

科技资料

THE CONFERENCE RECORD OF THE  
**TWENTY SECOND IEEE  
PHOTOVOLTAIC  
SPECIALISTS CONFERENCE**

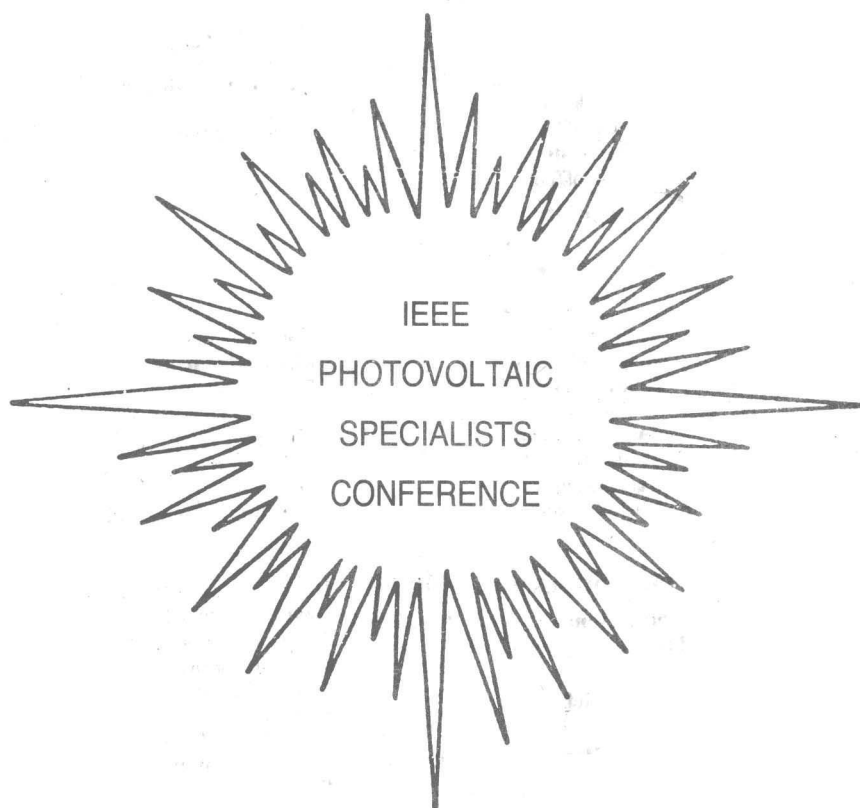
**Vol. 1**



THE CONFERENCE RECORD OF THE

# **TWENTY SECOND IEEE PHOTOVOLTAIC SPECIALISTS CONFERENCE — 1991 VOLUME I**

**Riviera Hotel  
Las Vegas, Nevada  
October 7-11, 1991**



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**IEEE**

**91CH2953-8  
0160-8371**

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# CHAIRMAN'S MESSAGE

Representatives from the world community assembled for the 22nd Photovoltaic Specialists Conference (PVSC) held at the Riviera Hotel in Las Vegas, Nevada October 7-11, 1991. The conference community included 675 people, representing 25 countries. This conference is the longest existing and the most comprehensive in the field. It is sponsored by the Institute of Electrical and Electronics Engineers (IEEE) Electron Devices Society. The conference is organized by committees of volunteers and its success depends upon support from the world community including professionals and others.

The highly successful features of past conferences were continued. There were four tutorial lectures on Monday attended by 289 people. Tuesday began with the presentation of the William R. Cherry Award to Mr. Peter Iles. For the remainder of the week there were 299 technical presentations (134 oral and 165 poster) and many other activities. The major technical areas (and the number of papers in each) were: High Efficiency (85), Polycrystalline (74), Amorphous Silicon (40), Space Systems (36), and Terrestrial Systems (64).

There were 39 exhibitors with displays that once again added to the scope of the conference. The centerpiece of the exhibits area was the solar powered car built by students from Arizona State University for the 1990 GM Sunrayce USA. There were high school PV science projects and a student PV powered model car race. These all enhanced the excitement of the conference, provided educational opportunities and excellent publicity. Local and national television and newspaper coverage was achieved and as a result the public learned more about the field of photovoltaics and about our conference.

A full agenda of social activities was an integral part of the conference and provided informal opportunities for people to interact. Receptions were sponsored by the conference committees, the exhibitors, the Riviera Hotel, and the PV industry. A luncheon attended by 220 people featured speaker Richard King from the U.S. Department of Energy. He gave an excellent talk entitled "Students Go Solar". He described the GM Sunrayce USA for colleges and the Junior Solar Sprint model car competition for high school students. His talk was informative and entertaining and set the stage for the first PVSC sponsored model car race for the PV community. It was held on the tennis courts and was very interesting. Six cars competed and, as you will see from the pictures on the following pages, everyone was enthralled. The 7th PVSC Fun Run was conducted early Wednesday morning. Sixty participants ran a course around the hotel. Times for individuals and teams were recorded. Awards were given for the Fun Run as well as the best exhibits, the best posters, the student projects, the student car race, and the PV Specialists car race. The final social event was a night in Old Nevada, an authentic western mining town. PV Specialists enjoyed a barbecue dinner and dancing. They saw western badmen roaming the streets and the sheriff and his deputy conduct a trial and a hanging!! A good time was had by all, especially the man who was hanged. The pictures on the following pages capture some of the special moments during the conference. I sincerely hope they hold memories of good friends and good times in a framework of professional accomplishment.

Richard Schwartz, the General Chairman of the 23rd PVSC, is already planning the meeting for Louisville in May of 1993. Begin your preparations now, and I look forward to seeing you in Kentucky.

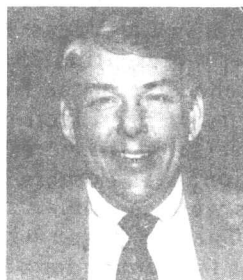
I extend my warmest thanks to all authors and attendees who provided the technical excellence, the stimulating discussions, the relaxed socializing, and the spark to make this a rewarding and exciting meeting. To the conference committees whose organizational talents, unselfish hard work and attention to detail made this conference a success, I give my sincere appreciation and thanks. Your most valuable contribution - the time you spent - will always be remembered.

Cosmo R. Baraona

## EXECUTIVE COMMITTEE



Cosmo R. Baraona



Dennis J. Flood



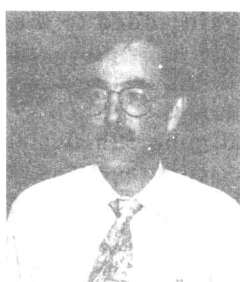
Wendy Coyle



James A. Albeck



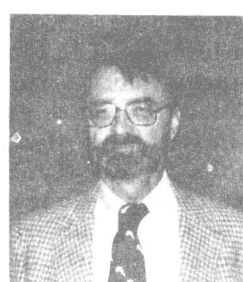
Timothy J. Coutts



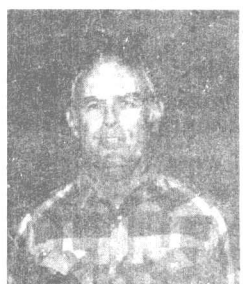
Eldon C. Boes



Sheila Bailey



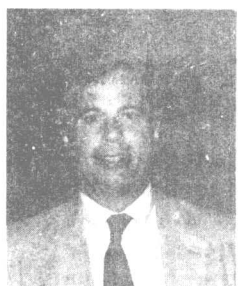
Bruce Anspaugh



Charles E. Backus



Judy Backus



Allen M. Barnett



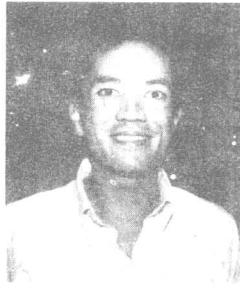
Paul Basore



## EXECUTIVE COMMITTEE



Richard J. Schwartz



James Gee



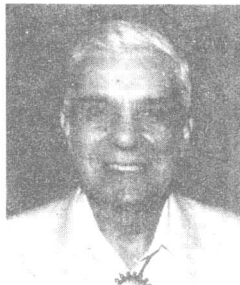
Howard E. Pollard



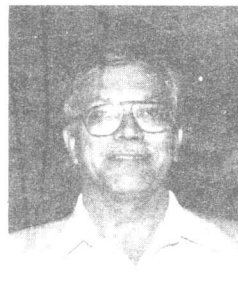
Robert Neff



Robert Francis



Morton Prince



Christopher Wronski



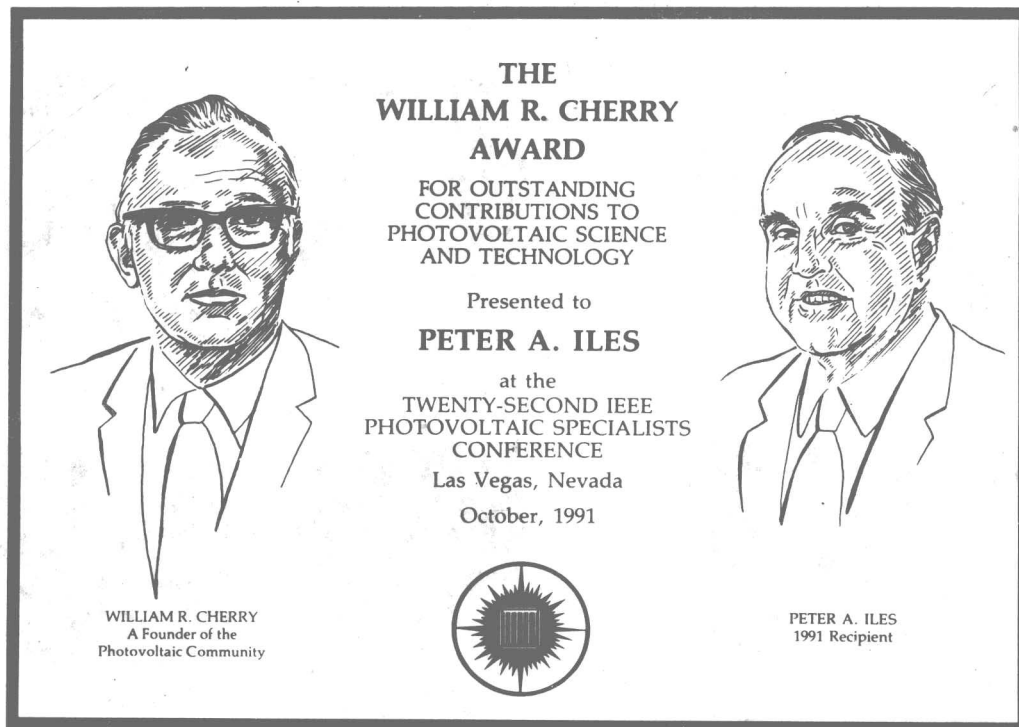
Mark B. Spitzer





## **WILLIAM R. CHERRY**

The fourteenth IEEE Photovoltaic Specialists Conference organizing committee established an award to recognize persons who have made "outstanding contributions to the advancement of photovoltaic science and technology," and named it in memory of one of the founders of the photovoltaic field, William R. Cherry. The award is to be given at each Photovoltaic Specialists Conference. The selection is made by the William R. Cherry Committee which is composed of all past general chairmen of the specialists conferences (those who may be nominated for the award are not participants in the selection), and all past recipients of the award. Past recipients of this award are Dr. Paul Rappaport, January 1980; Dr. Joseph L. Loferski, May 1981; Prof. Martin Wolf, October 1982; Dr. Henry W. Brandhorst, May 1984; Mr. Eugene L. Ralph, October 1985; Dr. Charles E. Backus, May 1987; Dr. David E. Carlson, September 1988; and Dr. Martin A. Green, May 1990.



## PETER A. ILES

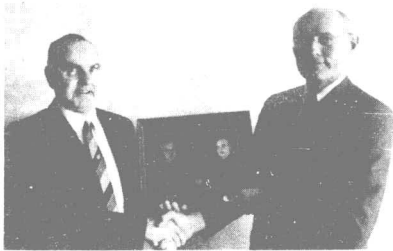
Peter Iles has devoted his entire life and career to the advancement and implementation of photovoltaics. After being raised and educated in New Zealand, he came to the United States to establish his professional career.

He joined Martin Wolf and Gene Ralph at Hoffman Electronics in 1959 to work on the development of solar cells. He has remained with this same company for the last 32 years although the company name and owners have changed many times. For the last several years, Mr. Iles has been the chief scientist for the Applied Solar Energy Corporation in southern California. He has successfully integrated a research and manufacturer's perspective into photovoltaic technology. He is best known for his pioneering research contributions in the space solar cell technologies. He has been a leader and innovator in developing both Silicon and III-V materials into high performance space cells. In addition he has developed high performance cells for terrestrial concentration systems.

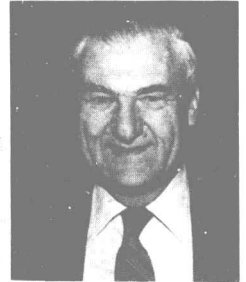
His contributions to photovoltaics has been significant and continuous for more than 30 years. He has contributed papers and attended the Photovoltaics Specialist Conference from the 2nd Conference through the present one. His more than 50 publications include contributions in unusually broad areas, from basic materials research to high volume production of solar cells. The photovoltaic community is extremely fortunate to have the talents and dedication of Peter A. Iles.



# WILLIAM CHERRY COMMITTEE



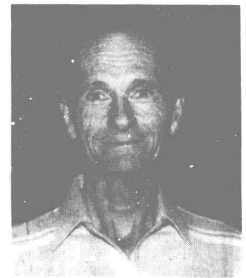
Richard L. Statler



Martin Wolf



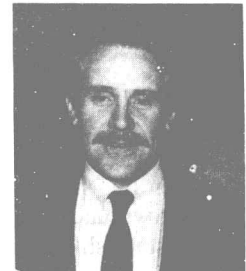
Americo Forestieri



Eugene L. Ralph



Joseph Wise



David E. Carlson



Lawrence Kazmerski

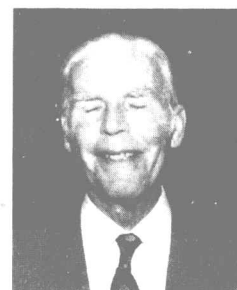


Martin Green

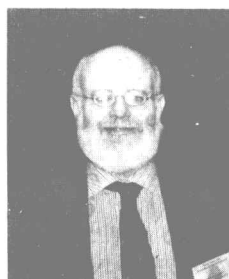
# INTERNATIONAL COMMITTEE



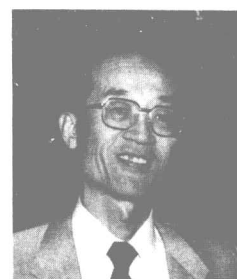
Masafuni Yamaguchi



Fred Treble



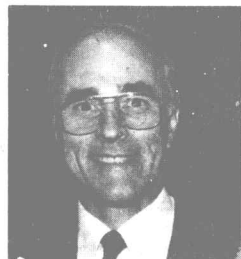
Antonio Luque



Hiroyuki Matsunami



Raj K. Jain

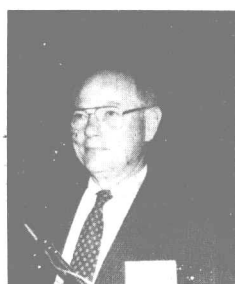


Armin Rauber

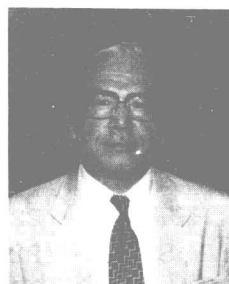
## TUTORIALS



Robert Hill



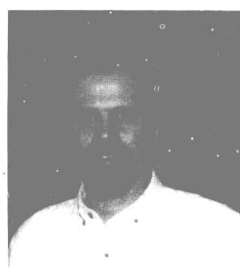
John Day



Yoshihiro Hamakawa



Makoto Konagai



Bulent Basol



Angus Rockett



# IEEE PVSC RUN FINAL RESULTS



## OVERALL WINNERS

Male: **B. Reed** **16:42**  
Female: **C. Jennings** **20:58**

## Age Categories

### Female

24 and under Waterhouse, Deb  
Pellaton, Natalie  
Stolz, Valeska  
25-29 Whipple, Margie  
30-35 Lewis, Carol  
Richards, Beth  
Lott-Fisher, Joanna

About 39 Addis, Judy

Special Firor, Kay

### Male

30 and Under Malone, Chuck  
Clemminck, Ivan  
Bruns, Jurgen

31-35 Yoshida, Takashi  
Rever, William  
Gee, James  
St. Angelo, David

36-38 Paletta, Fabrizio  
Dube, Chris  
Fortmann, Charles  
Schubert, Kent

39-41 Skelly, Jim  
Taylor, Roger

42-50 Mertens, Roger  
Moller, Hans  
Birkmire, Robert

50-60 Little, Roger  
Annan, Robert  
Boes, Eldon

60 over Czanderna, Al  
Berry, William  
Ralph, Gene  
Borrego, Peppi

## CORPORATE RUN

1. **NREL** 55:24  
A. Czanderna  
R. Taylor  
B. Stafford  
L. Kazmerski
2. **Sandia** 58:21
3. **IEC** 58:24
4. **Mobil Solar** 60:04
5. **Neuchatel** 91:07

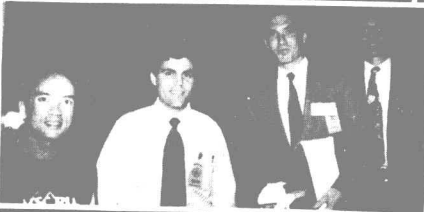
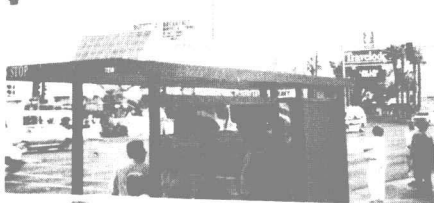
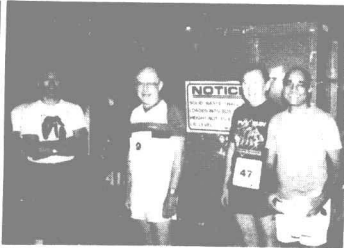
Thank you very much to the course volunteers: K. Emery, C. Osterwald, S. Ward, R. Dhere, F. Abou-Elfotouh, T. Gessert, N. Pearsall, Patricia Schmidt N. Coyle, and those others who either got up early or were just returning from a night out to officiate at this run! A special thank you to Conference Chair Cosmo Baraona, who participated (with his special nurse Pat tending to him) despite being mysteriously injured and unfortunately (or fortunately) incapacitated. We were happy to notice his miraculous recovery (within a few minutes after he last runner crossed the finish line)!

1 REED, B.	16:42	22 MÖLLER, H.	22:13	42 MAURITS, J.	24:41
2 MALONE, C.	17:50	23 KAZMERSKI, L	22:15	43 HUTCHBY, J.	25:16
3 PALETTA, F.	18:15	24 BIRKMIRE, R.	22:20	44 JADASHI, H	25:27
4 DUBE, C.	18:23	25 deMOOR, H.	22:46	45 RUSSELL, F.	25:27
5 SKELLY, J.	18:45	26 MICHEELS, R.	22:48	46 BERRY, W.	26:04
6 LITTLE, R.	18:58	27 LEVY, S.	22:58	47 DHERE, N.	26:28
7 YOSHIDA, T.	19:44	28 STERN, M.	23:15	48 YASUYUKI, A.	26:40
8 REVER, W.	19:50	29 WHIPPLE, M.	23:28	49 SINGH, P.	27:03
9 ANNAN, R.	19:52	30 COX, S.	23:34	50 RALPH, E.	27:05
10 MERTENS, R.	20:15	31 KRAUTER, S.	23:37	51 BELL, R.	27:08
11 FORTMANN, C.	20:27	32 LEPLEY, T.	23:38	52 AUGUSTIN, J.	27:08
12 CLEMMINCK, I.	20:51	33 STELLA, P.	23:40	53 LEWIS, C.	27:20
13 JENNINGS, C.	20:58	34 ANDRY, P.	23:43	54 RICHARDS, B.	27:37
14 BRUNS, J.	21:07	35 KENDRICK, Z.	23:44	55 GAY, R.	28:00
15 SCHUBERT, K.	21:09	36 STAFFORD, B.	23:45	56 HUND, T.	28:59
16 GEE, J.	21:33	37 SCHMIT, R.	23:59	57 BORREGO,	30:08
17 BOES, E.	21:38	38 MAISH, A.	24:21	58 WATERHOUSE, D.	31:04
18 CZANDERNA, A.	21:40	39 ADDIS, J.	24:24	59 PELLATON, N.	31:07
19 ST. ANGELO, D.	22:01	40 MEAKIN, J.*	24:32	60 LOTT-FISCHER, J.	31:08
20 FISCHER, D.	22:02	40a Where's Cosmo?		61 STOLZ, V.	31:09
21 TAYLOR, R.	22:12	41 BRAGAGNOLO, J.	24:35		

\*Conference Rabbit

Female runners in italics





# PROGRAM OVERVIEW

Monday, October 7, 1991

Time	Room	Session		Room
8:30 12:00	9	Session I Update/Review of Polycrystalline Thin Film Solar Cells	Session II The PV Market Through the 90's	10
12:00 1:30		Lunch		
1:30 5:00	9	Session III III-V Solar Cells: Physics, Processing and Reality	Session IV PV Modules: Reliability, Test- ing and Lifetime Prediction	10
6:00 7:30	Sky Room	Reception		Sky Room

TUESDAY, October 8, 1991

Time	Room	Session		Room
7:00 8:00	9-10	Presenter's Briefing (Turn in Manuscripts)		9-10
8:15 9:15	B	Opening Session William Cherry Award Presentation		B
9:15 10:45	B	Plenary Session 1 Overview of Recent Developments		B
10:45 11:00		Coffee Break		
11:00 12:00	B	Plenary Session 1 (Cont'd)		B
12:00 1:30		Lunch		
1:30 3:30	A	Oral Session 1A High Efficiency Tandem Cells	Oral Session 1B Polycrystalline Silicon	B
3:30 3:45		Break		
3:45 5:45	A Oral C-D View	Poster Session 1A High Efficiency Concepts I	Poster Session 1B Polycrystalline Thin Films	B Oral 1-4 View
6:00 7:30	E - H	Reception (Hosted by Exhibitors)		E - H

WEDNESDAY, October 9, 1991

Time	Room	Session		Room
6:45 7:45	9-10	Presenter's Briefing (Turn in Manuscripts)		9-10
8:00 9:00	B	Plenary Session 2 High Efficiency Cells		B
9:05 10:35	A	Oral Session 2A Single Crystal Silicon Solar Cells	Oral Session 2B Terrestrial Concentrator Systems	B
		Coffee Break		
10:50 12:05	A	Oral Session 3A High Efficiency GaAs Cells	Oral Session 3B CuInSe <sub>2</sub> Films and Devices	B
12:05 1:30		Lunch		
1:30 3:00	A Oral C-D View	Poster Session 2A Terrestrial Systems I	Poster Session 2B Polycrystalline Silicon	B Oral 1-4 View
3:00 4:00	B	Plenary Session 3 Polycrystalline Solar Cells		B
		Coffee Break		
4:15 5:45	A	Oral Session 4A Terrestrial Systems Testing and Reliability I	Oral Session 4B Polycrystalline Materials and Device Modeling	B
6:00 7:30	Sky Room	Reception		Sky Room

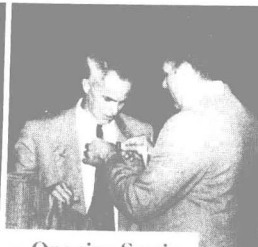
THURSDAY, October 9, 1991

Time	Room	Session		Room
6:45 7:45	9-10	Presenter's Briefing (Turn in Manuscripts)		9-10
8:00 9:00	B	Plenary Session 4 Space Solar Array Technology		B
9:05 10:35	A	Oral Session 5A Space Environ- mental Effects and Modelling	Oral Session 5B Amorphous Silicon Materials and Stability	B
		Coffee Break		
10:50 12:05	A	Oral Session 6A Indium Phosphide Solar Cells	Oral Session 6B Single and Multi- junction a-Si Cells	B
12:05 1:30		Lunch		
1:30 3:00	A Oral C-D View	Poster Session 3A Terrestrial Systems II	Poster Session 3B a-Si Materials and Applications	B Oral 1-4 View
3:00 4:00	B	Plenary Session 5 Amorphous Silicon Technology		B
		Coffee Break		
4:15 5:45	A	Oral Session 7A Space Solar Array, Cell and Compon- ent Technology	Oral Session 7B Amorphous Silicon Modules and Processing	B
5:30 6:30	E - H	Reception		E - H

FRIDAY, October 11, 1991

Time	Room	Session		Room
6:45 7:45	9-10	Presenter's Briefing (Turn in Manuscripts)		9-10
8:00 9:00	B	Plenary Session 6 Terrestrial Systems		B
9:05 10:50	A Oral C-D View	Poster Session 4A High Efficiency Concepts II	Poster Session 4B Space Technology and Applications	B Oral 1-4 View
10:50 12:05	A	Oral Session 8A High Efficiency Modelling and Characterization I	Oral Session 8B Terrestrial Applications I	B
12:05 1:30		Lunch		
1:30 2:45	A	Oral Session 9A High Efficiency Modelling and Characterization II	Oral Session 9B Terrestrial Systems Testing and Reliability II	B
2:50 4:20	A	Oral Session 10A CdTe Films and Devices	Oral Session 10B Terrestrial Applications II	B

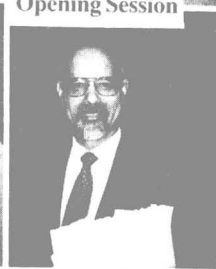
William Cherry Award



Opening Session



Registration

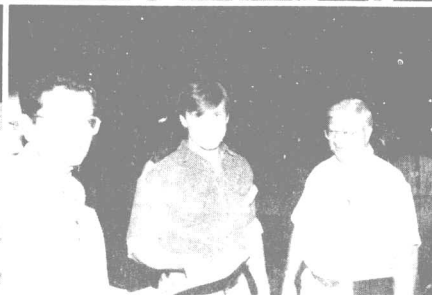
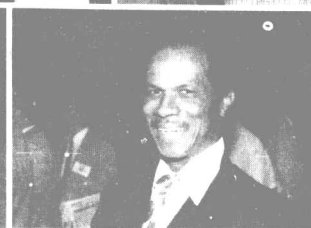


Conference Luncheon "Students Go Solar"



Richard King





Technical Sessions



Posters Sessions and Awards



