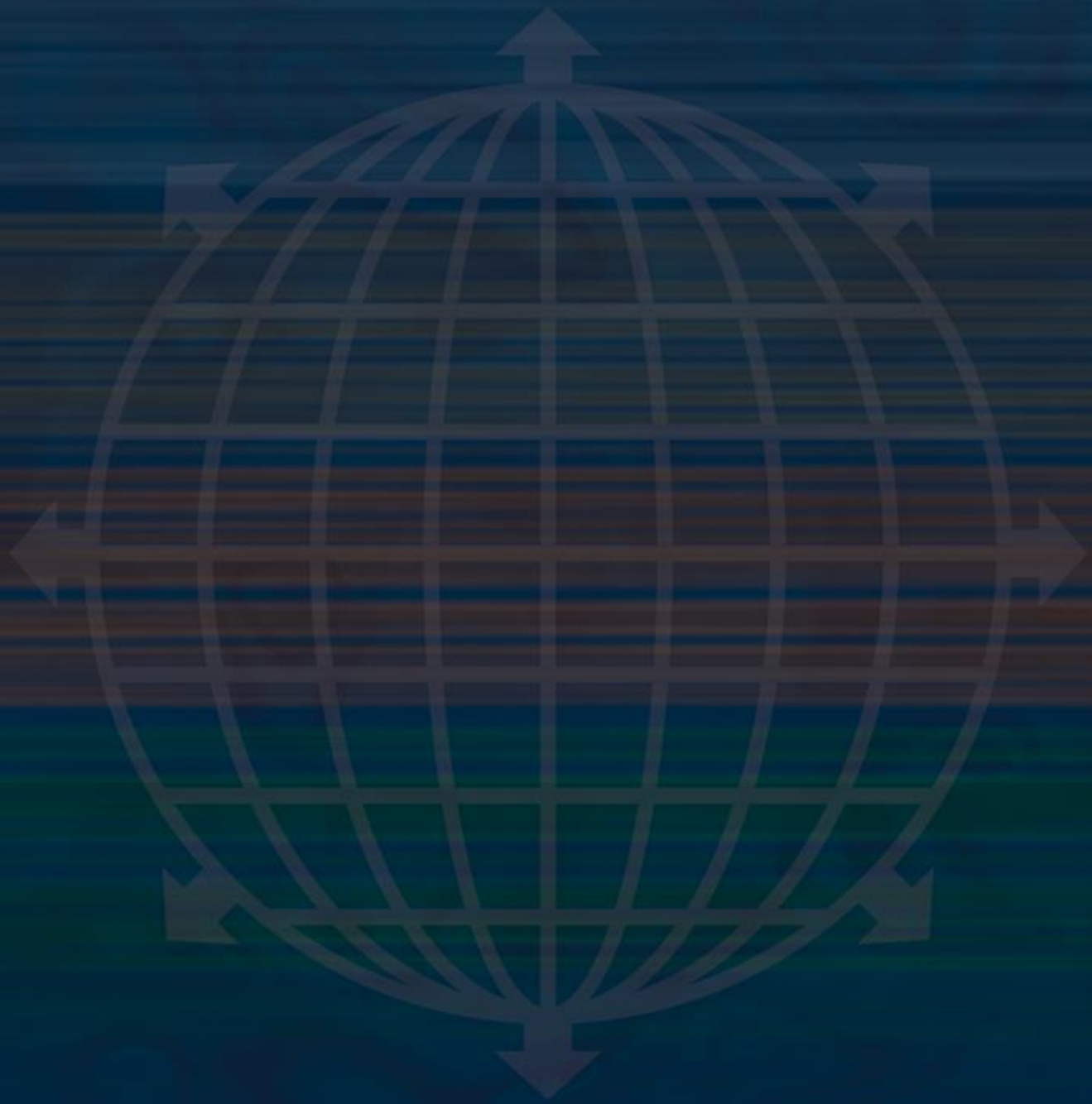

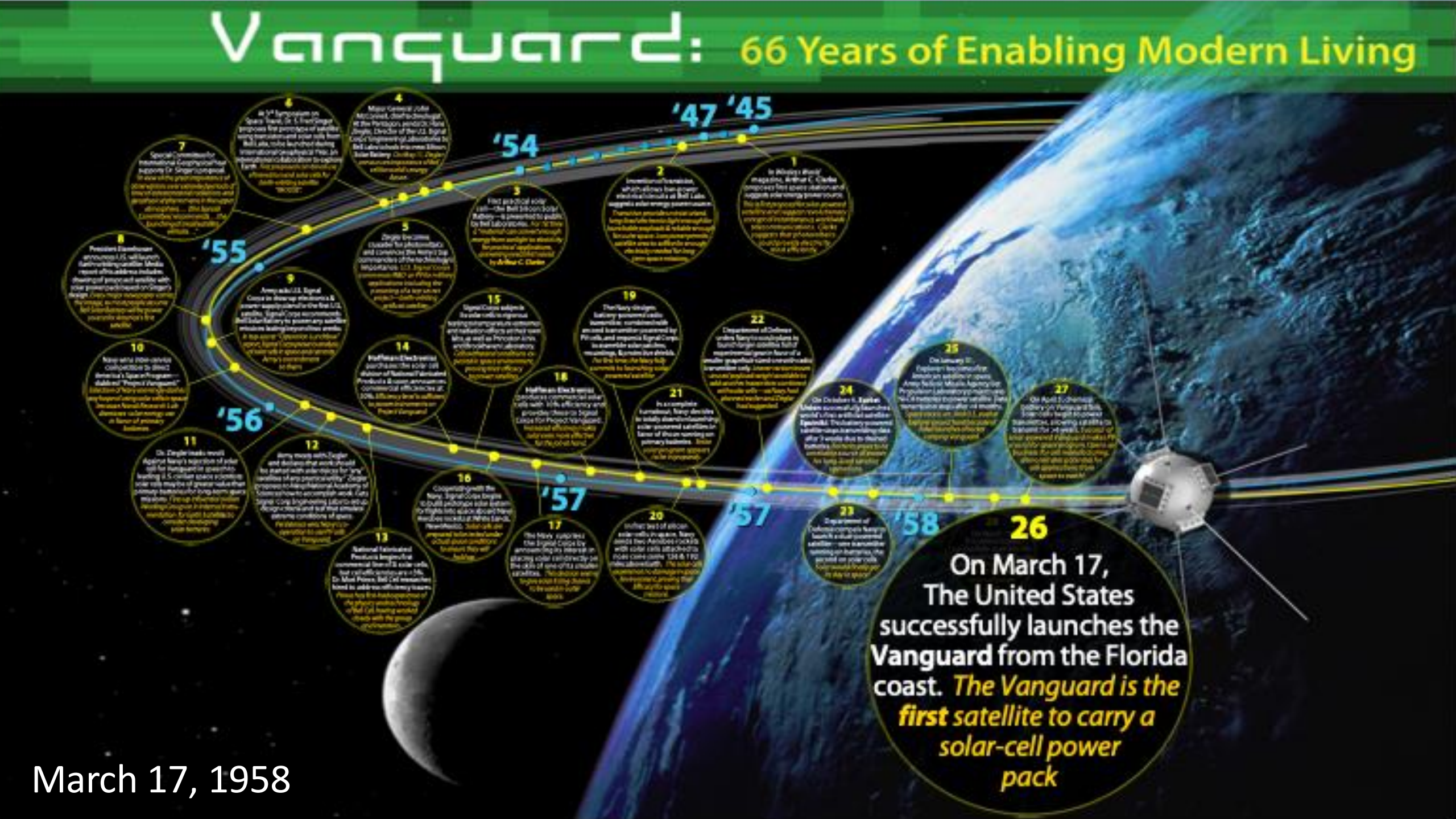
Vanguard: 66 Years of Enabling Modern Living
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On March 17, The United States successfully launches the Vanguard from the Florida coast. The Vanguard is the first satellite to carry a solar-cell power pack
March 17, 1958

getting started

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University of Arizona, Tuscon, AZ • October 31–November 1, 1955

Some 500 participants heard 96 papers in five subject areas:

- General papers
- Thermal processes
- Electrical processes
- Radiation
- Photochemical processes

Supported by:

- National Academy of Sciences
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- Rockefeller Foundation
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- United State Air Force
- UNESCO

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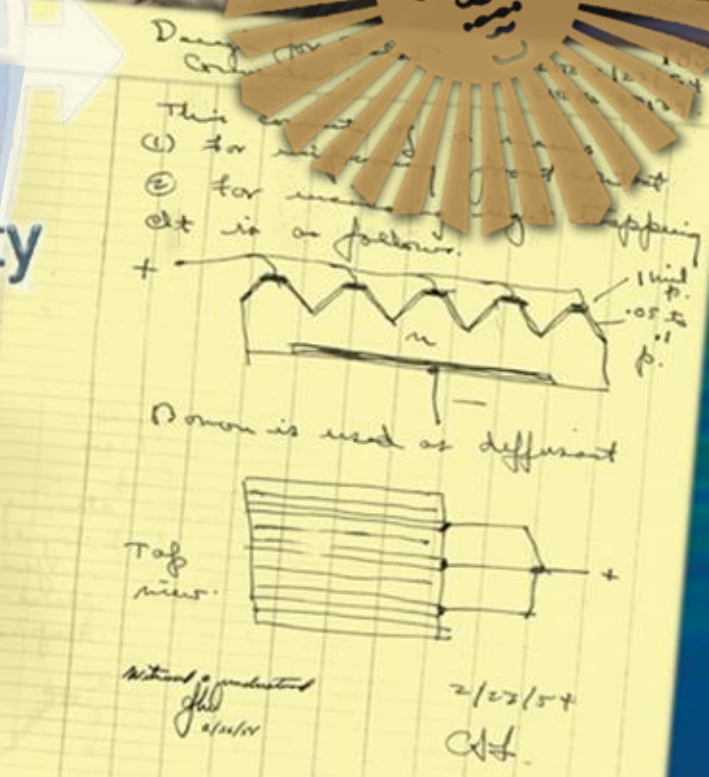
ISES

International Solar Energy Society



The 50th Anniversary Exhibit
Orlando, Florida, August 2005

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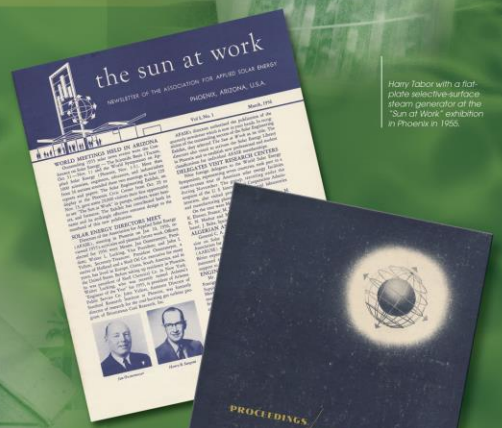

Harry Tabor with a flat-plate selective-surface steam generator at the "Sun at Work" exhibition in Phoenix in 1955.

SOMAR pump at Phoenix

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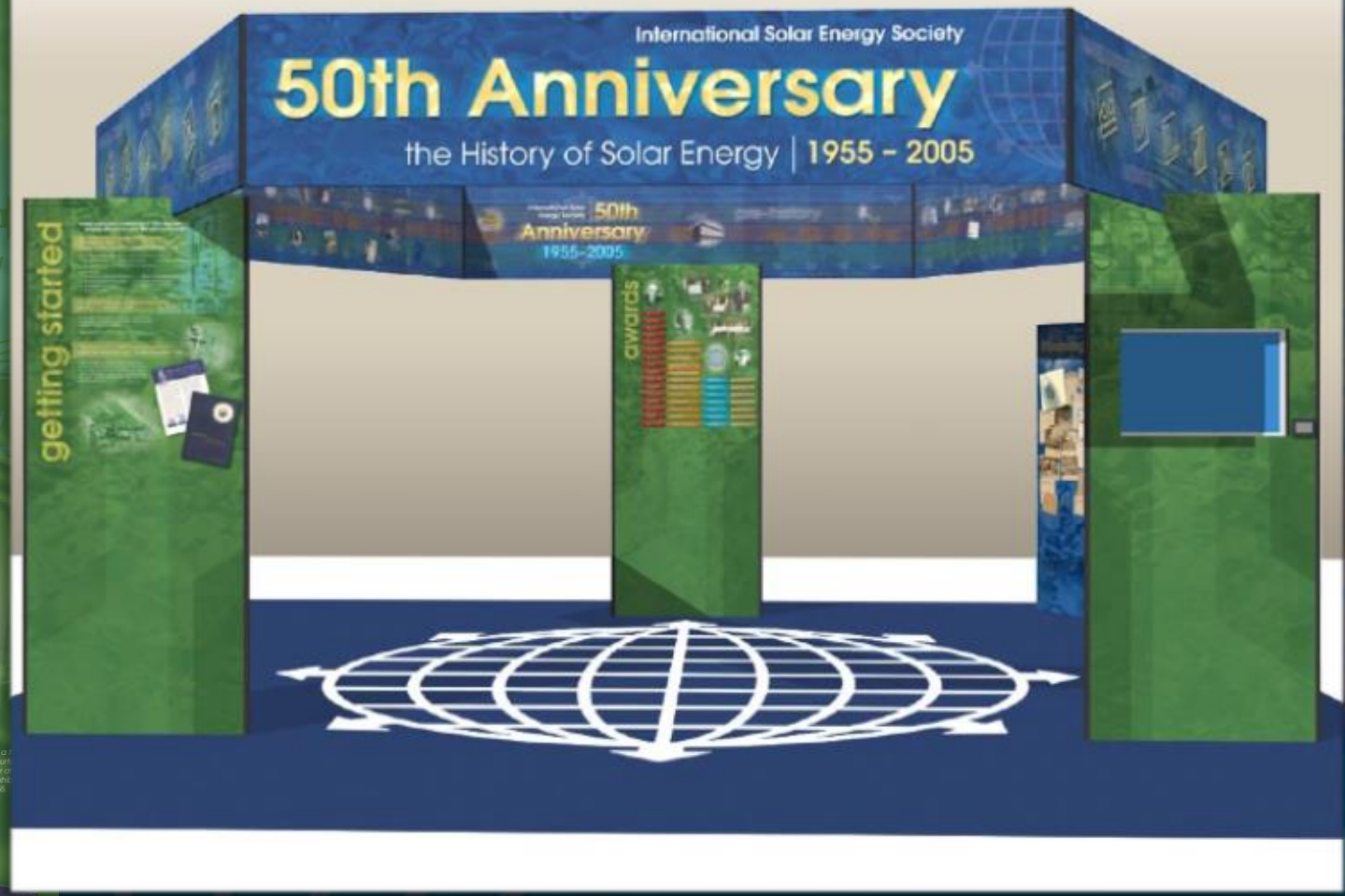

presidents

Association for Applied Solar Energy (AFASE)

Henry B. Sargent
USA

Jan Oostermeyer
USA

Harold Walmsley
USA

Solar Energy Society (SES)

Farrington Daniels
USA

Peter E. Glaser
USA

Roger N. Morse
Australia

International Solar Energy Society (ISES)

John A. Duffie
USA

George O. G. Löf
USA

William H. Klein
USA

R. L. Datta
India

congresses

Solar World Congress

1st ISES Solar World Congress
Melbourne, Australia (Mar 2-6,1970)

Sun's Energy—Resource for Survival
Greenbelt, Maryland USA (May 10-14, 1971)

The Sun in the Service of Mankind
Paris, France (July 2-6,1973)

Solar Use Now—A Resource for People
Los Angeles, California USA (July 28-Aug 1,1975)

Sun: Mankind's Future Source of Energy
New Delhi, India (Jan 16-21, 1977)

Silver Jubilee Congress
Atlanta, Georgia USA (May 28-June 1, 1979)

Solar World Forum—
Solar Technology in the Eighties
Brighton, UK (Aug 23-28, 1981)

Solar World Congress
Perth, Australia (Aug 14-19, 1983)

Intersol '85
Montreal, Canada (June 23-29, 1985)

Advances in Solar Energy Technology
Hamburg, Germany (Sept 13-18, 1987)

Clean and Safe Energy Forever
Kobe, Japan (Sept 4-8, 1989)

Solar Energy for the 21st Century
Denver, Colorado USA (Aug 19-23, 1991)

Harmony with Nature
Budapest, Hungary (Aug 23-27, 1993)

In Search of the Sun
Zimbabwe, Harare (Sept 11-15, 1995)

Solar Means Business
Taejon, South Korea (Aug 24-30, 1997)

Solar is Renewable
Jerusalem, Israel (July 4-9, 1999)

Millennium Solar Forum 2000
Mexico City, Mexico (Sept 17-22, 2000)

Bringing Solar Down to Earth
Adelaide, Australia (Nov 25-Dec 2, 2001)

Solar Energy for the Build Environment
Göteborg, Sweden (June 14-19, 2003)

Solar Energy: Bringing Water to the World
Orlando, Florida USA (Aug 6-12, 2005)

awards

Farrington Daniels
Outstanding intellectual leadership in renewable energy

Ms. Mary Hoskins
Author of Christopher Weeks

Achievement Through Action

Contribution to harnessing renewable energy for practical use (in memory of Christopher A. Weeks)

70 Hoyt Clarke Hottel, USA	80 University of Madison – Wisconsin Solar Energy Laboratory, USA		
71 Valentin A. Baum, Russia	81 University College Cardiff, Solar Energy Unit, Wales		
72 Félix Trombe, France	82 Colorado State University, Solar Energy Applications, USA		
73 Harry Tabor, Israel	83 University of Waterloo, Solar Thermal Engineering Centre, Canada; Lui Industries, Jerusalem, Israel		
74 Peter E. Glaser, USA	84 University of Melbourne, Solar Energy Research & Development Group, Australia		
75 George O.G. Löf, USA	85 Fraunhofer Institute for Solar Energy Systems, Adolf Goetzberger, Germany, Germany	Special Services	Karl Böer
76 John A. Duffie, USA	86 NB Institute for Rural Technology, Fenura India; OM Institute, Akio Okumura, Japan		
77 John Page, UK	87 Arnold J. Goldman, Jerusalem, Israel		
78 Tetsuo Noguchi, Japan	88 Panos Lamoni, SOLE S.A., Athens, Greece		
79 William W.S. Charters, Australia	89 Bernard McNelis, IT Power Ltd., Chanctonbury, UK		
80 Adolf Goetzberger, Germany	90 Warner Weiß, AEE, Gleisdorf, Austria		
81 Chris W.J. van Koppen, The Netherlands	91 Zhiqiang Yin, Tsinghua University, Beijing, China		
82 Ken-ichi Kimura, Japan	92 Michael Nicklas, USA; Douglas Lorrimon, Canada	93 President Jimmy Carter, USA	
83 Roland Winston, USA	94 Wal Read, Australia	95 David E. Carlson, USA	
84 Karl W. Böer, USA	96 Harry Tabor, Israel	97 Adolf Goetzberger, Germany	
85 William A. Beckman, USA	98 Sany Hallanda, Canada	99 Stanford R. Ovshinsky, USA	
	00 No awardee	01 Allen M. Barnett, USA	
	02 Donald W. Aitken, USA; Torben Esbensen, Denmark; Joachim Luther, Germany	03 Martin A. Green, Australia	
		05 Yoshihiro Hamakawa, Japan	

sections

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Regional Offices:
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Hartbeespoort, South Africa
③ **ISES Asia/Pacific**
Sydney, Australia
④ **ISES Europe**
Nicosia, Cyprus
⑤ **ISES Latin America**
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Argentina
Brazil
Costa Rica
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Cuba
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Arab Section (1977)
(First Chair: A.A.M. Sayigh)
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Egypt
Ghana
Israel
Kenya
South Africa (1974)
Zimbabwe

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Austria
Belgium (1977)
Bulgaria

Europe *(cont.)*
Croatia
Cyprus
Czech Republic
Denmark
Finland
France
Germany (1977)
Greece
Hungary
Ireland (1976)
Italy (1964)
Netherlands (1975)
(First Chair: V. Stowell, G. Nebbia)
Norway
Poland
Portugal
Romania
Russia

Europe *(cont.)*
Slovenia
Spain
Sweden (Scandinavia, 1976)
Switzerland
Turkey
Ukraine
United Kingdom (1973)

Asia/India
Bangladesh
Georgia
India (1967)
(First Chair: R.L. Datta)
Japan (1973)
Korea
Malaysia
Nepal
Pacific Islands
Pakistan
Philippines
Russia

Australia
Australia &
New Zealand (1962)
(First Chair: R.N. Morse)

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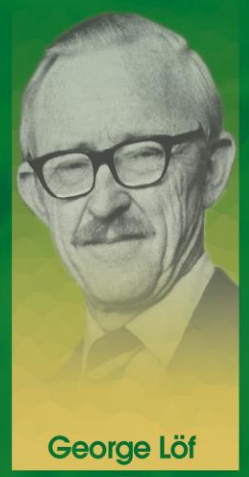
Photo from 2005 SWC Exhibit

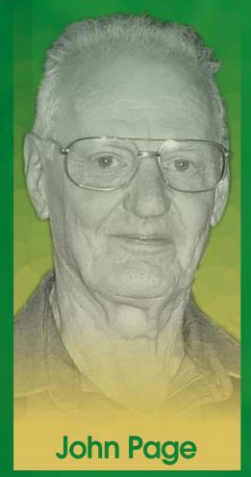
1955-2005 | International Solar Energy Society

Pioneers & Solar Leaders

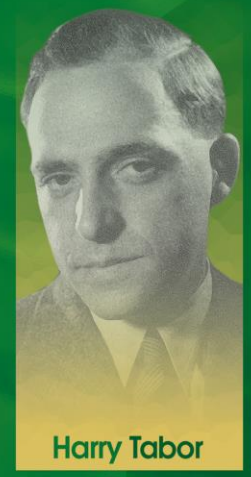
interviews

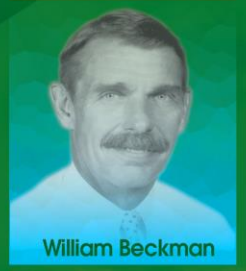

Erich Farber


George Löf

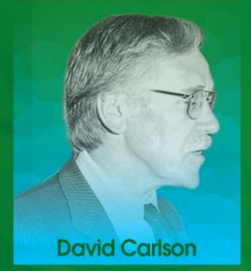

John Page


Mort Prince


Harry Tabor


William Beckman


Karl Böer

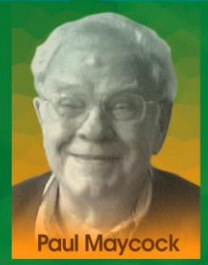

David Carlson


Peter Glaser

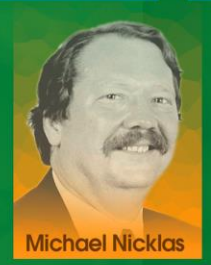

Martin Green


Yoshihiro Hamakawa


Anne Grete Hestnes


Paul Maycock


David Mills


Michael Nicklas


Cesare Silvi

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Energy

Pioneers & Solar

interviews


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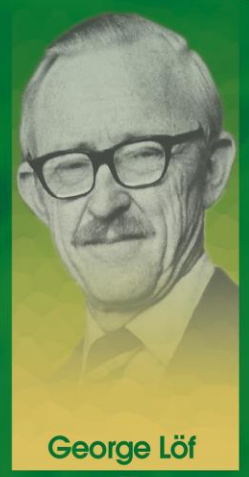
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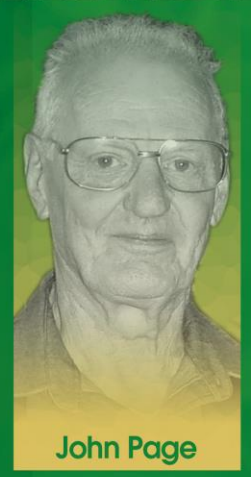
John Page


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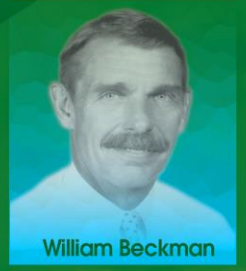
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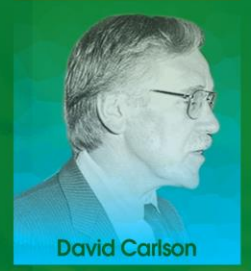
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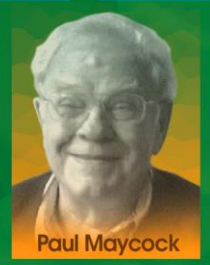
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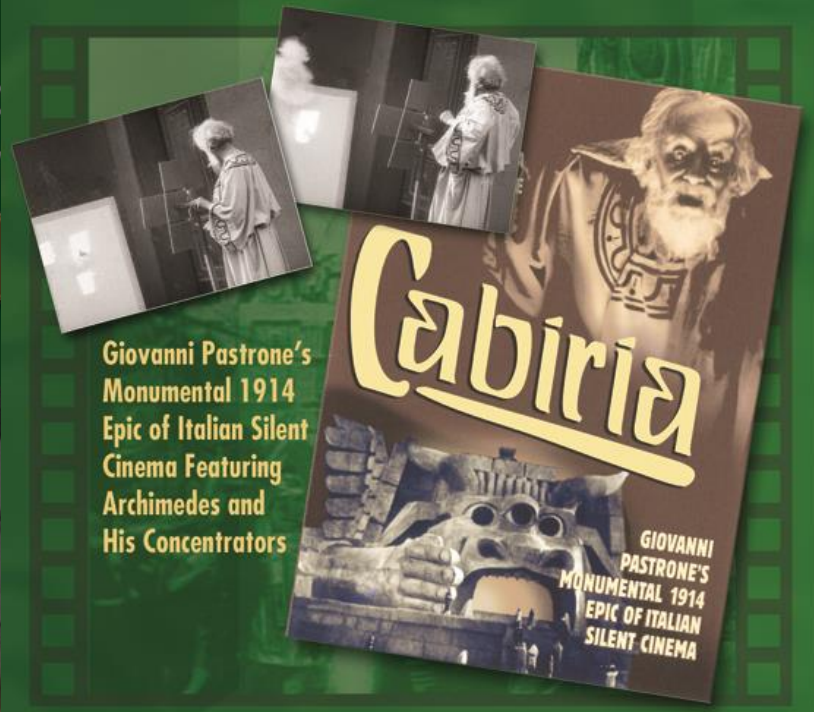
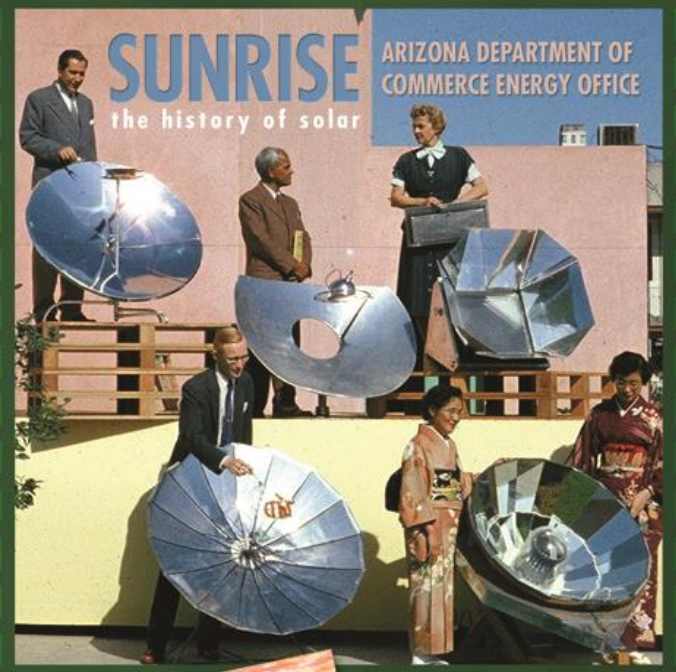
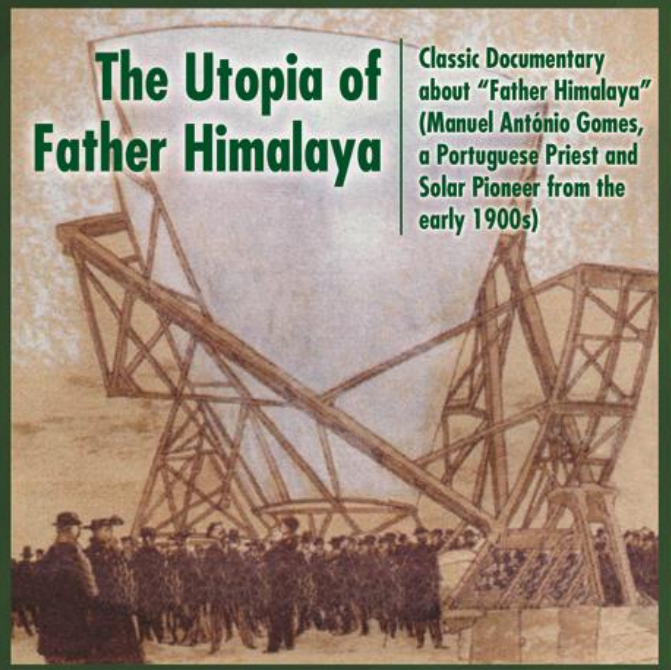
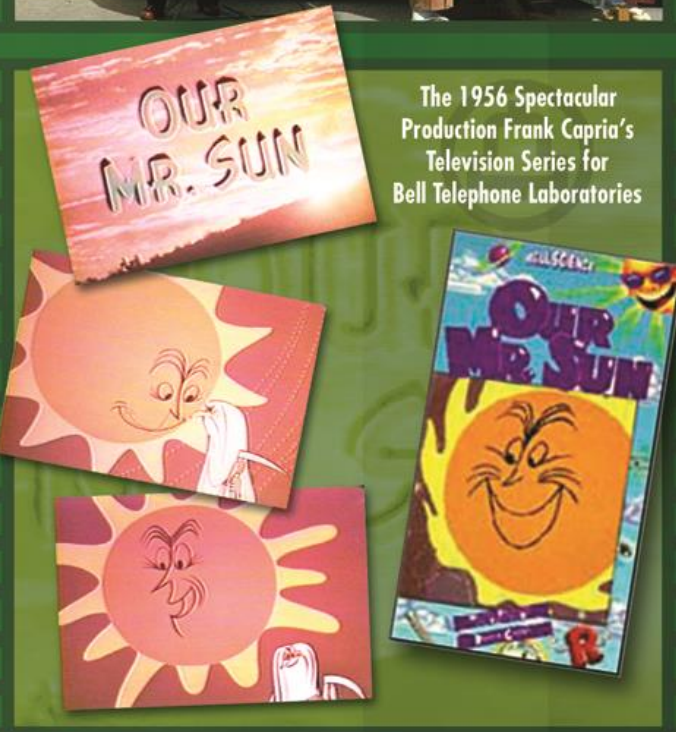
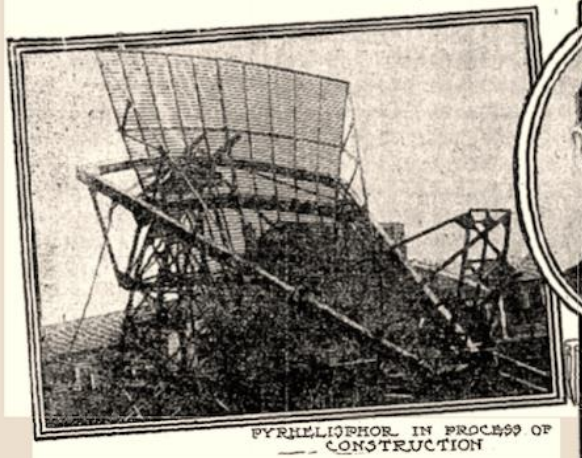








PYRHELIOPHOR, WONDER OF ST. LOUIS FAIR

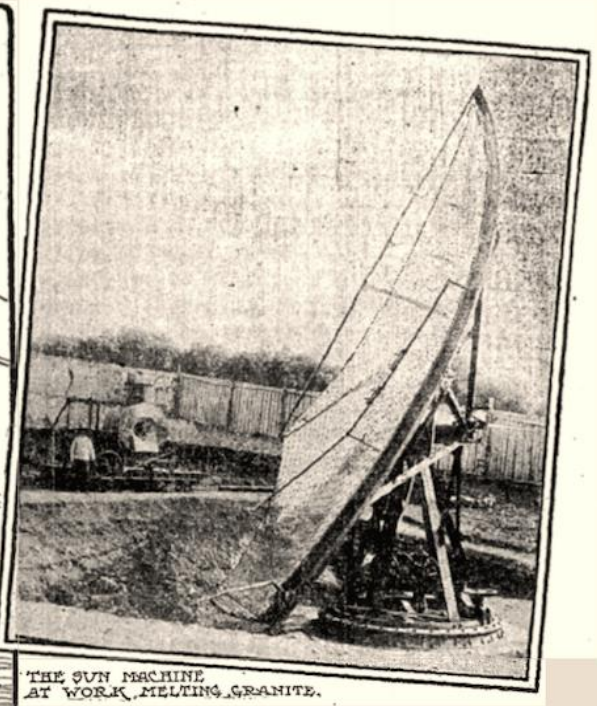


PYRHELIOPHOR IN PROCESS OF CONSTRUCTION

FATHER M. A. GOMES HIMALAYA, INVENTOR.

6117 mirrors
>3800°C

AT THE WORLD'S FAIR.



THE SUN MACHINE AT WORK MELTING GRANITE.

Sun Machine Invented by Father Himalaya, a Portuguese Priest, Generates 7,000 Degrees Heat Fahrenheit---As Yet He Claims no Commercial Value for It ---Principles of Its Construction and Operation.

SCIENTIFIC experiments and discoveries of revolutionizing value to chemistry and agriculture are being made these days at the World's Fair by the pyrheliophor, or sun machine, the invention of Father Himalaya. This gifted young Portuguese priest, exempted from clerical duties by the Archbishop of Braga, that he may devote his life to science, was Professor of Physics and Chemistry in the Colleges of Coimbra and Porto.

The sun machine, which he has been more than five months erecting on the hill in the rear of the Fish, Game, and Forestry Building, made its first revolution Oct. 18.

Despite the fact that the sun was partially hidden by a fog, more than 7,000 degrees of heat (Fahrenheit) were generated, while iron and magnesia crucibles melted. Subsequent experiments have not only confirmed those of the first day, but led to many important new discoveries of far-reaching import not only to pure science, but eventually to commercial industry.

The experiments are being made largely in the presence of Viscomte d'Alte, Portugal's Minister to the United States and Commissioner General to the Louisiana Purchase Exposition.

The sun machine is practically Portugal's contribution to the fair, since, unlike its continental neighbors, the country has no separate building or exhibit of its arts or industries. This is the fourth sun machine Prof. Himalaya has erected. The first three terprise has only been made possible by the liberality of a well-known woman of the Royal Court of large wealth and public spirit, and a philanthropist of Paris, who came to the financial aid of the inventor.

Capt. Francis Xavier de Brito of the Royal Artillery obtained five months' furlough that he might accompany Prof. Himalaya to this country and assist him in adjusting the machine. Capt. de Brito is one of the most skillful engineers in the royal army. He personally adjusted the 6,117 mirrors, 5 by 10, which comprise the interior of the conical, concave reflector.

Prof. Himalaya, like all men of science, was cautious and chary of speaking of the possibilities of the pyrheliophor while it was in process of construction. Now he is more than satisfied with the results actual experiment has brought.

"I feel compensated," he said, "in the enormous results already obtained for the fifteen years' arduous study I have given to the subject. I see the way clear to the sun machine's application to industry. Aside from many intensely interesting scientific deductions during the first day's experiment, I have made the following new discoveries:

"1. The heat of the sun is of absolute electric origin.

"2. The intensity of the rays which produce the solar radiation is very much higher than that of the electric arc.

"3. The machine reveals whence comes the electric energy that holds between the heat and the stars.

heat of the sun is not produced by the impact of aerolites on the solar mass, nor by the concentration of the so-called solar nebulae, nor by the oxidation or chemical reaction of any kind of solar matter, nor by any form of radio-activity. The radiation of the sun, he believes, is produced by powerful electrical discharges in the solar atmosphere at the level of the photosphere.

During the past week the sun machine has aided Prof. Himalaya, he says, to discover the source of this electric energy. This discovery alone, to the inventor's mind, is the most important he can hope to aspire to in this line.

With knowledge of the origin of the energy from which the sun's radiation is derived, we have, says Father Himalaya, the "key to the real forces of nature, the key which no person has yet discovered. As soon as these forces are known it is easy to capture them and put them to the service

for results are often obtained," said Father Himalaya, while the sun machine was in process of construction. "Should the pyrheliophor lead to some marvelously undreamed of discovery and fail to realize my original hope, I would be compensated."

Since the machine has been in operation the smoke coming out of the fourneau and the reflection surrounding it are attracting great crowds to the wire fence dividing the pyrheliophor from trespassers.

Curiosity, piqued when the machine began to take form on the hilltop, is now at heat scarcely less white than that reflected from the machine's mirror lining. The inventor's sense of humor has been touched by the various guesses made by World's Fair visitors as to the machine's raison d'être. He has been asked if it were an airship, a ducking machine, or an apparatus for drying clothes!

to be disastrous. The concave inside surface of this conical section is completely lined with squares of looking glass 5 by 10 inches. Each mirror square is riveted by brass screws to the steel slats of the reflector, and adjusted to its neighbor with mathematical exactness, giving a perfected concave surface of 6,117 mirrors. The machine rests on a north and south line, and is constructed to conform constantly with the two daily motions of the sun rather than the earth. The reflecting gridiron may be adjusted to any time of day to meet the sun. The rays are concentrated from a reflecting area 6,117 times that of the heating surface, which is a small point not more than six inches in diameter in the upper centre of a steel crucible the size of an ordinary barrel at the point of focus.

This crucible is lined with magnesia, the plumbago used in the previous machine at

irrespective of the climate to which the machine may be exposed, explains his apparent dilatoriness. It is a well-known fact that in Winter, when the earth is in perihelion, the sun is shining much hotter on the earth in the southern hemisphere. Only the slant of the rays prevents the northern latitudes from receiving a like heating. The pyrheliophor, unaffected by the obliquity of the sun's rays, takes them from any angle and sends them direct into the heating focus of the solar machine.

This fact enables Father Himalaya to meet with greater success in the Winter months, when the sky is clear and the atmosphere free of moisture. While he believes the machine will eventually be of great commercial value in that it will supply a new motor for the movement of machinery, he does not hope to use it except for scientific purposes in a climate such as is to be found about St. Louis, because there the sun does not shine continually, but in Arabia or California, where it shines the livelong day, the year round, the pyrheliophor will create steam and run engines. Here would seem to lie the solution of the fuel problem in sections where there is no fuel.

So intense is the heat coming from the pyrheliophor that birds flying forty feet above are killed by the intensity of the reflected ray.

Father Himalaya has had all sorts of offers from capitalists to form a company. To all propositions he makes the same re-

arrive eventually at enormous results, but it will take time and continued research. I feel sure in such a great country as America, with its immense wealth and immensely interesting people, there will be some one to find this work of value without deceiving themselves or allowing others to deceive them and fill them with regret. Even if I never reach with the sun machine the end to which I am working, some one by aiding the research will be a benefactor of humanity, and ultimately multiply his fortune, however great it may be now."

Father Himalaya has been twenty-five years a priest. For more than eight years of his priesthood he has lectured on physics and chemistry in various colleges of Portugal. It was while Chaplain in the Visitation College at Porto that his researchps attracted the attention of a brilliant Brazilian woman of Portuguese ancestry, Mme. Emilia dos Santos. A student of natural science at the Sorbonne, Mme. dos Santos encouraged the young professor in his studies, and by her sympathy and financial aid enabled him to construct his first machine. Five years ago, on the advice of his spiritual superiors, Father Himalaya went to Paris, where his later investigations have been pursued.

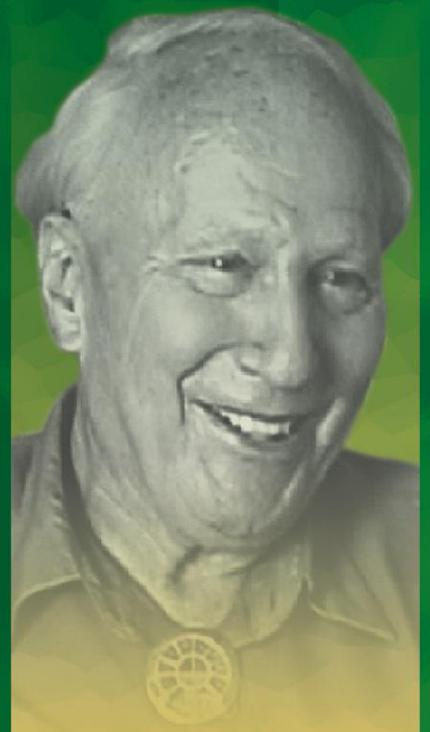
To the new physical principle of reflection and radiation he attributes the advance the pyrheliophor has made over his former successes and beyond the achieve-

1955-2005

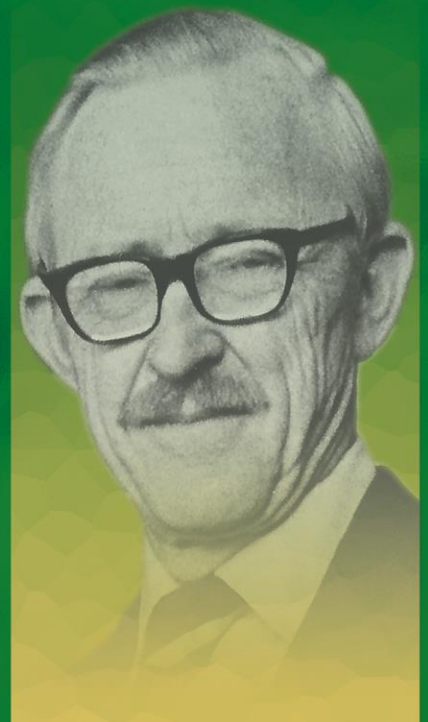
International Solar Energy Society

Pioneers & Solar Leaders

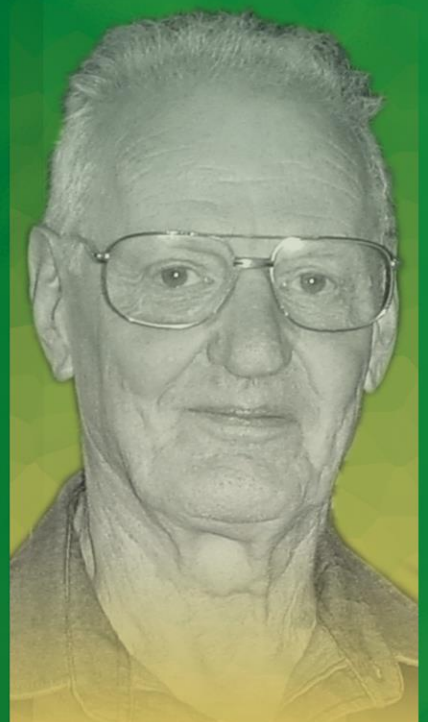
interviews



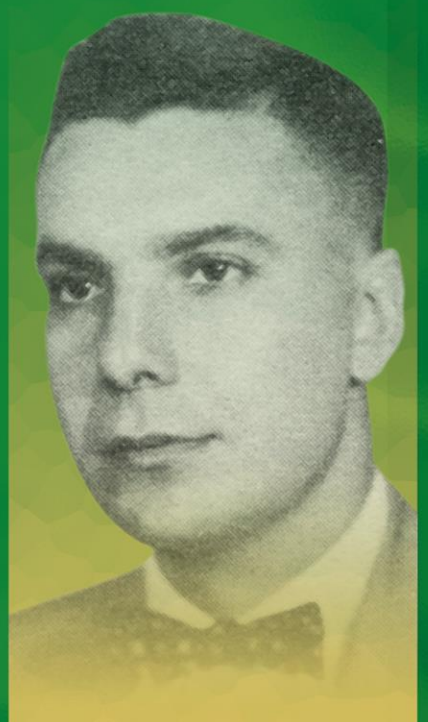
Erich Farber



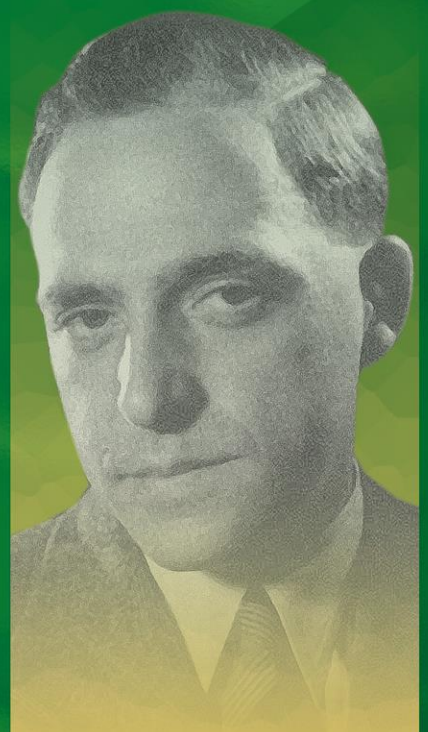
George Löf



John Page



Mort Prince



Harry Tabor

International Solar

Pio ers

Erich Fa ry Tabor

International Solar Energy Society

ISES History

1955–present

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ISES History

1955–present

pre-history

'48

Farrington Daniels' keynote address on solar energy at 100th anniversary celebration of American Association for the Advancement of Science

The Telkes-Raymond-Peabody solar-heated house in Dover, Massachusetts (1948)

'49

'50

'51

"Sun in the Service of Man" meeting organized by American Academy of Arts and Sciences in Boston, MA

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"Ohio Academy of Sciences Symposium," covered various solar topics; served as framework for first meetings of coming solar energy organization in 1955

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"Solar Energy Research" meeting organized by Farrington Daniels for National Science Foundation at University of Wisconsin

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Meeting to establish Association for Applied Solar Energy, Phoenix, AZ

Articles of Incorporation (Dec 24, 1954)

organizations/sections · people · meetings/activities · publications

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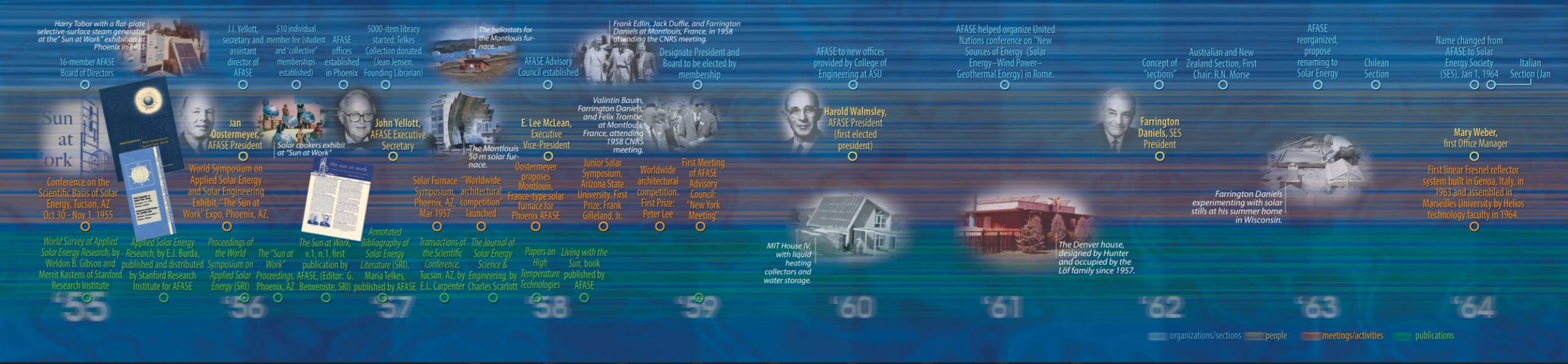
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J.I. Yellott, secretary and assistant director of AFASE
$10 individual member fee (student and "collective" memberships established)
AFASE offices established in Phoenix
5000-item library started; Telkes Collection donated (Jean Jensen, Founding Librarian)
The heliostats for the Montlouis furnace.
AFASE Advisory Council established
Frank Edlin, Jack Duffie, and Farrington Daniels at Montlouis, France, in 1958 attending the CNRS meeting.
Designate President and Board to be elected by membership
AFASE to new offices provided by College of Engineering at ASU
AFASE helped organize United Nations conference on "New Sources of Energy (Solar Energy–Wind Power–Geothermal Energy) in Rome.
Concept of "sections"
Australian and New Zealand Section, First Chair: R.N. Morse
AFASE reorganized, propose renaming to Solar Energy
Chilean Section
Name changed from AFASE to Solar Energy Society (SES), Jan 1, 1964
Italian Section (Jan
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John Yellott, AFASE Executive Secretary
The Montlouis 50 m solar furnace.
E. Lee McLean, Executive Vice-President
Valintin Baum, Farrington Daniels, and Felix Trombe, at Montlouis, France, attending 1958 CNRS meeting.
Harold Walmsley, AFASE President (first elected president)
Farrington Daniels, SES President
Farrington Daniels experimenting with solar stills at his summer home in Wisconsin.
Mary Weber, first Office Manager
First linear Fresnel reflector system built in Genoa, Italy, in 1963 and assembled in Marseilles University by Helios technology faculty in 1964.
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The Journal of Solar Energy Science & Engineering, by Charles Scarlott
Oostermeyer proposes Montlouis, France-type solar furnace for Phoenix AFASE
Papers on High Temperature Technologies
Junior Solar Symposium, Arizona State University. First Prize: Frank Gilleland, Jr.
Worldwide architectural competition. First Prize: Peter Lee
First Meeting of AFASE Advisory Council: "New York Meeting"
Living with the Sun, book published by AFASE
MIT House IV, with liquid heating collectors and water storage.
The Denver house, designed by Hunter and occupied by the Löf family since 1957.
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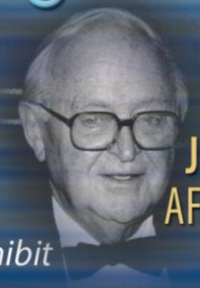

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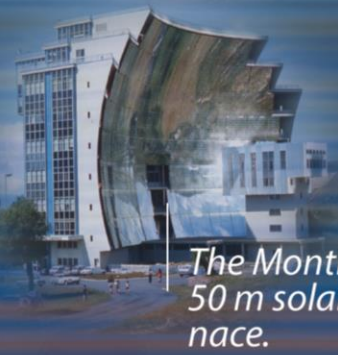

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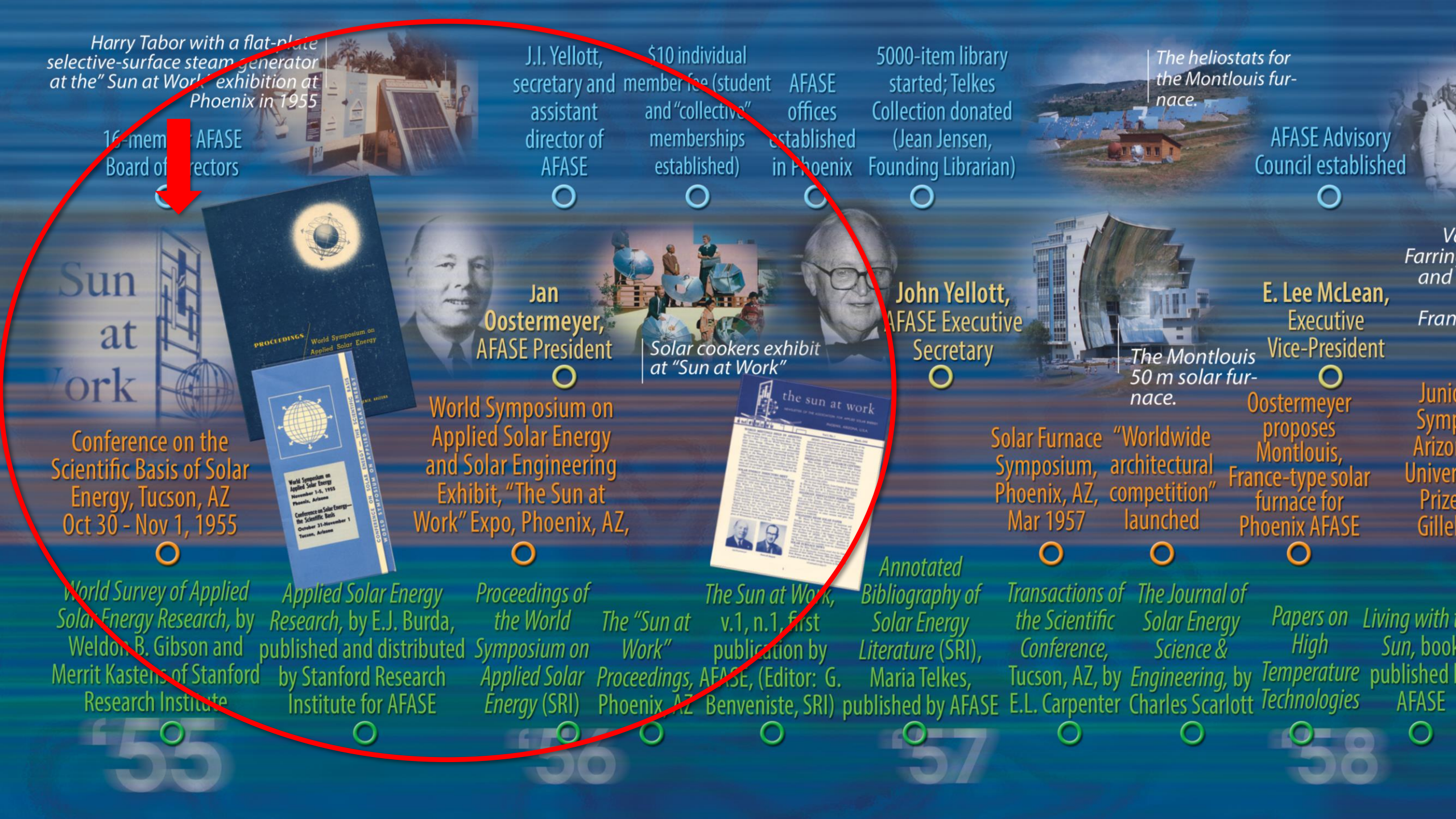
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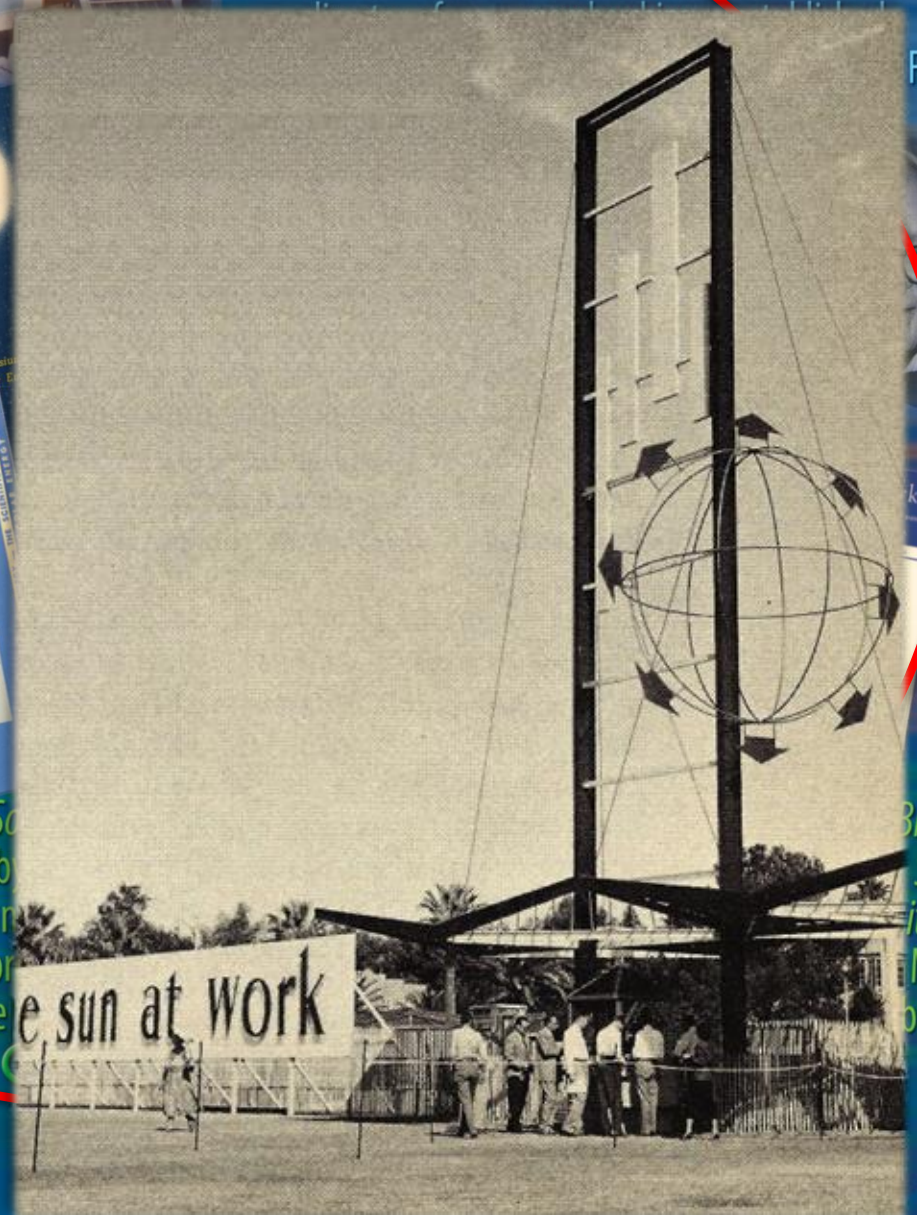

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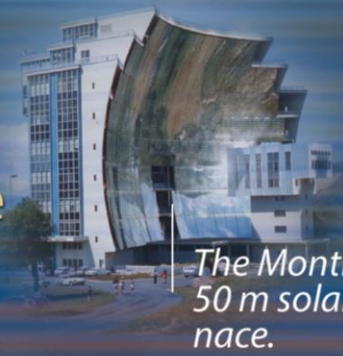

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RUSS SCIENTIST FAILS TO APPEAR AT SOLAR MEET

By GENE LINDBERG
Denver Post Staff Writer

PHOENIX, Ariz., Nov. 2.—Mystery clouded an otherwise sunny sky here Wednesday when A. V. Baum, the Russian physicist from Moscow, failed to show up for the opening of the world symposium on solar energy.

All was in readiness here for Dr. Baum's arrival, and the word had been passed that in press conferences he would be treated like any other scientist among the hundreds here from all parts of the world. Save that political questions were to be taboo.

But the one man of whom everybody here has been talking since Sunday, when the Advance Scientific Conference on Solar Energy opened in Tucson, still is missing. When he failed to appear on the University of Arizona campus in Tucson, the word was that he had been delayed. He'd be in Phoenix, sure. A room for him is reserved here at the Westward Ho hotel, symposium headquarters. But the telephone in room 1612 doesn't answer.

NEVER IN NEW YORK

Wednesday morning, George T. Hayes of the Stanford Research Institute's Washington D. C. office reached Phoenix from New York with the news that Dr. Baum had never arrived there. The port of New York even queried Moscow, but could get no assurance that Dr. Baum had even left Russia.

Stanford Research Institute is one of the major sponsors of this world meeting to discuss ways and means of putting the sun to work directly. So, Hayes was assigned the job of meeting Dr. Baum in New York and escorting him to Arizona with the assistance of the U. S. state department, which had made formal arrangements for Baum to come here.

Dr. Baum is the first Russian physicist slated to visit the United States since World War II.

Solar Energy Expert Sees Nuclear Power As Winner In Competition

Atomic energy and solar energy will be in competition as power sources and odds now are for nuclear energy to surge to the front because it is cheaper and presents no great storage problem.

That's the opinion of Dr. Hans Thirring, director of the Institute

DR. HANS THIRRING

of Theoretical Physics at the University of Vienna, Austria, who is attending the solar energy conference at the University of Arizona.

His particular field of interest —and the one he means when he speaks of solar energy—is solar energy for electrical power processes.

could still satisfy demands for all mechanical power demands if we were willing to spend great amounts of money," he said.

Spend as much money on solar energy for electrical power right now as a great country spends for armaments and the demands of that country for such power would be taken care of, the visitor added.

Dr. Thirring, who is writing a book on power production, present and future, scheduled for late spring publication in London, said that, even in the face of the current advantages of atomic energy over solar, it was still a definite possibility that in some areas solar energy might be quite an excellent supplement to all other methods of power production.

"Such places as Arizona and India and perhaps Florida—places where the sun's rays are fairly even over the year—might well make use of solar energy as a power supplement," he explained.

There is no doubt, he continued, that all of the electricity consumed in the world today and much more could be produced from solar energy alone without any other products, such as coal, oil, uran... price of ... be much,

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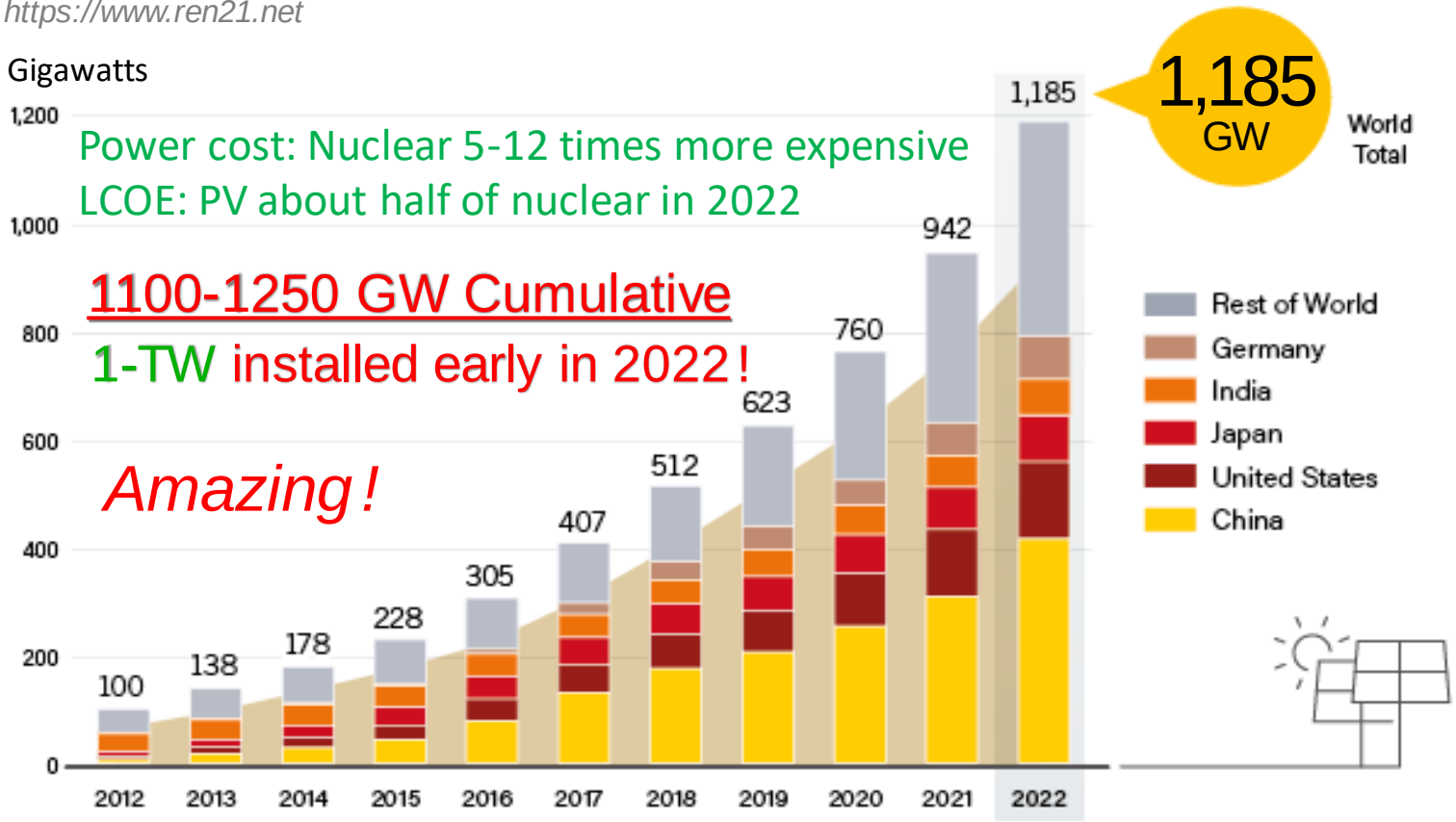
Solar PV Global Capacity and Annual Additions, 2012-2022

Source: Ren21 Renewable 2023 Global Status Report
https://www.ren21.net

Gigawatts



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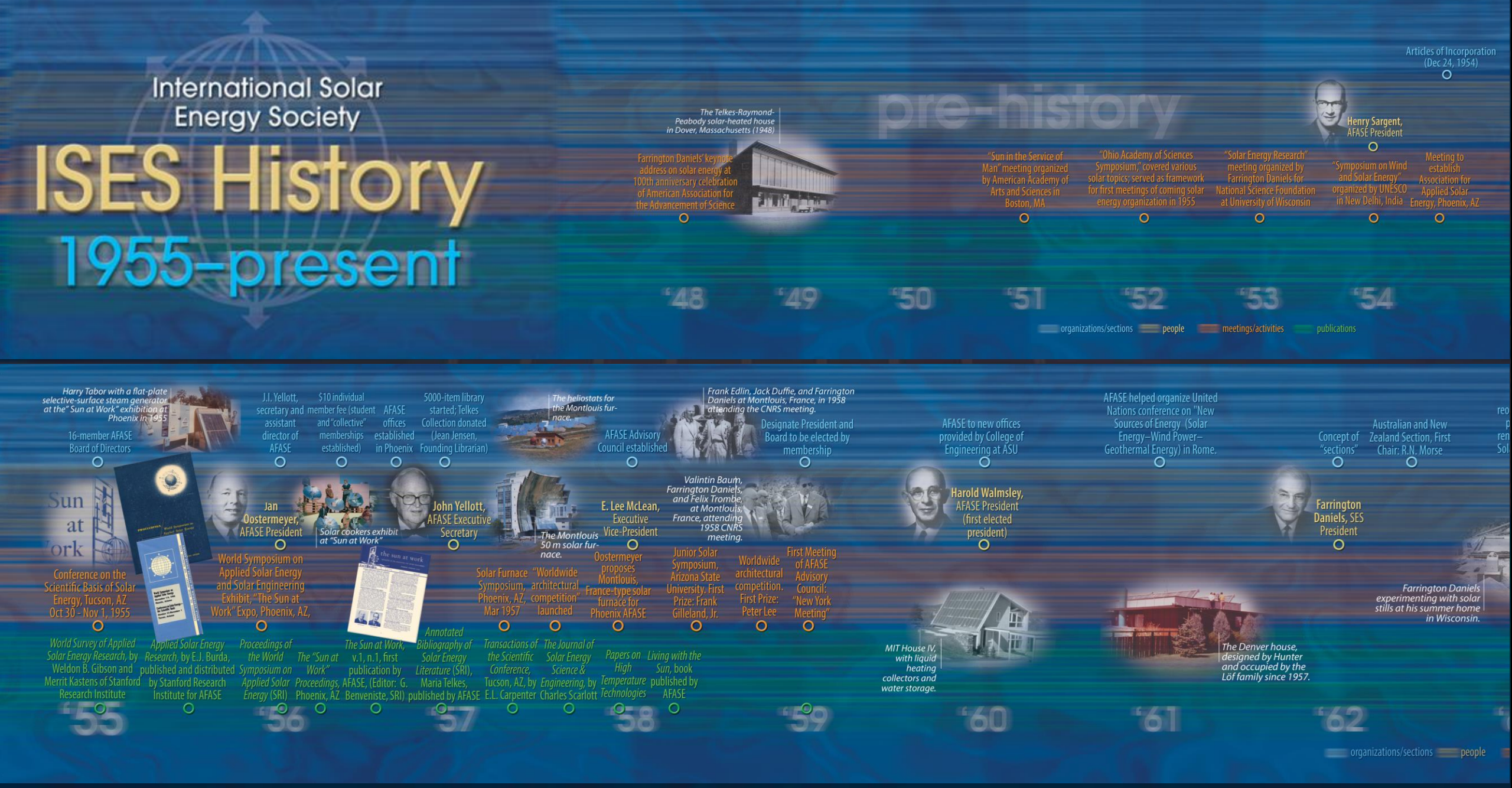
Maria Telkes
Scientist
1900 - 1995

Historical solar tipping points: Period 1954 - 1958



Historical solar tipping points: Period 1954 - 1958

"All the News That's Fit to Print"

The New York Times.

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VOL. CIII ... No. 35,178. NEW YORK, SUNDAY, APRIL 25, 1954

Vast Power of the Sun Is Tapped By Battery Using Sand Ingredient

Special to The New York Times.

MURRAY HILL, N. J., April 25—A solar battery, the first of its kind, which converts useful amounts of the sun's radiation directly and efficiently into electricity, has been constructed here by the Bell Telephone Laboratories.

The new device is a simple-looking apparatus made of strips of silicon, a principal ingredient of common sand. It may mark the beginning of a new era, leading eventually to the realization of one of mankind's most cherished dreams—the harnessing of the almost limitless energy of the sun for the uses of civilization.

The sun pours out daily more than a quadrillion (1,000,000,000,000,000) kilowatt hours of energy, greater than the energy content of all the reserves of coal, oil, natural gas and uranium in the earth's crust.

With this modern version of Apollo's chariot, the Bell scientists have harnessed enough of the sun's rays to power the transmission of voices over telephone wires. Beams of sunlight have also provided electricity for a transistor in a radio transmitter, which carried both speech and music.

They had achieved an efficiency of 6 per cent in converting sunlight directly into electricity. This, they asserted, compares favorably with the efficiency of steam and gasoline engines, in contrast with other photoelectric devices, which have a rating of no more than 1 per cent.

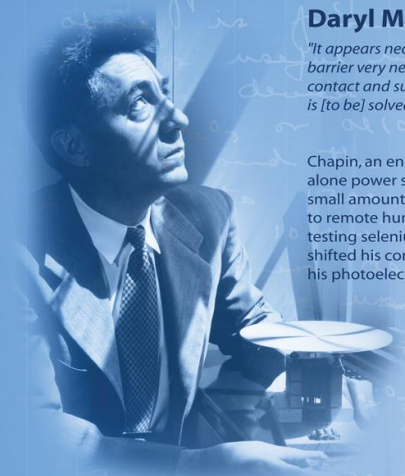
With improved techniques the efficiency may be expected to be increased substantially, they added. They observed that nothing is consumed or destroyed in the energy conversion process and there are no moving parts, so the solar battery "should theoretically last indefinitely."

The experimental solar battery uses strips of wafer-thin silicon about the size of common razor blades. These strips are extremely sensitive to light. They can be linked together electrically and can deliver power from the sun at the rate of 50 watts a square yard of surface.

The atomic battery recently announced by the Radio Corporation of America delivers one-millionth of a watt. The new Bell solar battery thus delivers 50,000,000 times the power of the R.C.A. atomic battery.

Silicon is a semiconductor,

The Inventors



Daryl M. Chapin

"It appears necessary to make our p-n barrier very near to the surface if the contact and surface resistance problem is [to be] solved in the vapor technique."

(Daryl Chapin, journal entry, 6/3/53)

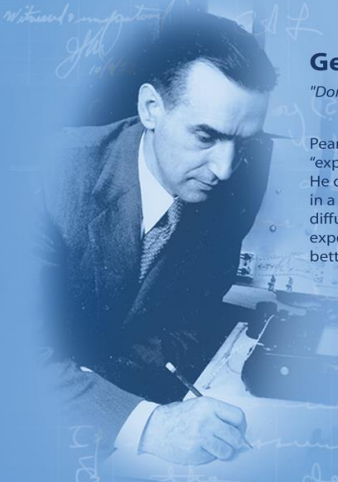
Chapin, an engineer, studied stand-alone power systems for providing small amounts of intermittent power to remote humid locations. He began testing selenium solar cells, but then shifted his concentration to silicon in his photoelectric studies.

Calvin S. Fuller

"Silicon is the material. Diffusion is the process."

(Attributed to Fuller by lab assistant)

Fuller, a chemist, focused on how to control the introduction of impurities into silicon. He discovered how to produce p-n junctions in silicon by lithium diffusion. But he later found that phosphorus-diffused silicon is more stable, and the p-n junction can be brought closer to the surface. Eventually, he diffused boron to form a thin p-layer on top of arsenic silicon.



Gerald L. Pearson

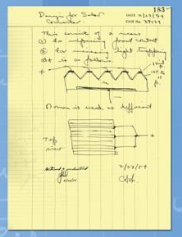
"Don't waste another moment on selenium."

(Attributed to Pearson by Daryl Chapin)

Pearson, a physicist, was considered the "experimentalist's experimentalist." He detected a strong photovoltaic effect in a rectifier built according to Fuller's diffusion method. And his continued experimentation led to devices with better conversion efficiencies.

The Beginning at Bell

April 25, 1954 – At a New York press conference, Daryl Chapin, Calvin Fuller, and Gerald Pearson present to the public the first material to directly convert enough sunlight into electricity to generate useful amounts of power. The New York Times recognizes their work as marking "the beginning of a new era, leading eventually to the realization of one of mankind's most cherished dreams—the harnessing of the almost limitless energy of the sun for the uses of civilization."

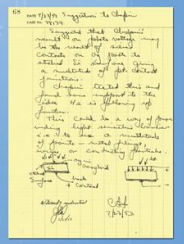


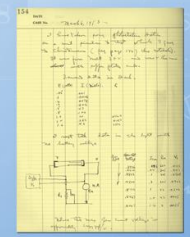
January 1954 – Starting with arsenic-doped silicon, Fuller diffuses boron to form a thin p-layer on top of the arsenic silicon. Chapin tests the new material and reports increased efficiencies, with the best cell converting 6% of incoming sunlight into electricity.

November/December 1953 – No matter what he tries, Chapin cannot exceed 4% efficiency with phosphorus-diffused silicon.

September/October 1953 – Chapin reports that a phosphorus-diffused silicon cell outperforms Pearson's original cell by a factor of 2, reaching 4% efficiency, and he proceeds to build a 0.1-watt solar generator.

May/June 1953 – Chapin chooses to concentrate on silicon in his photoelectric studies. Failing to get more power from other lithium-diffused silicon devices, he experiments with several phosphorus-diffused silicon cells produced in Fuller's diffusion furnace. Phosphorus-diffused silicon is more stable, and the p-n junction can be brought closer to the surface.





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January-February 1953 – Daryl Chapin begins testing selenium solar cells in his studies of stand-alone power systems.

1952 – Calvin Fuller produces p-n junctions in silicon by lithium diffusion.

1947 – The transistor is invented.

Gadget Now Being Used In South

Communications Seen As Best Customer

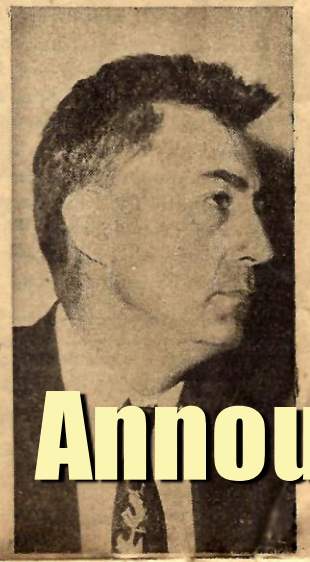
By DOROTHY KALIL

Greatest future for solar batteries lies in the field of communications where sunshine has already been put to work, according to D. M. Chapin, a member of the three-man Bell Telephone Laboratories team which produced the first silicon solar battery in April, 1954.

Chapin, who spoke at yesterday's closing session of the solar energy conference at the University of Arizona, said, in an interview, that a sun-run battery was already in operation for his company in Americus, Ga.

The battery, which was put to work last month, takes care of eight telephone lines. There is enough storage—through ordinary nickel cadmium storage batteries charged by the silicon solar unit— to carry on operations for a week without sunshine.

The unit being used in Georgia is an experimental one, but Chapin is optimistic about the



D. M. CHAPIN

The New York Times.

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NEW YORK, SUNDAY, APRIL 25, 1954

ast Power of the Sun Is Tapped
Battery Using Sand Ingredient

Special to The New York Times.

URRAY HILL, N. J., April A solar battery, the first of kind, which converts useful nts of the sun's radiation tly and efficiently into elec- y, has been constructed here he Bell Telephone Labora- s.

e new device is a simple- ng apparatus made of strips licon, a principal ingredient ommon sand. It may mark beginning of a new era, lead- eventually to the realization ne of mankind's most cher- l dreams—the harnessing of lmost limitless energy of the for the uses of civilization.

e sun pours out daily more a quadrillion (1,000,000,000,- 00) kilowatt hours of ener- greater than the energy con- of all the reserves of coal, natural gas and uranium in earth's crust.

ith this modern version of lo's chariot, the Bell scien- have harnessed enough of provided electricity for a sistor in a radio transmitter, h carried both speech and c.

they had achieved an efficiency of 6 per cent in converting sunlight directly into electricity. This, they asserted, compares favorably with the efficiency of steam and gasoline engines, in contrast with other photoelectric devices, which have a rating of no more than 1 per cent.

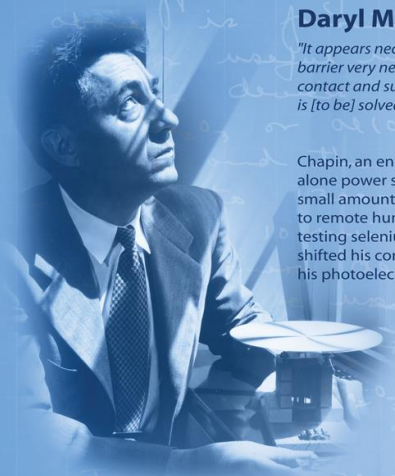
With improved techniques the efficiency may be expected to be increased substantially, they added. They observed that nothing is consumed or destroyed in the energy conversion process and there are no moving parts, so the solar battery "should theoretically last indefinitely."

The experimental solar battery uses strips of wafer-thin silicon about the size of common razor blades. These strips ly sensitive to ligh be linked together ar dollar power from the sun squ of su

The atomic battery recently announced by the Radio Corpora of th att Be solar battery thus delivers 50,000,000 times the power of the R.C.A. atomic battery.

Silicon is a semiconductor,

The Inventors



Daryl M. Chapin

"It appears necessary to make our p-n barrier very near to the surface if the contact and surface resistance problem is [to be] solved in the vapor technique."

(Daryl Chapin, journal entry, 6/3/53)

Chapin, an engineer, studied stand-alone power systems for providing small amounts of intermittent power to remote humid locations. He began testing selenium solar cells, but then shifted his concentration to silicon in his photoelectric studies.

Calvin S. Fuller

"Silicon is the material. Diffusion is the process."

(Attributed to Fuller by lab assistant)

Fuller, a chemist, focused on how to control the introduction of impurities into silicon. He discovered how to produce p-n junctions in silicon by lithium diffusion. But he later found that phosphorus-diffused silicon is more stable, and the p-n junction can be brought closer to the surface. Eventually, he diffused boron to form a thin p-layer on top of arsenic silicon.

Gerald L. Pearson

...nother moment on selenium."

(Attributed to Pearson by Daryl Chapin)

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The Beginning at Bell

1954

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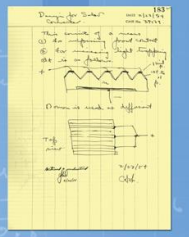

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April 25, 2024 70th Anniversary of the Announcement of the Bell "Solar Battery" Discovery

2024 Library of the "Solar Battery" Discovery

154

DATE

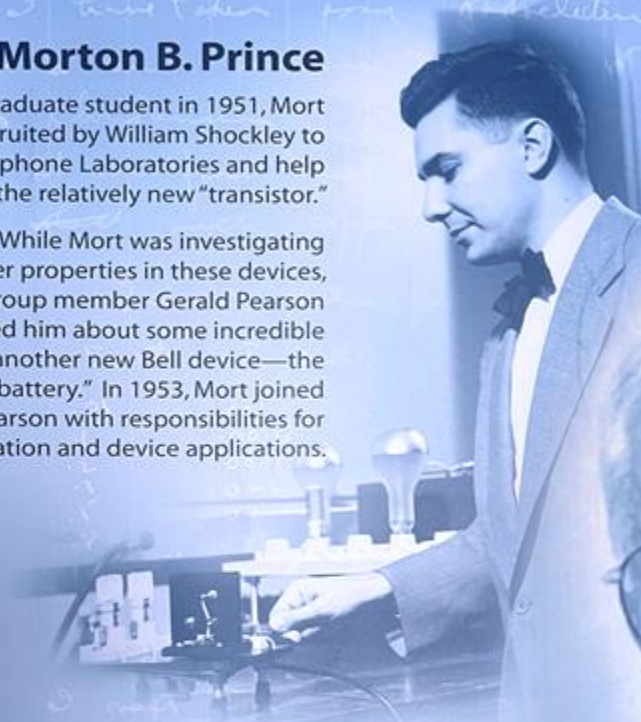
CASE No.

PV Pioneer

Morton B. Prince

As an MIT graduate student in 1951, Mort Prince was recruited by William Shockley to join Bell Telephone Laboratories and help develop the relatively new "transistor."

While Mort was investigating minority-carrier properties in these devices, fellow group member Gerald Pearson approached him about some incredible progress on another new Bell device—the "solar battery." In 1953, Mort joined Pearson with responsibilities for characterization and device applications.



Mort published a seminal 19
Applied Physics paper, "Silico
Converters," on the perform
of the silicon cell. He describ
behind the Bell cell in a pape
Junction Solar Energy Conver
historic 1955 international Co
Solar Energy—The Scientific Bas
Arizona, which gave birth to ASE

Beginning in 1956, Mort directed
Hoffman Electronics' semiconducto
division. As the first commercial prod
of solar cells, Hoffman supplied solar c
to the US Signal Corps, establishing PV as
the "power of choice" for space applications
with the first solar-power satellite,
Vanguard, in 1958.

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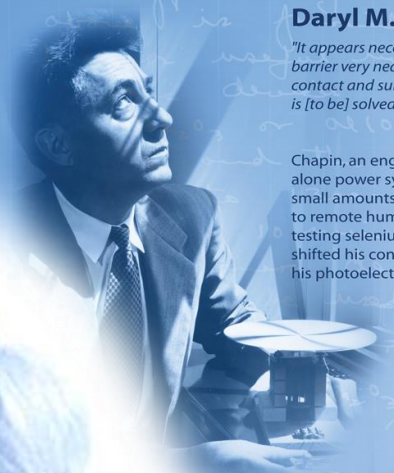

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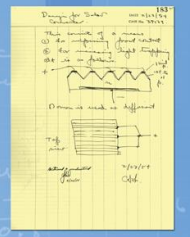

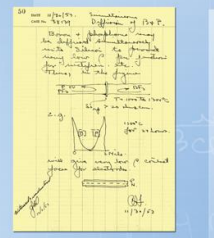

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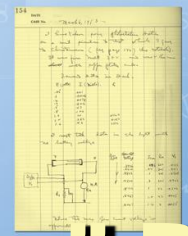

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