The Fifty-Year History of the International Solar Energy Society and its National Sections

Edited by
Karl W. Böer
University of Delaware

Volume 1

ISES
International
Solar Energy
Society

The Fifty-Year History of the International Solar Energy Society and its National Sections

Volume 1

Editorial Advisory Board

The Fifty-Year History of the International Solar Energy Society and its National Sections

Edited by
Karl W. Böer
University of Delaware

Published by
American Solar Energy Society, Inc.
Boulder, Colorado

Volume 1

Notice

Printed in Hong Kong, PRC. by Synergy Press Ltd.

LIBRARY OF CONGRESS CATALOGING IN PUBLICATION DATA
Main entry under title: The Fifty Year History of the International Solar Energy Society, 2005
1. Solar Energy History
ISBN – 0-89553-325-1

Publisher

American Solar Energy Society

The American Solar Energy Society (ASES) is the national individual membership organization dedicated solely to promoting solar energy technologies. ASES has over 8,000 members and 25 state, regional and student chapter affiliates serving 34 states. ASES members are engineers, architects, scientists, researchers, educators, builders, planners and interested individuals who support the development and utilization of solar energy technologies. Founded in 1954, ASES is also the United States Section of the International Solar Energy Society (ISES) and works closely with ISES to promote the use of solar energy technologies worldwide.

The ASES mission is to advance the use of solar energy for the benefit of U.S. citizens and the global environment. The ASES strategic goals are:

- Ensure that federal, state and local policies support the development and use of renewable energy;
- Advance research, development, demonstration and use of renewable energy technologies;
- Educate consumers about renewable energy technologies;
- Prepare the future workforce for the transition to renewables and support continued development of professionals currently in the field. To support these goals, ASES operates the following programs:
- ASES publishes SOLAR TODAY, the award-winning magazine providing engaging articles on practical solar technologies. In addition to distribution to members, SOLAR TODAY is available by subscription and on over 300 newsstands nationwide.
- ASES sponsors the National Solar Energy Conference. This annual conference showcases the state-of-the-art in solar technologies.
- ASES sponsors the National Solar Tour in October each year. Over 75,000 people visit solar houses across the country at this event.
- ASES publishes briefing papers on the development of solar energy technologies. Written for non-technical audiences, these papers provide excellent background information for people unfamiliar with the field.
- The ASES bookstore is one of the most complete sources of solar and renewables related publications.
- ASES uses the media to educate the public on renewable energy technologies.
- The ASES Solar Action Network alerts members when to write their legislators in support of good federal solar policy.

American Solar Energy Society • 2400 Central Avenue, Suite A • Boulder, CO 80301 • USA
303-443-3130 • ases@ases.org • www.ases.org

Foreword

It takes a significant event to make us want to review what has happened in the past. It is the fiftieth anniversary of the International Solar Energy Society, an important reason to celebrate and to take account of the historical development of the Society and its many international Divisions, to review the progress of solar energy development.

But this anniversary has much more importance to it than looking back to the forming of a society. It is based on the recognition of a few visionaries that it was time to elevate solar energy, the most important source of life on earth to become the focal point for energy in modern history; a focal point for human ingenuity, technical creativity, societal acceptance of the necessity to have our future's wealth determined by solar energy; the focal point of more developed means to use this resource, the sun's energy as a dominant source of energy in all of our future life.

The leader of this group of visionaries, no doubt, was Farrington Daniels, who, fifty years ago, assembled a group of world experts in solar technology and movers in economy, finances and politics to view in Arizona an unprecedented exhibition of solar conversion equipment, and to probe their assessment of the evolving field. This group wanted to assure us that modern means for solar energy conversion are feasible, and that the field needed an initial momentum to enter the future of universal acceptance for modern solar energy conversion, replacing conventional conversion of energy.

To give lasting credence to this initial step, a professional society, the Association for Applied Solar Energy (AFASE) was formed in 1954, among the initiators of these first events being a meeting in Tucson and a Symposium and Exhibition in Phoenix in 1955. This Association became the forerunner of today's International Solar Energy Society (ISES).

But again, there is more significance to those first events: Farrington Daniels and his co-founders already recognized that the resources for conventional energy conversion—fossil fuels—were limited and began to advocate the development of solar energy. This fact has come today into new focus. We have now been confronted with the data that the much accelerated use of these resources by all of us, including the rapidly developing countries, has shown that the time of maximum recovery of oil and gas (the Hubbard peak) has passed and depletion will approach in our life span. The price increase of oil and gas is real and determined by the interplay between supply and demand; and supply is no longer only in the hands of a capricious cartel. Also demand can no longer be switched around at liberty without major

consequences for world economies and must be orchestrated carefully, requiring substantial lead time when alternatives are to help.

And again, there is still more significance to the event that inspires this celebration of the fiftieth anniversary. As never before, we must recognize that with the increasing use of fossil fuels, we are filling up the formerly seemingly unlimited reservoir for our waste, the earth atmosphere, which reacts measurably, macroscopically with significant increases of this waste contaminant, most importantly with the increase in carbon dioxide, a powerful greenhouse gas. We can no longer ignore its effect in catastrophically increased weather patterns, with effects that cannot easily be returned to normal, even if we come to accept the need to become reasonable again and reduce pollution. It will take time to normalize, the more so the longer we wait.

This monumental task requires the help of professionals who have learned to investigate complex problems carefully, to assess the dynamics of events, and who are capable of extrapolating and producing unquestionable conclusions. Who else can amass such evidence to convince all of us to react within a time frame that is carefully evaluated, and who can come up with solutions that are realistic and achievable? And here again, it needs an international society to peer-check the evolving results, to provide credibility.

Finally, fifty years ago, when Farrington Daniels and the other solar pioneers put into motion the process that resulted in the creation of ISES, they began to replace uncoordinated research, often done as a hobby, with an urgent, large scale and coordinated development. This was a prophetic recognition that solar development can no longer be an activity of a few enthusiasts, but was to become an absolute necessity to meet the energy needs of the future.

Here, the International Solar Energy Society has become a most important visible forum for scientists and engineers in the world to communicate amongst each other, to check their results with each other, to critically analyze all ideas and findings, and to arrive at a constantly increasing wealth of facts that can be followed by armies of entrepreneurs and factories to provide the means for changing over from old technology to the benign and profitable technology of the future.

It is in recognition of the achievements of these fifty years that challenges us to assemble this documentary of the solar energy developments of the sections of ISES; to produce material that illuminates the many steps that have been taken during the last fifty years in so many countries of the world, showing the enthusiastic response of a few who have crystallized the work of so

many to create a worldwide force that cannot be shaken by adversaries. It may be that this document can encourage and invigorate many to prevail in the effort to further solar energy conversion, to strengthen the international communication among professionals as well as to provide more of the foundation that is urgently needed for the necessary progress in global solar energy utilization.

All of this would not have been possible without the untiring help of the many authors of the chapters of this book, following up through many revisions and providing their final manuscripts in time for publication; and for the excellent help received from the editorial office of the American Solar Energy Society (ASES), mainly from Dona McClain, Richard Haight and Patty McIntyre; and from the International Solar Energy Society (ISES) Headquarters, Christine Hornstein. To all of them, I would like to take this opportunity to extend my expression of deep gratitude.

My special thank you goes to Cesare Silvi and my wife Renate who have both encouraged me to solicit contributions, organize and edit this publication. I am very thankful for the patience and love Renate has given to me during the two years of working on this history book.

Karl W. Böer

International Solar Energy Society

The International Solar Energy Society (ISES) is the world's largest and most established membership organization dedicated to promoting renewable energy technologies. ISES consists of 54 National Sections and 30,000 members in more than 110 countries organised on a national, regional and international basis, representing a large international infrastructure in support of renewable energy.

ISES has been serving the needs of the renewable energy community since its founding in 1954. As UN-accredited NGO the Society supports its members in the advancement of renewable energy technology, implementation and education all over the world. Most importantly, it provides the platform through its international conferences for direct communication between professionals. Its goals include:

Towards a Sustainable World: Encouraging the use of Renewable Energy everywhere, through appropriate technology, scientific excellence, social responsibility, and global communication.

Realising a Global Community: Bringing together industries, individuals and institutions in support of Renewable Energy technologies - through communication, co-operation, support and exchange.

Supporting Development: Applying practical projects, technology transfer, education, training and support to the issue of global energy development. Supporting the Science of Solar Energy: Stimulating and encouraging both fundamental and applied research in solar energy.

Contributing to Growth: Ensuring individual and community growth through support of private enterprise and empowerment in the area of Renewable Energy.

Information and Communication: Rapid access to information through tailor-made communication and exchange platforms utilising modern technology.

With a long history and extensive technical and scientific expertise provided by its members, the Society is a modern, future-oriented non-governmental organisation (NGO). Clearly defined goals, extensive communication networks and practical, real-world projects are the hallmarks of ISES.

International Solar Energy Society (ISES)
International Headquarters
Villa Tannheim
Wiesentalstr. 50
79115 Freiburg, Germany

Tel. +49 761 45906 0
Fax. +49 761 45906 99
Web: http://www.ises.org/
E-mail: hq@ises.org

Table of Contents

Chapter 1: The International Solar Energy Society: The First 25 Years, 1955 to 1980 1
John A. Duffie and Harry Z. Tabor

Chapter 2: Argentina Solar Energy Society 1974 – 1980 65
Graciela Lesino
INENCO
Universidad Nacional de Salta-Conicet

Chapter 3: ASES American Section of ISES 73
Karl W. Böer
Distinguished Professor of Physics and Solar Energy, Emeritus
University of Delaware

Chapter 4: The Passive Solar Division of the American Solar Energy Society (ASES, The American Section of the International Solar Energy Society) 115
John S. Reynolds
Department of Architecture
University of Oregon
J. Douglas Balcomb, Retired

Chapter 5: Australia-New Zealand Section of the International Solar Energy Society (1954–80) 133
Garry F. Baverstock, B Arch, MSc, FRAIA
Adjunct Associate Professor Murdoch University,
Director of Wise Earth P/L t/a Ecotect-Architects
P.O. Box 3322, Broadway, Nedlands
Western Australia, 6009

Chapter 6: China Section of the International Solar Energy Society . . . 157
Li Zhongming
Beijing Solar Energy Research Institute
3 Huayuan Road, Haidian District
Beijing, China 100083

Chapter 7: German Section of the International Solar Energy Society History of Solar Energy and ISES in Germany 173
Adolf Goetzberger
Retired, Professor, former Director of the Fraunhofer Institute for Solar Energy Systems
and Sigrid Jannsen
Professor, President, Deutsche Gesellschaft fur Sonnenenergie, e.V

Chapter 8: UK Section of the International Solar Energy Society 191
Bernard McNelis
Managing Director
IT Power
The Manor House, Lutyens Close
Chineham, Hampshire
RG24 8AG UK

Chapter 9: Israeli Section of the International Solar Energy Society . . . 235
Gershon Grossman
Faculty of Mechanical Engineering
Technion – Israel Institute of Technology
Haifa 32000, Israel

Chapter 10: ISES-ITALIA Section of the International Solar Energy Society (1964–1980) 235
Cesare Silvi
GSES (Gruppo per la Storia dell' Energia Solare)
Via Nemorense, 18
00199 Roma, Italy
Email: csilvi@gses.com

Chapter 11: Japanese Section of The International Solar Energy Society 259
Tetsuo Noguchi
Chief, Solar Research Laboratory
Government Industrial Research Institute, Nagoya
Agency of Industrial Science and Technology
Ministry of International Trade and Industry
Hirate-machi, Kita-ku, Nagoya 462
Japan

Chapter 12: Lebanese Section of the International Solar Energy Society 275
Eng. Mhamad Bakhour
Assisted by
Dr. Fateh Sakkal
Eng.Walid baba
LSES, Lebanese Solar Energy Society
Beirut-Lebanon

Chapter 13: The Mexican Section of the International Solar Energy Society 287
Eduardo A. Rincón Mejía
School of Engineering
Autonomous University of the State of Mexico
Cerro de Coatepec, C.U., 50130 Toluca, Mexico

Chapter 14: Norwegian Section of the International Solar Energy Society 303
Rolf Jarle Aaberg
Statkraft SF, PB 200 Lilleaker
NO - 0216 Oslo, Norway

Chapter 15: History of Solar Energy Development in Pakistan 311
Dr. Nasim A. Khan
Member Technical / Secretary,
Alternative Energy Development Board
344-B, Prime Minister's Secretariat, Islamabad
Director, Solar Systems Laboratory, Rawalpindi Pakistan

Chapter 16: SPES—Sociedade Portuguesa de Energia Solar Portuguese Section of the International Solar Energy Society. 325
J. Farinha Mendes and M. João Carvalho
INETI—Department of Renewable Energies
Estrada do Paço do Lumiar, 1649-038 Lisboa, Portugal

Chapter 17: Russian Section of the International Solar Energy Society 351
D. S. Strebkov and I. I. Tyukhov
All-Russian Research Institute for Electrification of Agriculture
2, 1-st Veshnyakovsky proezd
Moscow 109456, Russia

Chapter 18: Solar Energy Utilization in Singapore 383
M. N. A. Hawlader and K. A. Jahangeer
Department of Mechanical Engineering,
National University of Singapore
9 Engineering Drive 1
Singapore 117576

Chapter 19: Solar Energy Society of Southern Africa 399
Brian Schaller
with contributions by Dieter Holm
and Charles Eduard Barnard
Private Bag X010
Howick, 3290, KwaZulu-Natal,
South Africa

Chapter 20: Solar Energy Association of Sweden—SEAS
(ISES Sweden) 421
Jan-Olof Dalenbäck
Building Services Engineering
Department of Building Technology
Chalmers University of Technology, Sweden
SE – 412 96 Göteborg, Sweden

Chapter 21: History of Solar Energy in Turkey. 437
Necdet Altuntop, Ph.D.
Associate Professor
Department of Mechanical Engineering
Erciyes University, Kayseri 38039, Turkey

Chapter 22: University of Florida Solar Energy and
Energy Conversion Laboratory. 455
Barbara J. Graham and D. Yogi Goswami
Department of Mechanical & Aerospace Engineering
PO Box 116300 University of Florida
Gainesville, FL 32611-6300 USA

Chapter 23: The Indian Section of ISES 471

Dr. Jayarao Gururaja
Now
Senior Interregional Advisor
Energy and Transport Branch
Division for Sustainable Development
Development of Economic and Social Affairs
United Nations
2 UN Plaza New York, NY 10017

Chapter 1

The International Solar Energy Society: The First 25 Years, 1955 to 1980

by
John A. Duffie[1] and Harry Z. Tabor[2]

Abstract

The International Solar Energy Society had its origins in late 1954 when it was incorporated in Arizona as the Association for Applied Solar Energy, AFASE. The nature of the organization, its activities, and the challenges it faced changed with time; and it became the Solar Energy Society, SES, in 1964 and the International Solar Energy Society, ISES, in 1970.

In this story of the years to 1980, Part I briefly reviews the state of solar energy development and applications in the early 1950s—when the Society was first conceived by its founders. Part II sets the stage for solar energy at the time of the start of the Society and highlights a few of the advances in solar research, development, and applications of the past fifty years, to emphasize the growing need for a society concerned with the many disciplines and nations involved in solar energy.

In Part III, the evolution of the society is traced. Its founders and directors for the first decade were Arizona businessmen who saw an opportunity to contribute to the solution of growing energy problems and at the same time promote the Arizona economy. They were succeeded by scientists and engineers who turned the society into a more professional interdisciplinary and international organization devoted largely to exchange of information. Data on membership, officers, meetings, and sections are shown in an Appendix.

[1] Retired Director of the Solar Energy Laboratory, University of Wisconsin-Madison; President of ISES, 1971-73. Address: 6225 Mineral Point Road, #D-75, Madison, WI 53705, USA; e-mail: jaduffie@aol.com

[2] Retired Director, NPL of Israel, Director, Scientific Research Foundation, Jerusalem, President of ISES, 1981-83. Address: POB 3745, Jerusalem, Israel, 91036

1.1 Introduction

The term solar energy has many diverse implications. All have one underlying, common motif, i.e., a concern with radiant energy from the sun—which can be converted by many different processes to meet many kinds of energy needs. The diversity of applications means that people of many backgrounds and disciplines are concerned with solar energy. Hence the multidisciplinary nature of a solar energy society.

1.1.1 Solar Energy Processes and Disciplines

Photosynthetic conversion is the process driven by solar energy absorbed in leaves, resulting in the formation of biomass. In the broadest sense, all agriculture is solar, with the objective of producing foods. It includes synthetic processes that convert solar to plant mass and store it for future harvesting as fuel for power production.

Photochemical or *photochromic conversion* are processes through which the absorption of solar radiation on a substance causes a chemical change in the substance. The change may later be reversed, resulting in the freeing of the solar energy absorbed.

Photovoltaic (PV) conversion, is achieved when solar radiation incidence on a semiconductor structure generates electricity (direct current). Electricity being the most versatile form of energy, PV has attracted an enormous amount of R&D.

In *thermal conversion*, solar energy is converted into heat by absorption by black surfaces This heat can be used for a myriad of purposes, such as heating of buildings, heating in general, for driving engines to produce mechanical or electrical energy, operating cooling systems, cooking, etc.

Evaporative processes include evaporation of brines to produce salt (a huge industrial operation) and distillation to produce purified water. These are special cases of thermal processes.

Architectural design can maximize or minimize the effect of solar radiation in our homes and buildings. The radiation, as light, can reduce the amount of artificial lighting needed during daylight hours. As heat it can save fuel or electricity in cold weather. Since the total amount of energy used to heat and cool buildings in the developed world is a sizable fraction of all the energy used, it is clear that intelligent architectural design is a vital factor in saving energy, apart from making the buildings pleasant to be in. The ancient Greeks and Romans understood this—and we still have a lot to learn.

Affecting all these processes is *meteorology*, which provides the basis of understanding, measuring, and predicting the solar energy supply. Additional

relevant sciences include cosmology and space science.

These various kinds of processes are the concerns of a wide variety of scientists and engineers, botanists, plant pathologists, chemists and photochemists, physicists, and mechanical and chemical engineers—and of manufacturers.

On the applications side, there are other kinds of people involved. Evaluations of processes are considerably affected by economics. Acceptability of solar equipment and applications, particularly in developing economies, is a concern for sociologists. Political decisions that relate to energy economics and availability of fuels have far-reaching effects on the success or failure of solar energy applications.

Thus there is a wide range of disciplines that is concerned with solar energy and its exploitation. The International Solar Energy Society has provided a vital forum for interaction of those involved in these many disciplines and has itself been shaped by the diverse people involved in solar energy.

1.2 Solar Energy in the Early 1950s

There is a long history of work on various aspects of solar energy, primarily in architecture and thermal processes. Butti and Perlin[3], in their book *A Golden Thread*, present an interesting and detailed account of the history of solar energy applications, starting with solar architecture in Greek and Roman times, and including power from the sun, solar water heating, and solar house heating. The possibilities of utilizing the sun's energy has intrigued people for centuries, and many of the basic ideas we use today were devised by inventors many years ago, but the technology to make the ideas work effectively was not available.

For example, the effort in the early twentieth century by the American Frank Shuman to harness solar energy to drive a heat engine, using cylindrical parabolic mirror concentrators, led to his demonstration plant in Egypt. His system is of special interest because, superficially, it is similar to the LUZ solar power units set up in California in the 1980s, except that the LUZ unit is 4.6 times as efficient, i.e., the area of concentator needed is reduced by this factor.

While there were many possibilities to be explored at the time, there was not much pressure to explore them. By the beginning of the 1950s, there was

---

3 Butti, K,. and Perlin, J. *A Golden Thread—2500 Years of Solar Architecture and Technology*, New York: Van Nostrand Reinhold, 1980. ISBN 0-442-24005-8

still almost no recognition that fuel supplies might be limited and that burning them in ever-increasing quantities could seriously (and perhaps irrevocably) damage the world climate. As a result, there was little motivation to develop technologies to harness the sun. Exploitation of other renewable energy sources such as wind and hydro—which have a long history—was a matter of local convenience and availability. But this situation was about to change.

Thus, in the 1950s there were ideas and processes that needed development but also needed new technologies such as materials and design methods to make them practical. In the next section examples of progress in the years of the solar energy society—progress made in part by people active in the society—are noted.

1.2.1 Some Developments of the Last Five Decades—A Brief Summary

Advances in exploiting solar energy in the last five decades of the twentieth.century have been dramatic in two main areas: (1) the use of computers to optimize components and systems; and (2) advances in materials technologies.

Fig. 1: Jack Duffie, c. 1955

Architects have benefitted greatly in both these areas. New computational methods have made it possible to optimize the exploitation of solar energy in the heating of buildings on a seasonal or annual basis. Progress in materials technology has provided photochromic glasses that can control the ingress of solar energy into a building without blinds. New low-emittance surfaces on glass have provided windows with improved insulating properties (known as “low loss” windows).

Selective surfaces have improved the efficiency of solar thermal collectors, making solar water heaters competitive in almost any sunny region and even making solar thermal power (using a heat engine or turbine) nearly competitive. The LUZ[4] solar power stations in California, totalling 354MWe, would simply not have been feasible without the new technologies.

There were also advances in the geometry of optical systems for concentrating solar energy, for example, to yield a moderate degree of concentration without the need to "track," i.e., follow the motion of the sun continuously.

Fig. 2: Harry Tabor (Israel), c. 1955

The improvement in PV conversion has been even more dramatic. The earliest (nonsilicon) solar cells had conversion efficiences of a fraction of 1%. A Bell Laboratories team developed their first silicon solar cells in 1953, achieving 2%, and had raised this to 6% when first publicly announced in 1954. They further increased the efficiency, in small research cells, to 11% by the time of the 1955 Arizona solar meetings. At that time, the Hoffman Electronics Corp. produced the first *commercial* cells, of 2% efficiency. Commercial cells with greater than 8% efficiency were available by 1957—which made them economical in many nongrid applications. Since then, silicon cells have been improved to over 20%, and multi-junction cells have been developed with conversion efficiencies of 30% or more. (These are expensive but have applications in the military and are used to power transmissions from satellites.)

---

4 The LUZ project became possible because U. S. law gave a subsidy on added generating capacity. When the period of the law terminated, the LUZ company was caught with big commitments and failed. But the operation of the power stations was handled by a separate company (not burdened with capital costs), and power production has continued to the present day.

One area of R&D not related to new materials has been black-bottomed solar ponds—proposed by an Israeli team—which are large-area (liquid) collectors, where convection is suppressed by imposing a density gradient (by the dissolution of salt). Temperatures up to 93ºC have been obtained, sufficient to operate new low-temperature turbines developed by the same team. Because these turbines, known as ORC (organic Rankine cycle) turbines, operate at temperatures below 100ºC, they are suitable for the conversion of low-temperature *geothermal* energy, (where steam machines cannot be used). They are now used worldwide for this purpose.

Now we turn to consideration of meetings on solar energy that preceeded the formation of AFASE, and who participated in those meetings.

Fig. 3: Detailed view of the LUZ collectors in a California solar thermal power plant. There are more than a million square meters of collectors in the several plants. The receivers utilize selective surfaces and are enclosed in vacuum jackets.

Fig. 4: One of the LUZ solar thermal power plants in California

1.2.2 Solar Energy Meetings Prior to AFASE

In the early 1950s there were several small symposia in the USA and elsewhere that had a bearing on the formation in 1954 of AFASE. In 1951, the American Academy of Arts and Sciences organized a conference on the "Sun in the Servce of Man." Those participating were primarily from the Boston area and many were from Harvard and MIT, where Godfrey L. Cabot[5] was supporting research on these questions. Prof. Farrington Daniels[6] (University of Wisconsin-Madison) was there as a speaker on "Efficiency of Biological Photosynthesis." Prof. Hoyt Hottel[7] (MIT) was also on the program, discussing the possibilities of using solar power for meeting energy needs.

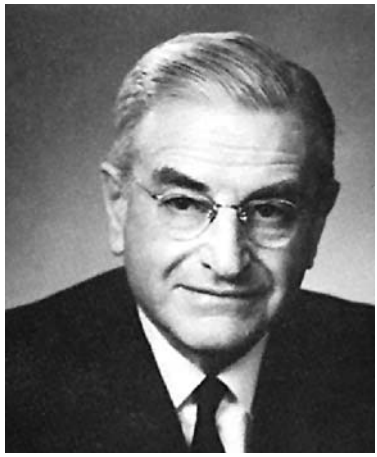

Fig. 5: Farrington Daniels, a key figure in the establishmeent of AFASE and the first president elected by the membership, 1964 – 67.

In 1952, an Ohio Academy of Sciences symposium included topics on solar radiation, heating, photosynthesis, photochemistry, photovoltaics, and optical systems. This one-day gathering, with a speaker on each of these topics, was a remarkably interdisciplinary meeting, and the program had strong similarities in its coverage to the first AFASE meetings.

In 1953, Farrington Daniels, with financial support from the National Science Foundation, organised a symposium at Wisconsin on solar energy that again covered a wide range of topics, with a broad range of speakers. Thirty speakers from five countries participated, with proceedings published in a book *Solar Energy Research*[8]. Farrington again spoke on photosynthesis

---

5 G. L. Cabot, Boston industrialist who in the 1930s – 1950s supported solar energy research at MIT and Harvard

6 F. Daniels: see section 3.2.1

7 H. C. Hottel, authority on combustion, established the basis for calculating collector performance

8 F. Daniels and J. A. Duffie (eds.). Solar Energy Research., Madison, WI: U. of Wisconsin Press 1955.

and also on solar distillation. The MIT group (Austin Whillier[9]—who subsequently participated in solar R&D at the Brace Research Institute of McGill University—and Hoyt Hottel), George Löf[10], and others spoke in detail about thermal processes. This symposium too, was a precursor of the widening interest in aspects of solar energy use other than by plants.

In 1954, the *Symposium on Wind and Solar Energy* took place in New Delhi, India, organized and supported by UNESCO. Participants included Farrington Daniels and Prof. Felix Trombe[11], the French solar scientist. This was followed by a tour of parts of India—to locales where the potential of solar energy to improve the lives of the population seemed particularly high. (It was on this trip that Daniels saw bullock-powered irrigation pumps, that his wife Olive was to paint in oils. He often stated that this was the picture that changed his life.)

Many of the participants in these symposia were involved in the planning and execution of the first major activities of AFASE—the 1955 Phoenix *World Symposium on Applied Solar Energy* and the Tucson *Conference on the Scientific Basis*. Hoyt Hottel, Felix Trombe, Eugene Rabinovitch[12], Charles G. Abbot[13], and Maria Telkes[14], were participants in the earlier meetings and in the programs at the Arizona events. Farrington Daniels was a keynote speaker at Phoenix.

Thus there was a group of scientists and engineers, mostly in America but with representation from other countries, who were known to each other and who participated in the early activities of the society while solar R&D gathered momentum.

1.3 AFASE/SES/ISES, 1955 to 1980

The history of the first twenty-five years of the society involved three distinct phases—which nearly coincided with the periods of its three names. The first of these phases lasted from 1955 until 1963, the AFASE years, when the Society was administered by officers and directors who were primarily

---

9 A. Whillier, from South Africa, collector and radiation data and space heating research.

10 G. O. G. Löf, Consultant, Denver, Air solar heating system design, distillation research. President of ISES 1973-75

11 F. Trombe, Scientific Director of CNRS Solar Energy Laboratory at Montlouis, France. Responsible for design and operation of the large solar furnace, and for house heating and cooling research

12 E. Rabinowitch, U. of Illinois, research on photochemical processes

13 C. G. Abbot, Emeritus Secretary of Smithsonian Institution, known for solar radiation instrumentation, measurements, and analysis, and inventions of solar engines

14 M. Telkes, of MIT and then New York University, research on solar house heating, phase-change chemical storage, and distillation

Arizona businessmen. The second phase was the seven-year SES period (1964 to 1970) spanning the presidencies of Farrington Daniels, Peter Glaser[15] and Roger Morse[16], the first three presidents to be elected by Society membership. During these years the major problem was survival of the Society. The third phase, ISES, after 1971, saw survival assured, growing membership, and major concerns with member services.

The first twenty-five years of ISES history was a time of dramatic changes and developments in the organization. How did it begin? What happened? Why? The answers to these questions involve the people who made the history, and the story of the society is to a significant extent the story of its early leaders.

1.3.1 The AFASE Years, 1955 to 1963

The first years of the Society's history were a far cry from those of most similar organizations, in that the individuals who were responsible for operation of the organization were not working in the field. These unusual arrangements persisted, with modification, for nine years.

1.3.1.1 The Origins of AFASE

Farrington Daniels—a visionary who dreamed of solar energy as a way to improve the human condition—in 1952 met Henry Sargent and suggested to him that there was a need for an organization to promote the development and application of solar energy—i.e., a solar industry. Two years later, on March 17, Sargent, with Walter Bimson and Frank Snell organized the Association for Applied Solar Energy, AFASE. Articles of incorporation, signed by the three founders, were filed with the State of Arizona on December 24, 1954. Sargent was the first president.

While Sargent, recognizing the importance of alternatives to oil and natural gas, saw the large business potential—Prof. Daniels saw the primary function of the association as educational, i.e., alerting the public to the need to find alternative renewable sources of energy. Thus its activities would be to encourage research (though carried out in other bodies), in organizing conferences, and in publishing articles on energy and the results of the research activities.

---

15 P. Glaser: see section 3.2.2

16 R. N. Morse: see section 3.2.3

The Association's objectives, as stated in the by-laws, were "to foster and encourage the research, development, application and education in fields related to solar and other energies."

Henry Sargent was in 1954 the president of Arizona Public Service Company—the Phoenix electric utility. In 1955 he moved to New York to become President of the American and Foreign Power Company. Walter Bimson was President of the Valley National Bank. Frank Snell was for many years a leading attorney in the Phoenix area. Jan Oostermeier, who succeeded Sargent as President of AFASE in late 1955 when the latter moved to New York, was a retired Vice-President of Shell Chemical Company.

Sargent in 1955 wrote of the founding of AFASE as follows:[17]

> The idea for the Association was conceived as a result of conversations between Farrington Daniels and myself some two years ago. It seemed desirable to have an association which could form a vehicle, not only to encourage further scientific and engineering work in connection with solar energy, but also would serve as a means of presenting to industry and business accurate information on the present state of the art. Its purpose in doing so would be to enlist the support of private capital in the development and application of those phases of solar energy utilization which give promise of economic feasibility.
>
> On March 17, 1954, in Phoenix, Arizona, the first meeting was held with a group of men of industry, agriculture, finance, and education who were interested in furthering the practical application of solar energy. Included in this group were representatives of Stanford Research Institute and the president of the University of Arizona. Everyone present felt that additional steps should be taken to meet the problem of greatly increased world requirements for energy. Expanding population and greatly increased per capita use of energy were putting increasingly greater demands for energy upon the non-replaceable sources of such energy, whether they were fossil fuels or nuclear energy. In order to supplement such sources initially and to replace them to a greater or less extent in the future, it seemed desirable to encourage aggressive investigations of tech-

---

17 Sargent, H., *Proceedings of the World Symposium on Applied Solar Energy*, Stanford Research Institute, 1956, p. 17.

niques for the economical application of the one great renewable source of energy—the sun.

These considerations led Sargent, Bimson and Snell to incorporate AFASE in December 1954. The Association's first activity was to engage the Stanford Research Institute to assemble and publish a directory of world activities and bibliography of significant literature on solar energy. The result, Applied Solar Energy Research, was a guide to the state of the art of utilizing solar energy at the time.

1.3.1.1a The 1955 Tucson and Phoenix Meetings

The first public activities of AFASE were to take place in October and November 1955—the year that is usually associated with the beginnings of the Society's activities. Two closely related meetings were planned. The first was *The Conference on the Use of Solar Energy—the Scientific Basis* at the University of Arizona in Tucson, Arizona, on October.31 and November 1. The second was the *World Symposium on Applied Solar Energy*, held at Phoenix the following week. They were both supported by an impressive group of agencies: fhe National Academy of Sciences, the National Science Foundation, the Rockefeller Foundation, the Ford Foundation, the Office of Naval Research, the United States Air Force, and UNESCO.

The Tucson conference program was developed by the chairmen of five subject areas, including general papers, radiation, thermal processes, photochemical processes, and electrical processes. ninety-six papers were presented. The list of authors included many of the people active in solar energy R&D at the time. The conference was to set the scientific and technological stage of the status of solar energy. About 500 participated in the meetings. The Transactions were published in five volumes by the University of Arizona Press in 1958.

The Phoenix *World Symposium on Applied Solar Energy* was held the next week. It was organized for AFASE by the Stanford Research Institute. The program was designed to present to the business, industry, and government delegates the state of the art and the opportunities in solar energy. It was a major event, attended by about 900 registrants, many of whom had been at Tucson. A thousand people dined on pheasant at the banquet. The list of members of the advisory committee and program committee included many familiar names: Abbot, Hottel, Löf, Telkes, Trombe, Rabinowitch, and Heywood,[18] all of whom were participants in solar energy conferences in the early 1950s.

---

18 H. Heywood, Mechanical Engineering, Imperial College of Science and Technology, University of London

Speakers at the Symposium included Harold Heywood from London, Valintin Baum[19] from the USSR, Austin Whillier[20] from South Africa, Gerald Pearson, Hoyt Hottel, George Löf, Richard Jordan,[21] and Farrington Daniels from the United States, Roger Morse from Australia, and others. Foreign delegates totaled 130 and represented 31 nations. The Proceedings of the Symposium were published by the Stanford Research Institute in 1956.

Accompanying the Phoenix Symposium was a major exhibition of solar energy–equipment—The Solar Engineering Exhibit, entitled "*The Sun at Work*." It included 85 exhibits from 50 exhibitors, and attracted 29,000 visitors. Key exhibits included the SOMAR solar engine, solar house designs, new solar cells generating electricity directly, and the first application of selective surfaces (to a solar flat plate collector producing steam at atmospheric pressure—without concentrating mirrors).

These meetings and the exhibit of AFASE made quite an impression and were widely publicized. They must be regarded as the jumping off point for solar R&D on a world scale.

1.3.1.2 The Board of Directors of the Association

The original Board of Directors of the Association included sixteen members, all leaders of business, industry, agriculture and education and mostly from Arizona. At a meeting of the executive committee of the board of AFASE in late 1955, a decision was made by AFASE and the Stanford Research Institute (SRI), to jointly employ an individual who would be the secretary of AFASE and an assistant director of SRI. This position was assumed by John I. Yellott on January 1, 1956. He was also elected to the board of directors for a three-year term. He came to AFASE from Bituminous Coal Research Inc, where he was Director of Development of their coal-burning gas turbine project.

The Board was made up primarily of Arizona bankers, utility executives, and other businessmen, and John Yellott who had a combined engineering and administrative background. The Board elected its own members and officers. The by-laws called for annual meetings of the Association and of the board of directors, and in the early years the directors regarded the board meetings also

---

19 V. A. Baum, head of the Heliotechnical Laboratory of the Krzhizhanoz Power Institute in the USSR

20 G. L. Pearson, Bell Telephone Laboratories, who together with D. I. Chapin and C. S. Fuller comprised the team that developed the Silicon solar cell for the practical direct conversion of solar to electrical energy

21 R. C. Jordan, U. of Minnesota, solar power systems, radiation data analysis and processing

as Association meetings. In fact, the board was the organization in 1954 and 1955. Memberships were solicited in 1955 – 56, primarily from industry and business.

Fig. 6: Harry Tabor with a flat-plate selective-surface steam generator at the "Sun at Work" exhibition at Phoenix in 1955

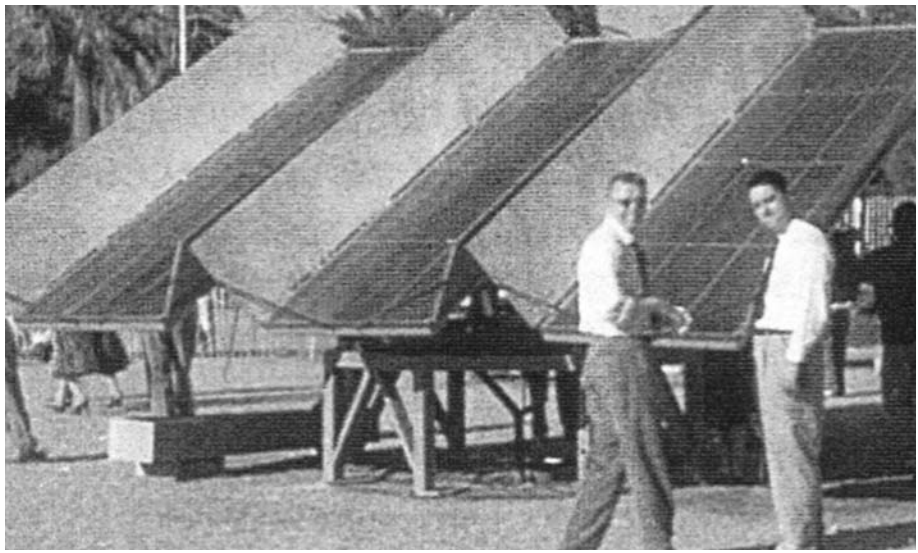

Fig. 7: SOMAR pump (Italy) at "Sun at Work" exhibition at Phoenix in 1955

Fig. 8: Solar cookers on display at the Phoenix "Sun at Work" exhibition, 1955

In 1956, there was already an ambitious list of activities under consideration. It included establishment of a permanent Solar Energy Museum (based on the Phoenix Engineering Exhibit), establishment and maintenance of a library, publication of a quarterly newsletter (*The Sun-at-Work*), publication of a technical journal (*The Journal of Solar Energy Science and Engineering*), and a solar house architectural design contest. Development of a membership structure, to include individual memberships at dues of $10.00 per year, was also under consideration.

The membership structure changed from time to time, but always included two basic types of membership, "collective" (corporate, institutional) and individual. In later years, a student membership category was added. (Membership data are shown in Table 1 in the Appendix.)

By May 1956 there were 138 individual, two Institutional and seventeen corporate memberships in the Association. The library had been activated, with Ms. Jean Jensen as librarian. The first issue of the Sun at Work had appeared. Work on the first volume of *The Journal of Solar Energy Science and Engineering* (usually shortened to *Solar Energy*) had started. Negotiations for space for a proposed Laboratory of the Sun were under way.

Fig. 9: Walter Lucking, Mrs. Frank Edlin, and W. B. Gibson at Tempe meeting of SES, 1967

AFASE offices were established in a Phoenix office building, which included space for the secretary, the office staff, and the library. An area of 10,000 square feet of roof area was available to the Association for a Museum of Solar Energy. The Association was involved in setting up solar energy exhibits at international trade fairs, notably in Greece and Morocco.

A proposed budget for 1957 included $50,000 income from corporate memberships and $10,250 from individual memberships. Major estimated expenses were for salaries totaling $35,500, publications $6,000, and other items, all adding up to $60,000. In late 1956 there were forty corporate members totaling $25,000 with contributions ranging from $5,000 to $50, at an average of a little over $600 per membership. There was also significant indebtedness; SRI had provided substantial services to the Association for which reimbursement had not been made, and funds had been borrowed from the Valley National Bank to provide operating capital.

The progress of some of the AFASE enterprises is noted below.

1.3.1.2a The Solar Furnace Symposium

The Association convened a Solar Furnace Symposium in January 1957. Held at Phoenix, it brought together many of those active in this area, including Felix Trombe[22] and Peter Glaser (who was to become the organization's second member-elected president). Fifteen papers were on the program, and approximately 200 attended. The proceedings of this symposium were published as part of Volume 1 of the journal *Solar Energy.*

22 Felix Trombe was the scientific director of the CNRS solar energy laboratory at Montlouis, France. He was responsible for design and operation of the large solar furnace at Montlouis and was active in research on passive house heating, cooling, and refrigeration. More later on Peter Glaser

1.3.1.2b The Solar Furnace Construction Project

President Jan Oostermeier (who had succeeded Henry Sargent) made a trip to Montlouis, France, to the solar furnace installation there and returned to the board with a recommendation that AFASE should build a similar facility in the Phoenix area, to be financed with industrial contributions. Oostermeier stated:[23]

> The furnace at MontLouis has given French Industry a magnificent tool for high temperature research. The Association can render a unique service to American industry by making available similar facilities in Arizona where 300 days of intense sunlight are available each year.

SRI, acting for AFASE, sent a team of three engineers to Montlouis to study the French furnace design. Negotiations with CNRS (the French government agency that operated the Montlouis facility) were undertaken to allow AFASE to use the Trombe furnace patents, and an advance royalty payment of $1,000 was made. A furnace of about 50 feet diameter was envisioned.

A group of scientists working in the solar field provided the Association with advice on the furnace design. A major recommendation was that the furnace should be designed to produce maximum temperatures, rather than to be very large. Cost estimates based on preliminary designs indicated that the investment would be of the order of $1,000,000. The Board was unable to generate the necessary level of industrial interest in the project, and the decision was made to terminate it.

1.3.1.2c The Library and Publications

The AFASE librarian, Jean Jensen, with considerable assistance from Maria Telkes and others, assembled a collection of some 5,000 items, including books, papers, periodicals, and patents relating to solar energy. Library services were made available to all comers, regardless of membership in the Association, although members were invited to use the facility.

---

[23] Oostermeier, J., report to the board of directors meeting of May 29, 1956, on his trip to Montlouis, cited in a review of the Board meeting dated June 5, 1956

Fig. 10: The Montlouis 50m solar furnace. The proposed AFASE furnace was to be of similar but smaller design

Fig. 11: The heliostats for the Montlouis furnace (not aligned when photo was taken)

Fig. 12: Frank Edlin, Jack Duffie, and Farrington Daniels at Montlouis, France, in 1958. They were attending the CNRS meeting on Applications Thermique de l'Energie Solare dans le Domaine de la Recherche et de l'Industrie, organized by Prof. F. Trombe.

Fig. 13: Valintin Baum (USSR), Farrington Daniels, Felix Trombe, and V. Storelli at Montlouis, France, 1958. A CNRS meeting organized by Prof. Trombe brought many researchers to the Laboratory in southern France

The Society's first periodical was the *Sun at Work*, a quarterly newsletter. The first issue appeared in March 1956. Volumes I and part of II were edited by Guy Benveniste, an SRI engineer who had participated in planning for the Phoenix symposium. After the first two issues he was joined by Jean Jensen as Associate Editor. She subsequently became the editor. This newsletter was

an informative publication. It included information on a wide range of topics, for example:

- AFASE news of meetings, and activities and those of other organizations
- Reviews of activities of programs and laboratories, such as the MIT solar heating program and the US Army Quartermaster Corps solar furnace
- Historical reviews, such as that of John Ericcson, an inventor of solar devices
- Editorials and political developments relating to solar energy
- Reports of work of inventors, such as H. Thomason
- Information on solar equipment available for purchase
- Background articles on scientific topics, such as fundamentals of pyrheliometry

Fig. 14: Deer-layer solar still designed by George Löf at Daytona Beach, Florida. This and other experiments were noted in AFASE publications

In 1957 a quarterly technical journal was established: *The Journal of Solar Energy Science and Engineering*—later shortened to *Solar Energy*. Jean Jensen also became editor of this journal and was responsible for the first three volumes. For the first two volumes, there was an editorial board that included one name familiar to the scientific/engineering community at that

time, Frank Edlin, an engineer from DuPont. For volume 3, the editorial board was expanded to include R&D people in the field. For volumes 4 and 5, A. B. Stafford of Arizona State University was editor, assisted by S. W. Wilcox. Charles A. Scarlott was the Society's editor starting in 1962, and served through six volumes of Solar Energy.

1.3.1.2d The Solar House Design Competition

The International Architectural Competition, launched in 1957, was a major initiative of AFASE—in ooperation with the Phoenix Association of Home Builders. The competition was financed by a $15,000 loan from the Valley National bank. The plan was to construct the building of the winning design on a site in the Phoenix area, and then operate and measure the performance of the heating system with the house occupied by a family. One hundred thirteen entries from thirteen countries were received by the Professional Advisor, J. M. Hunter,[24] of Boulder, Colorado. The five jurors met in September 1957, visited the site for the building, and flew to the Grand Canyon where they spent several days evaluating the entries.

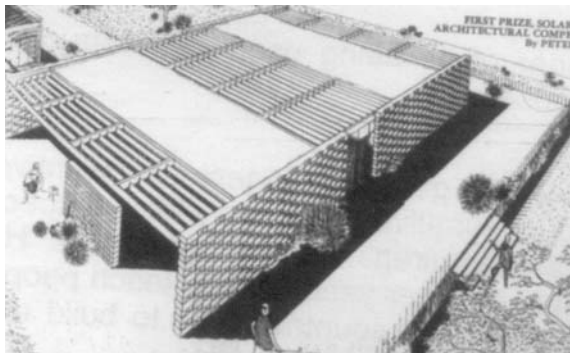

Fig. 15: Drawing of Peter Lee's winning design for the AFASE solar house competition

The winning design, by Peter R. Lee, a student at the University of Minnesota and an employee of the firm Bliss & Campbell, had collectors that were in the form of rotating louvers so the slope could be adjusted to increase incident radiation over what it would be on fixed collectors. Engineering of the heating system was undertaken by Bridgers and Paxton, a leading consulting firm, and materials for construction of the heating system components were supplied by (among others) DuPont and Reynolds Metals.

A grant of $13,000 from the John W. Pierce Foundation of Connecticut provided for instrumentation and system performance measurements. With

---

24 J. M. Hunter, Architect, designer of Löf solar house

financial support from the Phoenix business and construction community, the house was built. It was meant to be a showpiece, and it was open to the public for a month—until the neighbors complained about the traffic and took legal action. There were questions whether the design met zoning requirements for "conventional southwestern architecture." John Yellott commented that "Peter Lee's lovely house was certainly not southwestern in its architecture..." Action by the zoning commission upheld the complaint, ending the public phase of the project. Unfortunately, no operating data on the performance of the solar heating system were recorded. Monitoring and other equipment was turned over to Arizona State University and the house was sold. The unfortunate end of the project, reported in one newspaper under the headline "Sun Sets on Solar House," did not enhance the reputation of AFASE nor improve what was becoming a difficult financial situation.

John Yellott in 1980 recalled the situation thus:[25]

> The sun set not only on the solar house but on most of the paid staff of the Association because it became obvious that there was not sufficient financing to continue the operation in the manner originally contemplated. The writer's employment as Executive Secretary and later as Executive Vice President was terminated.

A book, *Living with the Sun*, included plans and drawings of sixty of the entries in the competition. They include the winning Lee entry, the next four runner-up designs, honorable mention designs, and others. It was published by AFASE in 1958 and is available from ISES Headquarters on CD.

Thus AFASE in its first years established an office with paid professional staff It embarked on ambitious publication and library service programs and other projects. These activities were to be financed by memberships, primarily corporate. When memberships did not materialize in sufficient numbers, economies were in order. As noted above, staff was reduced, and AFASE in 1960 moved to the Arizona State University at Tempe.

---

25 ISES News, No. 33, Sept. 1980. After leaving the Association, John Yellott established his own consulting organization, was affiliated with the architecture department of ASU, and served as the ISES representative in Arizona for many years.

1.3.1.2e The 1960 Affiliation with Arizona State University

With the 1960 reorganization, AFASE moved to offices on the ASU campus, to space donated by the University. Jan Oostermeier resigned as president and assumed a vice-presidency. Hal Walmsley was employed as president. Jean Jensen (the editor and librarian) and Lee McLean (who had been hired as executive officer) resigned. University staff and faculty took on responsibilities for some of the Association's activities. Milton Lowenstein became the AFASE librarian. Prof. A. B. Stafford became editor of Solar Energy, and S. W. Wilcox became editor of *Sun at Work*, arrangements that lasted until 1962 when Charles Scarlott became editor of both publications. AFASE would maintain its affiliation with ASU until the move of headquarters to Australia in 1970.

Fig. 16: The Denver house, designed by Hunter and occupied by the Löf family since 1957

1.3.1.3 The AFASE Advisory Council

The board of AFASE and its cooperating institutions (SRI and the University of Arizona) called on ad hoc committees to plan its first three meetings (Tucson, Phoenix, and the Solar Furnace Symposium). Included in each were scientists and engineers working in solar energy. The programs that were assembled were impressive and comprehensive. After the Tucson and

Phoenix meetings the committees had little formal input to AFASE and probably had little influence on its plans and activities. On paper there was an advisory committee, and at its meeting in May 1956 the directors decided to meet with members of the committee to review the Associations plans for 1957, but records of such a meeting have not come to light. Apart from that, and while there may have been personal contacts between directors and advisory committee members, the board was responsible for all of the decisions and activities of the Association.

Fig. 17: MIT House IV, with liquid heating collectors and water storage

The Advisory Council (which must have grown out of the committee) included among its members many of the scientists and engineers active in the field at the time. Members at various times included Farrington Daniels, George Löf, Hoyt Hottel, Harry Tabor, Maria Telkes, Charles G. Abbot, Dick Jordan, Felix Trombe, Roger Morse, Jack Duffie, and others. The Council's first organized function was to plan and carry out the scientific meeting in New York in 1959. Otherwise it was little involved as an organization in the operation if the Association—until the New York meeting.

1.3.1.3a. The 1959 New York Meeting

Members of the Council were conscious of the lack of contact between themselves and the board, and in 1958 George Löf made it known to the board that council members felt they were not being consulted by the Association. As a result, the council was expanded and plans were developed for the 1959 meeting.

The council’s purpose was to meet in technical sessions, and also to make recommendations regarding the role of the Association in future solar energy developments. Some members of the advisory council were not satisfied with

the direction in which the Association was going, and in an unscheduled gathering the discussion centered around basic questions: Should AFASE be abandoned, or should the organization be changed to a more traditional scientific/engineering society? Should the scientific members depend on their traditional scientific and engineering societies (like ASME, ASHRAE, APS) for forums to discuss solar energy matters, or would an interdisciplinary AFASE be a better forum?

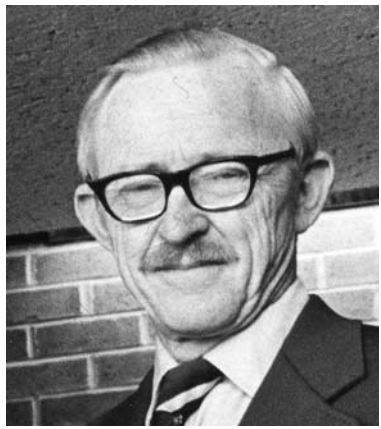

Fig. 18: George Löf, long-time advisory council member and ISES President, 1973 – 75

AFASE had significant accomplishments to its credit. It had sponsored conferences (Tucson, Phoenix, and the Solar Furnace Symposium) that were effective in bringing people in the field together. It had a publication program, including a journal and a newsletter. At the same time there were problems. No one on the board of directors had experience or competence in the science and technology of solar energy. The editors of Solar Energy were hard working, but lacked expertise in the field. There was not an adequate reviewing system in place.

In spite of its difficulties, AFASE was very much a going organization. It was a unique organization, one that cut across usual disciplinary lines. Active members included chemists, physicists, mechanical engineers, chemical engineers, botanists, meteorologists, and others. Traditional professional organizations were not set up to absorb and serve such a variety of members. Also, there were members from countries other than the United States, and nationally based societies did not lend themselves to international and interdisciplinary memberships.

The Council's deliberations resulted in two actions that were to change AFASE over the coming four years. First, the responsibilities of the Council in AFASE were defined. Second, the members urged that AFASE undergo

changes in its organization that would transform it into a society with a board of directors and officers elected by its members. This was a radical departure from the existing structure. In short, it would mean that the scientific community would assume from the Arizona business community the responsibility for the Association.

The Advisory Council met in April 1960 at Madison, with Hal Walmsley[26] (recently elected president of the Association by the directors). A set of by-laws for the Council was adopted, outlining the organization and responsibilities of the Council. In a section on Professional Assistance, the by-laws stated:

> The Council will make recommendations to the Board and accept such other responsibilities as are mutually agreed upon by the Council and the Board. The Council will be mainly concerned with:
> - Scope of all technical activities.
> - Major financial matters and support having scientific and technical implications.
> - Technical facilities, including library or laboratories.
> - Cooperation with other organizations, state and national governments.
> - Publications, including scientific, technical and promotional.

> The Council will be responsible for:
> - The review and approval of any proposed technical activities of the AFASE.
> - The review of technical papers submitted to the AFASE and the establishment of publications policy and standards.
> - Assistance in planning and conductance of symposia, conferences, and technical meetings of AFASE.

Particular concern was expressed at this meeting about the quality of the Association's publications, and an eight-member publications committee of the Council was formed. A. J. Drummond, who would play a key role in revitalizing the journal, Solar Energy, was a member.

Thus the newly organized Council outlined what it considered to be its growing role in Association affairs. The AFASE Board approved the Council by-laws in 1963, recognizing the importance of the scientific community in the affairs of the Association. This ultimately resulted in a new direction for

---

26 Hal Walmsley was a retired brigadier general who served in the U. S. Army's Chemical Corps.

the Association—a series of annual meetings organized by Council members and devoted to the science and technology of solar energy.

The proposal to reorganize AFASE was more far-reaching, and its progress more obscure. The essential fact is that the Council's ideas were approved by the board of directors at its meeting in January 1963, paving the way for officers and board members to be elected by the membership. The name of the society was changed to the SOLAR ENERGY SOCIETY, with the reorganization effective January 1, 1964.

As the new structure became effective in 1964, Hal Walmsley, the outgoing president, commented:[27]

> The execution of the new policies and organization will make the Society more responsible to the interests of the members, add to its world-renowned professional stature, and give it added force as the vehicle for dynamic progress in the science, technology and application of solar energy in all nations.

1.3.1.4 Other Concepts of AFASE

The advisory board was made up of scientists and engineers involved with solar energy research and was the group that developed the new concept of the organization. It is not surprising that the changes were to make it a society more along the lines of other scientific and engineering organizations (although a uniquely interdisciplinary one). There were a few dissenting voices, in particular of those who saw its potential as a more popular and more applied society. Harold Hay, for example, viewed the Sun at Work as more important than the Solar Energy journal and urged that the Society be more applications (and less research) oriented. These differences of opinion would persist over the lifetime of the organization.

1.3.1.5 Branches (Sections) of AFASE

Starting in 1955 there was international participation in AFASE meetings and symposia, although at a relatively low level. H. Tabor of Israel, V. A. Baum of USSR, F. Trombe of France, H. Haywood and John Page of England, and R. N. Morse of Australia were all at Tucson and Phoenix, and continued some level of AFASE activities. But the organization and its activities were largely American.

AFASE was a monolithic organization until 1962, when it first encour-

---

27 *Sun at Work*, VIII, No. 2, 16

aged the formation of national or local branches. The first of these to be established was the Australia—New Zealand branch (later to be called section), with Roger Morse as its chairman. The next section to be organized was Chile, in 1963, with Julio Hirschmann as chairman. Italy followed soon thereafter, under the guidance of V. Storelli and G. Nebbia. Thus, by the time of the change from AFASE to SES, the concept of national sections, conducting their own activities but with close ties to the Association, was firmly established and the organization was taking on a distinctly more international flavor. (The move of headquarters to Australia in 1970 accelerated this trend.) Table 4, in the Appendix, lists sections and years of origin.

1.3.1.6 A Summary of the AFASE Years

The Association for its first five years was almost entirely the creature of the directors, a group of public-spirited Arizona businessmen. The input from the scientific community was primarily in program planning for meetings. AFASE plans and activities ranged beyond meetings, and included an architectural competition and solar home construction, a museum, a solar furnace, publications, and others. Financing was sought primarily from business and industry and secondarily from individual memberships. The board of directors was a self-appointed group not elected by AFASE members.

Beginning in 1959, the advisory council, as it became known, sought a greater role for the scientific community (the membership) in influencing the activities of the Association and its governance. The emphasis was shifted to improving the publications and to organizing meetings, i.e., to the exchange of scientific and technological information. The final step was to convince the directors to turn over control of AFASE to officers and a new Board all elected by the membership.

It took four years, but the Council's ideas were accepted and implemented. As of January 1964, the name was changed to the Solar Energy Society, and Farrington Daniels became the first president elected by the membership.

1.3.2 The SES Years, 1964 to 1971

The years from 1964 to 1971 were eventful years for the Society. Severe financial pressures and some organizational problems threatened its existence. That it survived and later prospered was due to the contributions of many unpaid volunteers who provided critical support. There were, however, three individuals whose service to the Society was extraordinary. They were its first three presidents elected by the membership: Farrington Daniels, Peter Glaser, and Roger Morse. They were three very different kinds of people with

very different backgrounds.

Farrington Daniels played a critical role in the formation of AFASE and in keeping it alive during difficult years. He had a set of almost independent professional careers. He was a physical chemist who first made his mark in nitrogen chemistry. He worked in photochemistry and photosynthesis. During World War II he was the director of the Metallurgical Laboratory of the University of Chicago (where the first critical atomic reaction was carried out) and he was at Alamogordo when the first atomic bomb was exploded. His experiences in atomic bomb development drove him to seek alternative energy directions for the betterment of mankind. Based, perhaps, on his knowledge of photochemistry and photosynthesis, he directed his thoughts and efforts to developing and promoting solar energy.

He was generous, ingenious, inventive, and imaginative. He was widely respected and admired. He was a visionary. A trip to India for the 1954 Symposium on Wind and Solar Energy in New Delhi and the postmeeting tour where he saw water being pumped by bullock power broadened his interest in solar energy, and as he often said, "changed my life." One aim in his later years was to teach people in developing countries how to improve their lives by building and using solar cookers and stills.

Daniels was president of the American Chemical Society and vice-president of the U. S. National Academy of Sciences. He knew many people in many places. In 1953 he organized a symposium at the University of Wisconsin on "Solar Energy Utilization." This stimulated the interests of members of the engineering faculty, with the result that the U. W. Solar Energy Laboratory was established.

Peter Glaser was born and raised in Bohemia and educated in Czechoslovakia, England, and America. He was in the Free Czechoslovakian army during World War II. In 1955 he joined Arthur D. Little, a consulting organization in the United States, where he was a lunar scientist and worked with imaging furnaces and space power systems. He participated in the AFASE Solar Furnace Symposium in 1957 and was active in Society matters for many year thereafter.

Roger Morse was educated at Sydney University in Australia and had a half decade of experience in industry before his service with the Australian army in Papua-New Guinea during World War II. He was responsible for establishing the Engineering Section—later to become the Division of Mechanical Engineering—of CSIRO, and led its work on air conditioning, refrigeration, and solar energy applications. He was largely responsible for the work that led to development of the solar water heater industry in

Australia. A very practical, hands-on engineer, he could see in a minute what constituted a good or bad solar heater design.

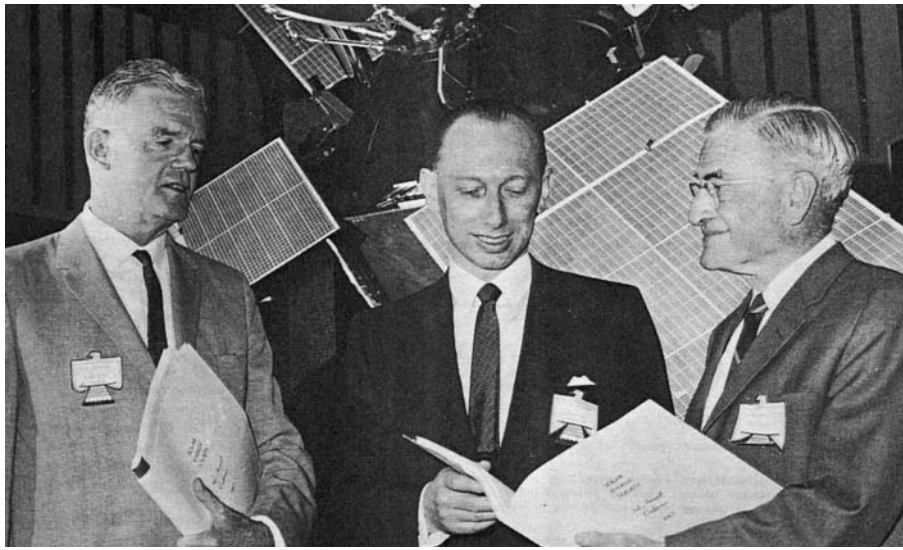

Fig. 19: Roger Morse (Australia), Peter Glaser and Farrington Daniels (USA), the first three presidents of SES elected by society membership

In the normal course of their professional activities, these three would probably never have met, but the Society was (and is) very much an interdisciplinary organization and bridged these differences. Their backgrounds and work were different, but they shared the conviction that solar energy had promise for improving the welfare of mankind and that the Society was a useful vehicle for achieving that end.

1.3.2.1 The Daniels Presidency

Farrington Daniels assumed the presidency of the Society in 1964, and his (paid) predecessor, Hal Walmsley, became the executive secretary. The headquarters were at Arizona State University. The editor of the Society's two publications, the Sun at Work and the Solar Energy journal, was Charles Scarlott. As Daniels became president, the name of the Society was changed to the Solar Energy Society, to better represent the broader scope of the Society's interests (beyond applications) and put the word "Solar" first. Membership in the Society at the beginning of 1964 was 787. The Society had a dedicated and able secretary in Mary Weber.

Fig. 20: Farrington Daniels. Photo from UW Archives

The new board of directors included a mix of fifteen directors from the previous board. It included Weldon Gibson as vice president of SES; he was Executive Vice President of Stanford Research Institute.. Five new members from the scientific community joined the board: Peter Glaser, George Löf, Roger Morse, Harry Tabor, and Felix Trombe. A mix of the new and old persisted until after 1967, when all of the directors were elected from the scientific community.

The new President wrote to a colleague in May 1964 as follows:[29]

> …The situation is really very critical and it would be so easy for the newly organized Solar Energy Society and its journal to simply fold up and die. The financial situation is very precarious, but by cutting of $10,000 from Hal Walmsley's budget and bringing the total down to $50,000, we may be able to survive this year, but after this year our support of the journal by the National Science Foundation will be discontinued. In addition to loss of NSF support, we are losing some of our industrial memberships and there is a possibility that we may […lose our donated space in …] the build-

29 *Daniels F., letter to Duffie, J. A. (then in Australia), dated May 12, 1964*

ing at the Arizona State University. The last blow was the cancellation by [NASA] of the previously approved support for our Solar Energy Symposium emphasizing terrestrial usages of space research. Perhaps the greatest worry of all, however, is the fact that Chuck Scarlott is not getting enough manuscripts to assure continuation of the Journal. If we do not have enough interest to justify the Journal, we do not have enough interest to justify a Society.

However, I will not accept these pessimistic views and I am doing my best to help the Society survive. …

Fig. 21: Farrington Daniels experimenting with solar stills at his summer home in Wisconsin

As Daniels took over the presidency, the Society's legal debts were large. The indebtedness to Valley National Bank was about $10,000, and tens of thousands were owed to Stanford Research Institute for services rendered to AFASE for the Tucson and Phoenix meetings, for solar furnace ventures, and for publications. One source listed the total debts as $120,000. The annual budget was of the order of $50,000, and membership income did not approach that figure. The financial problems were real and large.

In early 1965, Hal Walmsley, the Society's paid executive secretary resigned to pursue other activities. Frank Edlin agreed to replace him (at a salary of $5,000/yr). Frank was a chemical engineer who had retired from DuPont where he had been very active in solar distillation R&D and in mate-

rials for solar energy applications.. He was familiar with much of the technology and knew many of the scientists and engineers active in the field. He was to stay with the Society in this capacity until ill health brought on his retirement in 1968.

While the Society's fiscal and organizational problems persisted in the Daniels years, important functions continued. Meetings were held in Phoenix in 1965, Tempe in 1966, Boston in 1967, and in Palo Alto in 1968, with multiple symposia at each. The Solar Energy journal was published by the Society—although on an irregular basis. The Sun at Work continued. Thus the essential activities of exchange of information on the science and technology of solar energy provided motivation for people in the field to continue their memberships.

In the summer of 1965, the Society's day-to-day operations were at risk. At one point it was reported that there was a payroll of $500 to be met and a bank balance of $100. These were stressful times for both Daniels and Edlin, and for Mary Weber who had a deep personal involvement in these matters. That year a grant of $20,000 from the Rockefeller Foundation to support the Solar Energy journal provided some fiscal breathing room and enabled the Society to avoid bankruptcy. Headquarters were still in contributed space at Arizona State University.

Fig. 22: Frank Edlin, Mary Weber and John Yellott at the 1967 SES meeting, Tempe

At the time of the SES board of directors meeting in March 1966, there were among the fourteen members four from outside of the USA: Harry Tabor from Israel, Gerald Ward from Canada, Roger Morse from Australia, and Valintin Baum from USSR. The growing international nature of the Society was becoming evident.

Daniels opened the 1966 meeting with remarks about changes in the previous year. Frank Edlin took on the post of executive secretary. Some growth

in membership and subscriptions was reported. The ever-present financial problems were noted. Scarlott, the editor, reported that there was a steady flow of materials for the publications coming in, but that getting reviews was a problem.

On the international front, Valintin Baum told the board about the very active programs of solar energy research then under way in USSR. Roger Morse described a very active section of the Society in Australia, New Zealand, and surrounding islands, with most interest in thermal processes such as distillation and water heating. He noted that there was considerable interest in holding a 1970 meeting of the Society in Australia, that the government would extend a formal invitation to the Society if there were indications that the Society would be receptive, and that there would be some funds available to support the meeting. This news was received with enthusiasm by the board and action was taken to indicate the Society's interest in meeting in Australia in 1970.

At the 1967 board meeting, President Daniels opened the meeting with extensive remarks about the state of the Society. Starting with comments about the dedication of the staff (Frank Edlin and Mary Weber) and the fine relations with Arizona State University, he then spoke—as he had in the past—of the continuing dire fiscal situation of SES:[30]

> ...Finances are desperate. The National Science Foundation carried us for five years and said this was all. We borrowed $10,000 from the Valley National Bank to pay off back debts. … We have reduced this to $9,000 but that is all. We hoped we could reduce it by selling our bound copies of the Journal. …
>
> The only way we have been able to make it was for our executive secretary to forgo part of his token salary. And, that is what it is, a token salary. Many of our contributions are falling off and we are in a desperate situation. … It is going to be difficult to cut expenses any further. The office force is cut to Frank [Edlin] and Mary [Weber] and this isn't enough to handle things. We got the Rockefeller grant, but this was all earmarked. Part of this is for printing abstracts of articles in the Journal in French and Spanish. …

Frank Edlin was sufficiently discouraged in 1967 that he recommended the Society terminate its activities. This recommendation was rejected.

---

30 *Minutes of March 19, 1967 board of directors meeting*

The Society was still in trouble. But, even in those pre-OPEC times it had real strengths. It had a membership of about 1,000 that represented many disciplines. With members in many countries it was on the way to becoming a truly international organization. There were three national sections (Australia/New Zealand, Chile, and Italy). It had a going publications program. And it had a core of dedicated leaders. Peter Glaser was to assume the presidency and Roger Morse the vice presidency, and there was a real sense of determination to solve the problems and make the Society work.

Matters of concern to the Society at that time included (in addition to financial matters): how to form national sections, where in the world meetings should be held, and how to expand membership, There were continuing differences of opinion as to what should be the emphasis of the Society's programs and publications—to move in the direction of "high tech" and space applications, or to emphasize solar energy for developing economies.

1.3.2.2. The Glaser Presidency

At the end of the 1967 Board meeting, Peter Glaser assumed the presidency and Roger Morse the vice-presidency. Frank Edlin resigned his post as executive secretary because of physical limitations and inability to handle the workload, although he was to stay on until a successor could be found.

Fig. 23: Frank Edlin, Farrington, Daniels and Peter Glaser at Tempe meeting, 1967

In December 1967 Glaser wrote to the membership:[31]

> At the last meeting of the Board of Directors, new ways of handling the affairs of the Society were inaugurated. In the interest of economy, changes have been made in the administration of the Society, with all officers performing their duties without remunera-

31 *Glaser, P., "An Open Letter to Members,"" dated December 1967*

> tion. Professor Carl Hodges has taken on the function of Secretary-Treasurer, and Mr. Frank Edlin has accepted the office of International Corresponding Secretary. Mrs. Mary Weber continues in her capacity of administrative secretary. Mr. Charles Scarlott has relinquished the function of Editor of the Society Publications, and our thanks go to him for his many years of devoted and superior service on behalf of the Society. We believe that such steps will … lead to the establishment of this organization on a sound fiscal basis without having to rely on outside subsidies, and one that is capable of expansion.
>
> One such step of immediate interest to many members is the way we handle requests for technical information. In the future requests of this nature received at headquarters will immediately be routed to a recognized authority … (This was a simplification of functions, as headquarters itself had endeavored to act as a source for information for anyone who requested it.)

Thus, by 1968, there were substantial changes in the Society. The position of executive secretary had been abolished and replaced by a volunteer secretary-treasurer, with Carl Hodges, of ASU, in the new position. Publication of the Sun at Work was suspended to save money and for lack of an editor.

Fig. 24: Andy Drumond, editor of *Solar Energy* from 1970 to 1971, with Margaret (Mrs. Roger) Morse

Charles Scarlott, the paid editor (whose stipend was nominal and who did not always receive that stipend) was replaced by Andrew Drummond (who served without pay). Drummond was a physicist at Eppley Laboratories where he worked on problems of solar energy measurements, and he brought a new sense of high standards to the Journal. He visualized future issues in which papers relating to a single subject might be published, an idea that developed into the topical issues of recent years. He also sought review

papers for the journal, and he appointed associate editors to help make the reviewing process more manageable.

There were also substantial changes in the Society's financial position. The dire prospects of 1967 were improving. The efforts of Farrington Daniels, Peter Glaser, Walter Bimson, and Weldon Gibson bore substantial fruit. The Valley National Bank agreed to reduce the size of the debt to the bank by $2,000 per year. Frank Edlin announced that he would forgo salary owed to him, thus in effect making a cash gift of $1,440. The Stanford Research Institute had been owed money for support provided to the Society in its early days, and this indebtedness was cancelled by SRI. Farrington Daniels personally paid $900 in interest on the Valley National Bank loan.

A significant part of the fiscal problems faced by the society was its expenditures on the Journal. From activities of Czechoslovakian nationals in London during World War II, Glaser knew Robert Maxwell, the founder and head of Pergamon Press. Glaser went to New York and discussed with Maxwell the society's need for a new approach to publication. The result was an agreement for Pergamon Press to produce the journal, starting in 1968. The terms of the contract were generous for the Society. Pergamon would produce and distribute to each member four issues a year at a cost to the society of $6—and contribute to the Society 25% of all profits generated by sales of the publication to nonmembers.

Irrespective of any later activities of Mr. Maxwell, the arrangement with Pergamon was a real helping hand to the Society. It continued, with modifications, into the 1990s. With a cadre of unpaid authors, editors and reviewers, SES put in the hands of its members a creditable journal at very low cost.

The agreement worked out by Peter Glaser with Pergamon Press resulted in major savings. The society had to pay only for copies of the Journal going to members and not for extra copies. This greatly reduced overhead and was a substantial step in moving the Society towards solvency. In addition, the "new" journal was a more attractive publication with wider circulation, and helped to obtain new members.

The vice president, Roger Morse, commented that there were times during the previous months that there were real misgivings as to whether the Society could survive. He stated that he believed it was mainly due to the efforts of Glaser and Hodges that we had managed this feat. Things were looking up, and the leaders could begin to devote more of their attention to memberships and meetings.

Plans to hold the 1970 meeting of the Society in Melbourne, Australia, called for a five-day congress, with emphasis on what had been accomplished

in solar energy rather than on predictions for the future. This would be the first meeting outside of the USA and was to be on a scale that allowed special arrangements with airlines and hotels for attendees. The United Nations and other agencies would support attendance by representatives of developing countries. The meeting was to be the first significant international gathering since the Tucson and Phoenix conferences fifteen years earlier.

Many other issues were of concern. How should memberships for persons in developing countries be financed? (A characteristic of those countries is the lack of hard currencies to pay for journals and other services associated with joining the Society.) How could international sections be encouraged and developed? How could a balance be struck between high tech-applications, basic science, and applications? How could the Sun at Work or its equivalent be restarted?

1.3.2.3 The Morse Presidency

In 1969, Roger Morse became president, taking over from Peter Glaser. The new agreement with Pergamon Press was in place, the first issue produced by them with Andy Drummond as editor was in hand, and it was well received. There were still problems with the journal (then a quarterly), mostly concerning the supply of acceptable manuscripts and obtaining reviews, but the new editor's efforts were bearing very positive fruits.

Fig. 25: David Norris (Australia), Jack Duffie, Wal Read and Everett Howe inspecting an experimental CSIRO solar still at Griffith, New South Wales, Australia

Fig. 26: Roger Morse (Australia), Jack Duffie (USA), Taro Hisada (Japan) and Julio Hirschmann (Chile) examine a solar water heater at Melbourne, 1970

The Society had been maintaining a library at its offices at Arizona State University (ASU), with Mary Weber using it to respond to various inquiries. The decision was made to drop the library function and to turn the library facilities over to an appropriate organization. The collection was donated to ASU, that maintains it to this day.

Melbourne was the scene of the 1970 board of director's meeting, with members from nine countries in attendance. The Board meeting preceded the 1970 general meeting, and Roger Morse, the president, presided. Carl Hodges, the secretary-treasurer, was there, but had announced his resignation. This precipitated a discussion of future location for the Society's headquarters, since the secretary-treasurer should be at the same location as headquarters. Countries under consideration (in addition to the USA) were Australia, Japan, France, and the USSR. The decision was made by the board, in a later mail ballot, to move headquarters to Melbourne. The move was made, and Frank Hogg became the new secretary-treasurer.

The move to Melbourne was undertaken after considerable debate. The president and vice president wrote to the membership the following:[32]

---

32 *Morse, R. N. (President), and Duffie, J.A. (Vice President), Letter to Members of the Solar Energy Society dated June 16, 1970*

At this time in the history of the Solar Energy Society, the Board of Directors has made extensive and careful study of the affairs of SES, from viewpoints of both scientific and technical programs of the Society, and its management and fiscal affairs. This letter is to inform you of the results of these studies and the changes we are making in the Society's activities. The recommended changes are considered to be in the best interests of the Society from both operational and financial viewpoints.

Late in 1969 our secretary-treasurer of the past several years, Mr. Carl O. Hodges, indicated that the pressure of other affairs made it desirable for him to resign during 1970. This decision, together with other operational considerations, led to the study by a committee of the Board of the location of the head office, its relation to the appointment of a new secretary-treasurer, and related questions of the structure and finances of the Society.

This special committee considered that the secretary-treasurer and the permanent staff of the Society should be in the same city, that there should be continuity for three to six years in the office of secretary-treasurer, and that the headquarters should be in a country which is active in solar energy research and development. The Committee considered that the Society, being an international organization, could operate effectively with its headquarters outside the United States, and found that important savings in operating expenses would accrue if the office were located in Melbourne. It recommended that a United States Section of the Society be formed without delay with its office in or near Washington, D. C. It further recommended that Mr. Frank G. Hogg be appointed as secretary-treasurer for a three year period, subject to reappointment, and that the office of the Society be established in Melbourne, Australia.

…This marks an important milestone in the Society's development in that it can now be claimed to be a truly international organization. The pattern of an international organization within which largely autonomous national societies can operate independently is an attractive one and has already been working very successfully in Australia for many years. Those members affiliated with a national group, such as the United States or the Australia and New Zealand Sections of the Society, will first and foremost be members of the International Solar Energy Society, but will, in addition, be free, and indeed encouraged, to organize their own national meetings and

> functions through their national or local headquarters. Those members not affiliated with a national group will continue to communicate with the headquarters of the Society.
>
> A United States section of the Society is being organized, with the approval of the Board, and after July 1, 1970, the affairs of Society members in the United States will be handled through the assistance of Dr. William H. Klein. Bill has volunteered to act as secretary-treasurer for a U. S. Section ... This office will be operated by volunteers without payroll expense to the Society. …

There were other problems associated with the headquarters move and the increasing internationalization of the Society, which was (and is still) incorporated under the laws of the State of Arizona. Annual membership meetings were required, and as the international meeting schedule evolved into a biennial pattern, it was necessary to hold general meetings in conjunction with a section meeting; this was often done with the American Section, the largest in the Society.

It was also necessary to have a representative in Arizona. John Yellott, residing in the state, volunteered to act in this capacity. Annual reports of the Society were to be prepared by headquarters and filed by Yellott with the Arizona Secretary of State.

The organizers of the Melbourne International Conference obtained about $35,000 in support for the Conference, including funds to support the travel of delegates from developing countries. It was truly an international affair, with 189 registered delegates from 26 different countries. Eight-three papers were presented (and preprinted), and the conference program included technical visits, a postconference tour, and social events. It led to consideration of changing Solar Energy Society to International Solar Energy Society.

Meeting plans included gatherings at NASA-Goddard (with Bill Cherry as chairman) in 1971 and Montreal (with Tony Ward as chairman) in 1972. The possibility was explored of a joint meeting in Paris in 1973 with AFEDES, the French solar energy society, with Georges Peri their main contact.

1970 marked the end of the SES home base in Arizona, and the end of Mary Weber's tenure as administrative secretary. She was a devoted and able employee of the Society. Mary and Carl Hodges were described by a board member as the administrative backbones of the organization.

The first issue of ISES News, dated September 1971, appeared with a photograph of the building housing the new headquarters on the cover. In a report on the 1971 Annual general meeting it was noted "… All long-term

indebtedness has now been eliminated and, despite the costs associated with transfer of the headquarters, there was a modest surplus in the year's operations. Currently the Society is operating within its budget."

Thus, by a combination of contributions, economies, and publication arrangements, the Society was put on a sound financial basis. It went from perilously close to bankruptcy to having adequate cash reserves, and it survived to provide essential services to what would become a growing constituency.

1.3.3 The ISES Years, 1971 to 1980

In 1970 it had been proposed that the Society change its name, in recognition of its increasingly international nature. This change was formally adopted in 1971, so what started as the Association for Applied Solar Energy (AFASE) and then became the Solar Energy Society (SES), took on its present name, the International Solar Energy Society (ISES).

Fig. 27: Frank G. Hogg (Australia), secretary-treasurer of ISES from 1970 to 1985, and editor of *ISES News*

The primary concerns of the officers and board in 1971 and after shifted from survival to member services, i.e., what the Society should do for its constituents. Those services were primarily publication of *Solar Energy*, *ISES News,* and *SunWorld* (first published in 1976 as a successor to *Sun at Work*), and the organization of biennial world congresses.

1.3.3.1 The Energy World of the 1970s —OPEC and Other Outside Influences

It is of interest to briefly review what was going on in the world that affected ISES.

Solar energy had been used in applications like growing plants, salt production, and in architecture for ages, but interest in developing broader applications had been limited by availability of technology and by economic and other social considerations. Energy from other sources (coal, petroleum, natural gas, etc.) had been for many of the world's population readily available, cheap, and convenient. There had not been much incentive to develop alternatives like solar energy.

Three sets of circumstances changed the picture in the 1970s. The first of these was the environmental movement. The second was the rise of OPEC, the Organization of Petroleum Exporting Countries. The third need that spurred interest in a particular segment of solar energy technology, PV, was the unique energy requirements of space programs.

Concern for environmental considerations received a major boost in 1961 with the publication of Rachel Carson's book *Silent Spring*. The environmental movement became an important factor in the United States with the first Earth Day in 1970. A part of this movement was interest in renewable energies—the use of which would diminish pollution and wasteful expenditures of limited natural resources. As the movement gained steam, political decisions were made with environmental considerations very much a part of the decision-making process.

In 1960, OPEC was established, and included in its membership most of the Middle East and Latin American major oil producers. Primary aims were to establish a common price for crude oil and reduce tensions among its members. It took some years before it became an effective entity, but by the early 1970s it was an economic bloc of great influence on the international energy scene.

In 1973, OPEC sharply increased the price of crude oil, Middle-East members of the organization (the most dominant members) used oil prices as a political weapon in response to United States support of Israel during the Yom Kippur war of October 1973, and in December OPEC declared an embargo of oil shipments to the United States and to the Netherlands.

The result was shortages of gasoline and a reduction of the treasured mobility of the American people. This brought the energy economy very much into the forefront of American public policy and spurred a move (one that had already started) to develop alternatives to imported petroleum. In

short, more funds became available for solar energy research, development, and applications, and more people moved into the field. In other parts of the developed world, similar combinations of concerns for the stability of energy resources and for environmental considerations led to increased availability of resources for renewable energy R&D and to more people working in the field.

ISES was not the only technical organization that had interests in solar energy, but it was the major broad-based, interdisciplinary one and provided appropriate forums for discussions of solar energy technologies. As activities in the field expanded, so too did membership in ISES.

The need for long-term energy supplies for space vehicles, the obvious availability of solar energy in space, and the early development of photovoltaic processes (as shown by Bell Laboratories at the 1955 Phoenix Solar Engineering Exhibition) resulted in major R&D programs on photovoltaic processes and converters. For decades, space satellites have been powered by photovoltaics, and the technology has made tremendous strides. Terrestrial applications are developing in the early 21st century. However, organizations other than ISES have provided the primary forums for work in this area, and PV activities of ISES have been an important but not major function of the organization.

1.3.3.2 ISES in a Growth Period

These events had a profound impact on ISES. With energy costs rising and supplies threatened, interest in alternative energy sources soared. The environmental advantages of "clean" energy sources added to the push. The results were increased interest on the part of the public; increased political support for exploring and developing alternatives; and increased research, development and applications. These added up to many more people actively working in the solar energy field—and ISES was on its way.

The ISES years covered in this section, from 1971 to 1980, saw five presidents presiding over the fortunes of the society. There were three engineers (all research-oriented, but with applications as the goals), and a chemist and a biologist. All were themselves involved in solar energy research and development.

Jack Duffie took over as president (1971 – 73) from Roger Morse, as SES became ISES, and as interest in solar energy started its period of rapid growth. Duffie, a Chemical Engineer by training, established the Solar Energy Laboratory in the College of Engineering at Wisconsin, and was its director until he retired in 1988. With Bill Beckman and Sandy Klein he wrote a series of books on engineering of solar processes. He was on the SES and ISES

boards for many years, and served as editor in chief of *Solar Energy* for eight years from 1985 to 1993.

In 1971 – 72, Tony Ward, of the Brace Research Institute of McGill University was vice president. In the next year there were two vice presidents, Tony Ward and George Löf.

George Löf was president for 1973 – 75. He too is a Chemical Engineer, and established the Solar Energy Applications Laboratory at Colorado State University. Under his (and his successors') direction, the laboratory was a major systems development center for solar heating and cooling of buildings. Systems were designed, built, and operated, and their performance was measured. Löf also built a solar heating system on his own residence in Boulder, Colorado in the late 1940s. Then in 1957 he and his family moved into the Denver House with its solar air heating system (which is still keeping him comfortable in 2004).

The vice presidents for 1973 – 74 were Bill Klein and M. Perrot, of France. Professor Perrot, of the Laboratoire d'Électricité et d'Heliotechnique de l'Université de Provence in Marseille, was the president of COMPLES. In 1974-75 the vice presidents were Bill Klein and Fred H. Morse (USA). Fred was then on the Mechanical Engineering faculty of the University of Maryland.

Fig. 28: W.H. Klein, ISES President 1975 – 77, welcomes Prime Minister S. M. Desai to the ISES Congress in New Delhi. Dr. A. Ram, chairman of the India national Committee on Science and Technology is in the center of the photo.

Bill Klein was the ISES President in 1975-77. Bill is a plant pathologist and was Director of the Smithsonian Radiation Biology Laboratory in Bethesda, Maryland. Educated in the USA, Klein started his career with the Smithsonian in 1951. He was associated for many years with the classical work on solar radiation measurements of C. G. Abbot and developed an international network of stations measuring solar and ultraviolet radiation. He was a long time Director of ISES, and (with lots of help from his wife Winifred) served as assistant treasurer of ISES until 1992.

Reb Datta of India and Jim Eibling, (an engineer at the Battelle Memorial Institute in Ohio, USA, were the vice presidents during Bill Klein's term as president.

R. L. Datta, of India, succeeded Bill Klein for the 1977 – 79 years. Datta was educated in India and England, with his degrees in Chemistry and Applied Chemistry. He studied separation processes at the Max Planck Institute in Germany and worked at the Central Salt and Marine Chemicals Research Institute in India. His contributions in solar energy were in salt production by solar evaporation, solar distillation, solar ponds, and space cooling. He was active in a wide variety of energy agencies, including as chairman of the All-India Solar Energy Working Group, Convener of the Energy Research Committee of CSIR (the government of India), member of the ad hoc committee of the USA Academy of Sciences for Solar Energy for Developing Countries, and others.

Reb Datta's vice presidents were Bill Charters and Fred Morse.

Fig. 29: Bill Charters, of Melbourne University (Australia), president of ISES 1979 – 81

Bill Charters was president from 1979 to 1981 and was in a sense the bridge between this chapter of the ISES history and David Mill's history of the second half of the Society's existence. He received his early education in China and Australia, followed by university degrees from England and the USA, where he earned a master's in mechanical engineering from Princeton. He has had industrial and military experience in engineering R&D and has worked in Trinidad and in Canada at the Brace Research Institute of McGill University. His academic career is at the University of Melbourne, Australia, where he was chairman of the Mechanical Engineering Department. His international activities have been legion, in Bolivia, Pakistan, France, and many other countries. He is a Fellow of the Institution of Engineers Australia. He and his research group at Melbourne have contributed in collector design, heating and cooling systems, and heat transfer problems relating to solar energy processes.

The vice presidents in 1979 – 81 were Harry Tabor and Everett Howe. Howe was in mechanical engineering at the University of California at Berkeley, worked on solar distillation, and served ISES for years as Editor of *SunWorld*.

Thus the leadership of ISES in this decade was in the hands of a series of professional people with broad experience and knowledge of solar energy processes and their applications in various kinds of economies. They presided over the Society in a period of unprecedented growth, when meetings and publications, international sections, and the Society's organization and direction were major concerns.

1.3.3.3 Memberships and Dues

In the 1960s, members numbered in the 600 to 800 range, with most from the United States, a small percent from Australia-New Zealand, and the rest from other countries. Numerous calls for members to recruit new members went out, but the pool of people with active interests in the field was limited and there was little growth. The Society itself was not able to stimulate widespread interest, and it was not until the environmental movement and the energy crises of the 1970s that membership began to grow.

When growth began in 1973 – 74, it was rapid. Total membership went from 703 in 1970 to 815 in 1973 to 4,126 in 1975 to 8,854 in 1979. More data on memberships are shown in Table 1 of the Appendix.

There were several categories of memberships, including sustaining, and collective, but the large majority of the memberships were individual or student memberships. In 1979, out of the total of 8,854, 7,646 were individual

and 648 were student memberships. Annual dues for many years were $15. In 1970 the board recognized the need for increasing dues and recommended an increase to $20 per year ($10 per year for students) to the membership. This was approved in 1971. However, the publication of the journal Solar Energy was still on an irregular basis, and the increase was not implemented until 1974 when the journal appeared in a more timely fashion.

Fig. 30: Wal Read, Bill Charters, Jack Duffie and Roger Morse at CSIRO in Australia

With its financial crises behind it and with growing membership, ISES turned its attention to other kinds of problems. among them conferences, publications, the nature of the organization and how it should function, and how it could best serve members from a variety of national and economic backgrounds.

1.3.3.4 ISES Publications in the Growth Period

Publications were matters of central importance to ISES in the growth period. A major function of the Society was to facilitate communications among the membership, with the aim of making solar energy R&D as effective as possible. Publications, along with meetings, were the major means of exchange of information among members. The journal *Solar Energy* was pub-

lished during the ISES years. *SunWorld*, an applications-oriented news magazine that was in a sense a successor to *Sun at Work*, started its run in 1976. The *ISES Newsletter* (also referred to as *ISES News*) first appeared in 1971 and was published into the 1980s.

1.3.3.4a The *Solar Energy* Journal

Solar Energy, the centerpiece of the ISES publication program, was in 1971 a quarterly edited by Andy Drummond and produced by Pergamon Press. The transition from the old arrangements (with Chuck Scarlott as editor) took several years. Drummond had to establish working relations with Pergamon, set up the procedures for handling manuscripts, and develop a cadre of reviewers. By the time of the 1971 meeting, the "new" journal was in its second year. Publication had not yet gotten on a regular schedule, as circumstances beyond ISES control conspired to delay the publication. Pergamon moved its office from Dublin to Oxford, United Kingdom, and a major postal strike in the UK interfered with shipments of manuscripts. The journal was on track, but the transition from the old format to the new was not yet complete. In this time of transition, manuscripts were available from the 1971 Goddard meeting, and the delays were in large part due to factors other than availability of papers.

The editor's tasks were considerable, and as the journal evolved the editor-in-chief (as he is now called) needed help. Four associate editors was appointed to cover specific areas. As the frequency of publication increased and the journal covered more of the diverse topics that are treated under solar energy, more associate editors were added. (In 2004 there are thirty-four working with the Editor-in-Chief.)

Solar Energy was a quarterly, and under Drummond's guidance it published carefully reviewed papers. In late 1971 ill health forced him to give up the position as editor, and Peter Glaser took on the responsibility, a post in which he served for fourteen years. ISES was indebted to Drummond for setting high standards for the Journal, and also to his company, Eppley Laboratories, for its support of the editorial activities.

The clerical tasks were formidable when significant numbers of manuscripts were being reviewed and prepared for publication. Most of this work was done on a voluntary basis or supported by the editor's employers. It was not until 1974 that ISES was able to make a small contribution (at first $3,000 per year) to meeting these expenses.

Four issues of the journal were published in 1974, but the number of pages fell short of expectations. The publisher pointed out that proofs of two

manuscripts were not returned to Pergamon in a timely manner and that those papers could not be included in that volume. The editor's best efforts could not negate this kind of delay; fortunately there were not many of them,

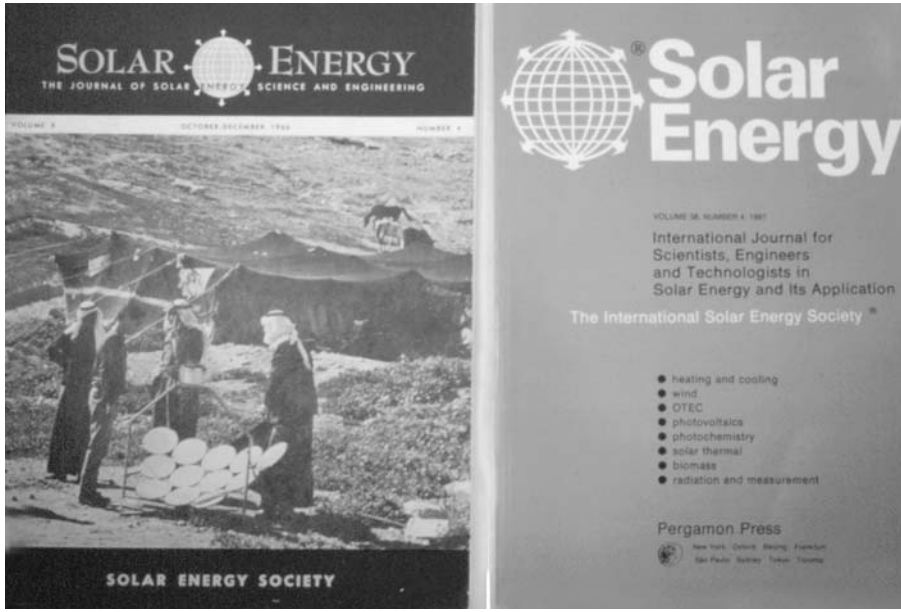

Fig. 31: New design of *Solar Energy,* instituted by Andy Drumond, on right. Old cover design is on left

By 1976 the level of activity in the field had increased and the Journal appeared in six issues (380 pages) rather than four. At that time the board agreed in principle that the Society should itself publish the journal. Representations were made to Pergmon to this effect, and the result was revised agreements with Pergmon to publish the following two volumes on terms more favorable to ISES, and more agreements were to follow. In 1976, the six issues of volume 18 totalled 590 pages. The journal was on solid ground.

Growth in solar energy activities and in the supply of available mnuscripts for the Journal was resulting in excessive delays in publication of papers, and in 1978 it was agreed that publication should go to a monthly basis. *ISES News* No. 24, in June of 1978, reported the situation as follows:

> In sympathy with an increase in contributed papers, the six issues of the Journal published during the year contained a total of

778 printed pages, as compared to 590 in 1976. Thanks to the dedicated work of Dr. Peter Glaser, Editor-in-Chief, ably assisted by the six Associate Editors, the high standards for which the Journal has become noted were amply maintained.

As a result of the worldwide growth in solar energy research and development activity, an increasing number of papers are being submitted for publication. On the other hand, the agreement that the Society has had with its publisher has imposed an upper limit on the size of each annual volume. In 1977 this limit was substantially relaxed, but even so, papers have been taking longer to pass through the review process and appear in print, and this has led to some dissatisfactions.

To improve this situation a new agreement has now been negotiated with the publisher, under which the Journal will become a monthly publication from the start of 1978. This in effect will double the number of printed pages per annum available to the Society, and authors are invited to take advantage of this improved facility. Due to the generous terms of the new publishing agreement, the Society should be able, at least for the present, to finance the enlarged publication without increasing members' dues.

In 1980 it was reported to the membership that *Solar Energy* was to be published regularly in issues of near uniform size and varied content. This achievement could be attributed to the editor-in-chief, his Editorial Assistant Anne Witkos, and to his associate editors. Much credit was also due to the many volunteer authors and reviewers who were major contributors to the success of the Journal.

1.3.4.4b ISES News

The *ISES Newsletter* (with its name later shortened to *ISES News*) was designed to inform the membership of what was happening in the Society and provide some coverage of applications. It first appeared in September 1971, when the headquarters were established in Australia. For four years it appeared three times a year, with four pages, and was prepared by the secretary-treasurers, first Frank Hogg and then Wal Read. In contrast to other ISES publications, it was distributed only to members. In 1975, the frequency of publicaion was increased to four a year, and each issue was expanded to eight pages. The object then was to report to the membership what was going on in the Society, and also to report news of events outside of the organization. (At that time, *SunWorld* was still five years off in the future.)

ISES News was the means of distributing information about publications, meetings and congresses of the Society and its sections, organization of new national sections, and elections. Election materials, including biographies of candidates and ballot papers were included. Agendas for and reports of annual general meetings were included, as were budgets and auditor's reports. Thorough readings of the newsletter would result in members being well informed about the Society and its activities.

It cost more to distribute the newsletter from Australia than to produce it, so it was compact, small type was used, and it was printed on thin paper. All of this was to minimize the cost of air-mailing it to members from Melbourne three or four times a year. For a time, they were mailed in bulk to Section offices, with distribution from there to members carried out by the Sections.

1.3.4.4c SunWorld

Fig. 32: Peter Glaser, Everett Howe, ISES vice president 1979 – 81 and editor of SunWorld, and George Löf

The *Sun at Work*, started in 1956, was an applications-oriented quarterly that also served as a newsletter. When the society's fiscal situation became perilous and economies had to be made in 1967, the *Sun at Work* was dropped (much to the dismay—understandably—of a segment of the Society that was most interested in news of applications). Replacing the *Sun at Work* was on

the minds of the directors for years, and in 1975 the publications committee was exploring the possibility of producing a popular magazine-type publication having broad appeal to experimenters and individuals. Later that year, Bill Klein, then president of ISES, wrote in *ISES News*:

> And now it is our hope to round out further the activities of the Society by launching a new publication. Although as yet unamed, it is being designed to resume the function of *Sun at Work*, a magazine with more popular, less technical articles. It is our expectation that the first issue will appear in the spring of 1976, carrying reports of progress, new concepts, new installations, new applications in all aspects of solar energy and related fields around the world. Its success, as well as the success of our other undertakings, will depend upon the contributions and cooperation of our many members.

The new and more ambitious quarterly, called *SunWorld*, made its appearance as promised in 1976, with Everett Howe and Yvonne Howell as editors. In view of the very favorable response to the first issue, the board authorized that three further trial issues be prepared in order that it could reach a considered decision at its 1977 meeting on the future of the venture. From *ISES News* No. 24:

> Further issues of the new magazine *SunWorld* appeared in 1977, each fully maintaining the high standard set by the initial trial issue. The magazine has been enthusiastically received by readers everywhere, and in view of its success the Board has now agreed that it should become a permanent ISES publication.
>
> …As in the case of the Journal, no increase in Society dues has so far been found necessary due to the introduction of Sun World.

SunWorld was to be published for years by Pergamon Press. It was to be a staple of ISES publications for decades. It started as a quarterly, and by 1980 it had gone from four to six issues a year.

1.3.4.4d Proceedings and Other Publications

There was an additional series of publications—proceedings of conferences—that started appearing in the mid-1970s. Once the meetings got large enough to justify the expense of their preparation (usually by obtaining camera-ready copy from authors) they appeared after each biennial meeting. Much of this was done by Pergamon Press, with ISES members serving as

editors. Also, for some meetings, preprints of papers were made available.

Thus ISES was deeply involved with publications of various sorts. As the situation evolved in the 1970s, much of this activity was done under agreements with Pergamon. There were extended debates in board meetings whether ISES itself should be its own publisher. In particular, Bill Klein and Peter Glaser advocated such a move, on the grounds that it would be an economic advantage to the Society to do so. The board in 1976 agreed to such a change, but Pergamon came back with revised terms that were too favorable to turn down. The Pergamon agreements took much of the risk out of the publications program and provided income to ISES from advertising that Pergamon was able to sell and from sales of publications to nonmembers.

In addition to the ISES publications noted above, many Sections had their own newsletters, magazines, and conference proceedings. These are noted in the Section histories.

1.3.3.5 Meetings and Congresses

ISES (and SES, AFASE) had from its inception sponsored scientific conferences. The first, those in Tucson and Phoenix, were large-scale meetings with many hundreds of attendees. Then for years, the conferences, all in the USA, attracted numbers more like 50 to 100 participants. Conferences did not show marked growth until the 1970 Melbourne meeting, when 189 registered. In 1973 ISES (in cooperation with AFEDES, the French solar energy society), met in Paris, with about 600 attendees. By 1975, the boom in interest in solar energy was at its height and the Los Angeles and Atlanta meetings had nearly 2,000 registrants.

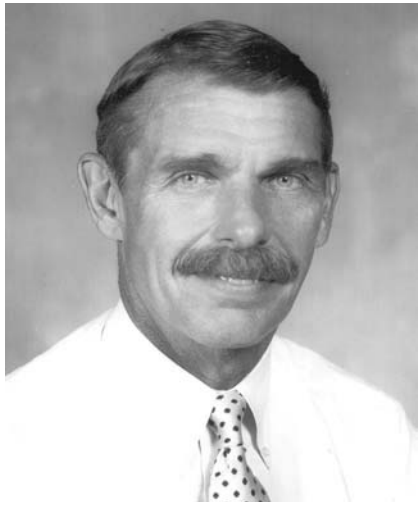

Fig. 33: Bill Beckman, program chair for the Atlanta ISES Congress. ISES president 1985 – 87

A pattern of major conferences every second year developed. At first the plan was to hold every other conference in the USA, but it soon became evident that activities elsewhere were as vigorous as in the USA and the policy was changed to meet wherever the circumstances merited. Following Los Angeles, venues for the biennial meetings were New Delhi, Atlanta, Brighton, Perth, Montreal, etc. In addition to the ISES conferences (which have become referred to as Congresses), there have been numerous section meetings, some of which hosted the ISES annual general membership meetings that are required under Arizona law (ISES still being registered as a corporation in that state).

At Congresses, the usual pattern is for an opening session to be devoted to welcoming addresses by host notables and plenary lectures by outstanding authorities on topics of general interest. Then the scientific, engineering, and applications sessions start, with each session including as many as five or six papers on special topics. There may also be poster sessions at which authors discuss their topics—with the aid of posters—with those who come to him/her in the session hall. Throughout, there are coffee breaks, informal sessions, and other opportunities for one-on-one discussions that for many are the heart of the gatherings.

Fig. 34: Peg Bilston of the Melbourne ISES office, Winifred Klein and Bill Klein

At the New Delhi Congress in January 1978 there was an exhibit of solar equipment at the nearby National Physical laboratory of India, to which participants in the Congress were invited. As a part of the Atlanta Congress in 1979, there was an exhibition of solar devices, equipment, and publications that included ninety-five exhibitors and attracted several thousand visitors in

addition to most of the 2,000 registrants. Exhibitions such as this became an integral part of subsequent ISES Congresses. (The precident was originally set by the "Sun at Work" exhibition at the 1955 conference in Phoenix).

Thus ISES (and its sections) provided many opportunities for its members to get together, present their new work, and engage in the all-important activities of informal give-and-take on technical matters that only personal contacts can provide. Workers in the field got to know their counterparts in other countries and in related solar energy fields.

At the 1971 meeting at NASA Goddard, W. R. Cherry, the meeting chairman, arranged for those at the banquet to be treated to a very special event. Dr. Charles G. Abbot, who was then a lively 99 years of age and had just received another patent on a solar engine, made a few remarks and then sang a song. His was a remarkable career, with his first publication on solar energy measurements appearing before 1900. It was a unique and special opportunity for ISES members to see and hear one of the true pioneers in solar energy.

1.3.3.6 Awards

By the time of the Los Angeles meeting in 1975, the Society was on sufficiently firm grounds that it could turn its attention to honoring the few who had made special contributions to the advancement of solar energy or the Society. The first award, the Farrington Daniels Award, was named in honor of the man who inspired the formation of the organization and who did so much to keep the Society alive during the crisis years.

> The award is conferred every two years for outstanding contributions in science, technology, or engineering of solar energy applications leading toward ameliorating the conditions of humanity, and for furthering this cause through the International Solar Energy Society.

It is customary for the award recipient to deliver an address to the Congress, on a topic of his/her own choosing. The first Daniels award was presented to Professor Hoyt Hottel at the Los Angeles meeting for his pioneering work on analysis of solar collectors—work that underlies all thermal applications of solar energy. His address was on a simplified model for atmospheric transmission of solar energy.

The second Daniels award went to Dr. Valintin Baum of the USSR and was presented at the New Delhi Congress in 1977. Professor Felix Trombe was the third recipient, at the 1979 Congress in Atlanta.

Fig. 35: Valintin Baum (USSR) receives the Daniels Award at the New Delhi Congress, 1978. The award was presented by ISES President R. L. Datta, with George Löf assisting

The second category of award of ISES, established in 1979, was to recognize outstanding papers published in Solar Energy. It was established through a gift to the Society from G. O. G. Löf and J. A. Duffie, with winning papers to be selected by the editors of the journal and the ISES board. The first of these awards was made in 1981.

1.3.3.7 Other Issues

ISES had made a major transition from the original organization (AFASE) to the more usual scientific and technical society (SES and ISES). There was one more major change to be made. ISES was an organization of individual members (many of whom were also members of Sections). An alternative structure, one in which ISES would become a federation of sections, was first noted in the letter to the membership from Morse and Duffie at the time of the move of headquarters to Australia. The idea was again brought forth in the November 1972 issue of ISES News. In 1977, the question of reorganization was again raised in ISES News, and a committee under the chairmanship of F. H. Morse was exploring the question. Two possibilities were suggested:[33]

33 Duffie, J. A., guest editorial "ISES in the Future," *ISES News*, No. 19 (March 1977)

> A first alternative is to retain the present basic structure of the Society, but elect members of the Board of Directors by Sections, rather than at-large. Members not affiliated with a Section would constitute a separate group analogous to a Section for purposes of electing Board members. The Board might then elect officers from its membership. …
>
> A second alternative would be to transform ISES into a federation of more independent national or regional societies, each carrying out its own activities and programs with relatively few constraints imposed by a constitution and by-laws of the federation. In this case individuals would be members of the constituent societies rather than of the federation. … Constituent society memberships in a federation would carry with it the obligation to support the federation and make possible its international activities.

By 1977 there were ten ISES sections in various stages of development, some with active programs and some in their formative years: Australia-New Zealand, Holland, United Kingdom, United States, Southern Africa, Irish, India, Italian, Japanese, and German. There was also an "unattached" Section.

Practical problems arose out of the international nature of ISES. The abilities of sections to contribute a portion of membership fees to ISES varied widely. Some sections withheld 15 percent of dues for their local operations, and some withheld larger portions—and were still subsidized in their activities by individual members.

Funds were coming into the organizations from a variety of countries. The headquarters were in Australia, and many of the functions were being carried out in the USA. The relative value of currencies fluctuated, and it is costly to transfer funds from one currency to another. To minimize the adverse effects of these problems on the Society's finances and to make dealing with Pergamon easier (their offices in New York were handling much of the Society's publications programs), W. H. Klein was appointed assistant treasurer in 1977. In effect, a second treasury was established in the USA, reporting to the secretary-treasurer in Australia, and operations were set up to minimize currency conversions and maximize the ease with which the Society's business could be conducted. Winifred Klein (Mrs. W. H. Klein) did much of the work in running the assistant treasurer office, attended board and membership meetings, and was always a source of useful current information.

Fig. 36: The Solar Energy Society Directors meet at NASA Goddard in 1971

1.3.3.8 The Society Loses Leaders

In the early 1970s, the Society lost several outstanding members. Farrington Daniels, who had played such a key role in keeping the Society alive during the crisis years and who served as its first elected president, died in June 1972. Andrew Drummond, the first Editor-in-Chief of the new Solar Energy, who set the standards for future editors, died in August 1972. Harold Haywood, a participant in the first Arizona meetings and a director of the Society, died in December 1971. Matthew Thekaekara was a distinguished physicist who made substantial contributions to the measurement and spectral distribution of solar radiation; he died in 1977. Walter Bimson, who died in 1980, was one of the founders of AFASE and was an active participant in Society affairs throughout the first twenty-five years of its existence. He was an honorary director until his death, and it was through his intervention that the Valley National Bank forgave the Society's debts to the bank.

1.4 Authors' Notes and Acknowledgments

The authors have relied on three major sources of information in preparing this history.

The Daniels archives at the University of Wisconsin have been a major source for anything involving Daniels; they are extensive and very well organized, and it has been possible for one of us (J. A. D.) to go into these records.

Arizona State University at Tempe maintains the AFASE archives and has extensive collections for the years before Society headquarters moved to Australia. James Allen, at the Archives and Special Collections of the Architectural and Environmental Library, has been most helpful in finding, copying, and sending to the authors a variety of files on AFASE. (Neither of the authors has been able to visit ASU to use the collections, so Mr. Allen's assistance has been invaluable.)

ISES headquarters in Freiburg has also been of substantial assistance in providing copies of publications and other materials. Christine Hornstein has been most helpful. She has searched the files at headquarters in Freiburg and found for us many of the photographs appearing in this chapter.

A fourth source has been our own files and memories. Both of us participated in the 1955 Phoenix and Tucson meetings and have been active in Society affairs most of the time since.

We are also glad to acknowledge the help of George Löf, Peter Glaser, Winifred and Bill Klein, Bill Charters, and Morton Prince. Neil Duffie and Peter Schmitz helped us with the intricacies of Word.

1.5 Other Histories of ISES

Several other histories of the International Solar Energy Society have been written. They are less detailed, but each contains insights and information that is unique.

Strum, Harvey, "The Association for Applied Solar Energy/Solar Energy Society, 1964 – 1970. "*Technology and Culture* 1985; 26: 571.

Duffie, J. A., "An Early History of ISES." *SunWorld* 1999 June; 23 (2): 9.

Howe, E. D., "IES Roots." *SunWorld* 1979; 3 (2): 32.

Yellott, J. I., paper presented at the Atlanta ISES Congress (1979). "The International Solar Energy Society (ISES)." (This paper was part of a set entitled "Historical Notes." Others in the set were very brief histories of Sections.) See also Yellott, J. I.,) "Twenty Five Years Later." *ISES News* 1980 Sept; 33.

Postscript

The authors prepared a Postscript to this history of the first twenty-five years, but it seemed more appropriate that it cover the entire fifty-year history of the Society. Thus at this point the reader is referred to the final section of David Mill's history of the second twenty five years for a Postscript authored by all three of us—a look in retrospect at what the Society was and what it has accomplished.

Appendix

Table 1 shows membership data by years. The early data come from minutes of board of directors meetings or correspondence. Data for the years 1974 and after were compiled by the secretary-treasurer (F. G. Hogg or W. R. Read) and were reported each year in *ISES News*. Note that an additional data point would be for 1955, when the membership of the board of directors, 16, was also the membership of the society.

Table 1. Membership

Date	Individual	Student	Group	Total
	AFASE			
5/56	138		19	157
9/57				864
12/61				663
	SES			
1/64				787
10/65				649
1970				703
	ISES			
4/73				815
4/74				1,808
12/74	1,959	160	352	2,471
12/75	3,321	291	514	4,126
12/76	4,317	402	539	5,258
12/77	6,029	544	654	7,227
12/78	6,747	550	636	7,933
12/79	7,646	648	560	8,854

The Officers and Staff

Table 2, adapted from Yellott (1979) indicates the officers of the society for the first twenty-five years. Some explanation helps to appreciate what occurred. John Yellott was the half-time executive secretary of AFASE, at a salary of $15,000 per year, with the balance of his time at the Stanford Research Insitute (SRI). He resigned in 1958 and E. Lee McLean was employed to fill the position. McLean stayed as executive vice president until a major reorganization at the end of 1959, when AFASE affiliated with Arizona State University. (At that time, Jean Jensen, the librarian and editor, also resigned.) Effective at the beginning of 1960, Jan Oostermeier resigned as president (while continuing as vice president), and Hal Walmsley was employed as president. (Walmsley was a retired Brigadier General, U. S. Army Chemical Corps.) These arrangements persisted for four years, until the restructuring of the organization in 1964.

Table 2. Officers of the Society

Year	President	Vice President	Secretary or Secretary-Trreasurer	Executive Officer or Assist. Treasurer
	AFASE			
1955	H. Sargent	W. R. Bimson	F. L. Snell	
1956	J. Oostermeier	W. T. Lucking	J. I. Yellott	
1957	J. Oostermeier	W. T. Lucking		J. I. Yellott
1958	J. Oostermeier	W. T. Lucking		J. I. Yellott (to 6/58) E. L. McLean (6/58)
1959	J. Oostermeier	W. T. Lucking H. Sargent	F. L. Snell (Sec'y)	E. L. McLean
1960	H. Walmsley	J. Oostermeier W. T. Lucking H. Sargent	F. L. Snell	
1961	H. Walmsley	J. Oostermeier W. T. Lucking H. Sargent	F. L. Snell	
1962	H. Walmsley	J. Oostermeier W. T. Lucking H. Sargent	F. L. Snell	
1963	H. Walmsley	J. Oostermeier W. T. Lucking H. Sargent	F. L. Snell	

Table 2 Continued

Year	President	Vice President	Secretary or Secretary-Trreasurer	Executive Officer or Assist. Treasurer
	SES			
1964-65	F. Daniels	R. Krause (to 3/64) W. B. Gibson		H. Walmsley
1965-66	F. Daniels	W. B. Gibson		H. Walmsley (to 5/65) F. E. Edlin (9/65)
1966-67	F. Daniels	W. B. Gibson		F. E. Edlin
1967-68	P. E. Glaser	R. N. Morse		F. E. Edlin
1968-69	P. E. Glaser	R. N. Morse	C. N. Hodges	
1969-70	R. N. Morse	J. A. Duffie	C. N. Hodges (to 2/70)	
1970-71	R. N. Morse	J. A. Duffie.	F. G. Hogg	
	ISES			
1971-72	J. A. Duffie	G. T. Ward	F. G. Hogg	
1972-73	J. A. Duffie	G. T. Ward G. O. G. Löf	F. G. Hogg	
1973-74	G. O. G. Löf	W. H. Klein M. Perrot	F. G. Hogg	
1974-75	G. O. G. Löf	W. H. Klein F. H. Morse	F. G. Hogg	
1975-76	W. H. Klein	R. L. Datta J. A. Eibling	F. G. Hogg	
1976-77	W. H. Klein	R. L. Datta J. A. Eibling	F. G. Hogg	
1977-78	R. L. Datta	W. W. S. Charters F. H. Morse	F. G. Hogg	W. H. Klein (asst. treas.)
1978-79	R. L. Datta	W. W. S. Charters F. H. Morse	F. G. Hogg	W. H. Klein
1979-80	W.W.S. Charters	E. D. Howe H. Tabor	F. G. Hogg	W. H. Klein

Table 3. shows a list of meetings and Congresses of the Society The data on attendance are incomplete, as it was not until publication of ISES News began that regular reporting of this information occurred.

In addition to these meetings, AFASE organized a Junior Solar Symposium in March 1956, where students aged 12 to 18 displayed the results of their ingenuity in designing and building solar furnaces, cookers, water heaters, stills, and other devices.

Table 3. Meetings and Congresses

Year, Place	The Meeting
AFASE	
1955, Tucson AZ	Conference on the Use of Solar Energy Approx 500 registrants, 93 papers
1955, Phoenix AZ	World Symposium on Applied Solar Energy 900 registrants Sun at Work Exhibition; 29,000 visitors
1957, Phoenix	Solar Furnace Symposium Approx 200 registrants, 15 papers.
1959, New York, NY	First Meeting of AFASE Advisory Council Sponsors: AFASE, SRI and New York University Approx 130 in attendance
SES	
1965, Phoenix, AZ	Annual Meeting of SES Approx 50 papers, 110 in attendance
1966, Boston, MA	Second Annual Solar Energy Society Conf. Approx 43 papers
1967, Tempe, AZ	Industrial Aspects of Solar Energy General Chair: P. E. Glaser Approx 100 in attendance, 40 papers
1968, Palo Alto, CA	4th Annual meeting of SES General Chair: W. B. Gibson
1970, Melbourne, Australia	1970 International Solar Energy Society Conference General Chair: R. N. Morse; Conf. Organizer: F. G. Hogg Approx 190 in attendance; 62 papers
ISES	
1971, Greenbelt, MD	Goddard Space Flight Center General Chair: W. R. Cherry 180 in attendance, 40 papers
1973, Paris, France	Theme: The Sun in the Service of Mankind Organized jointly with AFEDES and COMPLES General Chair: P. Auger Approx. 600 registrants, 300 papers, 60 countries represented
1975, Los Angeles, CA	Theme: Solar Use Now; a Resource for People General Chair: E. L. Ralph; Program Chair: J. A. Duffie Nearly 2,000 registrants, 280 papers. Daniels Award to H. C. Hottel
1977, New Delhi, India (January 1978)	Theme: Mankind's Future Source of Energy Secretary: J. Gururaja, Program Chair: F. de Winter 1,100 registrants, 342 papers Daniels Award to V. A. Baum
1979, Atlanta, GA	Theme: Silver Jubilee Congress General Chair: W. Shropshire, Program Chair: W. A. Beckman 2,000 registrants, 430 papers Daniels Award to F. Trombe

Table 4 lists Sections of the Society and the approximate year in which each was established. The information is from notes on section histories presented at the Atlanta ISES Congress in 1979.

Table 4. Sections and Year of Establishment

Section	Year
Australia - New Zealand	1962
Chile	1963
Italy	1964
India	1967
American	1970
Japanese	1973
United Kingdom	1973
South Africa	1974
Dutch	1975
Irish	1976
Scandinavian	1976
Arab	1977
Belgian	1977
German	1977