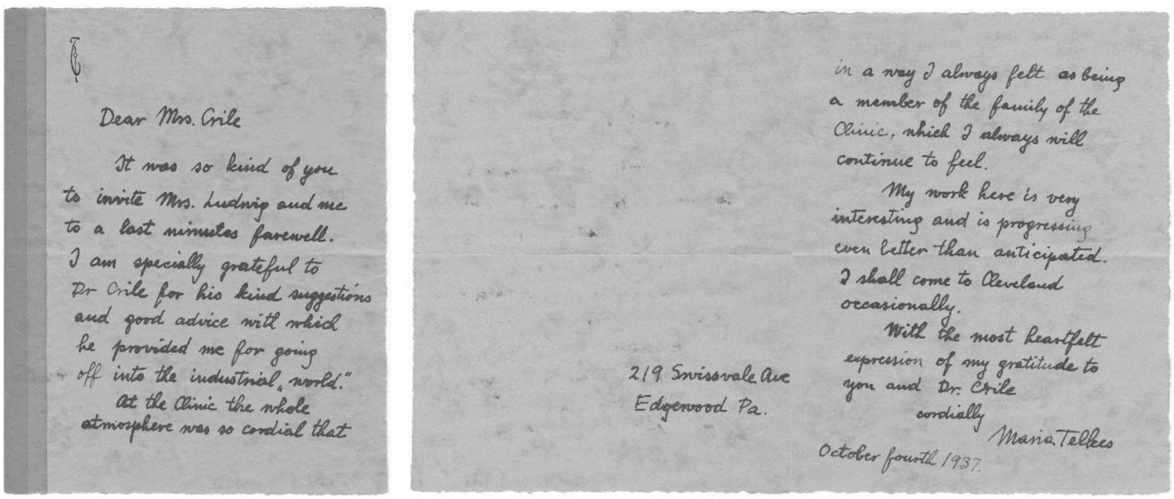
Conclusions

From the very beginning of their acquaintance, Amy Rowland supported Mária Telkes in many ways. She even signed Telkes's petition for US naturalization as a witness on July 6, 1937 (Petition 1937). There was a family atmosphere at the Cleveland Clinic during this period. Crile's wife, Grace, and his son, Barney, wrote about their recollections of everyday life and ongoing research at the Clinic, including Telkes's successful contributions. Rowland was part of this family: "Dear Mrs. Crile—We did it! And it was a wonderful experience. I'd fly again tomorrow," she wrote to Grace about her first flight experience in 1928. The employees not only put together the Cleveland Clinic Orchestra but regularly staged comedic opera performances.[33] "Dear Mrs. Crile, Thank you for your letter. Isn't it wonderful that even the grasshopper jumped on the 'lifeline'? As the enclosed shows, these misguided people invited me to talk about 'Scientific Research.' The University Buildings are beautiful here, and the meetings very well attended. Please do not forget me. With best regards to you and Dr. Crile" (Crile papers 1937c), Telkes wrote in her farewell letter to Grace Crile in the Fall of 1937, attesting to her deeply personal attachment to her workplace. In these years, Mária Telkes lived together with Mrs. Ernő Ludwig, the wife of Telkes's late uncle, who died in 1932. She was among those invited to Telkes's farewell dinner on October

[32] The team contained among others Shirley Temple, infant motion picture prodigy. For the full list see *The Cincinnati Post* "Nominations Made for 1934 All-American Team of Women," December 26, 1934

[33] See Picture 6 of the musical comedy covers.

4, 1937. "At the Clinic the whole atmosphere was so cordial that in a way I always felt as being a member of the family of the Clinic, which I always will continue to feel,"[34] Telkes admitted in her last letter to Grace. We know of no further documents pertaining to the friendship between Telkes and Amy Rowland, who in 1942 still worked at the Clinic. Amy Rowland died on March 10, 1953, at the age of 81. Telkes started her career utilizing the power of the Sun and went on to achieve great things, especially at MIT after she left Westinghouse, where she served as a researcher of the Solar Energy Research Project between 1939 and 1953. She became known mostly for projects such as the Dover Sun House, the Sun Oven, or the Cohasset Solar Distiller. Starting her new position at Westinghouse in September 1937 and receiving United States citizenship in December of the same year was also when Telkes began her career related to the utilization of solar energy.



Dear Mrs. Crile

It was so kind of you to invite Mrs. Ludwig and me to a last minutes farewell. I am specially grateful to Dr Crile for his kind suggestions and good advice with which he provided me for going off into the industrial „world." At the Clinic the whole atmosphere was so cordial that in a way I always felt as being a member of the family of the Clinic, which I always will continue to feel.

My work here is very interesting and is progressing even better than anticipated. I shall come to Cleveland occasionally.

With the most heartfelt expression of my gratitude to you and Dr. Crile

cordially
Maria Telkes

219 Swissvale Ave
Edgewood Pa.

October fourth 1937.

Picture 7. Mária Telkes' letter to Grace Crile on October 4th, 1937. Source: Crile 1937a.

The special bond between Amy Rowland and Mária Telkes shows how the outstanding enthusiasm of two women could achieve results in a completely male-dominated scientific community in the America of the 1920s and 1930s. Owing to her precise systematizing skills, Amy Rowland was not only an excellent editor of books and publications created at the Clinic but also indispensable in organizing and focusing Crile's own research engagements. Mária Telkes's unique talent for innovation emerged in this early period and led to several victories achieved together with Amy Rowland. Her strong vision of new ideas endowed her with the stamina to protect them and carry them out, often in adverse circumstances, which she insisted on with passion—both in Cleveland and elsewhere, later in her career. Just as importantly, a change in management attitudes towards the employment of female professionals, embraced by companies like the Cleveland Clinic in the 1930s, as we have seen, was indispensable for heroines of science to step onto the scene and set an example, as Mária Telkes and Amy Rowland certainly did.

[34] See picture 7 (Source: Crile 1937a.)

Works cited

Act XXIV of 1926 on Girls’ Secondary Schools and Girls' Dormitories. 2 Dec. 1926.

Bácskai, Vera. *A területi levéltárak fondjegyzékei III* [Catalogues of Regional Archives]. Magyar Országos Levéltár, 1970, p. 45. Hungaricana.hu, accessed 27 Mar. 2025.

Bix, Amy Sue. *Girls Coming to Tech! A History of American Engineering Education for Women.* MIT Press, 2013.

Bunts Family Papers. “Letter from Alexander T. Bunts to Barney and Carl.” 22 Feb. 1970. CWRU Dittrick Medical History Center, Allen Memorial Library, Box 4, Folder 107.

Bunts, Alexander T., and George Crile Jr., editors. *The Story of the Cleveland Clinic: To Act as a Unit.* Cleveland Clinic Foundation, 1971.

Búza, Péter. “(Jórészt igaz) mese, mózeskosárral” [(Mostly True) Story with Moses Basket]. *Budapest*, Dec. 2009, p. 15. Hungaricana, accessed 24 Aug. 2024.

“Ohioans Listed as Victims at Clinic.” *Cleveland Plain Dealer*, 16 May 1929, p. 7. NewsBank, Cleveland Public Library, accessed 2 May 2025.

Crile, G. W. *The Phenomena of Life: A Radio-Electric Interpretation.* William Heinemann Ltd., 1936.

Crile, G. W. Papers (MS 2806). “All World Watches Her: Harnessing of Sunshine May Upset Economics.” *Detroit Evening Times*, 26 May 1937. Box 57, Folder 218.

---. Letter from Mária Telkes to Mrs. Crile in October 1937. Western Reserve Historical Society, Cleveland History Center, Box 57, Folder 219a.

---. Letter from Rowland to Crile. 13 Aug. 1926. Western Reserve Historical Society, Cleveland History Center, Box 46, Folder 165.

---. Letter from Rowland to Crile. 14 Jan. 1927. Western Reserve Historical Society, Cleveland History Center, Box 46, Folder 167a.

---. Letter from Rowland to Crile. 25 Mar. 1927. Western Reserve Historical Society, Cleveland History Center, Box 46, Folder 167c.

---. Letter from Rowland to the Board of Directors. 27 May 1927. Western Reserve Historical Society, Cleveland History Center, Box 46, Folder 167d.

---. Letter from Rowland to the Board of Directors. 22 Nov. 1927. Western Reserve Historical Society, Cleveland History Center, Box 46, Folder 167e.

---. Letters from Rowland to Crile. 26 Jan., 8 Feb., and 12 Mar. 1927. Western Reserve Historical Society, Cleveland History Center, Box 46, Folder 167b.

---. “Living Cell Creation Exhibited at Science Meeting. ” *New York American*, 1 Jan 1931, Western Reserve Historical Society, Cleveland History Center, Clipping in Box 50 Folder 184c.

---. “Report of the Division of Biophysics,” by Rowland and Telkes. 17 Mar. 1931. Western Reserve Historical Society, Cleveland History Center, Box 50, Folder 182a-b.

---. Supporting Letter Written by Crile. 15 May 1937. Western Reserve Historical Society, Cleveland History Center, Box 57, Folder 218b.

---. Telkes's Letter to Crile. Oct. 1937. Western Reserve Historical Society, Cleveland History Center, Box 57, Folder 219c.

Crile, Georg. *An Autobiography.* J. B. Lippincott Company, 1947, p. 467.

Csorba, Csaba. “Miskolc középiskoláinak levéltári dokumentumai a kezdetektől 1950-ig” [Archive Documents of the Secondary Schools in Miskolc]. *Borsodi Levéltári Füzetek*, no. 29, 1989, p. 6. Hungaricana.hu, accessed 28 Mar. 2025.

ELTE Archives of University Library. Nr. 8/l.3.139. 1924-25.

Frank, Tibor. *Double Exile: Migration of Jewish-Hungarian Professionals through Germany to the United States, 1919-1945.* Peter Lang, 2009, p. 58.

“General Assembly, Catholic.” *The Heart (A Szív)*, 23 Oct. 1920, p. 3. Arcanum.hu, accessed 11 Dec. 2024.

Glasier, Jessie C. “Children's Play Will Be Given at Art Museum.” *Cleveland Plain Dealer*, 13 Nov. 1925, p. 17. NewsBank, Cleveland Public Library, accessed 2 May 2025.

Karády, Viktor. *School System and Denominational Inequalities in Hungary (1867-1945).* Replika Kör, 1997.

Konrád, Miklós. “Diskurzusok a zsidók névmagyarosításáról” [Discourses on the Hungarianization of Jewish Names]. *A mindenség megismerése* [Understanding the Universe], edited by Katalin Fenyves and Kata Vörös, Országos Rabbiképző – Zsidó Egyetem, 2024, p. 302-310.

Kornis, Gyula. *Nők az egyetemen* [Women at University]. Eggenberger-féle Könyvkereskedés, Rényi Károly, 1925.

Leacacos, John P. “Stern Chemists Listen to Woman.” *Cleveland Plain Dealer*, 26 Mar. 1937, p. 2.

Loop, Floyd D. “Dr. George W. Crile: The Father of Physiologic Surgery.” *Cleveland Clinic Journal of Medicine*, Jan.-Feb. 1993, p. 75-80.

Marx, György. *The Voice of the Martians.* Akadémiai Kiadó, 1994.

McCagg, William O., Jr. *Jewish Nobles and Geniuses in Modern Hungary.* Columbia University Press, 1972.

Morton, Marian J. “Eastman, Linda Anne.” *Encyclopedia of Cleveland History*, Case Western Reserve University, https://case.edu/ech/articles/e/eastman-linda-anne. Accessed 5 May 2025.

Nagy, Tibor Péter. “A középfokú nőoktatás a huszadik századi történetéhez” [Notes on the History of Secondary Education for Women in the Twentieth Century]. *Iskolakultúra*, no. 3, 2003, p. 3-14.

Palasik, Mária. “Women at the Technical University of Budapest in the 20th Century.” *Wie natürlich ist Geschlecht? Gender und die Konstruktion von Natur und Technik*, edited by Ursula Pasero and Anja Gottburgsen, Westdeutscher Verlag, 2002.

---. “Women in Technical Higher Education and in the Sciences in 20th Century Hungary.” *Hungarian Studies Review*, vol. XXIX, nos. 1-2, 2002, p. 25-49.

Petition for Naturalization, United States of America, no. 60160. 6 July 1937. Ancestry.com, accessed 3 May 2025.

Rédey, Soma. “Mária Telkes (1900-1995) and the Dover Sun House.” *Pioneer Hungarian Women in Science and Education II*, edited by Réka M. Cristian and Anna Kérchy, Akadémiai Kiadó, 2023, pp. 83-100.

Report (b) of the “Sophianum” Sacre Coeur Catholic Gymnasium for Girls in Budapest, 1917-18. Hungaricana.hu, accessed 26 Mar. 2025.

Report of the "Sophianum" Sacre Coeur Catholic Gymnasium for Girls in Budapest. *A Budapesti Szent-Szív-Szerzetesnők kath. Leánygimnáziumának "Sophianum" értesítője*, 1918. Hungaricana.hu, accessed 28 Mar. 2025.

Rossiter, Margaret W. *Women Scientists in America: Struggles and Strategies to 1940.* Johns Hopkins University Press, 1982.

Rowland, Amy. *Cleveland Clinic Foundation.* William Feather Company, 1938.

Strom, Sharon H. *Beyond the Typewriter.* University of Illinois Press, 1992.

Taylor, James S. "The Cleveland Clinic Quarterly: The First Fifty Years." *Cleveland Clinic Quarterly*, vol. 49, no. 4, 1982, p. 149-158.

Telkes, Maria Papers. "Biography – Maria Telkes." Box 6, Folder 15, "Companies 5: Donovan Leisure Newton 1951, 1952, 1955." ASU Library, Design and the Arts Special Collections, 1952, p. 10-15.

Telkes, Simon. *Hogy magyarosítsuk a vezetékneveket?* [How to "Magyarize" Family Names?]. Pallas, 1897.

Appendix I.

Research projects Telkes contributed during her stay at the Cleveland Clinic. Source: Amy Rowland, The Cleveland Clinic Foundation (1938)

No.	Project	Contributors
1	Measurements of the electric capacity and electric potential of biological materials under varying conditions	George Crile and Amy Rowland
2	Studies of the protein and lipoid constituents of protoplasm with the development of autosynthetic cells	George Crile and Amy Rowland
3	Investigations of the physical nature of cancer cells	George Crile
4	Studies of the chemiluminescence produced by various biological materials	George Crile
5	Preparation of a stable colloidal solution on lead	[Telkes alone]
6	Changes in the electric potential of tissues in living animals under normal and pathological conditions	George Crile and Amy Rowland
7	Experimental and theoretical investigations of electric capacity of tumors	George Crile

Appendix II.

Publications of Mária Telkes and Amy Rowland during Telkes' Cleveland years between 1927-36. Source: WRHS, Crile papers

No.	Author	Title	Year	Place of publication
1	Telkes	The Preparation of a Stable Colloidal Solution of Lead	1927	*Journal of the American Chemical Society*, vol. 49, no. 5, 1927, pp. 1382–86
2	Crile, Rowland, Telkes	An Interpretation of Excitation, Exhaustion and Death in Terms of Physical Constants	1928	*Proceedings of the National Academy of Sciences*, vol. 14, no. 7, pp. 532–538.
3	Crile,Telkes, Rowland	An Experimental Investigation of the Physical Nature of Death	1929	*Proceedings American Philosophical Society*, vol. lxviii, no. 2, pp. 69–81.
4	Crile,Telkes, Rowland	An Investigation of the Physical Nature of Cancer Cells	1931	*The American Journal of Cancer*, vol. XV, no. 4, pp. 2659–2665.
5	Crile,Telkes, Rowland	The Nature of Living Cells, with special reference to the nature of cancer cells and of fatty degeneration	1931	*Archives of Surgery*, vol. 23, pp. 703–714.
6	Telkes	Bioelectrical Measurements of Amoebae	1931	*The American Journal of Physiology*, vol. 98, no. 3, pp. 475–483.
7	Crile,Telkes, Rowland	Autosynthetic Cells	1932	*Protoplasma*, vol. XV, no. 3, pp. 337–360.
8	Crile,Glasser, Telkes, Rowland	Further Studies of Autosynthetic Cells with Special Reference to the Possible Role of the Nitro Group in the Energy Phenomena of Protoplasm	1932	*Proceedings of the American Philosophical Society*, vol. lxxi, no. 7, pp. 411–420.
9	Telkes	Studies of Electric Potential	1936	*The Phenomena of Life* by George Crile, edited by Amy Rowling, pp. 256–275.
10	Telkes	The Emission of Radiation from Animal Tissues	1936	*The Phenomena of Life* by George Crile, edited by Amy Rowling, pp. 314–339.