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The Rise of the Sun Queen: Mária Telkes' Early Years in the United States (1925-1953)

Soma Rédey

Abstract: Mária Telkes achieved outstanding results in the utilization of solar energy. Only thirteen years after her arrival in the US in 1925, she was accepted to work at MIT´s Solar Energy Research Group, as the only female participant of the team. During the period she spent at MIT between 1939 and 1953 the number of female students and professors was insignificant, just below 1%. Mária Telkes never felt discriminated against; in all the hardest situations she found her way to keep on the scientific track of solar research. She achieved several patents and publications during these years and became known nationwide. The paper focuses on the circumstances: both social and technical challenges she faced. Based mostly on primary documents available at MIT Libraries' Distinctive Collections, details of her application process or her development of solar stills during the Second World War give us a sophisticated image not only of the challenges Telkes faced, but of the social characteristics of the era as well.

Keywords: *Mária Telkes, Women in Science, Solar Stills, Dover Sun House, solar energy research*

Biography: Soma Rédey is an independent scholar in Montreal. After graduating in engineering and management at Budapest University of Technology and Economics he earned another diploma at Eötvös Loránd University in theory and history of film studies. In his research he mainly focuses on Mária Telkes and her solar research projects, science communication, science documentaries and the history of science. Between 2006 and 2020 he had been working at the Communication Division of the Hungarian Academy of Sciences.

Introduction

Mária Telkes was born in Budapest, Hungary on December 12, 1900, and died in the same city on December 2, 1995. After leaving Hungary at the age of 24, she returned to her native country only once, after seventy years, just before she died (Vámos 131). Mária Telkes' grandfather Simon Rubin,[1] who studied mathematics, was of Jewish origin and was born in 1845 in Szeged. After 1867, he moved to Budapest where he joined the staff at the newly established

[1] Simon Rubin (Telkes) was a leading figure of the patriotic "Name-Magyarization Movement" between 1881 and 1904 and published several articles encouraging Jewish families to change their family names to Hungarian.

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National Statistical Office (McCagg 68). In 1881 he changed his family name from Rubin to Telkes and in 1883 he converted from Jewish to Unitarian (Christian)[2] (Konrád 307). For his services he was honored with Hungarian nobility and the permission to use the name "Kelenföldi" in 1907. Mária Telkes was the oldest daughter of the eight children of Aladár Kelenföldi Telkes and Mária Laban, residents at 43 Gellérthegy utca. Telkes earned her diploma in 1922 at the University of Budapest majoring in chemistry and physics, where she went on to obtain her Ph.D. *cum laude* in 1924. Telkes was among the first women to be admitted to the university where the first female students were allowed to apply only after 1896 (Pukánszky 25), in a country where female enrollment in higher education remained under 10% until 1925 (Janik 8). The first female student in engineering graduated from the Budapest University of Technology only in 1920 (Palasik 25).

Telkes clearly deserved to be called the "Sun Queen" owing to her achievements in solar energy research. The public recognition of her professional work came into focus in recent decades, a good indication of which is that she was inducted into the National Inventors' Hall of Fame in 2012, the same year Steve Jobs received this honor (Busch-Vishniac 237). The mission of the organization is to acknowledge visionaries whose patented inventions brought about a major change in our world. During her lifetime, Mária Telkes registered 26 patents in the U.S. and another 17 in other countries, all related to the utilization of the power of the sun (see Appendix 1). On April 4, 2023, the Public Broadcasting Service (PBS) aired a documentary about her with the title "The Sun Queen" (PBS). The episode was broadcast as part of the American Experience program on PBS. A temporary exhibition titled "Emerging Ecologies: Architecture and the Rise of Environmentalism" at The Museum of Modern Art in New York between September 17, 2023 and January 20, 2024, introduced Mária Telkes' Dover House project among world famous and leading architects such as Frank Lloyd Wright or Emilio Ambasz (MoMA). This was the first major museum exhibition that brought together a wide range of works on architecture and the environmental movement in the U.S. and focused especially on architects who spearheaded the environmental approach. From the perspective of this thematic cluster, Telkes' life and career offer insights into the years following the major restrictions introduced on immigration by the United States, Telkes being an early representative of the group of outstanding Hungarian scientists arriving in the interwar period. Her work as a female scientist and accomplishments, however, have received much less scholarly attention so far, thus the aim of this paper is to shed light on her early years in the United States.

Arrival and First Years in the US (1925–1939)

Mária Telkes moved to the United States in 1925. While hundreds of thousands of people arrived in the country from Hungary before the First World War, after the 1921 Emergency Quota Act and especially the Johnson–Reed Act of 1924, the number of immigrants from Hungary was strictly restricted, the latter bill allowing only 473 people to legally immigrate into the country annually (see the Introduction to this thematic cluster for details). Therefore, the period of Telkes' arrival and its background deserves special scholarly attention. Deeply affected

[2] According to Konrád, Simon handled together the name changing and converting from Jewish religion. The motivation was never published by himself, anyhow he as wrote only Christians were accepted by the true sons of the Hungarian nation in his time.

by these legal restrictions, Hungarian American communities became more isolated from the mother country and only very few Hungarians could leave for the United States, as “migrations were directed toward European centers, in the first place to Germany” (Frank 131). The typically male immigrants who were allowed into the United States during this period comprised mostly qualified professionals, businessmen, and skilled workers. The 1924 Act divided the arrivals into two main categories: quota and non-quota immigrants. While the members of the first category could only be admitted up to the set numbers, non-quota immigrants could enter above these. During the interwar migration period, non-quota immigrants mostly included well-trained professionals with special intellectual abilities and prospective professionals. The US government favored the extension of the selective principle and put in a word for “those who are actually needed” to increase the percentage of highly qualified people.

In the case of Mária Telkes, we cannot find any evidence that she would have applied for a U.S. visa as a quota immigrant. As is attested by the “List or manifest of alien passengers for the U.S. immigration officer at port of arrival,” she arrived in the US in 1925 upon the invitation of her uncle, Ernő Ludwig, who used to fulfill consular services in Cleveland for Hungary at that time. Telkes’ purpose of coming to the U.S. was marked as “intended to return to Hungary after one year” without wanting to become a U.S. citizen. The temporary admission was extended two times until 1928 on the same document, probably justified by Telkes’ professional background (NARA). Telkes pioneered a group of Hungarian scientists emigrating to America a few years later, even though her motivations were undoubtedly different. Acknowledged for their outstanding scientific achievements, especially during the Cold War, these Hungarians also became known as the “Martians.” Some among them were considered by the press as hawks: Edward Teller (Teller Ede, arrived in America in 1935), John von Neumann (Neumann János, arrived in 1931), Eugene P. Wigner (Wigner Jenő, arrived in 1937) and others as doves: Leo Szilard (Szilárd Leó, arrived in 1938), Albert Szent-Gyorgyi (arrived in 1947), John G. Kemeny (Kemény János, arrived in 1940) (Marx74). Telkes may be seen as an early representative of this group, while her work and achievements have received much less scholarly attention so far.

Telkes decided to move to the United States after reading a book on solar energy as an alternative resource, which claimed that relevant ongoing experiments were mostly confined to America. Her uncle, Ernő Ludwig, a Hungarian consul who married an American woman, invited Telkes to Cleveland. On September 12, 1925, she bought a ticket to the *SS President Wilson* which set out from Trieste and arrived in New York on September 28 (NARA b). She made a trip back to Europe in 1928, from where she returned to the US in the same year.[3] The vessel carrying her, the *SS Majestic*, sailed out from Cherbourg, France, and arrived in New York on December 18.[4]

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[3] At this point we must mention Telkes’ oldest brother, László. He was born in 1902, attended the University of Budapest where he received advanced degrees in Administration in 1923 and Political Science in 1926. He arrived in the US just a few years after Mária, in 1930, with a scholarship to Harvard University where he received a Master of Law degree (Nyirady 6). Later he became the director of the New York-based Hungarian Reference Library and used to maintain a close connection during his life in the US with Mária, also helping in her professional work.

[4] According to the article published in *Budapesti Hírlap* on October 27, 1928, Telkes arrived in Berlin from the Cleveland Clinic in order to make research on cancer diagnosis at Kaiser Wilhelm Institution.

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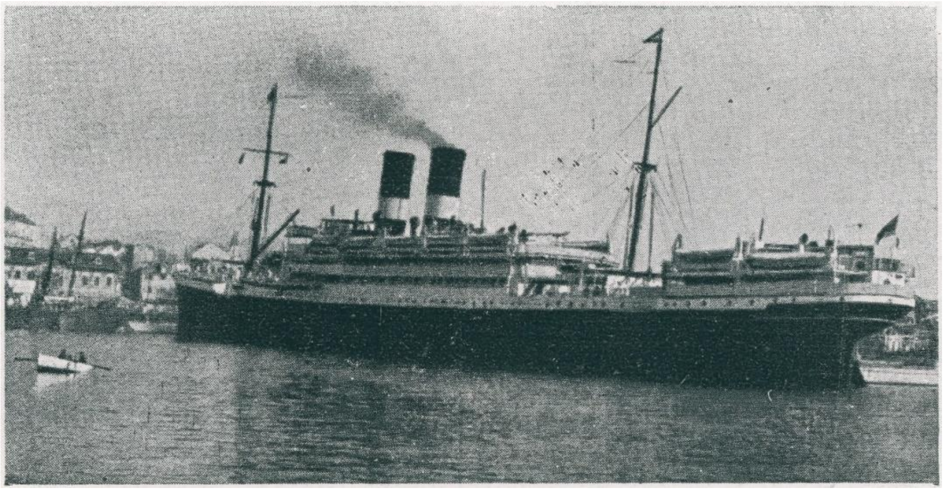
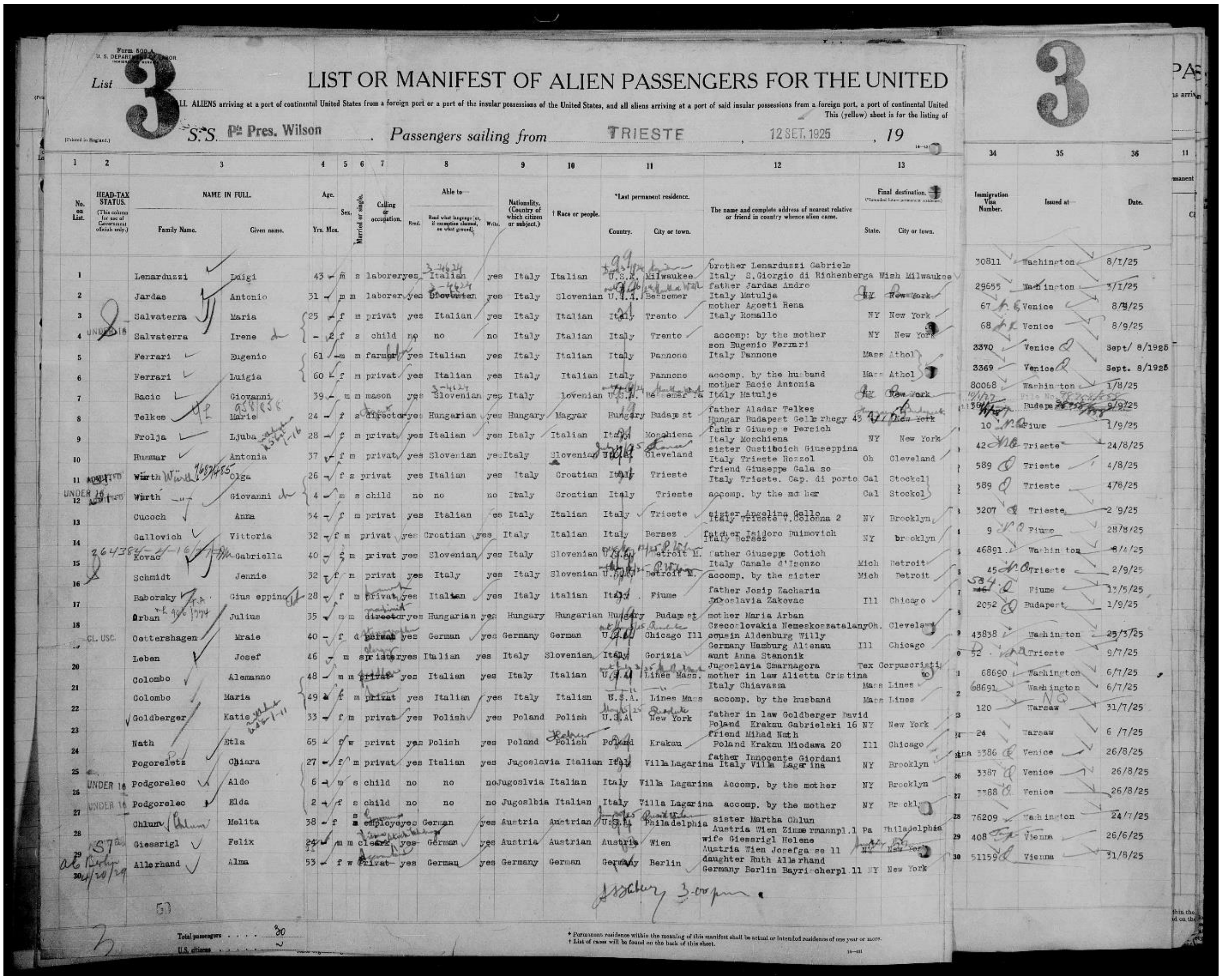


Fig. 1. The *SS President Wilson* in Split in 1928. Source: Vladimir Tkalčić, shipsnostalgia.com.



List 3

LIST OR MANIFEST OF ALIEN PASSENGERS FOR THE UNITED

ALL ALIENS arriving at a port of continental United States from a foreign port or a port of the insular possessions of the United States, and all aliens arriving at a port of said insular possessions from a foreign port, a port of continental United

This (yellow) sheet is for the listing of

S.S. Pᵗ Pres. Wilson Passengers sailing from TRIESTE, 12 SET. 1925, 19

No. on List	Head-tax status	Family name	Given name	Age Yrs.	Sex	Married or single	Calling or occupation	Read	Read what language	Write	Nationality	Race or people	Last permanent residence: Country	City or town	Name and address of nearest relative or friend in country whence alien came	Final destination: State	City or town	Immigration Visa Number	Issued at	Date
1		Lenarduzzi	Luigi	43	m	s	laborer	yes	Italian	yes	Italy	Italian	U.S.A.	Milwaukee	brother Lenarduzzi Gabriele, Italy S.Giorgio di Richenberga	Wish	Milwaukee	30811	Washington	8/1/25
2		Jardas	Antonio	31	m	m	laborer	yes	Slovenian	yes	Italy	Slovenian	U.S.A.	Bessemer	father Jardas Andro, Italy Matulje	NY	New York	29655	Washington	3/1/25
3		Salvaterra	Maria	25	f	m	privat	yes	Italian	yes	Italy	Italian	Italy	Trento	mother Agosti Rena, Italy Romallo	NY	New York	67	Venice	8/9/25
4	UNDER 18	Salvaterra	Irene	- 2	f	s	child	no	no	no	Italy	Italian	Italy	Trento	accomp: by the mother	NY	New York	68	Venice	8/9/25
5		Ferrari	Eugenio	61	m	m	farmer	yes	Italian	yes	Italy	Italian	Italy	Pannone	son Eugenio Ferrari, Italy Pannone	Mass	Athol	3370	Venice	Sept/ 8/1925
6		Ferrari	Luigia	60	f	m	privat	yes	Italian	yes	Italy	Italian	Italy	Pannone	accomp. by the husband	Mass	Athol	3369	Venice	Sept. 8/1925
7		Bacic	Giovanni	39	m	m	mason	yes	Slovenian	yes	Italy	Slovenian	U.S.A.	Bessemer	mother Bacic Antonia, Italy Matulje	NY	New York	80068	Washington	1/8/25
8		Telkes	Marie	24	f	s	director	yes	Hungarian	yes	Hungary	Magyar	Hungary	Budapest	father Aladar Telkes, Hungar Budapest Gellerthegy 43		New York	[illegible]	Budapest	9/9/25
9		Frolja	Ljuba	28	f	m	privat	yes	Italian	yes	Italy	Italian	Italy	Moschiena	father Giuseppe Persich, Italy Moschiena	NY	New York	10	Fiume	1/9/25
10		Hummar	Antonia	37	f	m	privat	yes	Slovenian	yes	Italy	Slovenian	U.S.A.	Cleveland	sister Gustibcich Giuseppina, Italy Trieste Rozzol	Oh	Cleveland	42	Trieste	24/8/25
11	ADMITTED	Wirth	Olga	26	f	s	privat	yes	Italian	yes	Italy	Croatian	Italy	Trieste	friend Giuseppe Galasso, Italy Trieste. Cap. di porto	Cal	Stockol	589	Trieste	4/8/25
12	UNDER 16 ADMITTED	Wirth	Giovanni	4	m	s	child	no	no	no	Italy	Croatian	Italy	Trieste	accomp. by the mother	Cal	Stockol	589	Trieste	4/8/25
13		Cucoch	Anna	54	f	m	privat	yes	Italian	yes	Italy	Italian	Italy	Trieste	sister Angelina Gallo, Italy Trieste V.Colonna 2	NY	Brooklyn	3207	Trieste	2/9/25
14		Gallovich	Vittoria	32	f	m	privat	yes	Croatian	yes	Italy	Italian	Italy	Bersez	father Isidoro Duimovich, Italy Bersez	NY	Brooklyn	9	Fiume	28/8/25
15		Kovac	Gabriella	40	f	m	privat	yes	Slovenian	yes	Italy	Slovenian	U.S.A.	Detroit M.	father Giuseppe Cotich, Italy Canale d'Isonzo	Mich	Detroit	46891	Washington	8/4/25
16		Schmidt	Jennie	32	f	m	privat	yes	Italy	yes	Italy	Slovenian	U.S.A.	Detroit M.	accomp. by the sister	Mich	Detroit	45	Trieste	2/9/25
17		Baborsky	Giuseppina	28	f	m	privat	yes	Italian	yes	Italy	Italian	Italy	Fiume	father Josip Zacharia, Jugoslavia Zakovac	Ill	Chicago	584	Fiume	13/5/25
18		Orban	Julius	35	m	m	director	yes	Hungarian	yes	Hungary	Hungarian	Hungary	Budapest	mother Maria Arban, Czecoslovakia Nemeskoszatalany	Oh.	Cleveland	2052	Budapest	1/9/25
19	CL. USC.	Oettershagen	Mraie	40	f	d	privat	yes	German	yes	Germany	German	U.S.A.	Chicago Ill	cousin Aldenburg Willy, Germany Hamburg Altenau	Ill	Chicago	43838	Washington	25/3/25
20		Leben	Josef	46	m		spriester	yes	Italian	yes	Italy	Slovenian	Italy	Gorizia	aunt Anna Stanonik, Jugoslavia Smarnagora	Tex	Corpuscristi	52	Trieste	9/7/25
21		Colombo	Alemanno	48	m	m	privat	yes	Italian	yes	Italy	Italian	U.S.A.	Lines Mass.	mother in law Alietta Cristina, Italy Chiavazza	Mass	Lines	68690	Washington	6/7/25
22		Colombo	Maria	49	f	m	privat	yes	Italian	yes	Italy	Italian	U.S.A.	Lines Mass	accomp. by the husband	Mass	Lines	68691	Washington	6/7/25
23		Goldberger	Katie	33	f	m	privat	yes	Polish	yes	Poland	Polish	U.S.A	New York	father in law Goldberger David, Poland Krakau Gabrielski 16	NY	New York	120	Warsaw	31/7/25
24		Nath	Etla	65	f	w	privat	yes	Polish	yes	Poland	Polish	Poland	Krakau	friend Mihad Nath, Poland Krakau Miodawa 20	Ill	Chicago	24	Warsaw	6/7/25
25		Pogoreletz	Chiara	27	f	m	privat	yes	Italian	yes	Jugoslavia	Italian	Italy	Villa Lagarina	father Innocente Giordani, Italy Villa Lagarina	NY	Brooklyn	3386	Venice	26/8/25
26	UNDER 16	Podgorelec	Aldo	6	m	s	child	no	no	no	Jugoslvia	Italian	Italy	Villa Lagarina	Accomp. by the mother	NY	Brooklyn	3387	Venice	26/8/25
27	UNDER 16	Podgorelec	Elda	2	f	s	child	no	no	no	Jugoslbia	Italian	Italy	Villa Lagarina	accomp. by the mother	NY	Brooklyn	3388	Venice	26/8/25
28		Chlun	Melita	38	f	s	employee	yes	German	yes	Austria	Austrian	U.S.A.	Philadelphia	sister Martha Chlun, Austria Wien Zimmermannpl.1	Pa	Philadelphia	76209	Washington	24/7/25
29		Giessrigl	Felix	24	m	m	clerk	yes	German	yes	Austria	Austrian	Austria	Wien	wife Giessrigl Helene, Austria Wien Josefgasse 11	NY	New York	408	Vienna	26/6/25
30		Allerhand	Alma	53	f	w	privat	yes	German	yes	Germany	German	Germany	Berlin	daughter Ruth Allerhand, Germany Berlin Bayrischerpl. 11	NY	New York	51159	Vienna	31/8/25

Total passengers 30

U.S. citizens . . . .

* Permanent residence within the meaning of this manifest shall be actual or intended residence of one year or more.

† List of races will be found on the back of this sheet.

Fig. 2. List of passengers on *SS Wilson* on September 28, 1925. Source: National Archives and Records Administration. Mária Telkes can be found in line 8.

Telkes' first job in her profession was as research associate at the Cleveland Clinic in Ohio, where she worked from 1926 to 1937 (Tietjen and Bailey 15). Here, she embarked on research projects jointly with her boss Dr. George Crile, with whom she co-authored several publications in the fields of colloids, the electric potentials of single cells, bioelectric phenomena, infra-red radiation measurements with thermocouples, chemiluminescence, heat production in living organisms, and properties of fats and emulsions (Hottel papers 1939-1954, 25).

A letter from Crile (Hottel papers 1939, 64) tells us more details about this period in Telkes' life. After her arrival in 1925, her uncle helped her to secure a position at the General Electric Company in Nela Park, Cleveland. The Nela Park (of the National Electric Lamp Association) was one of the earliest industrial parks in the U.S., visited by Einstein in 1921. This place served as the center of GE's lightning technology and innovation in the 20th century (Sisson). We do not know much else about her job there, except that when the budget of the factory was cut, Telkes was among those employees who had to leave. Subsequently, she applied for an assistantship with George Crile at the Cleveland Clinic Foundation.

During the eleven years Telkes collaborated with Crile, mostly pursuing research on protoplasm energy, Crile was more than satisfied with her work, describing her as an extremely versatile scientist and a very pleasant and cooperative person in every way. During this period, she published seven scientific papers, including five co-authored with Professor Crile and two authored by herself alone.[5]

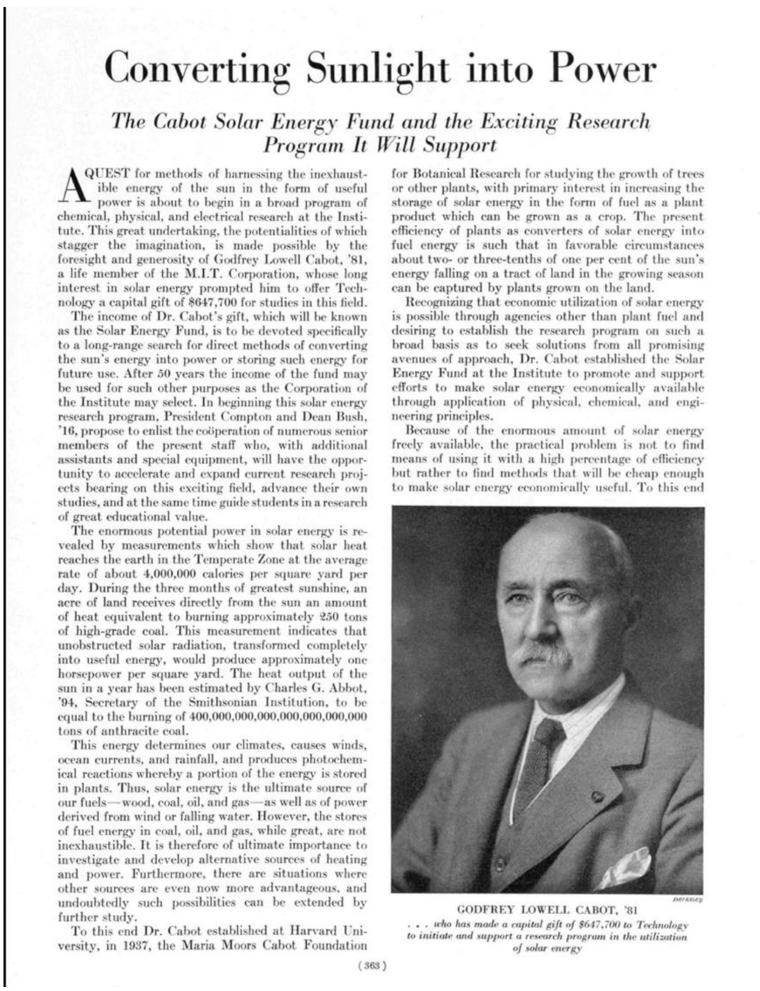
The Westinghouse Years (1937–39)

Telkes was hired as a research engineer at the Research Laboratories of the Westinghouse Electric and Manufacturing Company in East Pittsburgh, Pennsylvania, in September 1937. She started on the job on a temporary basis rather than as a regular staff member (Hottel papers 1939b, 68). She was assigned the task of working out the details of a thermo-couple invention originally developed by Westinghouse some years before, but without any successful industrial application for the conversion of heat into electrical power. Her first contract at Westinghouse expired in six months but was later extended until June 1939. As before, her colleagues at the new place were satisfied with her performance. She invented a specific composition of zinc and antimony, as described in the relevant patent application.[6] L. W. Chubb, director of research at Westinghouse, described Telkes as a well-trained hard worker who was instantly liked by everyone at the company (Hottel papers 1939c, 18). In those days, it was rather unusual for a female engineer to work in a male-dominated industry, including the Westinghouse company.[7] "Our experience has shown," Chubb wrote, "that a woman on major research work has a distinct disadvantage in dealing with the shops and members of the outlying engineering developments.

[5] See Appendix 2 at the end of the article.
[6] See Appendix 1 at the end of the article. The patent was issued finally in 1941.
[7] The company had been one of the most relevant actors of the electric industry in the US since 1886. In this year Westinghouse began experimenting with power distribution and formed the Westinghouse Electric Company. Realizing the potential in AC power, the company teamed up with Nikola Tesla and won the financial backing from industry leaders to support AC. https://www.loc.gov/collections/films-of-westinghouse-works-1904/articles-and-essays/the-westinghouse-world/the-westinghouse-electric-and-manufacturing-company. Accessed July 7, 2024.

We therefore avoid using them except on special service work within the Laboratories." (Hottel papers 1939, 19). This same attitude is obvious from a letter written by J. Sepian (Hottel papers 1939, 59), associate director of the company, regarding the employment of Mária Telkes: "Conditions at this laboratory and point of view among the personnel and managers is such that a woman physicist will not find employment here unless she has very unusual attainments."

Still working at Westinghouse while looking for other opportunities, in June 1938 Telkes came across an interesting article in *The Technology Review*, MIT's periodical (MIT 363). The article "Converting Sunlight into Power—The Cabot Solar Energy Fund and the Exciting Research Program It Will Support" reported on a financing solution named Solar Energy Fund, set up for supporting research on the ways of harnessing the inexhaustible energy of the sun in the form of useful power. This marked the moment Mária Telkes had been waiting for since her arrival in the U.S. in 1925. Now she was in the position to make meaningful progress toward becoming a member of the recently formed solar energy research group. She read fascinating accounts of the latest developments in X-ray generators used in cancer treatment, and another article about new ways of identifying petroleum reservoirs, but her interest was really piqued when she got to the page reporting on the recent establishment of the Fund at MIT.



Converting Sunlight into Power

The Cabot Solar Energy Fund and the Exciting Research Program It Will Support

A QUEST for methods of harnessing the inexhaustible energy of the sun in the form of useful power is about to begin in a broad program of chemical, physical, and electrical research at the Institute. This great undertaking, the potentialities of which stagger the imagination, is made possible by the foresight and generosity of Godfrey Lowell Cabot, '81, a life member of the M.I.T. Corporation, whose long interest in solar energy prompted him to offer Technology a capital gift of $647,700 for studies in this field.

The income of Dr. Cabot's gift, which will be known as the Solar Energy Fund, is to be devoted specifically to a long-range search for direct methods of converting the sun's energy into power or storing such energy for future use. After 50 years the income of the fund may be used for such other purposes as the Corporation of the Institute may select. In beginning this solar energy research program, President Compton and Dean Bush, '16, propose to enlist the coöperation of numerous senior members of the present staff who, with additional assistants and special equipment, will have the opportunity to accelerate and expand current research projects bearing on this exciting field, advance their own studies, and at the same time guide students in a research of great educational value.

The enormous potential power in solar energy is revealed by measurements which show that solar heat reaches the earth in the Temperate Zone at the average rate of about 4,000,000 calories per square yard per day. During the three months of greatest sunshine, an acre of land receives directly from the sun an amount of heat equivalent to burning approximately 250 tons of high-grade coal. This measurement indicates that unobstructed solar radiation, transformed completely into useful energy, would produce approximately one horsepower per square yard. The heat output of the sun in a year has been estimated by Charles G. Abbot, '94, Secretary of the Smithsonian Institution, to be equal to the burning of 400,000,000,000,000,000,000,000 tons of anthracite coal.

This energy determines our climates, causes winds, ocean currents, and rainfall, and produces photochemical reactions whereby a portion of the energy is stored in plants. Thus, solar energy is the ultimate source of our fuels—wood, coal, oil, and gas—as well as of power derived from wind or falling water. However, the stores of fuel energy in coal, oil, and gas, while great, are not inexhaustible. It is therefore of ultimate importance to investigate and develop alternative sources of heating and power. Furthermore, there are situations where other sources are even now more advantageous, and undoubtedly such possibilities can be extended by further study.

To this end Dr. Cabot established at Harvard University, in 1937, the Maria Moors Cabot Foundation for Botanical Research for studying the growth of trees or other plants, with primary interest in increasing the storage of solar energy in the form of fuel as a plant product which can be grown as a crop. The present efficiency of plants as converters of solar energy into fuel energy is such that in favorable circumstances about two- or three-tenths of one per cent of the sun's energy falling on a tract of land in the growing season can be captured by plants grown on the land.

Recognizing that economic utilization of solar energy is possible through agencies other than plant fuel and desiring to establish the research program on such a broad basis as to seek solutions from all promising avenues of approach, Dr. Cabot established the Solar Energy Fund at the Institute to promote and support efforts to make solar energy economically available through application of physical, chemical, and engineering principles.

Because of the enormous amount of solar energy freely available, the practical problem is not to find means of using it with a high percentage of efficiency but rather to find methods that will be cheap enough to make solar energy economically useful. To this end

GODFREY LOWELL CABOT, '81

. . . who has made a capital gift of $647,700 to Technology to initiate and support a research program in the utilization of solar energy

(363)

Fig. 3. Article and advertisement in *MIT Technology Review*, June 1938, p. 384. Source: MIT

The Cabot Solar Energy Fund and Application to MIT (1938–39)

Godfrey L. Cabot, a life member of MIT, offered the Institute a capital gift of USD 647,000[8] for studies in the field of solar energy. The amount was used to launch a broad program of chemical, physical, and electrical research on solar energy. The main purpose of the fund was to promote and support efforts to make solar energy economically feasible and available through engineering principles. As a prelude to this initiative, a few years earlier, in 1937, Cabot established another fund at Harvard University, the Maria Moors Cabot Foundation, worth USD 615,773 (*Science* 575). The Harvard program focused on botanical research for studying the growth of trees or other plants, mostly with a view toward increasing the storage of solar energy in the form of fuel in plants to be grown as a crop. Karl T. Compton, then president of MIT, welcomed the initiative and emphasized two of its key aspects. First, the program was an outstanding example of generosity in recognizing the importance of long-term basic research. Second, it showed how a broad scientific problem can be effectively addressed on a multidisciplinary basis by experts in diverse fields (“Harness” 1). “This co-operative approach to scientific and engineering problems is one of the most striking features of research at MIT,” Compton declared enthusiastically. The MIT president tasked with setting up a committee to steer the activities of the solar energy research group recommended Hoyt C. Hottel of the Department of Chemical Engineering as the head of the committee. Further members suggested, all male MIT professors, included Arthur C. Hardy, Department of Physics; Ernest H. Huntress, Department of Chemistry; Arthur R. von Hippel, Department of Electrical Engineering; and George W. Swett, Department of Mechanical Engineering.

Having read the article, Telkes did not hesitate. The next day, on June 12, 1938, she wrote to MIT Vice President Vannevar Bush. It is uncertain whether she knew Bush from former times, and if so, how they were acquainted. In any case, she addressed her letter to “My dear Dr. Bush” (Hottel papers 1938, 60). She also attached an outline of her invention she had been working on with the title “The utilization of solar energy by means of thermopiles,” summarizing her previous efforts and experiments performed before she joined Westinghouse. Her first invention related to thermoelectric coupling was registered in 1939 and patented in 1941, assigned to Westinghouse Co.[9] Her plan was to get connected and involved with the recent solar energy research initiative. She furnished a personal introduction to her invention along with an apparatus of demonstration. This was her first key action underlined within this period (1).

A few weeks later, on June 21, 1938, Telkes found a letter in her mailbox from Hoyt C. Hottel, professor of fuel engineering and Chairman of the Research Committee on Solar Energy Utilization at MIT. Her letter to Bush had apparently been forwarded along with her paper to Hottel, who became very interested in Telkes’s project using thermoelectric methods for the conservation of solar energy. An exchange by mail for well over a year ensued, amounting to a total of almost 80 pages of letters[10] among all the parties concerned. Telkes’s former employers

[8] Which equals approximately USD 14,500,000 today.

[9] Her first invention related to thermoelectric coupling was registered in 1939 and patented in 1941, assigned to Westinghouse Co.

[10] MIT Libraries Distinctive Collections, Hoyt C. Hottel papers, 1939-1954 Folder: Telkes Maria employ (MC-0544).

and associates, including George Crile at the Cleveland Clinic Foundation and her colleagues at Westinghouse, were approached by Hottel for a reference concerning Telkes's professional background, experience and work attitude. In the outcome, she was invited to present her thermoelectric generator at MIT in May 1939, at an event to be attended by all the committee members.

Hottel found Telkes' presentation convincing and decided to admit Telkes to the solar energy research group, at first to be employed at the MIT Department of Physics. Although department head John C. Slater also found Telkes's project worthy, he could not afford the space and facilities to accommodate her (Hottel papers 1939: 38). She was then recommended to the MIT Department of Metallurgy, where professors F. Bitter and Robert S. Williams had been familiar with and enthusiastic about Telkes's previous work. Finally, she was offered a position at the Department of Metallurgy as Research Associate on Solar Energy, with a yearly salary of USD 2,700 (which is equivalent to yearly USD 61,000 today), starting on August 1, 1939. Telkes accepted (Hottel papers 1939,10) and on September 1, 1939, started on the job at MIT working on solar energy, realizing a dream she had nourished since she first set foot in the US. With the help of her knowledge, connections and professional background, combined with her faith in solar energy, Mária Telkes thus finally succeeded in becoming a member of the MIT research group.

The War Years—The Development of Solar Stills (1940–44)

Like most actors of the U.S. scientific community during World War II, MIT played a major role in developing war technologies. In a letter from June 15, 1940, president Roosevelt informed MIT President Compton (Office of the president 1940a) of the creation of the National Defense Research Committee (NDRC), coordinated by the Advisory Commission to the Council of National Defense under the chairmanship of Vannevar Bush. "If, through the activities of this new committee," Roosevelt wrote, "the efforts of American scientists throughout the country are effectively oriented in aid of the armed services in the serious problems which today confront them, an important piece of work will have been well accomplished." Roosevelt appointed Compton to this committee, and he accepted the post (Office of the president 1940b). A year later, on June 28, 1941, the NDRC was reformed as the Office of Scientific Research and Development (OSRD), and Compton was so informed by President Roosevelt (Office of the president 1940c). Pursuant to the executive order, scientists did not receive a salary but were entitled to documented expenses incurred in the performance of their duties.

Hottel invited Telkes to participate in development projects focusing on problems defined by the NDRC, and her new assignment was confirmed by Compton on February 26, 1942 (Office of the president 1942). The first, informal request concerned a solar still which could be useful for the US Navy, representing a problem yet to be solved. The assignment was acknowledged on January 4, 1943, by the office of Vannevar Bush, which emphasized that "the problem of producing potable water from waters of high salinity or polluted water is a general problem" (Office of the president 1943a). Telkes was then personally tasked with evaluating possible alternatives in developing evaporators or stills using solar energy. By January 1943, she completed a 37-page report with the title "Distilling Water with Solar Energy," including detailed calculations on potential water-tray surfaces, the amount of water distilled, and the weights of materials used for the apparatus. She was able to produce these results in such a short time after the official request was submitted because she had been working on very similar problems since 1942, partly under the aegis of the Solar Energy Project. Her concept won the support of Cabot, who proceeded to offer a few technical ideas of his own after consulting with Telkes (Office of the president 1943b).

Bush was grateful to Telkes for her report on behalf of the NDRC, which was also busy with the development of the solar evaporator, Nevertheless, he hastened to mention that others were working on the same problem. "Various devices are now under development," Bush pointed out to Hottel on February 1, 1943, "and we are considering the desirability of arranging a conference which will bring together the various people concerned with this subject" (Office of the president 1943c). Several doubts remained regarding the financial resources to cover the increasing costs. As of the end of February 1943, the project had not received official "NDRC supported" status: "There is still a very real question as to whether solar devices can give an acceptable solution to the problem. Also, we have just learned that the Navy has already received, from inventors, two types of experimental solar stills for testing," the NDRC chairman's executive assistant wrote to Hottel (Office of the president 1943d). Despite the uncertainties, the project rolled on and was finalized during the spring and summer of 1943. The required raw materials for the latest development were provided to Telkes by DuPont and other suppliers. The final product was an inflatable, floating type of solar still for life rafts that had no metallic or rigid parts. It could be folded into a small volume of 60 cubic inches and weighed only one pound (Telkes 1108). Prototype testing was carried out and documented by the US Navy in Massachusetts and Florida. These records later became an invaluable reference for the presentation of materials by Hottel and Telkes.

As Telkes wrote in an article published in 1953, "Some of these devices were manufactured in larger quantities for the Armed Forces and the solar still became standard equipment for life rafts" (Telkes 1108). Despite her claims, however, no documentary evidence survives, at the MIT archives or elsewhere, to prove that the U.S. Navy ever signed a contract for Telkes's equipment. Just as interestingly, there is no trace from these years of a patent registration for this product, despite Telkes's consistent habit of patenting her inventions during her career. The records of the US Patent and Trademark Office do show a registered application for a "Solar Distiller," filed on July 24, 1944, by Mária Telkes and Hoyt C. Hottel as inventors, under the registration number 530,866 (Office of the president 1945a). Three years later, on June 16, 1947, this application was turned down by the Office. One reason for the rejection may have had to do with the fact that several other applications in the field had been pending, submitted by William Richard P. Delano and assigned to Gallowhur Chemical Corporation.[11]

The patent holder, William Richard P. Delano, maternal cousin of President Franklin Delano Roosevelt and related to Frank Elmer Delano, a Navy lieutenant in the Bureau of Aeronautics, held several patents in the field, all assigned to Gallowhur Corp.[12] By 1945, an agreement had been made between the inventors. According to the report written by the Research Corporation on this issue (Office of the president 1945b), the patent status was as follows: "After several months of negotiation a settlement was prepared and executed on the basis of a non-exclusive license to Gallowhur with provision for 1,25% royalty to be paid on apparatus covered by the claims of the Telkes patent manufactured by Gallowhur." After the war, in May 1947,

[11] "Apparatus for solar distillation" US patent nr. 2,405,877 (patented on August 13, 1946, application on October 6, 1943).
[12] See Chart 1 on Solar Still patents.

Gallowhur withdrew from the field, cancelling the agreement with and reassigning all the patents and applications to Delano, without contemplating any further involvement in this industry. As Gallowhur's representative stated in a letter (Office of the president 1947), "We have not made any apparatus embodied in the claims of the Telkes and Hottel invention, except for governmental agencies, bureaus or departments thereof for military, naval and national defence purposes." Other sources (Time) attest that the Gallowhur Chemical Corporation became a main wartime supplier, with gross revenues of over 8,000,000 USD in 1943 as a major manufacturer of insect repellents and solar still apparatus kits for life rafts, among other supplies. Only in 1966, some 20 years later, did Telkes apply for a patent for the very same device on "Collapsible solar still with water vapor permeable membrane," which she was granted on Dec 10, 1968.[13]

Chart 1: Solar Still patents in the 1940s assigned to the Gallowhur Chemical Corporation. Source: USPTO

No	Inventor	Patent name	Assignor	Application	Patented	Patent nr.
1.	W.R.P. Delano	Process and apparatus for distilling liquids	Gallowhur Chemical Corp.	Nov. 12, 1942	June 25, 1946	2,402,737
2.	W.R.P. Delano and W. Meissner	Solar distillation apparatus	Gallowhur	Aug. 30, 1943	Aug. 6, 1946	2,405,118
3.	W.R.P. Delano	Inflatable solar still	Gallowhur	Sept. 4, 1943	Sept. 9, 1947	2,427,262
4.	W.R.P. Delano	Apparatus for solar distillation	Gallowhur	Oct. 6, 1943	Aug. 13, 1946	2,405,877
5.	W.R.P. Delano	Solar Still with nonfogging window	Gallowhur	Oct. 20, 1943	Dec. 24, 1946	2,413,101
6.	W.R.P. Delano	Solar distilling apparatus	Gallowhur	Nov. 2, 1943	Apr. 9, 1946	2,398,292
7.	W.H. Miller Jr.	Inflatable floating solar still with capillary feed	Gallowhur	Dec. 24, 1943	Dec. 10, 1946	2,412,466

[13] See Appendix 1 on Mária Telkes' patents.

At the end of the war, Bush on behalf of the OSRD lauded the contribution of MIT professors to winning the war in these words: "This letter gives me the pleasure of expressing to you my personal and official appreciation and commendation of the aid the Massachusetts Institute of Technology has given to the war effort through the work it has performed under contract with this Office" (Office of the president 1946). After the war, on December 31, 1947, the OSRD wound up its operations and, according to the report *Science: The Endless Frontier*, written by Bush, the National Science Foundation was established – an institution that is still in existence today.

The Sun House Project (1939–1953)

After the war years, MIT's Solar Energy Research Group returned to their roots, resuming the pursuit of their original goals and previously defined objectives (Rédey, "A Successful Woman" 680). The group started to work again on the possibility of building a domestic house heated by the sun. "It was highly desirable to incorporate our best ideas of use of sunlight in domestic house construction into a dwelling house built actually to be lived in…," Hottel wrote in a memo to the Steering Committee on November 19, 1945 (Hottel papers 1945a). Before the war, MIT had built a number of smaller houses for the testing of solar energy use. In his report Hottel enthusiastically endorsed Mária Telkes and her ideas on solar power-supported heating and cooling in a domestic house. "In the new conception involving storage units which are at the same time the heat transfer unit, the idea looks very good, and Dr. Telkes's contribution may make a big difference in the outcome of our project," Hottel concluded his memo written to the Committee.

The time spent with this project is the best known and most researched period of Mária Telkes' career, with several studies discussing in depth the technical solutions and problems addressed by the project. For the purposes of this paper, I have chosen to focus on three cardinal questions: How did Telkes get involved with the Sun House project at MIT? When did she come up with the idea of using Glauber's salt? Why did she enter a conflict with Hoyt Hottel?

Telkes's idea was to harness the latent heat of fusion for storage. She suggested using a two-inch panel as the wall of the house facing south. Instead of water, she recommended the panel to be filled with Glauber's salt solution, a phase-change material which absorbs heat when it changes from solid to liquid state. In this way, the room would be heated by radiant energy from the panel fueled by the sun. The idea of using Glauber's salt seemed to be excellent. It was inexpensive and readily available. Telkes went further by providing preliminary calculations regarding the suggested medium and other usable chemical compounds in her report (Hottel papers 1945b). "According to the above table, Na2SO4 x 10H2O (Glauber salt) may prove the most convenient and least expensive to use, for the heating of houses" Telkes wrote, summarizing her research into the optimal material for this domestic application.

The Némethy family, of Hungarian background, became the residents of Telkes's experimental Sun House built in Dover, Massachusetts, around Christmas 1948. Ultimately, this practical implementation of Telkes's concept was not supported financially by the MIT Cabot Solar Energy Fund. Instead, financial aid came from Amelia Peabody, and Eleanor Raymond was hired as the architect. The project was thus realized independently of MIT and became known as the "Three Ladies Project" (Rédey, "Mária Telkes" 83).

Fig. 4. Mária Telkes at a ceremony of the Dover Sun House in 1949. In the background in the corn field there is Eszter Némethy, a tenant of the house. The Némethy family, of Hungarian origin, including Anthony and Eszter Némethy and their three-year-old child, Andrew, arrived in the US in 1948 escaping from Hungary under Soviet occupation and settled in Dover Sun House in search of their new life. Photo source: ASU Distinctive Collections

What happened between November 1945, when Hottel still backed Telkes, and December 1948, when the project was cut from MIT? Telkes was reassigned to the Department of Metallurgy, where she spent most of her research time outside of the Solar Energy Research Group. Eventually, she quit her job at MIT in 1953. To understand the reasons for the discrepancies and misunderstandings between Telkes and Hottel, we must take a closer look at the differences between the two personalities. Hottel was an experienced and distinguished professor in the field of fuel engineering. As the leader of the Solar Energy Research project, he had been surrounded by other male professors until Telkes was brought on as the only female member of the group. Her track record was modest in comparison with that of her male peers, in part due to her coming from Hungary where she was alone with her rather radical approach, which also went against the grain of MIT’s mainstream thinking. In building the solar houses for MIT, Hottel adhered to his credo of using standard, tried-and-true solutions, such as water-filled heating containers instead of phase-change materials. In this regard, Telkes was much more innovative and never tired of suggesting new materials and solutions, even as she remained fully committed to the utilization of solar energy. In contrast to Telkes’s idealistic solutions, Hottel was skeptical about harnessing solar power (Rinde). He remained realistic during his whole life and never overcame his doubts about the efficiency of solar energy storage compared to the relatively cheap fossil fuels and nuclear power. For Telkes, on the other hand, solar energy was a passion in which she believed all her life. She was convinced that the power of the sun could become a viable alternative to fossil fuels.

In 1945, a solar subcommittee was appointed to coordinate the design and heating issues within the Solar Energy Research Group. The head of the subcommittee became MIT architect Lawrence B. Anderson, with MIT building engineer Albert G.H. Dietz and Hoyt C. Hottel sitting in. It was the task of the subcommittee to consider the implementation of Telkes’s idea of the heating system operated with Glauber’s salt. “Our sub-committee asked Dr. Telkes to join us in our planning sessions; and we came to the conclusion that we did not, after all, know enough to build a house for occupancy without some preliminary experiments, if the new south wall storage idea was to be embodied in the plans,” Hottel stated years later (Harrison). Telkes presented all the requisite calculations, but the MIT faculty remained unconvinced. The subcommittee tested the idea on an experimental building, but its effectiveness was found less than good enough. Telkes’s solution drew criticism, and ultimately the entire concept was rejected. “The other result of the tests was the disappointing performance of Glauber’s salt. Discussion in our committee during this period were difficult, because Dr. Telkes simply refused ever to accept the judgement of the other three of us, kept us from covering our agenda by stubborn refusal to stop repeating her arguments for salt, and often affronted our two research men by intimations of their incompetence when they were before us in meeting” (Harrison), Hottel informed Harrison about the work and their conflicts with Telkes. As relations between the subcommittee and Telkes turned sour, she was reassigned to thermoelectric studies at the Metallurgy Department instead of the solar project. Telkes turned to Compton for help, and he did write to Hottel (Hottel papers 1947), but the situation did not change.

The Dover Sun House project was implemented with the financial help of Amelie Peabody, a well-known Bostonian sculptor and philanthropist. Telkes, after her concept had been turned down at MIT, wrote a letter to Peabody requesting financial support to realize her dream. This meant the second active key point for Telkes (2) in the paper. Aided by her connections, professional background, and her enthusiasm for solar energy, she was able to regain her footing from an adverse situation and turn it to her advantage. Amelie Peabody fell in love with the project. Not only did she offer USD 20,000 in cash contribution (about USD 210,000 in current value) but also donated her property in Dover, named the “Powisett Farm,” on which to build the house. As the architect, she brought in Eleanor Raymond, who had been working for Peabody since 1933 and was known for her revolutionary use of new materials and ideas (Rédey, “Mária Telkes” 90). Telkes remained in charge of designing the heating and cooling system of the house.

Although the Dover Sun House was built with resources external to MIT, it was later presented to MIT forums as well. One of the largest such events, hosted by MIT between August 21 and 25, 1950, was the “Symposium on Space Heating with Solar Energy.” Telkes’s presentation drew a massive press attendance and several visits to the house were organized for the public (Némethy). This nationwide appearance brought well-deserved publicity for Telkes, who became a widely known figure. At the same time, her new-found fame caused resentment on the part of Hottel, who was against the project. “Consequently, the experiment, widely publicized as proof of the value of salt for heat store, was not taken seriously by our sub-committee here, and the same view was held by a number of engineers who attended our solar house heating conference here in the summer of 1950,” Hottel wrote to Harrison in 1953 (Harrison). After being relegated to thermoelectric studies at the Metallurgy Department instead of working with the housing project, Telkes finally quit MIT in 1953. “She has now been informed by the administration that her employment at MIT will terminate as of June 30, 1953, and is said to have several satisfactory offers from elsewhere” (Harrison), Harrison added in his report to Compton. According to the documents available, we can see that both Telkes and MIT agreed to terminate their joint work.

After MIT (1953 and on)

During the period under review in this paper, the third important juncture was when Mária Telkes decided to change her professional carrier path (as the third active key point (3) of the period). Dissatisfied with her position at MIT's Metallurgy Department without any foreseeable chance of working for the Solar Energy Research Group, she resolved to move along. Undaunted by the censure of the MIT establishment, she kept her faith in solar energy and accepted the position of director of solar energy research at the Research Division of New York University's College of Engineering. Working for New York University between 1953 and 1958, she established and directed a solar energy laboratory, designed another solar house, researched and developed solar ovens, stills, heaters, wall panels, and agricultural devices. Telkes also helped to form the Association for Applied Solar Energy and organized the first world symposium on applied solar energy. MIT does not hold many records of Telkes's work from the years following her termination there. Still, it is interesting how Hottel reacted years later, when he once again came across the solution suggested by Telkes. In 1972, Hottel received a scientific report with the title "Phase Change Materials for Thermal Energy Storage Applied to Air Conditioning*"* (Kaufmann). The document referred to the Mária Telkes's research on phase change materials and built forward on her ideas toward utilization. Hottel's handwritten remarks on the cover of the report state that "Conclusion: sodium sulfate still does not work! Glauber's Salt is still n.g."

Conclusions

Mária Telkes' inventions pointed far beyond her times. Her ideas were certainly on the right track during her years at MIT, except that the available technical solutions and the social background at the time did not allow her to achieve more recognition. Since that time, the use of solar energy and phase-change materials has been among the most significant research topics and has now moved to the forefront. Telkes's work in several fields pertaining to the utilization of solar energy has motivated and inspired a large body of further research and professional literature. In the 1960s, after her years at New York University, she worked for private companies such as Curtis-Wright, Cyro-Therm, and Melpar. During this period, she directed solar research projects, designed another solar-heated building, and developed solar stoves and ovens. She contributed to research projects dealing with thermoelectric generators in space and phase-change thermal storage for containers to hold temperature-sensitive instruments. These projects included Polaris, Minuteman, and Apollo, among others.

She returned to academia in 1969, serving as chief scientist of energy conversion at the University of Pennsylvania until 1972. Between 1972 and 1978, she worked for the University of Delaware (UDEL) on the invitation of the physicist Karl Böer. Here she was offered a senior scientist position at the recently established Institute of Energy Conversion. One of her most important achievements here was the design and development of the thermal heating systems of Solar One sun house. The still existing institute at UDEL celebrated its fiftieth birthday in 2022. In their own words, "It is the world's oldest solar research facility, credited with significant advances in solar technology, developing new leaders in solar energy research and industry, and helping to expand renewable energy possibilities for the future" (UDEL).

In a late interview (Wasserman 18), Telkes was asked how she felt to have worked in what was essentially a male world. She answered that it never bothered her. She had been used to being the only woman in male-dominated groups. "I have too much of a sense of humor. If you are discriminated against, it's partly your own fault. I make a joke or something like that – you know 'well, I tried solar heating twenty-five years ago so obviously I am not quite a failure.' Fundamentally, I am trying to be a very pleasant person. I have no chip on the shoulder. I really haven't been discriminated against. It would be futile because I still have quite a few scientific and patentable ideas." Mária Telkes declared these words triumphantly in June 1976. Her statements, along with the three key actions previously outlined—writing an application letter to Bush (1), securing Amelia Peabody as an angel investor (2), and transitioning from MIT to New York University (3)—demonstrate that solar energy research was both her passion and her conviction. Such drive and determination could not be limited or defined by the social and technological circumstances of the era.

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Appendix 1: List of patents of Mária Telkes

1/a: US patents of Mária Telkes. Source: USPTO

No.	**Name** (location)	Patent title	Assignor	Year of Appl.	Patented	No. of patent
1	Telkes Maria (Edgewood, Pa.)	Heat Absorber	Westinghouse Electric	1939	1941	2,246,329
2	Telkes Maria (Edgewood, Pa.)	Thermoelectric Couple	Westinghouse Electric	1939	1941	2,229,481 2,229,482

3	Telkes Maria (Edgewood, Pa.)	Method of Assembling Thermoelectric Generators	Westinghouse Electric	1939	1942	2,289,152
4	Telkes Maria (Cambridge, Mass.)	Thermoelectric Alloys	Research Corporation	1943	1945	2,366,881
5	Telkes Maria (Cambridge, Mass.)	Radiant Energy Heat Transfer Device	-	1946	1952	2,595,905, CA 484780
6	Telkes Maria (Cambridge, Mass.)	Method and Apparatus for the Storage of Heat	-	1952	1954	2,677,243
7	Telkes Maria (Cambridge, Mass.)	Heat Storage Unit	-	1951	1954	2,677,367 CA 527118
8	Telkes Maria (Cambridge, Mass.)	Composition of Matter for the Storage of Heat és Perfectionnements aux accumulateurs de chaleur	-	1951	1954	2,677,664, FR 1,050,933, CA 531692
9	Telkes Maria (Cambridge, Mass.)	Apparatus for Storing and Releasing Heat	-	1952	1957	2,808,494
10	Telkes Maria (Cambridge, Mass.)	Method for Storing and Releasing Heat	-	1952	1958	2,856,506
11	Telkes Maria (New York, N.Y.)	Cooking Device and Method	-	1957	1959	2,915,397 CA663731 (1963)
12	Telkes Maria (New York, N.Y.)	Temperature Stabilized Fluid Heater and a Composition of Matter for the Storage of Heat Therefor	-	1960	1960	2,936,741
13	Telkes Maria (389 Terhune Road, New York, N.Y.)	Temperature Stabilized Container and Materials Therefor	-	1957	1961	2,989,856
14	Telkes Maria (Princeton), and Andrassy Stella (Kingston, N.J.)	Collapsible Cold Frame	The Dow Chemical Company	1960	1965	3,206,892
15	Telkes Maria (Allentown, Pa.)	Method and Apparatus for Making Large Celled Material	The Dow Chemical Company	1962	1966	3,248,464
16	Telkes Maria (Falls Church, Va.)	Dew Collecting Method and Apparatus	Melpar	1965	1966	3,270,515
17	Telkes Maria (Falls Church, Va.)	Collapsible Solar Still with Water Vapor Permeable Membrane	Melpar	1966	1968	3,415,719
18	Maria Telkes (Falls Church, Va.)	Large Celled Material	The Dow Chemical Company	1960, 1962, 1965	1969	3,440,130
19	Maria Telkes (Washington DC), and Henry Hahn (Fairfax, Va.)	Time / Temperature Indicators	American Standard	1970	1972	3,695,903
20	Telkes Maria (Newark, Del.)	Thixotropic Mixture and Method of Making Same	University of Delaware	1975	1976	3,986,969
21	Telkes Maria (Newark, Del.)	Cooling System	University of Delaware	1975	1977	4,010,620
22	Telkes Maria (Newark, Del.)	Selective Black for Absorption of Solar Energy	Ses Inc.	1975	1977	4,011,190
23	Telkes Maria (Newark, Del.)	Solar Heating Method and Apparatus.	University of Delaware	1974	1977	4,034,736

24	Telkes Maria (Killeen, Tex.)	Phase Change Thermal Storage Materials with Crust Forming Stabilizers	American Technological University	1978	1980	4,187,189
25	Telkes Maria (Killeen, Tex.)	Thermal Energy Storage to Increase Furnace Efficiency	Research Institute for Advanced Technology	1979	1981	4,250,866
26	MacCracken Calvin D (Englewood, N.J.), and Telkes Maria (North Miami, Fl)	Eutectic Composition for Coolness Storage	Calmac Manufacturing	1989	1990	4,954,278

1/b: List of patents extended to foreign countries, source: USPTO

Telkes Maria	Heat Exchange Bodies Utilizing Heat of Fusion Effects and Methods of Making Same	1979	EP0005362
Telkes Maria	Regenerative Heat Exchange Body Using Heat of Fusion	1979	AU4669579
Telkes Maria	Varmeutvekslingslegemer	1979	NO791377
Telkes Maria	Corps Echangeur de Chaleur et Procede de Preparation	1979	BE875995
Telkes Maria	Thixotropic Mixture and Method of making Same	1979	CA1056108
Telkes Maria	Body for Storage and Release of Themal Effects Using Heat of Fusion of Salt Hydrate	1980	NZ190339
Telkes Maria	Nucleating Device and Method of Preparing Same	1980	CA1077459
Telkes Maria	Heat exchange bodies utilizing heat of fusion Eeffects and Method of Making Same	1980	ZA791888
Telkes Maria	Phase Change Thermal Materials with Crust Forming Stabilizers	1980	WO8000257
Telkes Maria	Waermeaustauscher und Verfahren zur Herstellung Derselben	1981	DD145760
Telkes Maria	Thermal Energy Storage to Increase Furnace Efficiency	1982	CA1133777
Telkes Maria	Phase Change Thermal Storage Materials with Crust Forming Stabilizers	1982	PH15243
Telkes Maria	Heat Exchange Bodies Utilizing Heat of Fusion Effects and Methods of Making Same	1982	CA1122392
Telkes Maria	Phase Change Thermal Storage Materials with Crust Forming Stabilizers	1982	AU520562
Telkes Maria	Heat Exchange Bodies Utilizing Heat of Fusion Effects and Methods of Making Same	1982	EP0005362
Telkes Maria	Nucleating Device for Crystal Melts - Comprising Material with Micro-cavities Contg. Crystal Nuclei	1983	DE2639173
Telkes Maria	Metodo Mejorado para Producir un Cuerpo de Intercambio Termico	1986	MX153311

Appendix 2: Publications of Mária Telkes

2/a: Articles

No.	Author	Title	Year	Place of publication
1	Telkes, M	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, G. W., et al (Telkes)	An Interpretation of Excitation, Exhaustion and Death in Terms of Physical Constants.	1928	Proceedings of the National Academy of Sciences - PNAS, vol. 14, no. 7, 1928, pp. 532–38
3	Crile, George W., et al. (Telkes)	An Experimental Investigation of the Physical Nature of Death	1929	Proceedings of the American Philosophical Society, vol. 68, no. 2, 1929, pp. 69–81.
4	Crile, George W., et al. (Telkes)	The Physical Nature of Death	1930	Scientific American, vol. 143, no. 1, 1930, pp. 30–32,
5	Telkes, Maria	BIOELECTRICAL MEASUREMENTS ON AMOEBAE	1931	The American Journal of Physiology, vol. 98, no. 3, 1931, pp. 475–83
6	Crile, George, et al. (Telkes)	Further Studies of Autosynthetic Cells with Special Reference to the Possible Rôle of the Nitro Group in the Energy Phenomena of Protoplasm.	1932	Proceedings of the American Philosophical Society, vol. 71, no. 7, 1932, pp. 411–20.
7	Crile, George, et al. (Telkes)	Autosynthetic Cells	1932	Protoplasma, vol. 15, no. 1, 1932, pp. 337–60,
8	Slichter, Louis B., and Telkes, Maria	Electrical Properties of Rocks and Minerals	1942	Handbook of Physical Constants; edited by Francis Birch and others. pp. 299-319. National Research Council, (Geological Society of America. Special Paper 36.)
9	Telkes, Maria	Solar Distiller for Life Rafts	1945	Washington, D. C.: U. S. Office of the Publication Board (PB2I 2o.)
10	Telkes, Maria	Solar House Heating- a Problem of Heat Storage	1947	Heating and Ventilating 44, pp. 68-75, May 1947
11	Telkes, Maria	The Efficiency of Thermoelectric Generators. I	1947	Journal of Applied Physics, vol. 18, no. 12, 1947, pp. 1116–27
12	Telkes, Maria	A Review of Solar House Heating	1949	Heating and Ventilating, 46, pp. 67-74, Sept. 1949
13	Telkes, Maria	Space Heating with Solar Energy	1949	Scientific Monthly, vol. 69, no. 6, 1949, pp. 394–97.
14	Telkes, Maria; Eleanor, Raymond	Storing Solar Heat in Chemicals	1949	Heating and Ventilating 46, pp. 79-86, Dec. 1949
15	Telkes, Maria; Norton John T.; Cullity B.D.	Electrical Resistivity and Thermoelectric Power of Antimony-Selenium Alloys	1950	A.LM.E. Trans. (J. of Metals) 188, pp. 47-52, Jan. 1950
16	Telkes, Maria	A Low Cost Solar Heated House	1950	Heating and Ventilating 47, pp. 72-74, August 1950.
17	Telkes, Maria	Thermoelectric Power and Electrical Resistivity of Minerals	1950	The American Mineralogist, vol. 35, no. 7-8, 1950, pp. 536–55.
18	Telkes, Maria	Future Uses of Solar Energy	1951	Bulletin of the Atomic Scientists, vol. 7, no. 7-8, 1951, pp. 217–19
19	Telkes, Maria	Nucleation of Supersaturated Inorganic Salt Solutions	1952	Industrial and Engineering Chemistry, vol. 44, no. 6, 1952, pp. 1308–10

20	Telkes, Maria	Warmth for Comfort	1953	Centennial of Engineering; edited by L. R. Lohr. pp. 926-941, Chicago: Centennial of Engineering
21	Telkes, Maria	Fresh Water from Sea Water by Solar Distillation	1953	Industrial and Engineering Chemistry, vol. 45, no. 5, 1953, pp. 1108–14
22	Telkes, Maria	Power Output of Thermoelectric Generators	1954	Journal of Applied Physics, vol. 25, no. 8, 1954, pp. 1058–59
23	Telkes, Maria	Solar Thermoelectric Generators	1954	Journal of Applied Physics, vol. 25, no. 6, 1954, pp. 765–77
24	Telkes, Maria	Solar Energy Research. Farrington Daniels and John A. Duffie, Eds. Univ. of Wisconsin Press, Madison, 1955. Xv + 290 Pp. Illus. + Plates. $4	1956	Science (American Association for the Advancement of Science), vol. 123, no. 3188, 1956, pp. 188–188
25	Telkes, Maria	Wind and Solar Energy. Proceedings of the New Delhi Symposium. Arid Zone Research, Vol. VII. UNESCO, Paris, 1956. 238 Pp. $8	1958	Science (American Association for the Advancement of Science), vol. 128, no. 3318, 1958, pp. 247–247,
26	Telkes, Maria	Solar Cooking Ovens	1959	Solar Energy, vol. 3, no. 1, 1959, pp. 1–11
27	Altman, M., et al. (Telkes)	The Energy Resources and Electric Power Situation in the United States.	1972	Energy Conversion, vol. 12, no. 2, 1972, pp. 53–64,
28	Hodgins, J. W., et al. (Telkes)	Low Temperature Thermal Energy Storage	1977	Energy (Oxford), vol. 2, no. 1, 1977, pp. 70–75
29	Telkes, Maria	Remarks on 'thermal Energy Storage Using Sodium Sulfate Decahydrate and Water	1978	Solar Energy, vol. 20, no. 1, 1978, pp. 107–107
30	Telkes, Maria	Thermal Energy Storage in Salt Hydrates.	1980	Solar Energy Materials, vol. 2, no. 4, 1980, pp. 381–93

2/b: Books

No.	Author	Title	Year	Place of publication
1	Telkes, Maria	Distilling Water with Solar Energy	1943	MIT
2	Telkes, Maria	Research on Methods for Solar Distillation	1956	Office of Saline Water
3	Telkes, Maria	New and Improved Methods for Lower Cost Solar Distillation	1959	U.S. Department of the Interior
4	Telkes, Maria	Solar Still Construction	1959	U.S. Department of the Interior

2/c: Reviews

No.	Author	Title	Year	Place of publication
1	Telkes, Maria	Fresh Water from the Ocean	1955	The Scientific Monthly, vol. 80, no. 5, American Association for the Advancement of Science, 1955, pp. 323–323.
2	Telkes, Maria	Solar Energy Research	1956	Science, vol. 123, no. 3188, American Association for the Advancement of Science, 1956, pp. 188–188.
3	Telkes, Maria	World Symposium on Applied Solar Energy, Proceedings	1957	The Scientific Monthly, vol. 84, no. 6, American Association for the Advancement of Science, 1957, pp. 320–21.
4	Telkes, Maria	Wind and Solar Energy. Proceedings of the New Delhi Symposium. Arid Zone Research, Vol. VII	1958	Science, vol. 128, no. 3318, American Association for the Advancement of Science, 1958, pp. 247–247