INTERNATIONAL ACADEMY OF ASTRONAUTICS

ROCKETRY & ASTRONAUTICS

IAC HISTORY SYMPOSIA
1967-2000

ABSTRACTS & INDEX

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INTERNATIONAL ACADEMY OF ASTRONAUTICS

ROCKETRY & ASTRONAUTICS

International Astronautical Congress

History Symposia
1967-2000

Abstracts & Index

Editor
Hervé Moulin

Dedicated to the Pioneers of Astronautics
??????

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IAA President

IAA President

PREFACE

Frederick I. Ordway III

Since 1967, the International Academy of Astronautics has held history symposia at the annual International Astronautical Congresses. The papers delivered at these symposia have, in turn, been published, the first two by the National Air and Space Museum (USA)° in 1974 and the next four by the National Aeronautics and Space Administration in 1977.

Beginning with the seventh and eight symposia, an agreement was made between the Academy and the American Astronautical Society (AAS) to authorize the latter's publishing arm Univelt of San Diego, California to produce and distribute all further volumes in the series. At the same time, arrangements were made for Univelt to reprint the first six symposia in the same format as subsequent volumes.

Now, Hervé Moulin has come forward with a remarkable achievement, the publication of the General Index & Abstracts of papers presented between 1967 to 2000. He starts of by listing each and every symposia with their coordinators, chairmen and rapporteurs. Then comes the meat of his book, the abstracts, each identified by title, author, control number, and the Univelt volume in which they appear (with inclusive page numbers).

We are now presented with several kinds of indices, one by author's and co-author's names, conveniently directing the reader to the respective abstract numbers. Next comes a special treat, a listing by country and authors – if you are interested is seeing how many papers have been prepared by Chinese authors over the years, your known just where to look.

Is there more? Indeed there is. How about a listing by historical period? H. Moulin supplies it, divided into "Ancient Times", "19th Century", "20th

Century – Before 1945", "20th Century-After 1945", and "20th Century-After 1957", all keyed to year if presentation and abstract number.

To wind up this treasure-house of historical information, the author provides us with a listing by subject: "Biographical References, "General", Manned Spaceflight", "Organizational Histories", Rocketry & Rockets", "Satellites & Spacecraft", "Scientific & Technical Aspects", "Scientific Research", Space Policy, and "Technical Aspects". Ever mindful of reader convenience, some of these subjects are broken into sub-headings. A reader-friendly index!

This monumental undertaking, a combination of love of his subject, dedication and hard work, will bring the author accolades for many to come.

October 2002.

Arlington, Virginia
and Hunstville, Alabama, USA.

FOREWORD

Hervé Moulin

With the advent of the new millennium, it is timely summarise the different works presented at the "History of Astronautics Symposia" held since 1967 at International Astronautical Congresses organized by the International Astronautical Federation and co-sponsored by the International Academy of Astronautics.

The first Session dedicated to the History of Rockets and Rocketry was held at the 18th International Astronautical Congress, (Belgrade, Yugoslavia, 1967).[1]

From the first History Session, which was chaired by Eugen Emme(USA), to the one held at the 51st International Astronautical Congress (Rio de Janeiro, Brazil, 2000), ***458 papers*** were registered. During the same period, many subjects were covered by authors from all around the world.

The purpose of this work is to highlight history of rocketry and spaceflight, and I expect that it will also an interest in history by students and serve as a reference for researchers.

I take this opportunity to thank all authors and of the International Academy of Astronautics members who provided me information and assisted me in undertaking this task. Especially members of the IAA Study Group who have participated actively: Ivan Almar, George S. James, Philippe Jung, Otfried Liepack, Frederick I. Ordway III, Shirley Thomas and A. Ingemar Skoog.

I particularly address my warmest thanks to Dr. Frederick I. Ordway III for his close support from the beginning and to Dr. Frederick C. Durant III who took a great interest in my work and encouraged me until his

[1] In the proceedings of the earlier IAC Congresses other papers can be found which present also a great historical interest.

achievement. To Dr. A. Ingemar Skoog, I want to address a special thanks for his help in completing this endeavour. He is probably the man who has followed most closely the IAC History Symposia and kept in his archives relevant material…in perfect order. Thanks also to Philippe Jung who gave me several missing abstracts and other reference material.

Paris,

August 2004.

ABOUT METHODOLOGY

This book contains all titles and abstracts of presented papers.
To facilitate researches we have created several methods of locating information.

SYMPOSIA

Papers are presented by chronological order of Symposium and by Session.
At the beginning only one Session was dedicated to the History of Rockets and Rocketry. Then, from 1983, faced with an increasing of the number of papers submitted, two Session were organized. This interest in the History of space activities continued to grow leading to an increasing number of papers. From 1995, three Sessions became necessary to accommodate them.
For each paper we have indicated, in addition to the IAF/IAA numbers, a volume reference in the American Astronautical Society (AAS) History Seriesproceedings volumes.

Title

Camera Rockets and Space Photography Concepts Before World War II
Winter, Frank H.(USA) *(eventually co-authors' names)*
IAA 86-503 – vol 9 – AAS vol 15, pp.165-180 abstract n°192

Author(s)
Authors' Country
Number given by IAF/IAA
Volume reference of the history papers
Volume reference of the AAS proceedings
Page reference in the AAS proceedings
Abstract reference

ABSTRACTS

In this part, we have reproduced abstracts (unfortunately some of them were unavailable, and for the first years some of them are only in the Russian or sometimes the French or the German languages).
The abstracts are given as originally submitted by the authors of many nationalities, and may not in all cases representent an ideal English text.

AUTHORS' NAME

Author's and co-author's are sorted by alphabetical order.

AUTHOR'S COUNTRY

Under this part of the book, one can find papers by alphabetical order of the author's country. Authors inside each country are also listed in alphabetical order.

PERIOD

We have tried to list each paper by the main period it covers. When the paper covers a large period – i.e. a general survey of an activity – we have placed it in the earliest period it covers.
We have grouped the paper in three main categories:

- Ancient Time
- 19th Century
- 20th Century, itself subdivided in three sub-categories:
  - Before 1945
  - After 1945 and Before 1957
  - After 1957, which mark the beginning of the "Space Era".

THEME

In this part, we have listed papers by large thematic categories.
A few of them are also subdivided in more precisely sub-categories.
We also note if the paper was presented as a Personal Memoir.

1. General
2. Biographical references
3. Manned Spaceflight
4. Organizational Histories
5. Rocketry
6. Scientific Research
7. Technical Aspects
8. Satellites & Spacecraft

History Symposia

1st History of Astronautics Symposium

18th International Astronautical Congress
Belgrade (Yugoslavia), 1967.

This First History Symposium entitled "International Symposium on the History of Astronautics" was organized by the International Academy of Astronautics with the cooperation of the International Union of the History and Philosophy of Science.Its general theme was "Pre-1939 Memoirs of Astronautics".

Coordinator:
Dolfuss Charles (France)

Sessions 1 & 2

26 September 1967

Chairman: Emme Eugene, M. (USA)

DEVELOPMENT OF WINGED ROCKETS IN THE USSR, 1930-39
Shchetinkov, Yevgueny S. (USSR)
IAF n° *** - vol 1 - AAS vol. 6 pp. 247-257 abstract n° 9

THE BRITISH INTERPLANETARY SOCIETY'S ASTRONAUTICAL STUDIES, 1937-1939
Ross, H.E. (UK)
IAF n° *** - vol 1 - AAS vol. 6 pp. 209-216 abstract n° 1

ON SOME WORK DONE IN ROCKET TECHNIQUES, 1931-1938
Polyarny, A.I. (USSR)
IAF n° *** - vol 1 - AAS vol. 6 pp. 185-201 abstract n° 13

ANNAPOLIS ROCKET MOTOR DEVELOPMENT, 1936-1938
Truax, Robert C. (USA)
IAF n° *** - vol 1 - AAS vol. 6 pp. 295-301 abstract n° 12

EARLY ROCKET AND SPACECRAFT PERFORMANCE GUIDANCE AND INSTRUMENTATION DEVELOPMENT
Steinhoff, Ernst A. (USA)
IAF n° *** - vol 1 - AAS vol. 6 pp. 277-285 abstract n° 10

EARLY ITALIAN ROCKET AND PROPELLANT RESEARCH
Crocco, Luigi. (Italy)
IAF n° *** - vol 1 - AAS vol. 6 pp. 33-48 abstract n° 8

MY THEORETICAL AND EXPERIMENTAL WORK FROM 1930 TO 1939, WHICH HAS ACCELERATED THE DEVELOPMENT OF MULTISTAGE ROCKETS
Damblanc, Louis. (France)
IAF n° *** - vol 1 - AAS vol. 6 pp. 49-55 abstract n° 7

2nd History of Astronautics Symposium

19th International Astronautical Congress
New York (United State of America), 1968.

The general theme of this Symposium was "New Contributions to the Historical Literature on Rocket Technology and Astronautics, 1900 - 1939".

Coordinator:
Durant III, Frederick C. (USA)

Sessions 1 & 2

16 October 1968

Chairmen: G. Jitatovsky (USSR) – Lise Blosset (France)

3rd History of Astronautics Symposium

20th International Astronautical Congress
Mar del Plata (Argentina), 1969.

The general theme of this Symposium was "New contributions to the Historical Literature on Rockets and Astronautics, Before 1949".

Coordinator:
Emme, Eugene M. (USA),

Session

10 October 1969

Chairman: Emme Eugene M. (USA)

FIRST WORKS OF K.E TSIOLKOVSKY AND I. V. MESCHERSKY ON ROCKET DYNAMICS
Kosmodemiansky, Arkady A. (USSR)
IAF n° HAS 1-03 - vol 2 - AAS vol. 7 part 2 pp. 115-124 abstract n° 33

THE U.S. ARMY AIR CORPS JET PROPULSION RESEARCH PROJECT, GALCIT PROJECT N°1, 1939-1946: A MEMOIR
Malina, Frank J. (USA)
IAF n° HAS 1-04 - vol 2 - AAS vol.7 part 2 pp. 153-201 abstract n° 31

THE ALLEGED CONTRIBUTIONS OF PEDRO E. PAULET TO LIQUID PROPELLANT ROCKETRY
Ordway III, Frederick I. (USA)
IAF n° HAS 1-06 - vol 2 - AAS vol. 7 part 2 pp. 25-41 abstract n° 28

MAIN LINES OF SCIENTIFIC AND TECHNICAL RESEARCH AT THE JET PROPULSION RESEARCH INSTITUTE (RNII), 1933-1942
Shchetinkov, Yevgueny S. (USSR)
IAF n° HAS 1-08 - vol 2 - AAS vol. 7 part 2 pp. 43-57 abstract n° 35

THE SWEDISH ROCKET CORPS, 1833-1845
Skoog, A. Ingemar. (Sweden)
IAF n° HAS 1-09 - vol 2 - AAS vol. 7 part 1 pp. 9-22 abstract n° 32

ON THE WORKS OF S.S NEZHDANOVSKY IN THE FIELD OF FLIGHT BASED ON REACTIVE PRINCIPLES, 1880-1895
Sokolsky, Victor N. (USSR)
IAF n° HAS 1-10 - vol 2 - AAS vol. 7 part 2 pp. 125-139 abstract n° 30

ON THE HISTORY OF THE STRATOSPHERIC ROCKET SONDE IN THE USSR, 1933-1946

Tikhonravov, Mikhail K. (USSR) - Zaytsev, V.P, (USSR)

IAF n° HAS 1-11 - vol 2 - AAS vol. 7 part 2 pp. 65-78 abstract n° 34

ROMANIAN ROCKETRY IN THE 16TH CENTURY

Carafoli, Elie. (Romania) -Nita Mihai (Romania)

IAF n° HAS-1-** - vol 2 - AAS vol. 7 part 2 pp. 3-8 abstract n° 29

4th History of Astronautics Symposium

21st International Astronautical Congress
Constance (Germany), 1970.

The General Theme of this Symposium was "New Contributions to the Historical Literature on Rockets Technology and astronautics, Before 1950" and Survey Papers on the 19th Century Rocketry.

Coordinator:
Emme, Eugene M. (USA)

Session

9 October 1970

Chairmen: Emme, Eugene M. (USA)

GUIDO VON PIRQUET: AUSTRIAN PIONEER OF ASTRONAUTICS
Sykora, Fritz. (Austria)
IAF n° 141 - vol 2 - AAS vol. 7 part 2 pp. 140-155 abstract n° 36

LQUID-HYDROGEN ROCKET ENGINE DEVELOPMENT AT AEROJET, 1944-1950
Osborn, George H. – (USA) - Gordon, Robert. (USA) – Coplen, Herman L. (USA) - James, George S. (USA)
IAF n°163 - vol 2 – AAS col.7 part 2 pp.279-324 abstract n°37

NON MILITARY APPLICATIONS OF THE ROCKET BETWEEN THE 17TH AND THE 20TH CENTURIES
Sharpe, Mitchell R. (USA)
IAF n° 137 - vol 2 - AAS vol. 7 part 2 pp. 51-72 abstract n° 38

THE USE OF CONGREVE-TYPE WAR ROCKETS BY THE SPANISH IN THE 19TH CENTURY: A CHRONOLOGY
Sancho Pedro, Mateu. (Spain)
IAF n° 138 - vol 2 - AAS vol. 7 part 2 pp. 73-77 abstract n° 39

THE AERONOMY STORY: A MEMOIR
Kaplan, Joseph. (USA)
IAF n° 161 – vol 2 – AAS vol.7 part 2 pp. 423-427 abstract n°40

THE SILVER BIRD STORY: A MEMOIR
Sänger-Bredt, Irène. (Germany)
IAF n°160 - vol 2 – AAS vol.7 Part 1 pp.195-228 abstract n°41

EARLY POSTAL ROCKETS IN AUSTRIA: A MEMOIR
Schmiedl, Friedrich. (Austria)
IAF n° 139 - vol 2 - AAS vol. 7 part 2 pp. 107-112 abstract n° 42

EARTH SATELLITES, A FIRST LOOK BY THE UNITED STATES NAVY
Hall, Cargill R. (USA)
IAF n° 165- vol 2 – AAS vol.7 part 2 pp. 253-277 abstract n°43

ROCKET FLIGHT TO THE MOON - FROM IDEA TO REALITY: A MEMOIR

Nebel, Rudolf. (Germany)

IAF n° 140 - vol 2 - AAS vol. 7 part 2 pp. 113-121 abstract n° 44

5th History of Astronautics Symposium

22nd International Astronautical Congress
Brussels (Belgium), 1971.

The General Theme of this Symposium was "New Contributions to the Historical Literature on Rocket Technology and Astronautics before 1951.

Coordinators:
Emme, Eugene M. (USA)

Session

23 September 1971

Chairmen: Sokolsky, Viktor N. (USSR) - Hall, Cargill R. (USA)

EXPERIMENTAL RESEARCH AND DESIGN PLANNING IN THE FIELD OF LIQUID-PROPELLANT ROCKETS ENGINES CONDUCTED BETWEEN 1934-1944 BY THE FOLLOWERS OF F. A. TSANDER
Dushkin, Leonid S. (USSR)
IAF n° *** - vol 2 - AAS vol. 7 part 2 pp. 79-97 abstract n° 52

F. GOMEZ ARIA'S ROCKET VEHICLE PROJECT
Carreras, Ramón. (Spain)
IAF n° *** - vol 2 - AAS vol. 7 part 2 pp. 176-185 abstract n° 49

COMPARATIVE ANALYSIS OF THE DESIGNS AND IMPLEMENTATION OF VEHICLES BASED ON REACTIVE PROPULSION PROPOSED DURING THE 19TH AND BEGINNING OF THE 20TH CENTURIES
Sokolsky, Victor N. (USSR)
IAF n° *** - vol 2 - AAS vol. 7 part 2 pp. 3-24 abstract n° 56

A SURVEY OF ROCKETRY AND ASTRONAUTICS IN SPAIN
Maluquer, Juan J. (Spain)
IAF n° *** - vol 2 - AAS vol. 7 part 1 pp.78-101 abstract n° 55

EVOLUTION OF SPACECRAFT ATTITUDE CONTROL CONCEPTS BEFORE 1952
Roberson, Robert E. (USA)
IAF n° *** - vol 2 - AAS vol. 7 part 2 pp. 156-169 abstract n° 54

BARON VINCENZ VON AUGUSTIN AND HIS RAKETENBATTERIEN: A HISTORY OF AUSTRIAN ROCKETRY IN THE 19TH CENTURY
Winter, Frank H. (USA)
IAF n° *** - vol 2 - AAS vol. 7 part 2 pp. 23-41 abstract n° 53

6th History of Astronautics Symposium

23rd International Astronautical Congress
Vienna (Austria), 1972.

The General Theme of this Symposium was "New Contributions to the Historical Literature on Rocket Technology and Astronautics before 1952.

Coordinator:
Emme, Eugene M. (USA)

Sessions 1 & 2

13 octobre 1972

Chairmen: Emme, Eugene M. (USA) – Sokolsky, Viktor N. (USSR)

THE VIKING ROCKET: A MEMOIR
Rosen, Milton W. (USA)
IAF n° *** - vol 2 - AAS vol. 7 part 2 pp. 429-443 abstract n° 60

ORIGINS OF ASTRONAUTICS IN SWITZERLAND
Waldis, Alfred. (Switzerland) - Stemmer, Joseph. (Switzerland)
IAF n° *** - vol 2 - AAS vol. 7 part 2 pp. 123-133 abstract n° 66

BASIC STAGES IN THE DEVELOPMENT OF THE THEORY OF RAM-JET ENGINES (RJE)
Merkulov, Igor A. (USSR)
IAF n° *** - vol 2 - AAS vol. 7 part 1 pp. 229-238 abstract n° 65

ON FUNDAMENTALLY NEW SOURCES OF ENERGY FOR ROCKETS IN THE EARLY WORKS OF THE PIONEERS OF ASTRONAUTICS
Melkunov, T. M. (USSR)
IAF n° *** - vol 2 - AAS vol. 7 part 2 pp. 186-194 abstract n° 64

ANALYSIS OF LIQUID-PROPELLANT ROCKET ENGINES DESIGNED BY F.A. TSANDER
Dushkin, Leonid S. (USSR) – Moshkin, Yevgeny K. (USSR)
IAF n° *** - vol 2 - AAS vol. 7 part 2 pp. 99-105 abstract n° 63

COUNTDOWN TO SPACE EXPLORATION: A MEMOIR OF THE JET PROPULSION LABORATORY, 1944-1958
Pickering, William H. (USA) - Wilson, James H. (USA)
IAF n° *** - vol 2 - AAS vol. 7 part 2 pp. 385-421 abstract n° 61

FROM WALLOPS ISLAND TO PROJECT MERCURY, 1945-1958: A MEMOIR
Gilruth, Robert R. (USA)

IAF N° * - VOL 2 - AAS VOL. 7 PART 2 PP. 445-476 ABSTRACT N° 59**

7^{th} History of Astronautics Symposium

24th International Astronautical Congress
Baku (USSR), 1973.

The General Theme of this Symposium was "New Contributions to the Historical Literature on Research Pertaining to the Devlopment of Astronautics Initiated before 1953.

Coordinator:
Emme, Eugene M. (USA)

Sessions 1 & 2

11 & 12 October 1973

Chairmen: Emme, Eugene M. (USA) - Sokolsky, Viktor N. (USSR)

CAMERA ROCKETS AND SPACE PHOTOGRAPHY CONCEPTS BEFORE WORLD WAR II
Winter, Frank H. (USA)
IAF n° *** - vol 3 - AAS vol. 8 pp. 73-102 abstract n° 69

THE FIRST EXPERIMENTS IN COSMIC-RAY RESEARCH WITH THE AID OF ROCKETS, 1949-1957
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IAF n° *** - vol 3 - AAS vol. 8 pp. 263-271 abstract n° 68

A HISTORY OF THE ORGANIZATION AND ACTIVITY OF THE JET PROPULSION RESEARCH INSTITUTE (RNII), 1933-1944
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IAF n° *** - vol 3 - AAS vol. 8 pp. 67-71 abstract n° 67

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Tkachev, L. I. (USSR)
IAF n° *** - vol 3 - AAS vol. 8 pp. 23-39 abstract n° 74

8th History of Astronautics Symposium

25th International Astronautical Congress
Amsterdam (The Netherlands), 1974.

The General Theme of this Symposium was "New Contributions to the Historical Literature on Research Pertaining to the Development of Astronautics Initiated before 1954.

Coordinator:
Emme, Eugene M. (USA)

Sessions 1 & 2

4 & 5 October 1974

Chairmen: Hall, Cargill R. (USA) - Sokolsky, Viktor N. (USSR)

COMING DOWN WITH THE ROGALLO WING: EARLY IDEAS ABOUT RETURNING TO EARTH FROM SPACE
Hacker, Barton C. (USA)
IAF n° A74-23 - vol 3 - AAS vol. 8 pp. 11-22 abstract n° 78

HISTORICAL ORIGINS OF THE SERGEANT MISSILE POWERPLANT
Caroll, Thomas P. (USA)
IAF n° A74-25 - vol 3 - AAS vol. 8 pp. 121-146 abstract n° 83

AMERICAN ROCKET AIRCRAFT: PRECURSORS TO MANNED FLIGHT BEYOND THE ATMOSPHERE
Hallion, Richard P. (USA)
IAF n° A74-26 - vol 3 - AAS vol. 8 pp. 283-313 abstract n° 79

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Hoover, George W. (USA)
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THE ROLE OF MIKHAIL K. TIKHONRAVOV IN THE DEVELOPMENT OF SOVIET ROCKET AND SPACE TECHNOLOGY
Biryukov, Yu. V. (USSR)
IAF n° A74-28 - vol 3 - AAS vol. 8 pp. 343-349 abstract n° 85

SOME CONTRIBUTIONS TO THE HISTORY OF EARLY SPIN-STABILIZED ROCKETS
Nagy, Istvan Gyorgy. (Hungary)
IAF n° A74-29 - vol 3 - AAS vol. 8 pp. 3-7 abstract n° 81

DEVELOPMENT OF RAMJET ENGINES IN THE SOVIET UNION
Shchetinkov, Yevgueny S. (USSR) – Merkulov, Igor A. (USSR)
IAF n° A74-30 - vol 3 - AAS vol. 8 pp. 109-118 abstract n° 84

POLISH EXPERIMENTAL AND METEOROLOGICAL ROCKETS, 1954-1973
Walczewski, Jacek. (Poland)
IAF n° A74-31 - vol 3 - AAS vol. 8 pp. 169-179 abstract n° 80

A HISTORY OF THE FRENCH SOUNDING ROCKET VERONIQUE
Corbeau, Jean. (France)
IAF n° A74-32 - vol 3 - AAS vol. 8 pp. 147-167 abstract n° 82

9th History of Astronautics Symposium

26th International Astronautical Congress
Lisbon (Portugal), 1975.

The General Theme of this Symposium was "New Contributions to the Historical Literature on Research Pertaining to the Development of Astronautics Initiated before 1955.

Coordinator:
Emme, Eugene M. (USA)

Sessions 1 & 2

24 September & 26 September 1975

Chairmen: Rosen, Milton W.(USA) - Sokolsky, Viktor N. (USSR)

10th History of Astronautics Symposium

27th International Astronautical Congress
Anaheim (United States of America), 1976.

The General Theme of this Symposium was "New Contributions to the Historical Literature on Research Pertaining to the Development of Astronautics Initiated before 1956.

Coordinator:
Emme, Eugene M. (USA)

Session

15 October 1976

Chairmen: Hall, Cargill R. (USA) - Sokolsky, Viktor.N. (USSR)

OPERATION BACKFIRE: ENGLAND LAUNCHES THE V2
Sharpe, Mitchell R. (USA)
IAF n° A76-35 - vol 4 - AAS vol. 9 pp. 121-134 abstract n° 101

HISTORY OF DEVELOPMENT OF FIRST SPACE ROCKET ENGINES IN THE USSR
Prishcheps, V. I. (USSR)
IAF n° A76-36 - vol 4 - AAS vol. 9 pp. 89-104 abstract n° 99

BEGINNINGS OF AIRBORNE AEROMEDICAL WEIGHTLESSNESS RESEARCH
Von Beckh, Harald J. (USA)
IAF n° A76-37 - vol 4 - AAS vol. 9 pp. 29-35 abstract n° 97

HARRY BULL: AMERICAN ROCKET PIONEER
Winter, Frank H. (USA)
IAF n° A76-39 - vol 4 - AAS vol. 9 pp. 291-312 abstract n° 98

BEGINNINGS OF ROCKET AND MISSILE ACTIVITIES IN SWITZERLAND
Schiiep, Nik A. (Switzerland)
IAF n° A76-41 - vol 4 - AAS vol. 9 pp. 107-120 abstract n° 100

11th History of Astronautics Symposium

28th International Astronautical Congress
Praha (Czechoslovakia), 1977.

The General Theme of this Symposium was "New Contributions to the Historical Literature on Research Pertaining to the Development of Astronautics Initiated before 1957.

Coordinator:
Emme, Eugene M. (USA)

Session

28 September 1977

Chairmen: Emme, Eugene M. (USA) - Sokolsky, Viktor N. (USSR)

KEPLER'S "THE DREAM, OR LUNAR ASTRONOMY" AS A PREDECESSOR OF SPACE RESEARCH
Horsky, Z. (Czechoslovakia)
IAF n° 77-A-09 - vol 4 - AAS vol. 9 pp. 269-275 abstract n° 105

FIRST ROCKET EXPERIMENTS FOR RESEARCH ON SOLAR SHORTWAVE RADIATION
Ivanov-Kholodny, G.S. (USSR) - Vedeshin L. A. (USSR)
IAF n° 77-A-10 - vol 4 - AAS vol. 9 pp. 191-200 abstract n° 106

COMPUTER-ORIENTED DYNAMIC MODELING OF SPACECRAFT: HISTORICAL EVOLUTION OF EULERIAN MULTIBODY FORMALISMS SINCE 1750
Roberson, Robert E. (USA)
IAF n° 77-A-11 - vol 4 - AAS vol. 9 pp. 41-59 abstract n° 104

ORGANIZATION AND RESULTS OF THE WORK OF THE FIRST SCIENTIFIC CENTERS FOR ROCKET TECHNOLOGY IN THE USSR
Merkulov, Igor A. (USSR)
IAF n° 77-A-13 - vol 4 - AAS vol. 9 pp. 63-77 abstract n° 107

ALBERT FONÓ: A PIONEER OF JET PROPULSION
Nagy, István Gyöorgy. (Hungary)
IAF n° 77-A-14 - vol 4 - AAS vol. 9 pp. 277-281 abstract n° 102

S. P. KOROLEV AND SOVIET ROCKET TECHNOLOGY
Rauschenbach, Boris V. (USSR)
IAF n° 77-A-15 - vol 4 - AAS vol. 9 pp. 283-290 abstract n° 108

GENESIS OF LIQUID HYDROGEN PROPULSION THROUGH 1945
Sloop, John L. (USA)
IAF n° 77-A-16 - vol 4 - AAS vol. 9 pp. 79-87 abstract n° 103

12th History of Astronautics Symposium

29th International Astronautical Congress
Dubrovnik (Yugoslavia), 1978.

The General Theme of this Symposium was "New Contributions to the Historical Literature on Research Pertaining to the Development of Astronautics Initiated before 1958.

Coordinator:
Emme, Eugene M. (USA)

Session

6 October 1978

Chairmen: James, George S. (USA) - Sokolsky, Viktor N. (USSR)

THE SWEDISH FIRE ARROW: THE OLDEST ROCKET SPECIMEN EXTANT
Skoog, A. Ingemar. (Sweden) - Winter, Frank H. (USA)
IAF n° 78-A-01 - vol 5 - AAS vol.10 pp. 41-57 abstract n° 110

FROM CELESTIAL MECHANICS TO SPACE FLIGHT MECHANICS: HISTORICAL NOTES ON THE DEVELOPMENT OF ASTRODYNAMICS
Schulz, Wernher. (Germany)
IAF n° 78-A-02 - vol 5 - AAS vol.10 pp. 79-95 abstract n° 111

THEORETICAL AND EXPERIMENTAL INVESTIGATIONS IN THE FIELD OF ROCKETRY IN THE USSR (UP TO THE EARLY FORTIES)
Merkulov, Igor A. (USSR)
IAF n° 78-A-03 - vol 5 - AAS vol.10 pp. 113-114 abstract n° 113

A MAN OF THE FIRST HOUR: JOHANNES WINKLER
Engel, Rolf. (Germany)
IAF n° 78-A-04 - vol 5 - AAS vol.10 pp. 271-284 abstract n° 115

REACTION MOTORS INCORPORATED, THE FIRST LARGE SCALE AMERICAN ROCKET COMPANY: A MEMOIR
Shesta, John. (USA)
IAF n° 78-A-05 - vol 5 - AAS vol.10 pp. 137-150 abstract n° 114

HUNGARIAN LUNAR RADAR EXPERIMENTS, 1944-1946
Nagy, István György. (Hungary) – Vajda, Pál. (Hungary)
IAF n° 78-A-06 - vol 5 - AAS vol.10 pp. 153-157 abstract n° 109

THE CONTRIBUTION OF SOVIET SCIENTISTS AND ENGINEERS TO THE TECHNOLOGY OF ROCKET LAUNCHING
Mikhaylov, V. P. (USSR)
IAF n° 78-A-07 - vol 5 - AAS vol.10 pp. 105-110 abstract n° 112

MAURICE J. ZUCROW AND ROCKET RESEARCH AT PURDUE UNIVERSITY
Ehresman, C. M., (USA) – Osborn, J. R. (USA)
IAF n° 78-A-09 - vol 5 - AAS vol.10 pp. 303-311 abstract n° 117

V.V. RASUMOV'S EFFORTS IN THE FIELD OF ROCKETRY
Aleksandrova, L.M. (USSR)
IAF n° 78-A-11 - vol 5 - AAS vol.10 p. 285 abstract n° 116

13th History of Astronautics Symposium

30th International Astronautical Congress
Munich (Germany), 1979.

The general theme of this Symposium was "New Contributions to the Historical Literature on Research in Rocket Technology and Astronautics Initiated Before 1959".

Coordinator:
Emme, Eugene M. (USA),

Session

21 September 1979

Chairmen: Emme, Eugene M. (USA) - Sokolsky, ViktorN. (USSR)

ORIGIN OF THE BASIC EQUATIONS OF ROCKET DYNAMICS
Andjelic, Tatomir P. (Yugoslavia)
IAF n° 79-A-** - vol 5 - AAS vol.10 pp. 97-103 abstract n° 119

THE GENESIS OF THE ROCKET IN CHINA AND ITS SPREAD TO THE EAST AND WEST
Winter, Frank H. (USA)
IAF n° 79-A-46 - vol 5 - AAS vol.10 pp. 3-23 abstract n° 122

WALTER HOHMANN'S CONTRIBUTIONS TOWARD SPACE FLIGHT: AN APPRECIATION ON THE OCCASION OF THE CENTENARY OF HIS BIRTHDAY
Schulz, Wernher; (Germany)
IAF n° 79-A-47 - vol 5 - AAS vol.10 pp. 287-301 abstract n° 123

THE ANTECEDENTS OF THE SPACE SHUTTLE
Hallion, Richard P. (USA)
IAF n° 79-A-49 - vol 5 - AAS vol.10 pp. 227-244 abstract n° 120

THE FOUNDING OF THE INTERNATIONAL ASTRONAUTICAL FEDERATION: A MEMOIR
Ananoff, Alexandre. (France)
IAF n° 79-A-50 - vol 5 - AAS vol.10 pp. 261-268 abstract n° 121

SCIENTIFIC INVESTIGATIONS CARRIED OUT BY THE FIRST SOVIET SATELLITES AND THEIR RESULTS
Vernov, S. N. (USSR) – Tverskoy, B. A. (USSR)
IAF n° 79-A-52 - vol 5 - AAS vol.10 pp. 159-163 abstract n° 118

DEVELOPMENT OF METHODS OF COOLING LIQUID PROPELLANT ROCKET ENGINES (ZhRDs), 1903-1970
Salakhutdinov, G.M. (USSR)
IAF n° 79-A-53 - vol 5 - AAS vol.10 pp. 115-122 abstract n° 124

14th History of Astronautics Symposium

31st International Astronautical Congress
Tokyo (Japan), 1980.

Coordinator:
Emme, Eugene M. (USA)

Session

28 September 1980

Chairmen: Emme, Eugene M. (USA) - Sokolsky, Viktor N. (USSR)

ROCKETS AND ROCKET PROPULSION DEVICES IN ANCIENT CHINA
Fang-Toh, Sun. (China)
IAF n° 80-IAA-02 - vol 5 - AAS vol.10 pp. 25-40 abstract n° 132

JOHANNES KEPLER AND HIS LAWS OF PLANETARY MOTION
Schulz, Wernher. (Germany)
IAF n° 80-IAA-03 - vol 5 - AAS vol.10 pp. 61-77 abstract n° 131

TECHNOLOGICAL STEPS TO LIQUID HYDROGEN PROPULSION
Sloop, John L. (USA)
IAF n° 80-IAA-04 - vol 5 - AAS vol.10 pp. 177-189 abstract n° 125

ROCKET RESEARCH AND TESTS AT THE NACA/NASA WALLOPS ISLAND FLIGHT TEST RANGE 1945-1959: A MEMOIR
Shortal, Joseph Adams. (USA)
IAF n° 80-IAA-06 - vol 5 - AAS vol.10 pp. 203-225 abstract n° 130

THE PACIFIC ROCKET SOCIETY AND THE FOUNDING OF THE INTERNATIONAL ASTRONAUTICAL FEDERATION, 1944-1960: A MEMOIR
Sawyer, Edmund V. (USA)
IAF n° 80-IAA-07 - vol 5 - AAS vol.10 pp. 245-259 abstract n° 128

LIQUID ROCKET PROPULSION SYSTEM ADVANCEMENTS, 1946-1970
Murphy, J. M. (USA)
IAF n° 80-IAA-08 - vol 5 - AAS vol.10 pp. 191-201 abstract n° 129

EARLY EXPERIMENTS WITH LIQUID ROCKETS AT HIGH CHAMBER PRESSURES
Osborn, C. (USA) - Warner, C.F. (USA) – Murthy, S. N. B. (USA)
IAF n° 80-IAA-09 - vol 5 - AAS vol.10 pp. 165-176 abstract n° 127

ORIGINAL RESEARCH ON A ROCKET ENGINE WITH MULTIPLE COMBUSTION CHAMBERS DEVELOPED IN ROMANIA BETWEEN 1940-1944
Zăgănescu, Florin. (Romania)
IAF n° 80-IAA-10 - vol 5 - AAS vol.10 pp. 123-136 abstract n° 126

15^{th} History of Astronautics Symposium

32^{nd} International Astronautical Congress
Rome (Italy), 1981.

Coordinator:
Emme, Eugen M. (USA)

Session

11 September 1981

Chairmen: Durant III, Frederick C. (USA) - Sokolsky, Viktor N. (USSR)

ARY STERNFIELD: PIONEER OF SPACE NAVIGATION
Geisler, Wladyslaw. (Poland)
IAA 81-302 - vol 6 - AAS vol.11 pp. 209-217 abstract n° 137

ON THE DESIGN OF N. I. KIBALCHICH'S FLYING MACHINE (ON THE 100^{TH} YEAR OF ITS DEVELOPMENT)
Vinitsky A. M. (USSR)
IAA 81-317 - vol 6 - AAS vol.11 pp. 3-4 abstract n° 139
paper not presented, but included in proceedings

SPACE RESEARCH IN POLAND AFTER 1958
Subotowicz, Mieczyslaw. (Poland)
IAF n° 81-318 - vol 6 - AAS vol.11 pp. 161-162 abstract n° 134

NIKOLAI ALEXEYEVICH RYNIN (1877-1942), SOVIET ASTRONAUTICAL PIONEER: AN AMERICAN APPRECIATION
Winter, Frank H. (USA)
IAA 81-319 - vol 6 - AAS vol.11 pp. 175-193 abstract n° 141

ORIGINS OF MAGNETOSPHERIC PHYSICS
Van Allen, James A. (USA)
IAA 81-320 - vol 6 - AAS vol.11 pp. 59-74 abstract n° 140

THE SUPERSONIC WIND TUNNEL INSTALLATIONS AT PEENEMÜNDE AND KOCHEL AND THEIR CONTRIBUTIONS TO THE AERODYNAMICS OF ROCKET-POWERED VEHICLES
Hermann, Rudolph. (USA)
IAA 81-321 - vol 6 - AAS vol.11 pp. 39-56 abstract n° 142

THE HISTORY OF EXTRAVEHICULAR ACTIVITY (EVA) IN U.S. HUMAN SPACEFLIGHT
Millican, Scott R. (USA)
IAA 81-322 - vol 6 - AAS vol.11 pp. 147-159 abstract n° 138

EARLY EXPERIMENTS WITH EROSIVE BURNING IN SOLID ROCKETS
Murphy, J. M. (USA)
IAA 81-323 - vol 6 - AAS vol.11 pp. 129-140 abstract n° 135

M.V KELDYSH AND THE DEVELOPMENT OF SOVIET COSMONAUTICS (MVK 70TH ANNIVERSARY)
Rauschenbach, Boris V. (USSR)
IAA 81-324 -not published- abstract n° 136
paper presented, but there is no manuscript, no abstract is available and it is not reproduced in proceedings

SCIENTIFIC FOUNDATIONS FOR THE IMPLEMENTATION OF HUMAN SPACE FLIGHT
Yazdovsky, V. I. (USSR)
IAA 81-325 - vol 6 - AAS vol.11 pp. 145-146 abstract n° 133

16th History of Astronautics Symposium

33rd International Astronautical Congress
Paris (France), 1982.

This Session was Dedicated to Frank J. Malina, Founding Member of the IAA.

Coordinator:
Emme, Eugen M. (USA)

Session

27 September 1982

Chairmen: Durant III, Frederick C. (USA) - Sokolsky, Viktor N. (USSR)
Rapporteur: James, George S. (USA)

ROMANIAN PROFESSOR ELIE CARAFOLI: FIFTY-FIVE YEARS OF DEVOTION TO MODERN AERONAUTICS AND ASTRONAUTICS
Zaganescu, Florin. (Romania)
IAA 82-280 - vol 6 - AAS vol.11 pp. 201-207 abstract n° 145

THE CONTRIBUTION OF ROBERT ESNAULT-PELTERIE TO ASTRONAUTICS
Contensou, Pierre. (France)
IAA 82-283 - vol 6 - AAS vol.11 pp. 195-199 abstract n° 144

17th History of Astronautics Symposium

34th International Astronautical Congress
Budapest (Hungary), 1983.

Coordinator:
Buedeler W (FRG),

Session 1

12 October 1983

Chairmen: Durant III, Frederick C. (USA) - Sokolsky, Viktor N. (USSR)
Rapporteur: Becklake John E. (UK)

THE BRITISH INTERPLANETARY SOCIETY: THE FIRST FIFTY YEARS (1933-1983)
Shepherd, Leslie R. (U.K.) – Thompson, G.V.E. (U.K.)
IAA 83-286 - vol 7 - AAS vol.12 pp. 35-55 abstract n° 155

CONTRIBUTION OF THE ROMANIAN INVENTOR ALEXANDRU CHURCU TO THE DEVELOPMENT OF THEORETICAL AND PRACTICAL REACTIVE MOTION IN THE 19TH CENTURY
Zágánescu, Florin. (Romania) – Burlacu, Rodica. (Romania) – Stefan, I.M.(Romania)
IAA 83-290 - vol 7 - AAS vol.12 pp. 85-91 abstract n° 153

A STUDY OF EARLY KOREAN ROCKETS, 1377-1600
Yeon, Seok Chae. (USA)
IAA 83-291 - vol 7 - AAS vol.12 pp. 3-16 abstract n° 166

A LIFE DEVOTED TO ASTRONAUTICS: DR OLGIERD WOLCZEK (1922-1982)
Subotowicz, Mieczyslaw. (Poland)
IAA 83-292 - vol 7 - AAS vol.12 pp. 217-231 abstract n° 160

A COMPARATIVE STUDY OF THE EVOLUTION OF MANNED AND UNMANNED SPACEFLIGHT OPERATIONS
Lattu, Kristan R. (USA) – Hugues, Frank E. (USA)
IAA 83-294 - vol 7 - AAS vol.12 pp. 125-136 abstract n° 163

COMMUNICATIONS SATELLITES: THE EXPERIMENTAL YEARS
Edelson, Burton I. (USA)
IAA 83-302 - vol 7 - AAS vol.12 pp. 95-108 abstract n° 154

Session 2

13 October 1983

Chairmen: Durant III, F.C. (USA) - Sokolsky, V.N. (USSR)
Rapporteur: Ordway III, F.I. (USA)

18th History of Astronautics Symposium

35th International Astronautical Congress
Lausanne (Switzerland), 1984.

Coordinators:
Ordway III, Frederick I. (USA),

Session 1

9 October 1984

Chairmen: Durant III, Frederick C. (USA) - Sokolsky, Viktor N. (USSR)
Rapporteur: Buedeler W (FRG)

ANATOL ARKADIEVICH BLAGONRAVOV AND SOVIET COSMONAUTICS (FOR THE 90TH ANNIVERSARY OF HIS BIRTHDAY).
Frolov, K.V (USSR) - Parkhomenko, A.A. (USSR)
IAA 84-251 - vol 8 - AAS vol.14 pp. 197-203 abstract n° 176

THE SMALLER BRITISH SOCIETIES DEVOTED TO ASTRONAUTICS AND INTERPLANETARY FLIGHT - 1935-1945
Burgess, Eric. (USA)
IAA 84-252 - vol 8 - AAS vol.14 pp. 73-78 abstract n° 175

BRITISH ROCKETRY DURING WORLD WAR II
Becklake, John E. (U.K.)
IAA 84-253 - vol 8 - AAS vol.14 pp. 117-126 abstract n° 171

THE ROCKET DEVELOPMENT OF ISAAC LUBBOCK AND GEOFFREY COLLIN
Griffiths, J. (U.K.)
IAA 84-254 - vol 8 - AAS vol.14 pp. 51-64 abstract n° 170

THE CONTRIBUTIONS OF K.E TSIOLKOVSKY AND OTHER NATIVE SCIENTISTS TO THE TECHNOLOGY OF THE ROCKETS LAUNCHING
Mikhaylov, V. P. (USSR)
IAA 84-255 - vol 8 - AAS vol.14 pp. 67-72 abstract n° 169

NINETEENTH CENTURY ROCKETRY IN FRANCE
Moulin, Hervé. (France) - Ordway III, Frederick I. (USA)
IAA 84-256 - vol 8 - AAS vol.14 pp. 17-41 abstract n° 173

Session 2

11 October 1984

Chairmen: Durant III, Fredercik C. (USA) - Sokolsky, Viktor N. (USSR)
Rapporteur: Becklake, John E. (UK)

SOME IMPORTANT ASPECTS ON THE THREE CENTURIES OLD HISTORY OF ROMANIAN AEROSPACE TECHNIQUES
Zágánescu, Florin. (Romania)
IAA 84-250 - vol 8 - AAS vol.14 pp. 109-116 abstract n° 172

EARLY ROCKET-WEAPONS IN CHINA
Fang-Toh, Sun. (China)
IAA 84-258 - vol 8 - AAS vol.14 pp. 3-15 abstract n° 168

THE LEGACY OF SCHIAPARELLI AND LOWELL - PART I
Ordway III, Frederick I. (USA)
IAA 84-259 - vol 9 - AAS vol 15 pp. 33-53 abstract n° 174
paper presented in two parts in 1984 and in 1986 - both parts were published in 1986 proceedings

A HISTORY OF HEAT SHIELDS FOR U.S. MANNED SPACE FLIGHT
Ronquillo, Leon. (USA)
IAA 84-262 - vol 8 - AAS vol 14 pp. 185-188 abstract n° 177
paper presented and in proceedings

COMPARATIVE ANALYSIS OF THE DEVELOPMENT IN THE ACTIVE AND REACTIVE METHODS OF PROJECTION.
Mazing, G. Yu. (USSR)
IAA 84-263 - vol 8 - AAS vol.14 pp. 139-147 abstract n° 167

19th History of Astronautics Symposium

36th International Astronautical Congress
Stockholm (Sweden), 1985.

Coordinator:
Ordway III, Frederick I. (USA),

Session

9 October 1985

Chairmen: Durant III, Frederick C. (USA) - Sokolsky, Viktor N. (USRR)
Rapporteur: Becklake, John E. (UK)

THIRTY YEARS OF THE POLISH ASTRONAUTICAL SOCIETY
Geisler, Wladyslaw. (Poland)
IAA 85-451 - vol 8 - AAS vol.14 pp. 189-194 abstract n° 184

A BRIEF HISTORY OF THE FIRST U.S. JATO FLIGHT TESTS OF AUGUST 1941: A MEMOIR
Boushey, Homer A. (USA)
IAA 85-453 - vol 8 - AAS vol.14 pp. 127-137 abstract n° 181

FUNCTION, FORM AND TECHNOLOGY: THE EVOLUTION OF SPACE STATION IN NASA
Fries, Sylvia Doughty. (USA)
IAA 85-454 - vol 8 - AAS vol.14 pp. 79-93 abstract n° 178

ON THE WORKS OF V.A. ARTEMSEV IN THE FIELD OF ROCKETRY (FOR THE 100TH ANNIVERSARY OF HIS BIRTHDAY)
Aleksandrova, L.M. (USSR) - Erokhin, B.J. (USSR) - Prodnikov, A.E. (USSR)
IAA 85-455 - not published abstract n° 185
paper presented, but no abstract, no preprint and not reproduced in proceedings

REACHING FOR THE PLANET MARS: HUMANKIND'S EVOLVING PERSPECTIVES
Johnson, Stewart W. (USA)
IAA 85-456 - vol 8 - AAS vol.14 pp. 95-104 abstract n° 179

SOME FEATURES OF LIFESAVING ROCKET DEVELOPMENT IN THE 19TH AND EARLY 20TH CENTURIES
Mikhaylov, V. P. (USSR)
IAA 85-457 - vol 8 - AAS vol.14 pp. 43-50 abstract n° 186

ENGINES AND PROPULSION UNITS FOR SPACE VEHICLES CONSTRUCTED BY ALEXEY M. ISAEV
Tavzarashvily, A. D. (USSR)
IAA 85-459 - vol 8 - AAS vol.14 pp. 151-157 abstract n° 182

A SURVEY OF WORLD METEOROLOGICAL AND ENVIRONMENTAL SATELLITES - 1960-1985
Schnapf, Abraham. (USA)
IAA 85-460 - vol 8 - AAS vol.14 pp. 159-183 abstract n° 183

SOTIR CHERKEZOV: THE INVENTOR OF A DEVICE FOR RESCUING SPACEMEN
Simeonov, A. (USSR) – Belberov, I. (USSR)
IAA 85-461 - vol 8 - AAS vol.14 pp. 105-106 abstract n° 180

20th History of Astronautics Symposium

37th International Astronautical Congress
Innsbruck (Austria), 1986.

Coordinators:
Becklake John E. (UK) - Ordway III, Frederick I. (USA)

Session 1

9 October 1986

Chairmen: Durant III, Frederick C. (USA) - Sokolsky, Viktor N. (USSR)
Rapporteurs: Lattu, Kristan R. (USA) – Moulin, Hervé. (France)

THE PROPELLANT CHEMISTS' CONTRIBUTION TO MODERN ROCKET FLIGHT: A MEMOIR
Klager, Karl. (USA)
IAA 86-491 - vol 9 - AAS vol.15 pp. 201-209 abstract n° 197

THE BEGINNING OF THE U.S. SPACE PROGRAM: A MEMOIR
Pickering, William H. (USA)
IAA 86-492 - vol 9 - AAS vol.15 pp. 211-221 abstract n° 190

GEORGY NIKOLAEVICH BABAKIN'S CONTRIBUTION TO THE DEVELOPMENT OF AUTOMATIC SPACE STATIONS
Ivanovsky, O.G. (USSR) – Fainhstein, M.B (USSR)
IAA 86-493 - vol 9 - AAS vol.15 pp. 417-421 abstract n° 194

FIRE AND THRUST : EXPERIENCES WITH THE UNITED STATES VANGUARD SATELLITE PROJECT - A PERSONAL MEMOIR
Stehling, K. (USA)
IAA 86-494 - not published abstract n° 196
presented but without manuscript and abstract - not in proceedings

Session 2

9 October 1986

Chairmen: Durant III, Frederick C. (USA) - Ordway III, Frederick I. (USA)
Rapporteurs: Lattu, Kristan R. (USA) – Moulin, Hervé. (France)

THE APOLLO GENERATION: A PROFILE OF NASA'S FIRST ENGINEERS
Fries, Sylvia Doughty. (USA)
IAA 86-495 - vol 9 - AAS vol.15 pp. 223-234 abstract n° 195

THE CONSTRUCTION OF A REPLICA OF ROBERT H. GODDARD'S FIRST SUCCESSFUL LIQUID-PROPELLANT ROCKET
Ball, I.M (U.K.)
IAA 86-496 - vol 9 - AAS vol.15 pp. 181-194 abstract n° 198

WERNHER VON BRAUN AND COLLIER MAGAZINE'S MAN IN SPACE SERIES
Liebermann, Randy. (USA)
IAA 86-497 - vol 9 - AAS vol.15 pp. 235-242 abstract n° 191

SCIENTIFIC AND TECHNOLOGICAL PREREQUISITES FOR THE FIRST MANNED SPACECRAFT
Rauschenbach, Boris V. (USSR)
IAA 86-498 - vol 9 - AAS vol.15 pp. 73-78 abstract n° 193

YURY ALEXEYEVICH GAGARIN: HIS UNIQUENESS, TYPICALNESS AND WEALTH OF PERSONALITY
Kardashev, Tsvetan D. (Bulgaria)
IAA 86-500 - vol 9 - AAS vol.15 pp. 423-425 abstract n° 189

THE LEGACY OF SCHIAPARELLI AND LOWELL -- PART 2
Ordway III, Frederick I. (USA)
IAA 86-501 - vol 9 - AAS vol.15 pp. 33-63 abstract n° 188
paper presented in two parts in 1984 and 1986

ANALYSIS OF K.E TSIOLKOVSKY'S IDEAS ON SPACE INDUSTRIAL DEVELOPMENT AND EXPLOITATION
Zhelnina, T.N (USSR)
IAA 86-502 - vol 9 - AAS vol.15 pp. 65-71 abstract n° 187

CAMERA ROCKETS AND SPACE PHOTOGRAPHY CONCEPTS BEFORE WORLD WAR II - PART 2
Winter, Frank H. (USA)
IAA 86-503 - vol 9 - AAS vol.15 pp. 165-180 abstract n° 192

21st History of Astronautics Symposium

38th International Astronautical Congress
Brighton (United Kingdom), 1987.

Coordinators:
Becklake John E. (UK) - Ordway III, Frederick I. (USA)

Session 1

13 October 1987

Chairmen: Ordway III, Frederick I. - Sokolsky, Viktor N. (USSR)
Rapporteur: Kennedy, Gregory.P. (USA)

APOLLO SCIENTIFIC INVESTIGATIONS OF THE MOON
Compton, Wm. David. (USA)
IAA 87-645 - vol 9 - AAS vol.15 pp. 243-258 abstract n° 210
this paper was not presented in 1987, but in 1988 (IAF n°88-602), for unknown reasons it is reproduced two times in 1987 and 1988 AAS vol.

LUNAR SURFACE PHOTOGRAPHY: A STUDY OF APOLLO 11
Arnold, H.J.P. (U.K.)
IAA 87-646 - vol 9 - AAS vol.15 pp. 259-284 abstract n° 209

K.E TSIOLKOWKSY AND THE DEVELOPMENT OF 20TH CENTURY ANTHROPOCOSMISM
Kardashev, Tsvetan D. (Bulgaria)
IAA 87-647 - vol 9 - AAS vol.15 pp. 161-162 abstract n° 199

PERSONAL RECOLLECTIONS OF THEODORE VON KÁRMÁN
Kit, Boris. (USA)
IAA 87-648 - vol 9 - AAS vol.15 pp. 427-431 abstract n° 207

INTERNATIONAL GEOPHYSICAL YEAR TO INTERNATIONAL SPACE YEAR
Friedman, Herbert. (USA)
IAA 87-649 - vol 9 - AAS vol.15 pp. 285-291 abstract n° 217

AN ANALYSIS OF THE YU. A POBEDONOSTSEV'S SCIENTIFIC AND TECHNICAL ACTIVITY
Erokhin, B.T. (USSR) – Mazing, G.Yu. (USSR) - Prodnikov, N.E. (USSR)
IAA 87-650 - vol 9 - AAS vol.15 pp. 195-198 abstract n° 205

PROJECT MANHIGH : A BALLOON-BORNE PREDECESSOR FOR PROJECT MERCURY
Kennedy, Gregory P. (USA)
IAA 87-651 - vol 9 - AAS vol.15 pp. 293-303 abstract n° 204

Session 2

16 October 1987

Chairmen: Becklake, John E. (UK) - Durant III, Frederick C. (USA)
Rapporteur: Kennedy, Gregory P. (USA)

THE "BOUN BANG FEI" ROCKETS OF THAILAND AND LAOS: POSSIBLE KEY TO DETERMINING THE SPREAD OF ROCKETRY IN THE ORIENT
Winter, Frank H. (USA)
IAA 87-664 - vol 9 - AAS vol.15 pp. 3-24 abstract n° 216

THIRTY YEARS OF ASTRONAUTICS WITH MCDONNELL AND DOUGLAS
Walker, Charles D. (USA)
IAA 87-665 - vol 9 - AAS vol.15 pp. 369-375 abstract n° 215

THE DEVELOPMENT OF SPACE FLIGHT THEORY BY SOVIET SCIENTISTS
Rauschenbach, Boris V. (USSR) - Sokolov, V.N. (USSR)
IAA 87-666 - vol 9 - AAS vol.15 pp. 141-146 abstract n° 214

SPECULATIVE SPACECRAFT, 1610-1957
Miller, Ron. (USA)
IAA 87-667 - vol 9 - AAS vol.15 pp. 115-136 abstract n° 200

22nd History of Astronautics Symposium

39th International Astronautical Congress
Bangalore (India), 1988

Coordinators:
Becklake John E. (UK) - Kennedy Gregory P. (USA)

Session 1

11 October 1988

Chairmen: Kennedy, Gregory P. (USA) - Sokolsky, Viktor N. (USSR)
Rapporteur(s):

MAJOR DEVELOPMENT TRENDS OF ORBITAL SPACE STATION
Feoktiskov, Konstantin, P. (USSR)
IAA 88-595 - vol 10 - AAS vol.17 pp. 203-207 abstract n° 224

THE AERODMEDICAL FIELD LABORATORY OF SPACE MEDICINE
Kennedy, Gregory P. (USA)
IAA 88-596 - vol 10 - AAS vol.17 pp. 389-403 abstract n° 223

THE SE 4400/4401 FAMILY: A HYPERSONIC RAMJET IN THE 1950s
Jung, Philippe. (France)
IAA 88-597 - vol 10 - AAS vol.17 pp. 131-151 abstract n° 222

THE X-20 SPACE PLANE: PAST INNOVATION, FUTURE VISION
Sunday, Terry.L, (USA) - London III, John R. (USA)
IAA 88-598 - vol 10 - AAS vol.17 pp. 253-284 abstract n° 221

THE ROLE OF MIKHAIL KLAVDIYEVICH TIKHONRAVOV IN CREATING STAGE ROCKETS, 1947-1953
Yatsunsky, I.M. (USSR)
IAA 88-599 - vol 10 - AAS vol.17 pp. 451-456 abstract n° 220

INDO-ARYAN TRADITIONS AND HISTORY OF ASTRONAUTICS
Pinotti, Roberto. (Italy)
IAA 88-600 - vol 10 - AAS vol.17 pp. 3-12 abstract n° 230

APOLLO SCIENTIFIC EXPLORATION OF THE MOON
Compton, Wm. David. (USA)
IAA 88-602 - vol 10 - AAS vol.17 pp. 405-419 abstract n° 231
this paper was not presented in 1987, but in 1988 (IAF n°88-602), for unknown reasons it is reproduced two times in 1987 and 1988 AAS vol.

Session 2

14 October 1988

Chairmen: Becklake, John E. (UK) - Sokolsky, Viktor N. (USSR)
Rapporteur(s):

THE AMERICAN ROCKET SOCIETY, 1953-1963: A MEMOIR
Harford, James J. (USA)
IAA 88-605 - vol 10 - AAS vol.17 pp. 209-216 abstract n° 225

THE BRITISH BLACK KNIGHT ROCKET
Becklake, John E. (U.K.)
IAA 88-607 - vol 10 - AAS vol.17 pp. 165-181 abstract n° 219

A LEGACY FOR THE FUTURE: PRESERVING SPACE-RELATED HISTORIC SITES
London III, John R. (USA)
IAA 88-608 - vol 10 - AAS vol.17 pp. 63-83 abstract n° 226

THE ACTIVITIES AND THE ROLE OF VLADIMIR PETROVICH VETCHINKIN IN THE FIELD OF ROCKETRY
Belov, B.L. (USSR)
IAA 88-609 - vol 10 - AAS vol.17 pp. 457-460 abstract n° 227

WILLIAM CONGREVE AND THE CITY OF TOULOUSE
Escalettes, Jean-Paul (France) - Jung, Philippe. (France)
IAA 88-610 - vol 10 - AAS vol.17 pp. 13-32 abstract n° 228

ARIEL 1: THE WORLD'S FIRST COOPERATIVE SATELLITE VENTURE
Willmore, A.P. (U.K.)
IAA 88-611 - vol 10 - AAS vol.17 pp. 183-196 abstract n° 229

23rd History of Astronautics Symposium

40th International Astronautical Congress
Torremolinos-Malaga (Spain), 1989.

Coordinators:
Becklake, John E. (UK) – Kennedy, Gregory P. (USA)

Session 1

12 October 1989

Chairmen: Durant III, Frederick C. (USA) - Sokolsky, Viktor.N. (USSR)
Rapporteur: Dowling, Richard. (USA)

"BLACK BETSY": THE 6000C-4 ROCKET ENGINE, 1945-1989 - PART I
Winter, Frank H. (USA)
IAA 89-726 - vol 10 - AAS vol.17 pp. 221-252 abstract n° 241

BRITISH ROCKET EXPERIMENTS IN THE LATE 1950s/EARLY 1960s
Becklake, John E. (U.K.)
IAA 89-727 - vol 10 - AAS vol.17 pp. 153-164 abstract n° 242

THE FIRST CONTROL SYSTEM FOR SPACE VEHICLES
Rauschenbach, Boris V. (USSR)
IAA 89-728 - vol 10 - AAS vol.17 pp. 197-201 abstract n° 240

AMERICAN MANNED PLANETARY MISSION STUDIES, 1962-1968
Dixon, Franklin P. (USA)
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Jung, Philippe. (France)
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Chairmen: Durant III, Frederick.C. (USA) - Sokolsky, Viktor.N. (USSR)
Rapporteur: Jung, Philippe. (France)

THE EVOLUTION OF LIQUID PROPULSION IN FRANCE IN THE LAST 50 YEARS
Villain, Jacques. (France)
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Martin, Richard E. (USA)
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Kit, Boris. (USA)
IAA 89-742 - vol 10 - AAS vol.17 pp. 217-220 abstract n° 235

PRESERVING CHAPTERS IN AEROSPACE HISTORY
Thomas, Shirley. (USA)
IAA 89-743 - vol 10 - AAS vol.17 pp. 41-61 abstract n° 234

THE COLLABORATION OF WERNHER VON BRAUN AND FRED FREEMAN
Liebermann, Randy. (USA)
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24th History of Astronautics Symposium

41st International Astronautical Congress
Dresden (Germany), 1990.

Coordinator:
Becklake, John E. (UK)

Session 1

10 October 1990

Chairmen: Ordway III, Frederick I. (USA) - Skoog, A.Ingemar. (Germany)
Rapporteur: Dowling, Richard. (USA)

Session 2

11 October 1990

Chairmen: Kennedy, Gregory P. (USA) - Sokolsky, Viktor N. (USSR)
Rapporteur: Jung, Philippe. (France) -

ON THE HISTORY OF ROCKETRY DEVELOPED IN THE USSR IN THE FIRST YEARS AFTER THE SECOND WORLD WAR.
Bork, P. (Germany) - Sadovoj G. A. (USSR)
IAA 90-623 - vol 11 - AAS vol.19 pp. 143-152 abstract n° 251

THE ORIGIN OF GRAVITY-PROPELLED INTERPLANETARY SPACE TRAVEL
Dowling, Richard L. (USA) – Kosmann, William J. (USA) – Minovitch, Michael A. (USA) – Ridenoure, Rex W. (USA)
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IAA 90-633 - vol 11 - AAS vol.19 pp. 225-236 abstract n° 248

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Winter, Frank H. (USA)
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THE ROLE OF S.P. KOROLEV AS A DESIGNER OF LAUNCHERS FOR SPOUTNIK AND VOSTOK
Mishin, Vasily P. (USSR)
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25th History of Astronautics Symposium

42nd International Astronautical Congress
Montreal (Canada), 1991.

Coordinators:
Becklake, John E. (UK) - Kennedy, Gregory P. (USA)

Session 1

7 October 1991

Chairmen: Jung, Philippe. (France) - Ordway III, Frederick I. (USA)
Rapporteur: Dowling, Richard. (USA)

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Mishin, Vasily P. (Russia)
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Singer, Fred S. (USA)
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Kit, Boris (USA) - Heinz B. (Germany)
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Dowling, Richard L. (USA) – Kosmann, William J. (USA) – Minovitch, Michael A. (USA) – Ridenoure, Rex W. (USA)
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Ispas, Stefan. (Romania) - Zaganescu, Florin. (Romania)
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8 October 1991

Chairmen: Ordway III, Frederick I. (USA) - Sokolsky, Viktor N. (Russia)
Rapporteur: Villain, Jacques. (France)

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London, III John R. (USA)
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Rauschenbach, Boris V. (Russia)
IAA 91-686 - vol 12 - AAS vol.20 pp. 151-158 abstract n° 270

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Klager, Karl. (USA)
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By sudden illness of the author, the paper was not presented, but abstract and preprint exist.

THE EXPERIENCE OF HERMANN OBERTH
Elder, John. (USA)
IAA 91-688 - vol 12 - AAS vol.20 pp. 277-318 abstract n° 269

BLACK ARROW: THE FIRST BRITISH SATELLITE LAUNCHER
Gould, R.D. (U.K.) – Harlow, John. (U.K.)
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Maximov, G. Yu. (Russia)
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Day, M.S. (USA)
IAA 91-691 - not published abstract n° 259
abstract and preprint exist, paper was presented but not in proceedings

26th History of Astronautics Symposium

43th International Astronautical Congress
Washington DC (U.S.A.), 1992.

Coordinators:
Becklake, John E. (UK) – Kennedy, Gregory P. (USA)

Session 1

1st September 1992

Chairmen: Sokolsky, Viktor N. (USSR) – Skoog, A.Ingemar. (Germany)
Rapporteur: Jung, Philippe (France)

THE ORIGINS OF U.S. SPACE POLICY: EISENHOWER: OPEN SKIES, AND FREEDOM OF SPACE
Hall, Cargill R. (USA)
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Stroup, T. L. (USA) – Allen, R. D. (USA)
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2nd September 1992

Chairmen: Ordway III, Frederick I. (USA) – Villain, Jacques. (France)
Rapporteur: Rohrwild, Karl-Heinz. (Germany)

27th History of Astronautics Symposium

44th International Astronautical Congress
Graz (Austria), 1993.

Coordinators:
Becklake, John E. (UK) – Rohrwild, Karl-Heinz (Germany)

Session 1

21 October 1993

Chairmen: Skoog, A.Ingemar. (Germany) - Sokolsky, Viktor N. (Russia)
Rapporteur: Rothmund, Christophe. (France)

Session 2

22 October 1993

Chairmen: Ordway III, Frederick I. (USA) – Jung, Philippe. (France)
Rapporteur: Sharpe, Mitchell R. (USA)

28th History of Astronautics Symposium

45th International Astronautical Congress
Jerusalem (Israël), 1994.

Coordinators:
Jung, Philippe. (France) – Becklake, John E. (UK)

Session 1

11 October 1994

Chairmen: Ordway III, Frederick I. (USA) - Sokolsky, Viktor N. (Russia)
Rapporteurs: Rohrwild, Karl-Heinz. (Germany) – Gould, D. (UK)

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Sokolov, Oleg A. (Russia)
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Prisniakov, V. F. (Ukraine) - Sanin, F.P. (Ukraine)
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Chertok, B. E. (Russia)
IAA 2.1.616 - - not published abstract n° 310
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Rapporteurs: Dougherty, Kerry. (Australia) – Rothmund, Christophe. (France)

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Oberg, James. (USA)
IAA 2.2.620 - - not published abstract n° 314
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Jung, Philippe. (France)
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Roth-Oberth, E. (Germany) – Layritz, Rheinhard. (Germany)
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IAA 2.2.626 - vol 15 - AAS vol 23 pp. 527-531 abstract n° 321

THE EVOLUTION OF THE INSTITUTIONAL STRUCTURE OF THE UNITED STATES MILITARY SPACE PROGRAM: THE HISTORY OF THE NATIONAL RECONNAISSANCE OFFICE
Day, Dwayne A. (USA)
IAA 2.2.627 - vol 15 - AAS vol 23 pp. 489-503 abstract n° 320

29th History of Astronautics Symposium

46th International Astronautical Congress
Oslo (Norway), 1995.

Coordinators:
Braun, Julius H. (USA) – Jung, Philippe. (France)

Session 1

3 October 1995

Chairmen: Rothmund, Christophe. (France) – Matogawa, Yasunori. (Japan)
Rapporteurs: Dougherty, Kerry. (Australia) – Pirard, Théo. (Belgium)

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Bartley, Charles E. (USA) – Bramscher, Robert G. (USA)
IAA 2.1.02 - vol 15 - AAS vol 23 pp. 267-277 abstract n° 332

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IAA 2.1.03 - vol 15 - AAS vol 23 pp. 35-49 abstract n° 345

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Augenstein, Bruno W. (USA)
IAA 2.1.05 - vol 15 - AAS vol 23 pp. 505-525 abstract n° 323

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IAA 2.1.06 - vol 15 - AAS vol 23 pp. 279-291 abstract n° 336

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Prisniakov, V. F. (Ukraine) - Sanin, F.P. (Ukraine) – Gorbulin, B. P. (Ukraine)
IAA 2.1.07 - vol 15 - AAS vol 23 pp. 293-302 abstract n° 337

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Ciancone, M. I. (USA)
IAA 2.1.08 - - not published abstract n° 338
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EVOLUTION OF THE MANAGEMENT OF SOVIET SPACE ACTIVITIES
Golotyuk, S. V. (Russia)
IAA 2.1.09 - - not published abstract n° 339
paper not presented, not preprint exists

Session 2

6 October 1995

Chairmen: Sokolsky, Viktor N.. (Russia) – Moulin, Hervé. (France)
Rapporteur(s): Liepack, Otfried G. (Germany) – Gould, R.D. (USA)

A-1: THE FIRST FRENCH SATELLITE
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IAA 2.2.01 - vol 15 - AAS vol 23 pp. 51-72 abstract n° 326

WHAT THE RUSSIANS LEARNED FROM GERMAN V-2 TECHNOLOGY
Harford, James J. (USA)
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ETUDE 4212: THE FIRST FRENCH LARGE LIQUID ROCKET PROJECT
Rothmund, Christophe. (France)
IAA 2.2.03 - vol 15 - AAS vol 23 pp. 73-90 abstract n° 324

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Matogawa, Yasunori. (Japan)
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Buongiorno, Claudio. (Italy)
IAA 2.2.06 - vol 15 - AAS vol 23 pp. 303-313 abstract n° 333

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Harlow, John. (U.K.)
IAA 2.2.07 - vol 15 - AAS vol 23 pp. 91-105 abstract n° 330

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IAA 2.2.08 - vol 15 - AAS vol 23 pp. 425-450 abstract n° 329

THE HISTORY OF SPACE LAUNCH VEHICLE DEVELOPMENT
Konyukhov, S.N. (Ukraine) - Paschenko, V.A. (Ukraine)
IAA 2.2.09 - vol 15 - AAS vol 23 pp. 451-458 abstract n° 325

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6 October 1995

Chairmen: Harlow, John. (G-B) - Ordway III, Frederick I ((USA))
Rapporteurs: Russo, Arturo. (Italy) – Tarasenko, M. (Russia)

ALBERT PÜLLENBERG AND THE GESELSCHAFT FÜR RAKETENFORSCHUNG (GEFRA): A MEMOIR
Dannenberg, Konrad K. (USA) - Sharpe, Mitchell R. (USA)
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THE EXCLUDED: HERMANN OBERTH AND RUDOLF NEBEL IN THE THIRD REICH
Neufeld, Michael J. (USA)
IAA 2.3.03 - vol 15 - AAS vol 23 pp. 209-222 abstract n° 341

ANOTHER DESTINY OF ROCKETRY IN JAPAN: FESTIVAL ROCKETS IN JAPANESE SHRINES
Matogawa, Yasunori. (Japan)
IAA 2.3.04 - vol 15 - AAS vol 23 pp. 315-326 abstract n° 342

THE "TRIP TO THE MOON" AND OTHER EARLY SPACEFLIGHT SIMULATION SHOWS, ca. 1901-1915: PART I
Winter, Frank H. (USA)
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Rauschenbach, Boris V. (Russia) -Sokolsky, V.N (Russia)
IAA 2.3.07 - vol 15 - AAS vol 23 pp. 255-266 abstract n° 344

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Thomas, Shirley. (USA)
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EVOLUTION AND ACCOMPLISHMENTS OF THE SUPERVISION OF YOUTH RESEARCH EXPERIMENTS (SYRE) SUBCOMMITTEE OF THE IAF EDUCATION COMMITTEE
James, George S. (USA) – Moulin, Hervé. (France)
IAA 2.3.09 - vol 15 - AAS vol 23 pp. 3-34 abstract n° 327

30th History of Astronautics Symposium

47th International Astronautical Congress
Beijing (China), 1996.

Coordinators:
Jung, Philippe. (France) - Ordway III, Frederick I. (USA)

Session 1

8 October 1996

Chairmen: Liepack, Otfried G. (USA) - Sokolsky, Viktor N. (Russia)
Rapporteurs: Winter, Frank. H. (USA) – Moulin, Hervé. (France)

RESTONE'S FIRST FLIGHT - SUCCESS OR FAILURE?
Braun, Julius H. (USA)
IAA 2.1.01 - vol 16 - AAS vol 25 p.81-91 abstract n° 356

THE "TRIP TO THE MOON" AND OTHER EARLY SPACEFLIGHT SIMULATION SHOWS, ca. 1901-1915 – PART 2
Winter, Frank H. (USA)
IAA 2.1.03 - vol 16 - AAS vol 25 p.3-28 abstract n° 364

THE LEGACY OF THE OBERTH ROCKET OF 1935
Rohrwild, Karl-Heinz. (Germany)
IAA 2.1.04 - vol 16 - AAS vol 25 p.29-44 abstract n° 368

REALISED AND NON REALIZED PROJECTS OF THE SOVIET MANNED LUNAR PROGRAM
Sokolov, Oleg A. (Russia)
IAA 2.1.05 - vol 16 - AAS vol 25 p.259-266 abstract n° 367

THE APOLLO FIRE AND INVESTIGATION: FACTS NOT CONSIDERED
Thomas, Shirley. (USA)
IAA 2.1.06 - vol 16 - AAS vol 25 p.267-306 abstract n° 366

K.E. TSIOLKOVSKY AND HIS CONTRIBUTION TO SPACE LIFE SCIENCES
Gazenko, Oleg G. (Russia)
IAA 2.1.07 - vol 16 - AAS vol 25 p.45-49 abstract n° 362

"MAN'S NOW GOING TO GO TO THE MOON": PROFESSOR FRANK COTTON AND AUSTRALIA'S CONTRIBUTION TO THE ORIGINS OF THE PARTIAL PRESSURE SUIT
Dougherty, Kerry. (Australia)
IAA 2.1.08 - vol 16 - AAS vol 25 p.335-352 abstract n° 361

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10 October 1996

Chairmen: Matogawa, Yasunori. (Japan) – Harlow, John. (UK)
Rapporteurs: Dougherty, Kerry. (Australia) - McKenna-Lawlor, Susan. (Ireland)

A STUDY OF THE HISTORY OF ROCKETRY AND ASTRONAUTICS IN THE INTERNATIONAL ACADEMY OF ASTRONAUTICS
Sokolsky, Victor N. (Russia) - Durant III, Frederick C. (USA) - Ordway III, Frederick I. (USA)
IAA 2.2.01 - vol 16 - AAS vol 25 p.51-63 abstract n° 360

ARIANE: THE STORY OF A SUCCESSFUL COOPERATION
Villain, Jacques. (France)
IAA 2.2.02 - vol 16 - AAS vol 25 p.67-80 abstract n° 359

THE FLIGHT THAT NEVER HAPPENED : THE STORY OF THE FIRST WOMEN'S COSMONAUT TEAM
Ponomareva, Valentina. (Russia) – Faktor, Debra.D. (USA)
IAA 2.2.03 - vol 16 - AAS vol 25 p.307-318 abstract n° 358

THE RAE-VICKERS ROCKET POWERED TRANSONIC AIRCRAFT MODEL, 1945-1948
Becklake, John E. (U.K.)
IAA 2.2.04 - vol 16 - AAS vol 25 p.93-108 abstract n° 363

THE HISTORICAL PROGRESS AND DEVELOPMENT OF SPACE TECHNOLOGY AND EDUCATION IN CHINA
Shilu, Chen. (China) – Hui, Yan. (China) – Yuanli, Cai. (China) – Xiaoping, Zhu. (China)
IAA 2.2.05 - vol 16 - AAS vol 25 p.109-121 abstract n° 357
This paper was presented with paper IAA 2.3.01 - only one abstract and preprint for both

JAPANESE SOLID ROCKETS IN WORLD WAR II
Matogawa, Yasunori. (Japan)
IAA 2.2.07 - vol 16 - AAS vol 25 p. 123-136 abstract n° 347

THE HISTORY OF THE BEGINNING OF THE RUSSIAN PLESETSK COSMODROME
Shatalov, D. V. (Kazakhstan)
IAA 2.2.08 - vol 16 - AAS vol 25 p.137-144 abstract n° 355

SOVIET SPACE DESIGNERS WHEN THEY WERE SECRETS
Lardier, Christian. (France)
IAA 2.2.09 - vol 16 - AAS vol 25 p.319-334 abstract n° 365

Session 3

11 October 1996

Chairmen: Braun, Julius H. (USA) – Rhorwild, Karl-Heinz. (Germany)
Rapporteurs: Pirard, Théo. (Belgium) – Gould, D.R. (UK)

DEVELOPMENT OF THE CHINESE LONG MARCH LAUNCH VEHICLE SERIES
Hui, Yan. (China) – Shilu, Chen. (China)
IAA 2.3.01 - vol 16 - AAS vol 25 p. 109-121 abstract n° 354
This paper was presented with paper IAA 2.2.05 - only one abstract and preprint for both

THE DEVELOPMENT OF SOLID ROCKET MOTORS IN CHINA
Jianding, Huang. (China) – Dingyou, Ye. (China)
IAA 2.3.02 - vol 16 - AAS vol 25 p.145-151 abstract n° 353

SNCASE CANNES ROCKETS OF THE 1950s
Jung, Philippe. (France)
IAA 2.3.03 - vol 16 - AAS vol 25 p.153-200 abstract n° 352

SOME PAGES OF HISTORY OF THE FIRST RUSSIAN BIOLOGICAL EXPERIMENTS ABOARD ROCKETS AND ARTIFICIAL EARTH SATELLITES
Gurijan, A. A. (Russia) - Seyapin, A.D. (Russia)
IAA 2.3.04 - vol 16 - AAS vol 25 abstract n° 351

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Pirard, Théo. (Belgium)
IAA 2.3.05 - vol 16 - AAS vol 25 p.201-234 abstract n° 350

THE D1-FRENCH SATELLITE PROGRAM
Moulin, Hervé. (France)
IAA 2.3.06 - vol 16 - AAS vol 25 p.235-250 abstract n° 349

THE ROCKET FLIGHT STABILITY: A HISTORY OF MISCONCEPTIONS
Rauschenbach, Boris V. (Russia)
IAA 2.3.09 - vol 16 - AAS vol 25 p.251-256 abstract n° 348

31st History of Astronautics Symposium

48th International Astronautical Congress
Turin (Italy), 1997.

Coordinators:
Jung, Philippe. (France) - Ordway III, Frederick I. (USA)

Session 1

7 October 1997

Chairmen: Sokolsky, Viktor N. (Russia) - Liepack, Otfried G. (USA)
Rapporteurs: Moulin, Hervé. (France) - Winter, Frank H. (USA)

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49th International Astronautical Congress
Melbourne (Australia), 1998.

Coordinators:
Jung, Philippe. (France) - Ordway III, Frederick I. (USA)

Session 1

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Chairmen: Chen, Shilu. (China) – McCracken, K.G. (Australia)
Rapporteurs: McKenna-Lawlor, Susan. (Ireland) - Thomas, Shirley. (USA)

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50th International Astronautical Congress
Amsterdam (The Netherlands), 1999.

Coordinators:
Jung, Philippe. (France) - Ordway III, Frederick I. (USA)

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Rapporteurs: Thomas, Shirley (USA) – Edelby, George. (Syria)

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51st International Astronautical Congress
Rio de Janeiro (Brazil), 2000.

Coordinators:
Jung, Philippe. (France) - Ordway III, Frederick I. (USA)

Session 1

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Chairmen: Liepack, Otfired G. (USA) – Matogawa, Yasunori. (Japan)
Rapporteurs: Freemann, D.C. (USA) – Pirard, Théo. (Bekgium)

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4 October 2000

Chairmen: Braun, Julius H. (USA) - De Oliveira, Fabiloa.I. (Brazil)
Rapporteurs: Edelby, George. (Syria) – Harlow, John. (U.K)

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5 October 2000

Chairmen: Moulin, Hervé. (France) – Sokolsky, Viktor. N. (Russia)
Rapporteurs: McKenna-Lawlor, Susan. (Ireland) – Rothmund, Christophe. (France)

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ABSTRACTS

abstracts

1 **THE BRITISH INTERPLANETARY SOCIETY'S ASTRONAUTICAL STUDIES, 1937-1939**

Ross, H.E .

1967 – IAF/IAA *** - vol 1 - AAS vol. 6 - pp. 209-216

The B.I.S was founded by P.E. Cleator in October 1933. A Journal and a Bulletin were published from Liverpool, lectures given, and articles written to stimulate interest whenever opportunities arose. Membership (though never more than about one hundred till after 1945) soon became international. Correspondence with other astronautically minded societies was maintained, and during 1934 Cleator visited Germany and contacted members of the then disbanded V*f*R. In 1936 Cleator's book "Rockets Through Space" awakened general interest in Britain, and paved the way to better understanding of astronautical possibilities. By 1936, however, the numerically strong London Branch dominated affairs. As a result, Headquarters became transferred to the metropolis early in 1937, and Professor A.M. Low was elected as the new President. Technical and experimental committees then began work under the direction of J.H. Edwards. A small rocket proving stand was designed to conduct motor and propellant tests, but progress was hampered by lack of money and facilities. On the other hand, a simple device - the "Coelostat" -- able to provide a stationary view from a rotating spaceship, was constructed and demonstrated. The main work undertaken during this period was, however, design of a manned spaceship tentatively capable of a round trip to the Moon. This embodiment prospered, and details of unique 1000 tonne cellular-step solid-propellant Outbreak of war then rendered further concerted work impossible and the Society's activities were suspended.

2 **A HISTORICAL REVIEW OF DEVELOPMENTS IN PROPELLANTS AND MATERIALS FOR ROCKET ENGINES**

Lutz, O.

1967 – IAF/IAA *** - vol 1 - AAS vol. 6 - pp. 104-112

In 1935, in the early days of the development of rocket propulsion in Germany, our first vital interest concerned the right choice of propellant combinations based on thermodynamic calculations. A special point of interest was those propellants having hypergolity. Already at that time, among the spectrum of propellants considered, we became familiar with the use of hydrogen peroxide and several forms of hydrazine compounds, propellants that are still in use today. Questions relating to the mechanism of ignition in connection with special designs of mixing injectors were also studied. Another objective in those days was to increase the output of cyclic power plants by chemical means. Furthermore, we tried to apply special materials, such as compound materials and compound ceramics, for resisting high temperatures. The review describes our work done in this field 30 years ago. It was achieved through cooperative research of the chemist and the design engineer.

3 ON THE GALCIT ROCKET RESEARCH PROJECT, 1936-38

Malina Frank J.

1967 – IAF/IAA *** - vol 1 - AAS vol. 6 - pp. 113-127

The GALCIT (Guggenheim Aeronautical Laboratory, California Institute of Technology) Rocket Research Project was initiated in February 1936. It was carried out by John W. Pearsons, A.M.O Smith, Hsue Shen Tsien, Edward S. Forman, Weld Arnold and by the author, who led the group. From the work of this group developed in the Air Corps Jet Propulsion Research Project in 1939, and the jet Propulsion Laboratory, which was founded by Theodore von Kármán and the author, in 1944. The memoir describes the formation of the GALCIT group, and its relations with von Kármán, Robert A. Mllikan, Clark B. Millikan and Robert H. Goddard. It reviews the theoretical and experimental studies of liquid and solid propellant rocket engines, and the analyses of the flight performance of sounding rockets that were made. The first steps taken towards the successful development in America of storable liquid propellants and of composite solid propellants for long duration rocket engines are outlined. The author expresses special appreciation of the work of John W. Parsons, which has been little recognized. The story of the author receiving the REP-Hirsch Prize is recounted. A summary is given of the report the author prepared in August 1938 for the Consolidated Aircraft Co., San Diego, California, on the use of rockets for assisting the take-off of heavily loaded aircraft. The memoir ends with a discussion of the report the author presented on 28 December 1938 to the Committee on Air Corps Research of the National Academy of Sciences in Washington D.C, for the initiation of a research program on rocket engines for aircraft super-performance applications.

4 MY CONTRIBUTIONS TO ASTRONAUTICS

Oberth Hermann

1967 – IAF/IAA *** - vol 1 - AAS vol. 6 - pp. 129-140

As a boy of eleven the author read, in 1906, the books by Jules Verne, "von der Erde zum Mond" (*From the Earth to the Moon*) and "Reise um dem Mund" (*Travel Around the Moon*). He was fascinated by the idea of space travel, but he soon saw that the use of a cannon proposed by Verne would not be feasible; and, seeking effective means, he found that rocket-like engines and the principle of reaction would provide them. For a long time he did not have the financial means for expensive experiments, and to do at least something, he made theoretical studies of the operation of the rocket. Before him, nobody had thoroughly this. As late as 1919, for example, Goddard wrote that the relations between propellant consumption, air drag, gravitational retardation, and propellant consumption could not be expressed by mathematical formulae. In 1921, the author began his Doctor's thesis, including some of these formulae. In 1923, it was published under the title "Die Rakete zu den Planetenräumen" (*The Rocket to Interplanetary Space*). Most of his formulae were published in 1929, in his book "Wege zur Raumschiffahrt" (*Means for Space Travel*). In this book he proposed the first electrostatic spaceship and wrote about the space mirror. Besides that, he investigated (*also by experiments on himself*) effects of high acceleration and zero-gravity, and predicted that they could be overcome by training and by gymnastics for a short time, and, for a long time, by staying in capsules suspended by wire ropes and rotating around the common centre of inertia. In any case, the psychological effects of zero gravity could be overcome by drugs, if by no those means. Finally, in lecture discusses the reaction of the public, the propagation of these ideas, the author's acquaintance with other pioneers of Astronautics, and his activity before 1933.

5 EARLY ROCKET DEVELOPMENTS OF THE AMERICAN ROCKET SOCIETY

Pendray Edward G.

1967 – IAF/IAA *** - vol 1 - AAS vol. 6 - pp. 141-155

This paper presents a summary of rocket experimental work carried on by the American Rocket Society (at first known as the American Interplanetary Society) from the time of its founding in 1930 until 1939. The Society began its work on the development of rockets with a study of available technical material on rocket developments in the U.S. and other parts of the world. In 1931 two of the founders, Mr and Mrs G. Edward Pendray, visited Italy, France and Germany to discuss rockets with experimenters in those countries. In Germany the ARS delegates witnessed a proving stand test of a liquid-propellant motor developed by the Verein *f*ür Raumschiffahrt. On their return to the U.S. the Pendrays helped organise the Experimental Committee of the ARS, and Mr. Pendray became its first chairman. Under the auspices of this Committee four liquid propellant rockets (gasoline and liquid oxygen) were constructed and tested, and a series of proving stand tests of liquid propellant motors was carried on, culminating in the development of the Wyld regenerative liquid propellant motor, which led to the formation of Reaction Motors, Inc. The Experimental Committee also sponsored a series of solid fuel rocket tests, principally to determine aerodynamic configurations for rockets. The formal ARS tests were discontinued in 1941 because of World War II and renewed interest in the development of solid propellant rockets on a significant scale by the U.S. Army.

6 EARLY EXPERIMENTS WITH RAMJET ENGINES IN FLIGHT

Pobedonostsev Yuri A.

1967 - IAF/IAA *** - vol 1 - AAS vol. 6 - pp. 167-175

During the twenties, astronautics "pioneers" proposed the use on various projects of atmospheric oxygen as an oxidizer, after the first stage of spacecraft had been equipped with air-jet engines. In December 1928, Professor Boris Sergueievitch Stetchkin expounded the general theory of air-jet engines for the first time before the students of the Moscow Technical University. In the Spring of 1929 it was published in the review "Tekhnika vozdouchnogo flotta" (*Aviation Engineering*). This article was subsequently reprinted in many foreign astronautics reviews. The theory thus found a place in world technical thought. The famous Italian hydrodynamics specialist Arturo Giovanni Crocco wrote in his essay "Superaviation and Hyperaviation" (published in 1931 in the review "Rivista Aeronautica") that the classic theory of the air-jet engines had been formulated for the first time in the U.S.S.R. by professor Stetchkin in Moscow. This paper deals with the first experiments carried out in the U.S.S.R. in 1930 and their principal results. There is a description of one of the first devices enabling a supersonic airflow to be achieved.

7 **MY THEORETICAL AND EXPERIMENTAL WORK FROM 1930 TO 1939, WHICH HAS ACCELERATED THE DEVELOPMENT OF MULTISTAGE ROCKETS**

Damblanc, Louis

1967 - IAF/IAA *** - vol 1 - AAS vol. 6 - pp. 49-55

In the course of the said period I undertook, on my initiative and without anyone to assist me, to study and construct the powder rockets which bear my name, and test them in action, working under the auspices of the Minister for War (*Ministères des Armées*) and of the National Scientific Research Center (CNRS). The entire resources of the Central School of Pyrotechnic at Bourges were put at my disposal. I contrived to "tame" black powder, as shown by the diagram and tables of results given in my two works, one published

8 **EARLY ITALIAN ROCKET AND PROPELLANT RESEARCH**

Crocco, Luigi

1967 - IAF/IAA *** - vol 1 - AAS vol. 6 - pp. 33-48

This paper summarizes the history and the principal technical details of the research on rockets and propellants initiated in 1927 in Italy by G.A. Crocco and later continued under his guidance by the author and a few collaborators. The research was initially sponsored by the Italian General Staff, and centered on solid propellant rockets. Experiments, both on a test stand and at a firing range were conducted in 1927 and 1928 at the B.P.D. facilities of SEGNI, with tubular grains of cordite. Further experiments were conducted in 1928 and 1929 at the S.C.A of the Italian Ministry of Aeronautics. Test stand experiments were conducted which showed the superiority of another double base propellant, the C-powder of the Navy.. In 1930 the research switched to other quarters and toward liquid propellant rocket research. The successful operation of a bipropellant rocket was achieved using benzene as the fuel and nitrogen tetroxide as the oxidizer. Further research on monpropellants was carried out at the Instituto di Aeronautica Generale of the University of Rome in 1932 and 1933, leading to the discovery of the excellent monopropellant qualities of nitromethane and to the experimental verification of these qualities. In an attempt to use nitromethane in an experimental piston engine independent of the atmospheric oxygen, the injection pump exploded and the Author was injured. Other paths for the utilization of nitromethane were followed after the explosion; also additional research on bipropellants, including tetranitromethane as an oxidizer, was conducted in the following years. Only after the war research on the applications of nitromethane to rocketry was resumed by the Author, first in France, later in U.S.A.

9 **DEVELOPMENT OF WINGED ROCKETS IN THE U.S.S.R., 1930-1939**

Shchetinkov Yevgueny S.

1967 - IAF/IAA *** - vol 1 - AAS vol. 6 - pp. 247-257

The pioneers of rocket engineering K.E. Tsiolkovsky and F.A Tsander had already demonstrated that liquid propellant rocket engines could usefully be applied to winged rockets. Experiments in this field started in the U.S.S.R. in 1930-1932 at the G.I.R.D. (Study Group on Jet Propulsion) in Moscow and at the G.D.L (Gas Dynamics Laboratory) in Leningrad. Three main paths were explored: (1) the simplest means of achieving manned jet flight was to construct and test a liquid propellant rocket glider. (RP-1 and RP-318). With the experience thus acquired, an experimental model of jet fighter BI-I was later created (1942). (2) in the period under review there were as yet no liquid propellant rocket engine capable of providing an optimal ratio (of 0.7 to 1) between the thrust and weight of a scale craft. It was therefore necessary in the study of the flight dynamics of winged rockets of such a thrust/weight ratio to have recourse to models with solid propellant rocket engines and with unmanned automatic solid propellant rocket engines. Rockets 212, 216, 217 and others built in our country were of this type. (3) Experiments on accelerating rockets installed in overloaded classic propeller-driven aircraft proved to be of great practical significance. The accelerating rockets used were solid propellant rocket engines.

10 EARLY ROCKET AND SPACECRAFT PERFORMANCE GUIDANCE AND INSTRUMENTATION DEVELOPMENT

Steinhoff Ernst A.

1967 - IAF/IAA *** - vol 1 - AAS vol. 6 - pp. 277-285

During late 1938, the author was invited to join Dr. Wernher Von Braun at Peenemünde (Germany) to take over the development of guidance and control of rocket vehicles and to direct the areas of test instrumentation, flight testing and flight performance measurements. The reason for this selection was that Dr. Studling, a former colleague and head of the Flight Mechanics Department, felt that work I was doing at the DFS (German Research Institute for Motorless Flight) at Darmstadt, Germany, was directly leading to applications in the control of rockets and spacecraft. Work performed in the 1936 to 1938 time period by the author and team-mates dealt with conceptional studies of high volume to surface ratio controlled rocket propelled missiles, the analysis of strapped-down type of gyro references on flight path oriented reference signals and the coordination on transfers required. At that time also came the recognition that rate and acceleration measurements were needed to control flight paths of unmanned vehicles, and to do this with repeatable accuracy. Of the concepts worked on at that time period, low attitude recovery of missiles by duration of recovery sequence by rate of pitot pressure change, use of angle of attack vanes to limit air loads under wind shear, use of acceleration and rate besides displacement sensors to make rocket trajectories more repeatable, use of hydraulic servomotors besides rates and acceleration to achieve high response rates needed for missile applications, particularly when guided, or use of integration of acceleration for precision propulsion cut-off, are applications which found actual use in the emerging years of the past 1938 area, and led to patent applications by members of my team and myself. Many aspects of flight performance measurements, data acquisition and evaluation were directly applied to subsequent early rocket and missile work. As a student, while working at DPS, I followed up earlier experiments of Stamer and while employed there, my group supported flight performance measurements on prototypes of what later became the Me-163 of Alexander Lippisch.

11 FROM THE HISTORY OF EARLY SOVIET LIQUID PROPELLANT ROCKETS
Tikhonravov Mikhail K
1967 - IAF/IAA *** - vol 1 - AAS vol.6 - pp. 287-293
Much of the attention of research in the Soviet Union in the thirties was concentrate on jet propulsion problems. The Jet Propulsion Study Group (GIRD), set up in 1932, provided the experimental production basis for research and the development of the first Soviet liquid fuel rockets. It was headed by S.P. Korolev, Chairman of the Technical Council. The Group formed four teams in the research laboratory which were headed by F.A. Tsander, M.K. Tikhonravov, Y.A. Pobedonostzev and S.P. Korolev. The team headed by the author of this report worked on an RP-2 spacecraft motor using pump-fed fuel components; rocket 05 propelled by a ODL-built nitric acid ORM-50 engine; rocket 07 propelled by liquid oxygen and kerosene; rocket 09 using a blended aggregate composition fuel. This list does not cover the work done by the other GIRD teams. Rocket 09, first launched on 17 August 1933, marked the beginning of liquid fuel rocket flights in the Soviet Union. Rocket 09 was further developed in the Jet Research Institute (RH11) where it was given the number 13. A series of these rockets was made and served for experimental study on flight dynamics. Rockets 05 and 07 were also completed and made flights in 1935-1937. To obtain rocket experience, control and measuring instruments, launching systems and launching installations were developed….

12 ANNAPOLIS ROCKET MOTOR DEVELOPMENT, 1936-1938
Truax Robert C.
1967 - IAF/IAA *** - vol 1 - AAS vol. 6 - pp. 295-301
During the period 1936-1938, while a midshipman at the U.S. Naval Academy, Annapolis Maryland, the writer designed, constructed and tested several differently configured rocket motors. Tests were made with gasoline and compressed air, and with gasoline and gaseous oxygen. One of the motors was also tested by the American Rocket Society using liquid oxygen and alcohol. A number of refractory nozzles were fired on both propellant combinations. Chambers were uncooled, water control and partially and wholly regeneratively cooled. While the tests were by no means entirely successful, they laid the groundwork for a project, set up in the summer of 1941, which successfully developed liquid propellant rockets for a number of applications.

13 ON SOME WORK DONE IN ROCKET TECHNIQUES, 1931-1938
Polyarny A.I.
1967 - IAF/IAA *** - vol 1 - AAS vol. 6 - pp. 185-201
The paper deals with the first practical steps taken during the period by certain bodies who had embarked on the search for ways leading to the conquest of space. Experiments explored two main paths : (1) creation of liquid propellant rockets (in accordance with the ideas of K.E. Tsiolkovsky) (2) creation of a liquid propellant rocket-engined aircraft with the aim of accumulating data on human control, in

flight conditions, of liquid propellant rocket engines. The carrying out of later research on the creation of a "composite" rocket aircraft, the last stage of which would enter space (in accordance of the ideas of F.A. Tsander), was not lost sight of. The paper deals with the experiments carried out by F.A. Tsander's team at the I.A.M. (Institute of the Construction of Aircraft Engines), the G.I.R.D. (Study Group on Jet Propulsion, Moscow), and the R.N.I.I. -Institute for Jet Propulsion Research) during 1931-1934. During this period, the rocket GIRD-X was developed and launched. The first trials were carried out of the OR-II propulsor with liquid fuel, destined for the R.P.I. Glider….

14 RECOLLECTIONS OF EARLY BIOMEDICAL MOON-MICE INVESTIGATIONS

Generales, Constantin D.J.

1968 - IAF/IAA *** - vol 1 - AAS vol. 6 - pp. 75-80

1931 was the year when Karl Jansky was studying peculiar noises from outer space that gave birth to radio astronomy and Wiley Post was successfully completing the first round-the-world flight in his monoplane, Winnie Mae. At the same time, the earliest space-oriented biomedical experiments were being carried out by two students, one in medicine, the other in engineering. Acceleration in rocket propulsion was recognized as an important factor in the physiology of space flight. The research and the circumstances to be described were performed by the author and Dr. Wernher von Braun in Zurich and later continued by the author at the Sorbonne in 1932. This work represents the first acceleration studies on mice with histoathological slides, and preceded the launching of the Mirak I, conducted by the trio von Braun, Nebel and Riedel at the historic Raketenflugplatz in Berlin. Of interest is the comment by the senior editor of Newsweek, Norman Diamond, who wrote (quoting von Braun) in 1961, "This was probably the first experiment in Space medicine. The Air Force has probably spent $7 million to find out what we learned".

15 THE FOUNDATIONS OF ASTRODYNAMICS

Herrick, Samuel

1968 - IAF/IAA *** - vol 1 - AAS vol. 6 - pp. 81-86

The astrodynamics underlying space navigation, as distinguished from these portions in the realms of orbit design on the one hand and of mathematical celestial mechanics on the other, has roots that reach back at least 2300 years and that developed increasing power and precision in the 19th century, and in the period from 1900 to 1939 that is emphasized in this Symposium. The contributions were far reaching, detailed, and essential to accurate and trouble-free space navigation; the contributors were for the most part unconscious of the fact that their work would be so used. The writer dates his own conscious studies in this area from his 1931-32 correspondence with R.H. Goddard, who had the vision, even at that early time, to encourage his entering the field of celestial mechanics specifically to anticipate the basic problems of space navigation.

16 ROBERT H. GODDARD AND THE SMITHSONIAN INSTITUTION
Durant III, Frederick C.
1968 - IAF/IAA *** - vol 1 - AAS vol. 6 - pp. 57-69
Throughout most of his professional career, Robert H. Goddard was associated, formally or informally, with the Smithsonian Institution. In 1916, Professor Goddard wrote to the Smithsonian Institution telling of his research activity on the rocket as a device to explore scientifically the upper atmosphere at altitudes beyond the reach of balloons. From 1917 to 1929 the Smithsonian Institution supported the research effort of this American rocket pioneer. Originally experimenting with rocket designs utilizing repetitive firing of solid propellant charges, Goddard switched to liquid propellants and launched the world's first liquid propellant rocket in 1926. The emphasis of this paper is on the relationship of Professor Goddard and the Smithsonian Institution, how the Smithsonian helped financially sponsored and encouraged the research effort. Numerous, still unpublished reports written to the Smithsonian during the period 1917-1929 reveal Professor Goddard's deep interest in the utilization of rocket power to achieve space flight to the Moon and the planets, both by scientific probes and by man. The earliest known experimental effort on electric propulsion for space flight purposes was in the winter of 1916-1917. A discussion of these and later experiments and abstracts of other correspondence with the Smithsonian Institution will be presented.

17 ROBERT ESNAULT PELTERIE: SPACE PIONEER
Blosset, Lise
1968 - IAF/IAA *** - vol 1 - AAS vol.6 - pp. 5-31
The paper presents the life and the works of Robert Esnault-Pelterie, France, (1881-1957) who was one of the first space pioneers who foresaw in their theoretical studies and confirmed by their experiments the possibilities of astronautics beyond those of aviation. On November 15, 1912 he presents an important paper where he envisaged for the first time the theoretical possibility of a body with certain properties being able to travel between the Earth to the Moon. In 1927 he gave a second lecture and at this occasion added the word "astronautics" to the scientific vocabulary. In 1930 he published his book "*L'astronautique*" followed by a supplement in 1934.

18 GIULIO COSTANZI: ITALIAN SPACE PIONEER
Eula, Antonio
1968 - IAF/IAA *** - vol 1 - AAS vol. 6 - pp. 71-73
M. Giulio Costanzin (1875-1965) was an officer in the Italian Army and Italian Air Force, an engineer, an experimenter, and a technical and legal adviser. In 1914 M. Costanzi published in the Italian magazine "AER" a paper which can be considered the first Italian contribution to the study of space flights.

19 SOME JET PROPULSION FORMULAS OF OVER THIRTY YEARS AGO

Bartocci, Aldo

1968 - IAF/IAA *** - vol 1 - AAS vol. 6 - pp. 1-3

We present some formulae taken from studies published in the journal "L'Aeronautica" in 1933 and 1934. In one of these articles, the vertical motion of a constant acceleration vehicle could be a spaceship with controlled mass consumption is considered. The aerodynamic drag and the delaying effect of gravity are evaluated, the height of burnout being defined in relation to the apogee altitude and the acceleration. The return to the Earth and variations in mass during vertical ascent and braked descent are studied and the quantity of propellant required is calculated. Another article considers the vertical motion of a vehicle with a constant mass consumption such as an inert rocket. The equations of the motion are established and a diagram is presented for the rapid solution of the problems involved. The study is completed by considerations of the exhaust velocity of the gas, the aerodynamic drag and the delaying action of gravity.

20 S.P KOROLEV AND THE DEVELOPMENT OF SOVIET ROCKET ENGINEERING TO 1939

Rauschenbach Boris V. - Biryukov Yu. V.

1968 - IAF/IAA *** - vol 1 - AAS vol. 6 - pp. 203-208

S.P. Korolev (1906-1966) was a major Soviet scientist who played an outstanding role not only in the direct opening up of the space age but also in the inception and creation of modern rocket technology in the years preceding the Second World War. Korolev was one of the first to apply the basic ideas of the K.E. Tisolkowsky and the other pioneers of theoretical astronautics in practice, by applying the principles of jet propulsion in modern engineering practice to solve urgent problems in connection with increasing the speed, range and altitude of flight in the atmosphere, and at the same time pursuing lines of application that directly promoted the development of astronautics.

21 SOME NEW DATA ON EARLY WORK OF THE SOVIET SCIENTIST PIONEERS IN ROCKET ENGINEERING

Sokolsky Victor N.

1968 - IAF/IAA *** - vol 1 - AAS vol. 6 - pp. 269-276

The present paper sets out some of the results of recent investigations by Soviet scholars who have been studying the creative scientific genius of K.E. Tsiolkovsky, F.A. Tsander and Yu. V. Kondratiuk. These results enable us to take a new look at some aspects of the work of our country's scientists, who were pioneers of rocket technology. The paper also draws upon information in the archives of the U.S.S.R. Academy of Sciences, the scientific documentation of the Institute for the History of Science and technology (U.S.S.R. Academy of Sciences) and the personal papers of these oustanding scientists.

22 THE DEVELOPMENT OF REGENERATIVELY COOLED LIQUID ROCKET ENGINES IN AUSTRIA AND GERMANY

Sänger-Bredt Irène - Engel Rolf

1968 - IAF/IAA *** - vol 1 - AAS vol. 6 - pp. 217-246

Inspired by publications of Hermann Oberth, particularly his book "Die Rakete zu den Planetenraumen" published in 1923, enthustiac engineers and students at various places in the German-speaking countries started independently from each other - from about 1926 on - with the practical development of liquid rocket motors. Especially two of these groups, working on their own, account and without public support, were able to arrive at decisive and lasting achievements. The technical features for liquid rocket motor design arrived at by tests of propulsion system models conducted under Eugen Sänger at Vienna and under Rudolf Nebel and Klaus Riedel at Reinickendorf near Berlin. Propulsion systems of that type were applied to carry out the first successful space flights of the world in 1957/58. The guiding principle for materials, propellant combinations, feed-injection-, and cooling-systems, combustion chamber dimensions, nozzle profiles, etc., worked out in the 1930's at Vienna and Berlin, are still applied today for usual liquid rocket motors and have not yet been replaced by any fundamentally new technology. The present report is an attempt to reconstruct the development of cooling methods for liquid rocket motors in chronological sequence between 1926 and 1936 with respect to the Vienna and Berlin tests. As to the various possibilities of dynamic engine cooling, a distinction will be made on one hand between separate and regenerative cooling, and on the other, between free-flow and forced-flow cooling. The report is based on publications, non-published test logbooks, and patents of the scientists who contributed to the development concerned.

23 VLADIMIR MANDL : FOUNDING WRITER ON SPACE LAW

Kopal Vladimir

1968 - IAF/IAA *** - vol 1 - AAS vol. 6 - pp. 87-90

Dr. V. Mandl was born on 20 March 1899 in the industrial city of Pilsen. Became a pioneer in astronautics he was author of the first monograph on legal problems of outer space. Following graduation of the Charles University of Prague, he practiced for a short time at a district court in Prague. In March 1927, he opened his onw office in Pilsen. Then, Mandl studied legal problems of aviation, and became a pilot. His keen interest in aeronautics led V. Mndl to think about the more advanced means of space transport. The results of his studies and thoughts in astronautics fall into two categories. The first is found in his book "The Problem of Interplanetary Transport" (1932). N the second category we found his book "The Law of Outer Space", a Problem of Spaceflight" (1932). Died on January 8, 1941, V. Mandl is considered as the founding writer of the space law.

24 FIRST ROCKET AND AIRCRAFT FLIGHT TESTS OF RAMJETS

Pobedonostsev Yuri A. - -

1968 - IAF/IAA *** - vol 1 - AAS vol. 6 - pp. 177-184

After successful experimental trials of ramjet models mounted in 3 inch shells, consideration was given to the use of this type of motor as propulsion units for rockets and aircraft. The paper will give an account of the results of the first tests with a two-stage rocket, in which the booster was a gunpowder rocket, and the second stage was the experimental ramjet that was being studied. The next stage was to use aircraft to test the ramjet in subsonic flight. The fighter planes used for this purpose were the I-15Mk 2, the I-153 designed by N.N. Polkarpov, the Yak-7B and others. Ramjets were used by a number of pilots on 54 flights. A considerable increase was recorded in the speed of military aircraft of this class, and it was found that the experimental DM-2 and DM-4 motors designed by I.A. Merkulov were reliable and safe in operation.

25 DEVELOPMENTS OF ROCKET ENGINEERING ACHIEVED BY THE GAS DYNAMICS LABORATORY IN LENINGRAD

Kulagin I.I.

1968 - IAF/IAA *** - vol 1 - AAS vol. 6 - pp. 91-102

The Gas Dynamic Laboratory (GDL) was the first scientific research, testing and design organization concerned with rocket technology in the U.S.S.R. to specialize in the development of (a) dry-fuel rockets and the fuel and motors for them; (b) electric rocket motors for interplanetary flight; © liquid-fuel rocket motors and their fuel. Further experimental rockets of the ORM series (ORM-4 to ORM-22) were designed in 1932. These rockets were used to investigate the type of ignition, launching methods and mixing systems for various fuels. Further rockets (ORM-23 to ORM-52) made and stand-tested in 1933 employed pyrotechnic and chemical ignition of nitric acid and kerosene fuel. A turbo-pomp unit was developed in which centrifugal pumps supplied fuel to the motor with a tractive force of up to 300 kg. The GDL was the organization that laid the foundations of Soviet rocket motor construction, which has progressed from rocket motors with a thrust of a few kilograms to highly perfected rocket motors with a thrust of many hundred of tons.

26 WILHELM THEODOR UNGE: AN EVALUATION OF HIS CONTRIBUTIONS

Skoog, A. Ingemar

1968 - IAF/IAA *** - vol 1 - AAS vol. 6 - pp. 259-267

The paper presents the life and the works of Wilhelm Theodor Unge, Sweden, (born 1845) who started his career as an inventor in the mid-1880's after a quick military career. His first invention was an optical telemeter and an automatic rifle. After different attempts to improve the artillery by using different types of rotation-guns, he soon realised that the only possible method at that time to fire a high explosive like nitroglycerin over a great distance was by the use of a rocket. He constructed his first rocket in 1892, and soon started a collaboration with Alfred Nobel.

27 LUDVIK OČENASEK: CZECH ROCKET EXPERIMENTER

Peśek Rudolph - Budil Ivo

1968 - IAF/IAA *** - vol 1 - AAS vol. 6 - pp. 157-165

The first Czech rockets were launched to the height of 5000 feet in the neighbourhood of Prague(Czechoslovakia) during the period 1928-1931. They were designed, constructed and tested by Ludvik Očenasek (1872-1949).

28 THE ALLEGED CONTRIBUTIONS OF PEDRO E. PAULET TO LIQUID PROPELLANT ROCKETRY

Ordway III, Frederick I.

1969 - IAF/IAA HAS 1-06 - vol 2 - AAS vol. 7 part 2 - pp. 25-41

Historical accounts of the history of liquid propellant rocketry often mention the name of Pedro E. Paulet. Just as often, information presented on his contributions is sketchy, inevitably giving rise to speculations as to its authenticity. Even a cursory investigation shows that, since the early 1930's, secondary sources only have been consulted, a circumstance explained by the fact that original documentation is sparse, obscure, and exceedingly difficult to obtain. Paulet, a Peruvian chemical engineer turned diplomat, spent much of his professional foreign service career in Europe. Research reveals that his claim to being a precursor of liquid propellant rocketry rests in a letter he wrote from Rome on the 23rd of August 1927 that was published in the 7 October issue of the Lima, Peru newspaper, "*El Comercio*". Therein, he describes liquid propellant rocket engine experiments he had conducted as a student in Paris thirty years earlier. Somehow, this letter, or at least a report of its contents, came to the attention of the German-writing, Russian-born rocket enthusiast Boris A. Scherschevsky, who reported on it in his book "*Die Rakete für Fahrt und Flug"* (1929). Relying on this source and derivatives, many subsequent writers have accorded Paulet a perhaps undeserved place in the history of rocketry. This paper first examines Paulet's alleged contributions as presented by Scherschevsky (and later authors basing their analyses on his book), and then compares them with the few original sources available from Peru. It is concluded that there is no demonstrable proof that Paulet did, indeed, perform liquid propellant rocket experiments during the final decade of the 19th Century; however, it is still impossible to disprove his assertions. The paper is accompanied by illustrations and extensive quotations from Peruvian documents.

29 ROMANIAN ROCKETRY IN THE 16TH CENTURY

Carafoli, Elie - Nita Mihai

1969 - IAF/IAA HAS-1-** - vol 2 - AAS vol. 7 part 2 - pp. 3-8

This report includes the results of research undertaken in the past few years in Romania concerning the technical development of rocket construction in the 16th century. The main object of this research has been a medieval manuscript written in old German by Conrad Haas and discovered in the town of Sibiu, which lies in the central area of Rumania. The manuscript was translated and commented by M. D. Torericiu in his book "The Prehistory of Modern Rockets - The Manuscript of Sibiu (1400-1569)" published in 1969. The documents that have been studied make an important contribution to our knowledge concerning the evolution of human thought and experience in the field of rocket technology and jet propelled flights.

30 ON THE WORKS OF S.S NEZHDANOVSKY IN THE FIELD OF FLIGHT BASED ON REACTIVE PRINCIPLES, 1880-1895

Sokolsky Victor N

1969 - IAF/IAA HAS 1-10 - vol 2 - AAS vol. 7 part 2 - pp. 125-139

Sergei Sergeyevich Nezhdanoski (1850-1940) was a Soviet scientist and inventor comparatively well knwon for his work in aviation science and technology. Until recently, however, scientific technical and historical literature made virtually no mention of his research in the field of jet-propelled flight. Nezhdanovski's interest in the theoretical possibilities of jet propulsion began at the end of 19th century. His manuscript notes contain a number of extremely original ideas, some of them of fundamental importance and of considerable interest to the historians of technology. Nezhdanovski proposed the use of liquid propellants for rocket motors, including nitric acid or nitrogen oxide; he studied such questions as the supply of fuel to the combustion chamber by means of pumps, and the use of one of the fuel components for cooling the combustion chamber walls; he applied himself to the problem of determining the quantity of energy required for jet-propelled flights, and proposed the use of air-jet engines for single-rotor and twin-rotor helicopters.

31 THE U.S ARMY AIR CORPS JET PROPULSION RESEARCH PROJECT, GALCIT PROJECT 1, 1939-1946: A MEMOIR

Malina Frank J.

1969 - IAF/IAA HAS 1-04 - vol 2 - AAS vol.7 part 2 - pp. 153-201

The author gives the background that brought about the initiation at the California Institute of Technology in 1939 of the first rocket research project for the propulsion of aircraft supported by the U.S. Government. It was, at first, carried out under the auspices of the National Academy of Sciences, and then, of the Army Air Corps. The project was begun by Theodore von Kármán and three members of the Galcit Research project, the author, John W. Parsons and Edward S. Forman.

32 THE SWEDISH ROCKET CORPS, 1833-1845

Skoog, A. Ingemar

1969 - IAF/IAA HAS 1-09 - vol 2 - AAS vol. 7 part 1 - pp. 9-22

Some years after the English bombardment of Copenhagen in 1807, Swedish scientists got the opportunity to examine some of the rockets used by the Englishmen. During the 1810's and 1820's tests were conducted with war rockets of the Congreve type e.g. a 3-inch war rocket with a 3-pound shell. A most interesting type was a 2-inch rocket with delta wing for Vailliant's construction instead of the guiding stick. The Swedish Rocket Corps consisted of 74 men handling 8 launch-stands which were brought along on rocket-wagons. The organization was such that it could easily be doubled to 16 rockets stands, which was thought to the number needs in war. The Rocket Corps was, however, dissolved in 1845, but order was given to keep two launch stands with rockets at each artillery regiment until the mid-1860's.

33 **FIRST WORKS OF K.E TSIOLKOVSKY AND I. V. MESCHERSKY ON ROCKET DYNAMICS**

Kosmodemiansky Arkady A.

1969 - IAF/IAA HAS 1-03 - vol 2 - AAS vol. 7 part 2 - pp. 115-124

Examination of the K.E. Tsiolkovsky archive conserved at the U.S.S.R. Academy of Sciences confirms that he began a systematic investigation of the theory of rocket motion in 1896. In 1898, he produced strictly mathematical solutions.

34 **ON THE HISTORY OF STRATOSPHERIC ROCKET SONDES IN THE U.S.S.R., 1933-1946**

Tikhonravov Mikhail K - Zaytev, V.P -

1969 - IAF/IAA HAS 1-11 - vol 2 - AAS vol. 7 part 2 - pp. 65-78

Stratospheric rockets are used for investigation of the upper atmosphere, which is here taken to mean the whole of the atmosphere with the exception of the troposphere. Rockets that explore the troposphere are referred to as "meteorological". This paper provides brief descriptions of several rockets constructed in the U.S.S.R. between 1934 and 1946.

35 **MAIN LINES OF SCIENTIFIC AND TECHNICAL RESEARCH AT THE JET PROPULSION RESEARCH INSTITUTE (RNII), 1933-1942**

Shchetinkov Yevgueny S.

1969 - IAF/IAA HAS 1-08 - vol 2 - AAS vol. 7 part 2 - pp. 43-57

The Rocket Research Institute (RNII) was created at Moscow in October 1933, deriving its origin from the two organizations previously concerned with rocket research: the Gas Dynamics Laboratory (GDL) and the State Jet Propulsion Group (GIRD).

36 **GUIDO VON PIRQUET: AUSTRIAN PIONEER OF ASTRONAUTICS**

Sykora Fritz

1970 - IAF/IAA 141 - vol 2 - AAS vol. 7 part 2 - pp. 140-155

In the Encyclopaedia Britannica you will find that a third of the pioneers of astronautics derive from the Austro-Hungarian Monarchy. One of them is Guido von Pirquet. This paper presents a short biography and treats extensively his contribution to the development of astronautics.

37 **LIQUID-HYDROGEN ROCKET ENGINE DEVELOPMENT AT AEROJET, 1944-1950**

Osborn George .H - Gordon Robert – Coplen Herman L. – James George S.

1970 - IAF/IAA 163 - vol 2 - AAS vol. 7 part 2 - pp. 279-324

Many of the early pioneers in rocket development studied the use of liquid hydrogen as a fuel, but the severe handling problems associated with its extreme physical properties were somewhat discouraging. Illustrative of these properties which make practical handling difficult, are a boiling point of - 426°F at one atmosphere and a density about one-seventh that of water. Interest in the methods and apparatus used in hydrogen gas liquefaction became much more widespread during the mid-1940's because of a realization that handling methods could be developed to copy with the problem so as to supply the steadily increasing requirements for liquid hydrogen in the basic research field. In the course of a rocket research and development program carried on at Aerojet, it was necessary to design, build, and operate a hydrogen liquefaction plant with a capability of over 12-lb per hour. This plant was the largest known hydrogen liquefaction plant of its day and was designed for continuous 24-hour operation. Dr. H. L. Johnston of the Ohio State University Research Foundation acted as consultant in the plant design. Extensive experience in the handling of low-temperature fluids was gained as a result of the production and handling of approximately 7400 pounds of liquid hydrogen during a period of about six months. As a part of the major purpose for which the plant was built, a high-performance injector for use with the liquid-hydrogen liquid-oxygen propellant combination was developed on a 400-lb thrust scale. A 3000-lb thrust chamber was then developed that operated at specific impulse values ranging from 93 to 99 percent of theoretical. The first pump to successfully produce high heads in pumping liquid hydrogen was built and tested at Aerojet during this same program. Liquid hydrogen pump tests were conducted at shaft speeds to 35,000 rpm, producing heads to 15,000 ft (450 psi.) at flow rates to 0,75 lb/sec. It was, therefore, demonstrated that pumping liquid hydrogen in a turbo-rocket engine was perfectly feasible and could be accomplished with a single-stage centrifugal pump.

38 NON MILITARY APPLICATIONS OF THE ROCKET BETWEEN THE 17TH AND THE 20TH CENTURIES

Sharpe Mitchell R.

1970 - IAF/IAA 137 - vol 2 - AAS vol. 7 part 2 - pp. 51-72

A very short introduction propose China as the most probable country of invention of the rocket and briefly traces its introduction to Europe via the established trade routes of the times. From its invention in the 10th century until the end of the 19th century ; relatively few technological advances were made in it. These are discussed briefly. In chronological order of development and use are described the non-military rockets from the 17th through the 20th centuries. The discussion does not include the rocket in firework displays, since this is adequately covered in standard histories that are cited. It begins with the use of the rocket for driving whaling harpoons in the 17th century by the Dutch. The course of the whaling rocket is traced through its demise in the late-19th century and reasons for its probable lack of universal adoption are given. The lifesaving rocket, which appeared at the end of the 18th century, is next discussed. With it is included the ancillary use of the oil-dispersion rocket. Also included in the 19th century is the beginning of the sounding rocket, with the work of Alfred Maul, which foreshadows that of Goddard. Non-military rockets in the 20th century are varied and several. Discussed in this context are rockets used to propel automobile and gliders. Also the use of rockets to deliver the mail is recounted. The more recent history of the rocket in non military roles closes with brief recapitulations of it in casting fishnets, weather modification, lightning research, dispersing insecticides, excavation, burning forest wastes, terradynamical studies, geodetic measurements, aeronautical research, and individual transportation.

39 THE USE OF CONGREVE-TYPE WAR ROCKETS BY THE SPANISH IN THE 19TH CENTURY: A CHRONOLOGY

Mateu Pedro Sancho

1970 - IAF/IAA 138 - vol 2 - AAS vol. 7 part 2 - pp. 73-77

The paper describes the development of rocketry in Spain. Luis de Collado in his "Platica Manual de Artilleria (1592) speaks of the use of rockets by the Spanish in the first half of the 15th century. The next references worth consideratng are from the War of Independence (19th century) beginning in Seville with the manufacture of rockets in Seville, their employment by the French in Cadiz (1810-1811) and then by the English and Spanish in Badajoz (1812). In 1815 they were used against the French in the siege of Barcelona. According to the Marquis de Viluma, in 1817, Spain began officially to deal with rockets as military weapons, although progress was variable because of economic problems. Launchings took place in Havana and Latin America, and later (1835) during the First Carlist War, as described in "Cohetes a la Congreve" in the Artillery Memorial (844) in which there is a detailed description. In 1859, by Royal decree fleets were organized and sent to the war in Africa.

40 THE AERONOMY STORY: A MEMOIR

Kaplan J.

1970 - IAF/IAA 161 - vol 2 - AAS vol. 7 part 2 - pp. 423-427

I have changed the title of this memoir, from "Origins of Ionospheric Research Before 1950" to "The Aeronomy Story", because it was the recognition of the importance of the physics and chemistry of the Earth's upper atmosphere which not only gave ionospheric research in increasingly strong theoretical base, but eventually led the way into the broad spectrum of activities which are now referred to as space research. In a short memoir no attempt will be made to give a complete picture of the way in which ionospheric research eventually led to research in space, but instead, this account will be essentially autobiographical. Such an approach is based on the fact that a relatively few scientists were responsible for recognition the importance of the physics and chemistry of the Earth's upper atmosphere, and also on the additional fact that a few of them were primarily responsible for the remarkable impact that upper atmospheric research has had on international cooperation in science.

41 THE SILVER BIRD STORY: A MEMOIR

Sanger-Bredt Irène

1970 - IAF/IAA 160 - vol 2 - AAS vol. 7 part 2 - pp. 195-228

abstract not available

42 EARLY POSTAL ROCKETS IN AUSTRIA: A MEMOIR

Schmiedl Friedrich

1970 - IAF/IAA 139 - vol 2 - AAS vol. 7 part 2 - pp. 107-112

This paper describes the author's tests, during the period from 1918 to 1935, with postal rockets, guided missiles with remote and automatic control, as well as rockets equipped with cameras. It further includes the discussion of underwater firing of rockets, rocket groups and multi-step rockets. Rocket firing from a balloon as well as from a model aircraft with jet propulsion are described. This report presents several technical details and gives an interpretation of the phenomena observed in the course of technical developments.

43 EARTH SATELLITES. A FIRST LOOK BY THE UNITED STATES NAVY

Hall, Cargill R.

1970 - IAF/IAA 165 - vol 2 - AAS vol. 7 part 2 - pp. 253-277

abstract not available

44 ROCKET FLIGHT TO THE MOON - FROM IDEA TO REALITY: A MEMOIR

Nebel Rudolf

1970 - IAF/IAA 140 - vol 2 - AAS vol. 7 part 2 - pp. 113-121

The author describes the evolution of his interest in aviation and rocketry, which began in 1908 when, at the age of 14, he built a glider and then a camera with which to take pictures from his glider. In 1932, he worked on a diagram for an international rocket with a radius of action of 1000 km, which formed the basis for the V-2 rocket, and he also wrote a book entitled "Raketenflug" with a design of a future manned space station. In 1937, the German Reich confiscated the patents and paid a licence royalty of RM 75,000.

45 AMERICA'S FIRST LONG RANGE MISSILE AND SPACE EXPLORATION PROGRAM: THE ORDCIT PROJECT OF THE JET PROPULSION LABORATORY, 1943-1946 - A MEMOIR

Malina Frank J.

1971 - IAF/IAA *** - vol 2 - AAS vol. 7 part 2 - pp. 339-383

The author discusses the events, beginning in 1943, that led to the initiation at the California Institute of Technology of America's first research program for the development of rocket propelled vehicles for long-range missile and space exploration. The program was sponsored by the U.S Ordnance Department in January 1944 and given the project designation of ORDCIT (an acronym for ORDnance, California Institute of Technology). The basis for the progress was an analysis of the performance and design of long-range rocket projectiles made by Hsue Shen Taien and the author, and a covering memorandum by Th. Von Kármán prepared on 20 November 1943. The background to the negociations that resulted in the progress being sponsored by the ordnance Department rather than by the Army Air Forces is commented upon in the light of the inter-service rivalry on the responsability for long-range rocket missiles that developed later. The reorganisation of the Air Corps Jet propulsion Research Project in the jet propulsion Laboratory, GALCIT, the initial program of research on fundamental problems of liquid and solid propellant rocket engines, the ramjets engine and the design and testing of the first experimental missiles, the Private A, Private F and WAC Corporal are reviewed. The work initiated on the design of the CORPORAL missile with an automatic guiding system is described. The author recounts his experiences during missions to England and France in 1944 and in 1946. Astly, the studies carried out on the problem of escape from the Earth by orcket and the launching of Earth satellites are discussed, including the possibility of using nuclear energy for rocket propulsion.

46 A STONE'S THROW THE UNIVERSE: A MEMOIR

Zwicky Fritz

1971 - IAF/IAA *** - vol 2 - AAS vol. 7 part 2 - pp. 325-337

Ten days after I first tried to launch a man-made object into interplanetary space from a V-rocket at White Sands, NM, E.B. White, in the New Yorker of December 27, 1946 reported: "The year end on a note of pure experimentation. Dr Fritz Zwicky last week tried to hurl some metal slugs into space, free of the Earth's gravitational pull. Dr. Zwicky stood in new Mexico and tossed from there. He was well equipped, he had a rocket that took the slugs for the first forty mile leg of the journey and then discharged them at high velocity to continue on their own. The desire to toss something in a new way, or to toss it at a greater distance, is fairly steady among men and boys….". Author White had guessed correctly. As a boy in the Swiss Alps I had throw stones across rivers and snow balls up church toward as far as high as i could without having anything in particular in my mind, except to be the best. My attempt to throw stones (artificial meteors) away from the Earth, however, was to be just a first step in a more purposeful chain of events. Col. Rivkin (American Ordnance Journal, March/April 1947, p.429-431) who inquired of me at White Sands in December 1946 just what this purpose was. I told "First we throw a small slug into space, then a bigger one, then a shipload of instruments and finally ourselves". What I really had in mind doing out in extraterrestrial space dates essentially back to 1928, when George Ellery Hale, for whom the entire complex of the observatories of the California Institute of technology and the Carnegie Institution in Washington is named, obtained a grant of six million dollars for the construction of the 200-inch Hale telescope and the necessary auxiliaries. At that time three of us who were physicists at the California Institute of technology (that is Sinclair Smith, John Strong and myself), shifted our principal scientific activities from physics to astrophysics, and observational and experimental astronomy which eventually included the use of both optical and radio terrestrial telescopes, as well as balloons, sounding rockets, earth circling artificial satellites and spaceships. All of these carriers of instruments to great heights and to distant extraterrestrial locations became available thanks to the technical developments during World War II, in which I participated as director of research of the Aerojet Engineering Corporation (later the Aerojet General Corporation). Our practical activities with rockets during World War II and the decade which followed, culminated in the launching (on October 16, 1957) from an Aerobee rocket of the first man-made object into interplanetary space, as well as in the invention, construction and production of both large scale rockets, new propellants and various novel propulsive powerplants such as the aeroplanes, the aeroresonator (buzz bomb engine), hydropulse, hydroturbojet and terrajet engines. In connection with the practical work, large projects were conceived concerning the future uses of INNER SPACE (the depths of the oceans and the interior of the Earth), as well as OUTER SPACE (extraterrestrial space) for unique observations, experimentation and exploitation, including the potential reconstruction of the solar system.

47 THE EVOLUTION OF AEROSPACE GUIDANCE TECHNOLOGY AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY, 1935-1951 - A MEMOIR

Draper, Stark C.

1971 - IAF/IAA *** - vol 2 - AAS vol. 7 part 2 - pp. 219-252

Guidance is the overall function which acts to cause a directable vehicle to move along a preselected path required for accomplishing an assigned mission. Attitude stabilization is a sub-function to maintain desired states of angular and linear motion, and which permits the system to be subject to accurate control changes in response to correction commands. Navigation is also a sub-function involving determination of the location and velocity of a vehicle. This data can be compared with programmed information to plan required manoeuvres. The author first analyzed the requirements for aircraft guidance while flying airplanes under conditions of zero visibility during the deacdes of 1920 and 1930. He ascertained that difficulties associated with "blind flight" had their origin in the loss of reference coordinate information ordinarily provided visually by the earth's surface features. Starting in the 1930's and continuing until the present time, the author and the Instrumentation Laboratory (later teh Charles Stark Draper Laboratory Division of the Massachussetts Institute of Technology - the organization he has been associated with for some 35 years) have devoted persistent efforts to the development of aerospace guidance technology. While a faculty member in the M.I.T Department of Aeronautical Engineering during the 1930's, the author developed theory, designed instruments, constructed guidance equipment and conducted flight tests in aircraft. Experimental results were interpreted, theory matched to observations, and the results provided as teaching material for his classes. Between 1935 and 1945 financial support for automated guidance work was very small, almost non-existent, and the author was limited to trials with commercially available Sperry Flight Instruments, the Artificial Horizon and the Directional Gyro. These devices, however, could only provide angular references with inaccuracy levels having the order of one or more degrees. Such equipment was useful for purposes of aircraft stabilisation and the maintenance of general directions, but not for following specific paths over the earth. Accurate navigation continued to depend upon visual or radio contacts. In his teaching, the author was concerned with the theory of more accurate instruments, including means for indicating the vertical, and a number of theses on these subjects were carried out by his students during the late 1930's. The first inertial system that was designed and constructed was named Febe (a variant of Phoebus Apollo, the sun god). It was designed, constructed, and subsequently test flown between Boston and Wright Field during 1948. Although performance was still marginal, Febe indicated the large potential of inertial operations, and elements of this system were made part of the more sophisticated inertial guidance system designed, built and tested during the 1950's.

48 ON THE HISTORY OF THE DEVELOPMENT OF SOLID-PROPELLANT ROCKETS IN SOVIET UNION

Pobedonostsev Yuri A.

1971 - IAF/IAA *** - vol 2 - AAS vol. 7 part 2 - pp. 59-63

The report described the work of the first Soviet organization for the construction of a rocket propelled by solid fuel, which began work in 1921 and subsequently received the title of Gas Dynamic Laboratory (GDL). The first rockets propelled by smokeless powder were tested in the GDL on 3 March 1928, and they already posed all the principal parts of which modern solid-fuel rockets consist. In the period between 1928 and 1933, the GDL produced and tested many different types of powder rockets of different weights and dimensions, differently problems was how to achieve the stability of their various different characteristics and accuracy of flight along a given trajectory. These rockets were further perfected in the RNII (Rocket Research Institute) where as a result of a series of thorough research operations, described in the report, a number of perfected types of powder rockets complete with firing platform were produced, designed for wide use. The success of these rockets was largely responsible for the concentration on the development of rocket engineering in the U.S.S.R. after 1945, which produced such outstanding progress in the field of cosmonautics.

49 F. GOMEZ ARIA'S ROCKET VEHICLE PROJECT

Carreras, Ramon

1971 - IAF/IAA *** - vol 2 - AAS vol. 7 part 2 - pp. 176-185

The idea of using rockets as a potential aircraft propulsion system appeared in Spain in the 19th century. Possibly one of the incentive that made several authors take up the application of rocket engines for this purposes was the great problem of diffusion of the direction of aerostatic balloons; and that of theflight of heavier-than-air vehicles. Two of the Spanish predecessors of F. Gomez Arias were Antonio MaClaret (1807-1870) and Pedro Maffiotto (1826-1870). Antonio MaClaret dealt for a short while the possibility of propelling an aerostatic balloon by means of a rocket. In 1949, in an article on Claret, L. Maqueda reproduced Claret's original writings dealing with this subject. Among them was to following passage: "…The thrust is given by a tube placed across the ballon boat, which should have a closed end in the front and an opened one behind. The tube is filled with black powder, so that once ignited it will cause a forward thrust like the rockets…". P. Maffiotto sent to the editor of "Revista de Obras Publicas", on Feb. 14, 1858, a note disclosing the results of his tests with a little model of a rocket propelled airplane. Maffiotto hoped that an improved and bigger model could be built, which would be able to transport a certain charge from one place to another. He also gave other considerations dealing with the future of man's conquest of the air. After a brief discussion of Claret's and maffiotto's ideas, the work of F. Gomez Arias is fully analysed. The latter's work is worth mentioning in a "History of Astronautics", together with that of the Russian, Kibaltchich, and of the German, Ganswindt.F. Gomez Arias is the first author to provide a detailed design of rocket propelled manned aircraft (1872). His "Memoria sobre la propulsion aerodynamica" was presented in the "primera Exposicion Maritim Espanola" that took place in Barcelona (Sept.-Oct. 1872). In the first part entitled: "Elevacion y direccion de aparatos mas graves que la atmosfera" (Ruising and direction of crafts heavier than the atmosphere), Gomez Arias described a design for a rocket aircraft almost ten years before Kibaltchich. His idea is summarized in the following lines:"… I believe the aerodynamic motor-propeller, among my other inventions explained in this "memoir", to be the most adequate for an easy test because of its great simplicity…It is based on the uninterrrupted gas speed by a convenient section, causes the reactive thrust necessary for propulsion." He gives a detailed description of the craft, which had the pilot-operator housed in a little boat. He indicated that food would have to be carried in extract to decrease the weight. He also proposed the use of the craft obtaining astronomic and geodesic observations. Although Gomez Arias' project was a wingless, vertical take-off, rocket-propelled serial vehicle, he did not consider the possibility of flight beyond the earth's atmosphere, and the only special protection he proposed for the aeronaut was against wind.In a later work Gomez Arias took up the use of a special scaphander for balloon ascensions to unbreathable atmospheric regions, and describes several systems of air stockage and iar renovation. This is probably the first space-suit design. Although Gomze Arias does not directly mention the possibility of interplanteray voyages, in his " Coloccion de problemas", he also considered the satellization and escape velocity. The place dealing with this particular subject is found in a pragraph on "Considerations upon inertia".

50 THE IDEAS OF K.E. TSIOLKOVSKY ON ORBITAL SPACE STATIONS

Kolchenko I.A. - Strazheva, I.V.

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Already in his earliest works on Astronautics, K.E. Tsiolkovsky proposed the use of orbital stations (O.S.) for the assembly and launching of interstellar space vehicles. In later publications, he discussed the use of orbital station (O.S.) a laboratories for astronomical, bio-medical, industrial and technical reserach work in space. He considered as the most important aspect of this reserahc the possibility of assuring man's life in space over the longest possible period of time. In a number of his works, Tsiolkovsky developed the idea that the conquest of other planets of the solar system must start with the creation around those planets of a system of O.S. He considered that after the time necessary for the accumulation of experience and knowledge concerning the design and exploitation of the O.S.. Humanity will create huge populated rings of "towns in the ether" on orbits around planets and stars. As Tsiolkovsky developed still further his concepts concerning the aims and purposes of the O.S., he submitted various specific projects. Thus, he proposed to build the complete O.S. by sections which have to be sent separately from the earth, and to provide the complete O.S. system with solar energy, he suggested to create an artificial gravity in some of the compartments of an O.S. and to establish a closed life support system using the solar energy, this system being designed to supply food as wall as oxygen for the crew. The historical analysis of Tsiolkovsky's concepts concerning Orbital Stations leads to the following conclusions:

1. K.E Tsiolkovsky was the first to forumlate the precise program according to which O.S. are being developed today.
2. Tsiolkovsky considered the O.S. as the most important element of the whole program of the conquest of space, which the founder of astronautics had suggested. In the study of various problems related to the O.S., he realized what should be called "the system approach".

51 HISTORY OF THE DEVELOPMENT OF ROCKET TECHNOLOGY AND ASTRONAUTICS IN POLAND

Geisler, Wladyslaw

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Rockets were used in Poland for several hundred years. Tatars used rocket weapons on Polish territory probably as early as the 13th century. Jan Dlogosz, a Polish historian of the 15th Century, describing the battle of Lognica (1241), mentioned the tatars carried high above their troops dragon heads spitting fire and smoke on the Polish knights who were then unable to fight any longer. A convent built near the battlefield was decorated with frescoes showing the battle of Lognica and the dragonheads described by Dlugosz. An architect, Valenty Sebish (1577-1657) living in Wroclaw, was also known as rocket constructor. He left many drawings and descriptions of rockets. According to those descriptions, rocket-launchers in the form of dragon heads were traditonally used in the Middle Ages, and later in the Renaissance period both as military and as decorative rockets. Sebish prepared dragon wings and descriptions of rockets with a stabilizing bar connected internally with the rocket body, as well as bundles of rockets corresponding to recent rocket batteries. Books on rockets were published by a Polish, Marcin Bielski (Wolski) in 1569, by an anonymous author in 1623, and by del Aqua, a Venitian working for Poland, in 1637. In 1643 a Polish translation appeared of a book on rocket construction by a Spaniard, Diego Uffano. The greatest credit for the development of rocketry in Poland - and to a large extent in Europe - is dues to Kazimiercz Siemonowicz, who served as deputy chied in the roayl artillery of Wladyslaw IV, king of Poland. Siemonowicz was the author of "Artis Magnae Artilleriao - Pars Prima", written in Latin and printed in 1650. It was published in French a year later, in German in 1676 and in Dutch and English in 1729. For more than 100 years the book of Siemienowicz was known as the best handbook for instruting European artillery-men. In a very systematic manner, Siemienowicz described recent rockets, their construction and propellants and described his own rokets; for example, a 3-stage and a 2-stage construction, whose first stage was, in fact, a rocket battery. Captain Josef Bem improved military rockets in the Warsaw Armory. In 1820 he published in French and German, a report of their uses. Bem described, among others, the use of rockets by the English navy against the town of Gdnask in 1813. During the battle of Grochow on 25 February 1831, the chief-of-staff of the November Insurrection, general Pradzynski, used successfully the "Congreve rockets" against the Russian cavalry. The theoretical possibilities of the use of rockets for flight beyond the Earth's atmosphere were presented in 1895 by the young Mieczyslaw Wolfke, later a professor of the Warsaw technical University. Franciszek Abdan Ulinski began in

1913 to study problems of rocket flights. In 1920 he published in a Viennese journal" "Der Flug", a paper on the use of electric particles ejected from a "cathode" rocket for its propulsion. As the energy source, he proposed solar radiation and thermoelectric batteries. In 1932-33 Ary Szternfield, born in Sieradz (near Lodz) wrote his "Introduction to Cosmonautics". On 6 December 1933, he presented his achievement at the Astronomicla Observatory of Warsaw University. As we know, the trajectories calculated by Szternfield for "space travel" in 1933 were realised 25 or 30 years later in launching many artificial Soviet and Americans Earth satellites. In 1935, Ary Szternfield emigrated to the U.S.S.R. and in 1937 he published his first book in Russian. Rockets flights in the Earth's atmosphere and beyond were also studied in the 1930's by Kazimierz Zarankiewicz, later professor and first president of the Polish Astronautical Society.

52 EXPERIMENTAL RESEARCH AND DESIGN PLANNING IN THE FIELD OF LIQUID-PROPELLANT ROCKETS ENGINES CONDUCTED BETWEEN 1934-1944 BY THE FOLLOWERS OF F. A. TSANDER

Dushkin, Leonid S.

1971 - IAF/IAA *** - vol 2 - AAS vol. 7 part 2 - pp. 79-97

On the basis of his theroetical and pratical work F.A. Tsander founded his school for the theory and construction of jet engines. The records available for the period 1934-44 indicate the influence of the F.A Tsander school on part of the work done in the U.S.S.R. during this period by his pupil and followers. The report lists some of the reserach and work on LPRE carried out with the direct participation of the author. These include the following:

1. Alcohol-oxygen, single action, LPRE "12/K" with 300 kg. Thrust (1934-36)
2. Experimental research on the functioning and characteristics of the chambers of nitric-acid LPRE;
   a) methods of ignition and combustion of fuel in a bomb with semi-enclosed volume (1937-38);
   b) methods for atomization and combustion of fuel, and cooling of the chamber walls and the nozzle (1938-39);
   c) distribution of the heat flux in the walls of the nozzle with external cooling (1942).
3. Alcohol-oxygen, multiple action, LPRE "RDK-I-150", with variable thrust, 160-80 kg (1940).
4. Nitric acid, multiple action, LPRE "RDA-I-150" with variable thrust 150-70 kg, for rocket plane RP-318 (1939-40).
5. Combined solid and liquid fuel, single action, rocket engine "KRD-604", with staged thrust of 5000-1100 kg, for rockets (1939-40).
6. Nitric acid and kerosene, multiple action, LPRE "D-I-A-110" with variable thrust of 350-1400 kg, with pumping system for supply of fuel for rocket plane (1941-42).
7. Nitric acid and kerosene, multiple action, LPRE for autonomous airplane with pumping system for fuel feed:

a) single-chambered engine "RD-2M", with variable thrust 350-1400 kg. (1943-44)

b) dual-chamber engine "RD-2MZV" with variable thrust, 100-1400 kg (1944).

Analysis of the data submitted shows that the solutions to various questions of principle relating to the research on and designing of LPRE adopted in the U.S.S.R. in the period 1934-44 by followers of the F.A. Tsander school were characteriszed by both originality and maturity.

53 BARON VINCENZ VON AUGUSTIN AND HIS RAKETENBATTERIEN: A HISTORY OF AUSTRIAN ROCKETRY IN THE 19TH CENTURY

Winter Frank H.

1971 - IAF/IAA *** - vol 2 - AAS vol. 7 part 2 - pp. 23-41

Of the many military rocket establishments in the nineteenth century, Austria's was the largest and most sophisticated. Austria's preeminence spawned the growth of other rocket system directly through military or political channels, or indirectly through imitation. The Austrian example is thus the quinteseence of the state of the art during the post Congreve and late Congreve period in Europe. The Austrian establishment typically can be traced to experiences with Congreve rockets during the Napoleonic wars. Invented by the Englishman Sir William Congreve, in 1804, Congreve rockets were generally constructed of sheet iron tubing and propelled by strong formulaes of gunpowder, and contained explosives or incendiaries within their warheads. Rudimentary models were constructed in Austria as early as 1808, but i was the meritorious service of the English Rocket Troop at the Battle of Leipzig ("the Battle of nations") in 1813 that led directly to the establishment of the Austrian system. Austrian aide-de-camp, Major Vincenz von Augustin of the Artillery, witnessed the Rocket Troop's actions and their strange, new weapons inspired him to build a similar force for his own nation. Augustin first sought to learn what he could of this hitherto unknown arm, first by visiting Congreve in London, then by clandestinely travelling under Army and diplomatic orders to Denmark to interview a Danish officer who was secretly making war rockets for his own country. Like the V-weapons of World War II, Congreve rockets were regarded with considerable dread and were treated with the greatest secrecy. Concgreve and the Danish officer were therefore not able to afford Augustin any details of manufacture, and only permitted him to view experimental flights and to visually examine their rockets. Augustin persisted, however, and began experiments on his own. By 1815 he had convienced the authorities to place Austrian rocket troops in the field using rockets of his own design, and by 1817 the first of the great Reketenbbatterien were officially formed. At thier height, in the 1850's, the Austrian establishment had swollen to a huge, 600 man battalion, and their rocket weapons wwere considered the finest in Europe. They were also among the most active rocket troops on the continent, having been deployed notably in quelling the insurgent Italians and Hungarians during Austro-Hungary's bloody revolutionsd of 1848-49. The town of Weiner-Neustadt, just ouside of Vienna, was the site of Augustin's rocket manufacture and achieved such fame that it became colloquially called "Raketendorf" (Rocket Town). Besides rockets for war, Weiner-Neustadt produced a variety of other rocket devices and was thus ythe foundation for rocket technology in Austria. Life-saving signal, and flare types were made, and new manufacturing and testing techniques begun. As the Austrians' conventional artillery advanced markedly in accuracy after 1860, their rockets could not keep pace. They were soon declared obsolete. With ethe gradual dissolution of the Raketenbatterien begining 1860, and with it eventual abolishment in 1867, the majority of European nations followed the exemple of this leading nation in rocketry, and likewise abandoned their own once "formidable rocketeers". Only life-saving and signal rockets survived the century - long enough to provide basic hardware for the precursors of the twentieth century rocket man the spaceship.

54 EVOLUTION OF SPACECRAFT ATTITUDE CONTROL CONCEPTS BEFORE 1952

Roberson Robert E.

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Those who formulated the early space flight concepts, the pioneers of flight, were quite nautrally preoccupied by problems of propulsion. Without propulsion the vehicle would not leave the ground, and questions of auxiliary functions, however important they ultimately might be, were academic. Yet in surprising that the problem of spacraft attitude control (or stabilization) during periods of unpowered flight was so alow to be recognized as one that potentially played a critical role in the operational utility of the craft. until 1952 did not the first systematic investigations of this problem as the incident domain of a separate subsystem begin. Nevertheless, the subject was not completely absent from the astronautics literature during the preceding half-century. Casual allusions to its needs almost as casual comments about how it might be accomplished can be dicovered among the slightly more plentiful descriptions of control during powered flight. Even some direct attention was given to attitude control toward the close of the period, as a part of several vehicle preliminary design studies, forerunners the much more detailed attitude control investigations of the early and mid- This paper surveys the evolution of attitude concepts in the astronautical literature before 1951, a natural dividing date between what might be regard as the gestation and exploitation periods of spacecraft attitude control. The nature of the attitude control problem is reviewed briefly, its ingredients of sensing and actuation are identified, and control during powered and unpowered flight is carefully distinguished. Within this framework the of Tsiolkovksy, Hohman, Oberth, Esnault-Pelterie and Goddard are reviewed, although the citations are not confined to these authors. It is shown that, regards attitude control, the 1920's and early 1930's are the only important historical periods until the late 1940's; indeed, they are the only periods significantly represented by bublication in the archive literature. Contributions of the late 1940's and early 190's originally were in the form of company reports whose distribution was explictly restricted. Only recently have these become available for general inspection. Although their influence on developments at that time is moot, they are reviewed here because they do provide a kind of status summary of extant viewpoints toward spacecraft orientation and its control at a convenient date.

55 A SURVEY OF ROCKETRY AND ASTRONAUTICS IN SPAIN

Maluquer Juan J.

1971 - IAF/IAA *** - vol 2 - AAS vol. 7 part 1 - pp.78-101

This paper is based on the work of the author "Data for a History of Astronautics in Spain before 1939", complemented by some new data recently uncovered in research. This study is presented in a systematized structure; the author believe it is the first publication covering the entire field on Astronautics in Spain till 1951.

56 COMPARATIVE ANALYSIS OF THE DESIGNS AND IMPLEMENTATION OF VEHICLES BASED ON REACTIVE PROPULSION PROPOSED DURING THE 19TH AND BEGINNING OF THE 20TH CENTURIES

Sokolsky Victor N.

1971 - IAF/IAA *** - vol 2 - AAS vol. 7 part 2 - pp. 3-24

This paper gives the results of a comparative analysis made of projects for jet planes and jet planes actually constructed, based on the application of the reaction principle, in the 19th and first half of the 20th centuries. On the basis of a survey of existing scientific and historical material relating to the problem of jet flight, the author show that all the planes projected and constructed in this period may be divided into the following groups:

1. Projects for jet planes designed to fly through the air (19th century).
2. Projects for cosmic flying machines, designed to operate in interplanetary space (end of 19th - begining of 20th century).
3. Rocket-propelled flying machines (principle of rocket dynamics for lift force), flight tests carried out in the 1920's and 1930's.
4. Jet-propelled flying machines (principle of aerodynamics for lift force), flight tests carried out in the 1930's and 1940's.

In addition the paper sub-divides the various types of flying machines into sub-groups in accordance with structure, types of fuel used and other factors relating to construction and power used. On the basis of research done the report then endeavours to establish certain law and trends characterizing the development of jet and cosmic rocket engineering in the period in question.

57 THE DEVELOPMENT OF ROCKET TECHNOLOGY AND SPACE RESEARCH IN POLAND

Subotowicz Mieczyslaw

1972 - IAF/IAA *** - vol 2 - AAS vol. 7 part 2 - pp. 135-151

There are three period of the history of the development of rocketry in Poland: (1) from the beginning to the lazst few decades of the XIXth century: construction and practical applications of primitive powder-rcokets used for fireworks and military purposes; (2) the last years of the 19th century up to the beginning of the Iind World War: primary experimental work on jet propulsion and the early theories of rocketry and space flight; (3) after the Second World War: modern research and rapid development of rocket technology, its peaceful and military applications, problems and their solutions of space research; human factors in space research.

1 / In Poland and in Europe rockets were used probably for the first time by Tartars during the battle of Legnica/Dolny Slask - Silesia, a province in Western Poland, in

1241. A monk Seweryn (about 1380), living in Legnica, has written on the application of powder to propell the "Tubes" which were probably rockets. The first exact description in Polish of rocket production is given in the book of M. Bielski, 1569. The next Polish author dealing with rocket problems was Walenty Sebish (1577-1657), the military architect of Wroclaw. His manuscripts from the time of about the year 1600 contain sketches of rockets with the delta-type stabilisers, conic nozzles in rockets, a rocket battery and a sketch showing a device similar to the two stage rocket. The outstanding work is the manuscript of A. Dell'Aqua (1584 - after 1654), written between 1630-1635, containing the sketch of the two stage combined rocket. The well known and outstanding book " Artis Magnae Artilleriae, Pars Prima" (1650) of Kazimiers Siemienowicz, translated later into many European languages, contains the sketches of a mutli-step rocket, a rocket battery, the conic rocket nozzles, and delta-type rocket stabilizers. The living in Poland (1617-1682) T.L Borttini, constructed flying models of heavier - than air flying ships. His invention was also to separate two different functions in the flying apparatus: lift force and thrust force. Rockets used in fireworks and for military purposes were described by W. Bystrzanowski (1749). Polish captain J. Bem (1820), later a general and a hero of Hungary and Turkey, gives in his report many technological descriptions of how to produce the military rockets and summaries the results of fiels experiments carried out with rocket weapons.

2/ From 1895 to 1903 a young man, M. Wolfke (1883-1947), later a professor of physics in Warsaw, the inventor of holography and co-discoverer of He-II, dealt in his youth manuscripts with the problem of communications with other planets by use a reaction space ship. Probably the first idea of the space rocket using the charged particles (electrons) as the jet names was formulated by A.F. Ulinsky (1920), an Austrian officer of Polish origin. More exact description of the experiments performed in Poland with the military rocket, jet engines and theoretical problems of the space flight solved in 20th century will be presented and more briefly discussed in the paper published in

58 HUNGARIAN ROCKETRY IN THE 19TH CENTURY

Nagy Istvan Gyorgy

1972 - IAF/IAA *** - vol 2 - AAS vol. 7 part 2 - pp. 42-50

The Hungarian rocketry in the last century was in close connection with the memorable historical events taking place in this counrty during the years 1848-1849. In the War of Independence the newly formed Hungarian army was greatly in need of a large quantity of various then up-to-date weapons among them war-rockets. The military preparations were greatly hampered since the available supply of war materials could not satisfy the demands. The government set about to tackle the task on the one hand by buying the arms from abroad, on the other hand by starting the home production of arms. There were negociations with the British inventor William Hale too about getting his spin-stabilized stickless rockets for the Hungarian army. These talks have not brought a satisfactory result. A great number of people offered their designs of different weapons to the government. Sandor Mozer, a one-time non-commissioned officer of the Austrain rocket corps, appeared in October &848 with ihs rocket design. Together with his comrades

Karoly Unger and Jozsef Vilfling he somewhat simplified the Augustin-type rockets. Obtaining with these rockets of 3 and 6 pounds favourable results the national arms factory began to produce them. Besides the mentioned types more rockets of 4 and 7 pounds were made in the factory too, by using the designs of Jozsef Szkopal, the head of the rocket department of the factory. The meninent Transylvanian gun-founder Aron Gabor in May 1849 visited the arms factory and made a study of the production of rockets. Returning home he began to make use of his new knowledge and produced some rockets which were put to test in June 1848. After the suoppression of the War of Independence the Hungarians in exile made plans for an armed uprising in their country. Lajos Kossuth, the former Governor-president of Hungary renewed the relations with William Hale. In consequence of a denuntiation these plans were frustrated. A Hungarian scientists, Lajos Martin made a design of a spin-stabilized rocket in 1856. He published some of his theoretical investigations in the journal of the Hungarian Academy of Sciences in 1860. The priority of William Hale as inventor of the spin-stabilized rocket is beyond dispute. Nevertheless everything points to Martin being the first who worked out a mathematical method in dimensioning for stress the mentioned type of rockets. In this manner Martin was one of the pioneers in the field of theory of rocket technology.

59 FROM WALLOPS ISLAND TO PROJECT MERCURY, 1945-1958: A MEMOIR

Gilruth, Robert R.

1972 - IAF/IAA *** - vol 2 - AAS vol. 7 part 2 - pp. 445-476

The group that created the Mercury concept came largely from the old National Advisory Committee for Aeronautics (NACA). The Missile Range at Wallops Islands, operated by the NACA, was a major factor in the development of this group, hence the title of this memoir "From Wallops Island to Mercury". The concept of the Mercury capsule and, indeed, the whole plan for putting man in space was remakable in its elegant simplicity, yet it was a daring and unconventional approach and the subject of considerable controversy. It demonstrated principles, however, that were so sound that they were to be applied also in the design and operation of the Gemini and Apollo flight programs. The period covered by this memoir extends from the founding of Wallops Island as a missile range in May 1945 through the establishement of the Mercury Project in 1958. It is a time period that saw great change, not only in science and technology, but also in world history. With the advent of the space age, the old NACA faded away and became NASA (National Aeronautics and Space Administration). Many of the people who had worked on and developed Wallops Island research projects helped from the nucleaus of the Space Task Group, the group that was to manage the Mercury Project. They were joined by others from NASA, and by specialists from the Army, Navy, and Air Force, and also from indusrty. Much of the work at Wallops Island and in NACA, inthe years just before space, was done in support of the ballistic missile program in the United States. Had it not been for the ballistic missile development effort, we would not have the knowledge of reentry bodies, guidance systems, or others factors such as the launch rockets themselves that were to make possible manned flight in space in such a brief span of time after the space age arrived. The first American astronaut orbited the Earth in only a little over three years after NASA was created, and yet the Soviets were the first to put man in space. Yuri Gagarin was to fly in April 1961, nearly a year earlier that John Glenn in Friendship 7.

60 THE VIKING ROCKET: A MEMOIR

Rosen Milton W.

1972 - IAF/IAA *** - vol 2 - AAS vol. 7 part 2 - pp. 429-443

The Viking rocket was conceived in 1946 by the Naval Research Laboratory as a vehicle for upper atmosphere research. Previously, the ionosphere had been probed by radio sounding from the ground and balloons had acrried isntruments up to heights of 20 to 30 kms. Il one could transport instruments to altitudes of 80 to 150 kms and above, many new doors would open. It would be possible to measurer directly the temperature, pressure and density of the atmosphere, and also to make direct measurements of ion and electron density in the ionospherics layers. By carrying a spectrograph above the ozone layer one could record the ultra-violet spectrum of the sun and the stars. At higher altitudes one could identify and measure primary cosmic-ray particles. And, finally one could take large-aera pictures of the earth, useful for meteorology, geology, hydrology and other earth sciences.Viking was the first large American rocket developed for these purposes. It was intended to supersed the V-2 rocket, when the supply of captured V-2's became exhausted. A total of 12 Vikings were devoted to upper air research; of these, seven were successful, in that they reached altitudes above 150 km and made significant measurements in the upper atmosphere. Among these are the hightest measurements of air density and winds up to that time, the first measurements of positive ion composition at high altitudes, the hightests exposures of cosmic ray emulsions and the hightests altitude photorgaphs of the earth for those early years. The Viking history, however, is best told through the stories of the launchings, and I have chosen four of them to relate in some detail. Theses are the first one, the fourth - launching at sea, and finally the eight and the tenth, in which we experienced exciting accidents. Summary performance data on twelve Vikings are presented in Tables at the end of this paper.

61 COUNTDOWN TO SPACE EXPLORATION: A MEMOIR OF THE JET PROPULSION LABORATORY, 1944-1958

Pickering William H. - Wilson, James H.

1972 - IAF/IAA *** - vol 2 - AAS vol. 7 part 2 - pp. 385-421

abstract not available

62 DEVELOPMENT OF THE GERMAN A-4 GUIDANCE AND CONTROL SYSTEM, 1939-1945: A MEMOIR

Steinhoff Ernst A.

1972 - IAF/IAA *** - vol 2 - AAS vol. 7 part 2 - pp. 203-215

abstract not available

63 ANALYSIS OF LIQUID-PROPELLANT ROCKET ENGINES DESIGNED BY F.A. TSANDER

Dushkin, Leonid S. - Moshkin Yevgeny K.

1972 - IAF/IAA *** - vol 2 - AAS vol. 7 part 2 - pp. 99-105

A prominent scientist in the area of the development of a wide range of problems in the theory of space flights is F.A.

64 **ON FUNDAMENTALLY NEW SOURCES OF ENERGY FOR ROCKETS IN THE EARLY WORKS OF THE PIONEERS OF ASTRONAUTICS**

Melkunov T. M.

1972 - IAF/IAA *** - vol 2 - AAS vol. 7 part 2 - pp. 186-194

The first efforts of the pioneers of rocket science and technology nturally were bound by the use of the chemical energy of uels. However, all of the initiators of the theory of rockets clearly understood the great value of the speed of the emission of gases from the jet of the rocket engine and therefore sought theoretically new sources of energy, which might permit the production of greater speeds of spacecraft and more distant controlled flight.

65 **BASIC STAGES IN THE DEVELOPMENT OF THE THEORY OF RAM-JET ENGINES (RJE)**

Merkulov Igor A.

1972 - IAF/IAA *** - vol 2 - AAS vol. 7 part 1 - pp. 229-238

In the history of the devlopment of the theory of ramjet engines the following principal periods may be distinguished:

- development of the fundamental propositions of the theory of ramjet engines (1929-1939)
- first experimental studies of ramjet engines in test beds and in flight (1932-1941)
- investigation of the processes, occuring in ramjet engine (1939-1940)
- the devlopment of the theory of hypersonic ramjet engines
- theoretical development of problems of space ramjet engines.

66 **ORIGINS OF ASTRONAUTICS IN SWITZERLAND**

Waldis Alfred - Stemmer, Joseph -

1972 - IAF/IAA *** - vol 2 - AAS vol. 7 part 2 - pp. 123-133

abstract not available

67 **A HISTORY OF THE ORGANIZATION AND ACTIVITY OF THE JET PROPULSION RESEARCH INSTITUTE (RNII), 1933-1944**

Pobedonostsev Yuri A. - Shchetinkov Yevgeny - Galkowsky V. N.

1973 - IAF/IAA *** - vol 3 - AAS vol. 8 - pp. 67-71

The achievements of the Soviet cosmonautics that led to the launching of the Earth's first artificial satellites in the U.S.S.R. were due not only to the swift development of post-war rocketry but also to the preparations that were conducted in the U.S.S.R. before the war, namely at the Rocket Research Institute (RNII). The development of the principles of rocketry and space technology was started in the Soviet Union with the work of his founder theoretical cosmonautics K.E. Tisolkowsky and other scientists, and also with the practical steps taken by the Leningrad Gas-Dynamics Laboratory, set up in 1921, and the Moscow Group for the Study of the Jet Propulsion, set up in 1931, which were a school for rocket and engines designing and served as the basis for the formation of the first Rocket Research Institute. The Rocket Research Institute was organized mainly on the initiative and under the direction of M.N. Tukhaschevsky with the active participation of B.S. Petropavlovsky and S.P. Korolev, who were respectively the heads of the Gas-Dynamic Laboratory and the Group for the Sutudy of Jet propulsion. Its purpose was to study the problems and schedule of the research in a programme proposed by K.E. Tsiolkovsky. The two orientations for research and experimental designing were divided by the staff and laboratory of the Institute into two specialities : the task of the first speciality in developing rockets using solid fuel was carried out and much was done to pave the way for liquid-fuel rockets. The paper conclude by the description of the different contribution of the Rocket Research Institute to the development of rocketry in the U.S.S.R..

68 THE FIRST EXPERIMENTS IN COSMIC-RAY RESEARCH WITH THE AID OF ROCKETS, 1949-1957

Vernov S. N. - Vedeshin, L. A. -

1973 - IAF/IAA *** - vol 3 - AAS vol. 8 - pp. 263-271

The only means for cosmic ray investigation the scientist disposed of the beginning of the 20th century was the ground equipment. At that time information on cosmic rays was rather spare. It was known that cosmic rays had high penetration capability and their intensity gradually increased with altitude. The next stage of cosmic ray investigation was application, in the 20th -30th of various aircraft for lifting of recording instrument into the stratosphere and beyond its limits. For studying primary cosmic rays new, advanced facilities were needed which could lift instruments beyond the upper atmosphere limits, to the altitudes more than 30 km. Early rockets experiments of 1946-1947 revealed some peculiarities of primary cosmic rays investigation with the above mentioned facilities. Experiments carried out in 1947-1951 permitted to estimate the altitude distribution of charged particles; the

69 CAMERA ROCKETS AND SPACE PHOTOGRAPHY CONCEPTS BEFORE WORLD WAR II

Winter Frank H.

1973 - IAF/IAA *** - vol 3 - AAS vol. 8 - pp. 73-102

The spectacular space photos taken on such projects as Apollo and Mariner are products of a highly sophisticated technology of the space age - However, the history of rocket and space photography can actually be traced back to the turn of the century. This paper, containing much material never before published will documented this significated technology from its infancy up to the World War II. The paper is divided in two parts:

The first part spans the period 1888 to 1918 and concerns itself almost exclusively with serial reconnaissances. Designs and experiments made during this time by Amédée Denisse, Ludwig Rohrmann, Alfred Nobel, Alfred Boyarsky, Alfred Maul and others, will be detailed. New material from the unpublished notes of Alfred Nobel's rocket experiments will be presented. The origins of rocket photography and contemporary aerial photos reconnaissance methods will be examined and include kite, balloon, pigeon, and airplane photography.

The second part of the paper covers the years following World War I up to pre-World War II and deals with the first pure research photo rockets as well as with rockets fitted with cameras to record flight performance. In this era were also the earliest known concepts of space photography, or suggestions of mounting cameras in rockets for obtaining astronomical or space photos from beyond the Earth as contained in writtings of Robert H. Goddard, Robert Esnault-Pelterie and hermann Oberth. Hitherto unpublished notes of Goddard's concepts of space photography will be covered. Among the experimenters discussed in this period are Vladimir V. Rasumov, A.I. Polyarny, Friedrich Schmiedel, and Robert H. Goddard. Post-war developments in rocket and space photography will be highlighted and will conclude the paper.

70 THE CREATION OF THE FIRST ARTIFICIAL EARTH SATELLITES: SOME HISTORICAL DETAILS

Tikhonravov Mikhail K

1973 - IAF/IAA *** - vol 3 - AAS vol. 8 - pp. 207-213

It became possible to build an artifical Earth satellite after the large engineering, scientific and production teams, organized in the U.S.S.R. during the fullfilment of the five-year plans, had worked for several years on problems of rocketry and the building of carrier rockets. In the U.S.S.R. the work on artificial satellite started in 1953 after it became clear that this was feasible. The foillowing permises underlay the designing of the first satellite: it had to be as simple as possible and reliable, its shape had to be spherical and it had to have a continuously operating transmitter. The scientific significance of the launching of this Earth's first man-made satellite was, first, that it showed the feasability of the project and the working capacity of the instruments in it; second, the satellite's thermal regime was studied and the pressure in it was preserved. Then followed the study of the passage of radio waves through the ionosphere with their source lying above the maximum electronic concentration of the F2 layer. And, lastly, the density of the upper atmosdphere was studied along the evolution of the satellite's orbit. These investigation's were facilitated by the satellite's spherical shape. The first satellite gave the impetus for the fulfilment of the series of space programmes both in the Soviet Union and abroad. The launching of the Earth's first artificial satellite on October 4, 1957 ushered in the space era with ist fabulous prospects for the exploration of inter-planetary space.

71 HIGH ENERGY ROCKET PROPELLANT RESEARCH AT THE NACA/NASA LEWIS RESEARCH CENTER, 1945-60: A MEMOIR

Sloop John L.

1973 - IAF/IAA *** - vol 3 - AAS vol. 8 - pp. 273-282

abstract not available

72 ROBERT H. GODDARD: ACCOMPLISHMENTS OF THE ROSWELL YEARS, 1930-1941

Durant III, Frederick C.

1973 - IAF/IAA *** - vol 3 - AAS vol. 8 - pp. 317-341

The Smithsonian Institution sponsored Robert H. Goddard's early research in both solid and liquid propellant rocket propulsion from 1917-1929. Four flights of liquid propellant rockets were made during the period 1926-1929. In June 1930 on the recommendation of Charles A. Lindberg, the Daniel and Florence Guggenheim Foundation of New York made the first of several research grants to support construction of facilities at a remote desert area near Roswell, New mexico, and development and test of enlarged rockets. The work at Roswell proceeded from 1930-1941 except for an interruption from 1932-1934 by the financial depression at that time. At Roswell, Goddard conceived and conducted a remarkable program of design, test and flights of liquid propellant rockets. Shop facilities, launching tower, control and tracking stations were constructed and equipped. Gas generator and turbine-powered centrifugal pump systems as well as gyro-stabilization systems utilizing retractable air vanes and rocket jet deflector vanes were designed and tested. Flight vehicles as large as 6,71 m long and 46cm dimeter were constructed and flown. Rocket motors were built and tested with thrust ranges of 131 kg to 448 kg. Thirty one flight were made. Gyro-stabilized flight and gimbaled motors were demonstrated. Flight velociies in excess of

73 FROM A-4 TO EXPLORER: A MEMOIR

Debus, Kurt H.

1973 - IAF/IAA *** - vol 3 - AAS vol. 8 - pp. 215-262

The progressive development of missile technology in progress in which the former Peenemünde development group took part is discussed from their arrival in the United States in 1946 through the launch of the first U.S. Earth satellite, Explorer 1, January 31, 1958. Activities conducted at White Sands, new Mexico, where V-2 rockets were fired in upper atmospheric research projects, and at Fort Bliss, Texas, where the group engaged in ram jet development and other assigned tasks, are summarized. Transfer of the group to Hunstville, Alabama in connection with the consolidation of U.S. Army rocket development at Redstone Arsenal in 1950 opened up a new phase as they were assigned to design, develop, test, and prepare for deployment the Redstone Ballistic Missile System. This program is treated in chronological order until the system's deployment in Europe. The paper then takes up the follown-on program to develop the Jupiter Intermediate Range Ballistic Missile System and carries this through deployment to Italy and Turkey. In connection with the Jupiter project, the solution to reentry heating is discussed which required the development of a minimum satellite capability. The paper conclude with a detailed description of the launch of the first U.S. satellite, Explorer 1, which made use the reentry heat test vehicle, on January 31, 1958.

74 DEVELOPMENT OF THE PRINCIPAL PROBLEM OF INERTIAL NAVIGATION
Tkachev L. I.
1973 - IAF/IAA *** - vol 3 - AAS vol. 8 - pp. 23-39

The historical criterion: the inertial navigation, as a science, originates from the time when the possibility of eliminating all the methodical errors from the inertial readings was stricktly proved.

1) Prehistory (1903-1942). The investigations of many scientists favoured to make the problem clear, but they didn't solve it.
2) The qualification leap (1942-1943). The solution of the inertial navigation's problem as a whole was first brought to scientists notice in L.I. Tkachov's report at the Leningrad University in 1943.
3) The chronosequence of the inventions of some particular types of INS (1942-1958).

75 THE DEVELOPMENT OF SYSTEMS OF AUTOMATIC FLIGHT CONTROL OF ROCKETS IN THE U.S.S.R., 1935-1939
Rauschenbach Boris V.
1973 - IAF/IAA *** - vol 3 - AAS vol. 8 - pp. 103-07

abstract in English not available, only in Russian

76 A HISTORY OF THE MECHANICS OF BODIES OF VARIABLE MASS IN THE U.S.S.R. AND SOME OF ITS APPLICATIONS IN ROCKET DYNAMICS
Kosmodemiansky Arkady A.
1973 - IAF/IAA *** - vol 3 - AAS vol. 8 - pp. 41-48

The first part of the paper will outline the history of the discovery of the basic equation of the propulsion or rockets in free space (Tsiolkovsky formula). The Tsiolkovsky theory of the propulsion of multistage rockets was a major achievement in the theory of rocket propulsion. It will be shown that the Hohmann trajectories were known to Tsander as early as 1923 and it will be noted that the optimal trajectories of intercontinental ballistics missiles in the Earth's field of gravitation were studied in details by Tsander in 1929. The application of methods of the calculus of variations in 1940-1970 was a substantial contribution to the theory of rocket propulsion.

77 THE DEVELOPMENT OF SPACE TRANSPORTATION WITHIN A HISTORICAL FRAME OF REFERENCE
Koelle Heinz H.
1973 - IAF/IAA *** - vol 3 - AAS vol. 8 - pp. 49-54

The paper begins with a broad picture of rocket development during the last on hundred years. Then the leading indicators of space transportation systems are explained using a typical multi-stage rocket. The propulsion trends are indicated by such parameters. Vehicle characteristics and their development trends as a function of time used as indicators for the state of the art. The overall performances of space carrier vehicles within the space programme of his planet is indicated. It is attempt also to draw a broad picture for the total development effort for all rocket vehicles in all countries, to estimate the average total operating cost of rocket as a function of time, to calculate the specific direct operating cost for orbital and escape missions respectively, in order to indicate the general economic trends. The paper concludes with an outlook on the space transportation trends to be expected for the rest of thus century and attempts to indicate such development projects which are particular promising and desirable.

78 COMING DOWN WITH THE ROGALLO WING: EARLY IDEAS ABOUT RETURNING TO EARTH FROM SPACE

Hacker, Barton C.

1974 - IAF/IAA A74-23 - vol 3 - AAS vol. 8 - pp. 11-22

abstract not available

79 AMERICAN ROCKET AIRCRAFT: PRECURSORS TO MANNED FLIGHT BEYOND THE ATMOSPHERE

Hallion, Richard P.

1974 - IAF/IAA A74-26 - vol 3 - AAS vol. 8 - pp. 283-313

Beginning in 1944, the United States initiated development of a series of rocket-propelled aricraft for transonic and supersonic aerodynamic research. In time, the research mission of these aircraft began pointing the way toward manned flights beyond the atmosphere. In 1950, the National Advisory Committee for Aeronautics (NACA) became interested in developing ypersonic research aircraft which could operate at least briefly outside the atmosphere. This required studies on maintaining aircraft attitude via reaction controls, aerodynamic heating, and the problem of winged reentry into the atmosphere. In 1952-53, the various projects undertaken by the NACA Committee on Aerodynamics, the NACA Pilotless Aircraft Research Division,the Office of Naval Research, and the Air Force Scientific Advisory Board's Aircraft Panel permitted development of a Mach 5-7 aircraft -- one that could provide information for the design of winged, manned orbital aircraft -- to proceed. Out of this later work came the Mach 6.7 North American X-15, the first aircraft to be flown beyond the atmosphere. Much of the technology that was later emploiyed in NASA's manned spacecraft, in space sciences, and in "human factors" research on the role of the pilot in areas was fashioned during the X-15 program. The early American rocket aircraft also contributed to the evolution of the space suit and spacecraft life-support systems, the use of ground-tracking facilities to development of reliable, reusable rocket engines….

80 POLISH EXPERIMENTAL AND METEOROLOGICAL ROCKETS, 1954-1973

Walczewski Jacek

1974 - IAF/IAA A74-31 - vol 3 - AAS vol. 8 - pp. 169-179

The paper summarizes Polish activities performed in frameworks of civil rocket programmes, from their very beginning in 1958 up to the recent developments in 1973. At first, a brief review is given of the design and research works started jointly by the Polsih Astronautical Society and the Academy of Mining and Metallurgy in Cracow, then continued and, developed with participation of various

Institutions, mainly the Aero-Club of Poland, the Polish Hydro-Meteorological Institute/ now the Institute of Meteorology and Water Economy, and the Institute of Aviation. Rocket type families are described with their brief history. The family of "RM" and "RD" rockets was used for basic research works. The "RM-1" rocket belongs to this family, being the first Polish research rocket - launched in 1958. The "RP" rockets were used for experiments with rockets transport of small loads - "rocket mail"- and for training purposes. The "RASKO" rockets were intended for use in experimental cloud-seeding operations. The most powerful rocket types built in Poland are belonging to the "Meteor" rocket family. The "Meteor-1" and "Meteor-3" meteorological rockets were built in series and were used in routing soundings of the upper atmosphere in the years 1965-1971 ; more than 200 of these rockets being fired. "Meteor-2" with 90 km ceiling was the biggest of the Polish research rockets. One of the interesting echoes of the Polish rocket developments was the adoption of some "RP" and "RASKO" rocket features in Indian rockets built in Birla Institute of Technology.

81 SOME CONTRIBUTIONS TO THE HISTORY OF EARLY SPIN-STABILIZED ROCKETS

Nagy Istvan Gyorgy

1974 - IAF/IAA A74-29 - vol 3 - AAS vol. 8 - pp. 3-7

In our previous paper we have pointed to some Hungarian relations to the history of early spin-stabilized rockets. We succeded finging more data referring to this subject in the last years...

Some data are connected with the activities of the well-known Britain inventor William Hale. It is a matter of commun knowledge that he designed the first practical spin-stabilized rockets in 1844. He was in connection with the Hungarians already in 1849, at the time of the Hungarian War of Independece. Two years fater the suppression of the war Lajos Kossuth, the former president of Hungary, then the leader of the Hungarian refugees renewed the relations with im. From donations collected in the United States in support of the Hungarian national libearion movement Kossuth was in possession of the means to give an order for weapons. Hale was commissioned by him to produce the rockets. We obtained further data about this so-called "Rocket Affairs". Amongother things we found a list of the Hunagrain refugees who on Kossuth's initiative wer employed by Hale. As it turns out from a letter Kossuth was in connection with Hale even after the inquiry instituted against them. Kossuth supported Hale's plans to establish a rocket factory in Belgrade. Other new data throw light upon the activities of an early designer of spin-stabilized rockets, the Hungarian scientist Lajos

82 A HISTORY OF THE FRENCH SOUNDING ROCKET VERONIQUE

Corbeau, Jean

1974 - IAF/IAA A74-32 - vol 3 - AAS vol. 8 - pp. 147-167

The history of the VERONIQUE sounding rocket is a rather long one, which is still continuing nowadays. It satrst indeed in 1949; since then 83 rockets of that type have been launched, the last on in april 1973, and four further ones are anticipated to be launched in 1975. During several years these rockets were the only French vehicles available for high atmospheric research; the knwo-how they permitted to obtain was directly used for other larger achievements such as the VESTA sounding rocket, the first stage of the DIAMANT satllites launcher, which made it possible for France to be the third nation accessing to space with its onw means in 1965. The second stage of the EUROPA launcher, and finally the first and the second stages of the ARIANE launcher which is now being developed and which is due to put 750 kg of payload into geostationary orbit in 1979. …

83 HISTORICAL ORIGINS OF THE SERGEANT MISSILE POWERPLANT
Caroll, Thomas P.
1974 - IAF/IAA A74-25 - vol 3 - AAS vol. 8 - pp. 121-146
Engineers and historians most often remember the U.S. Army's Sergent guided missile as the first operational missile to incorporate an all-interial guidance systems, but few remember that it was also the first relatively long-range tactical missile with a solid propellant powerplant. This advance was made possible by the utilization of a composite rubber base propellant in a case-bonded internal burning configuration -- a radical departure from the contemporary state-of-the-art; every current large American solid-propellant powerplant is derived from this design. Stemming primarly from the JATO work performed at caltech's Jet Propulsion Laboratory and its antecedents, the technology for the Sergent booster was developed between, roughly, 1940 and 1954. The American rubber industry and other rocket groups, such as the Hermes Project of the General Electric Cy, provided significant technical input, and a crucial conceptual advance was imported from Great Britain during World War II. This paper traces these development, with an emphasis upon the emrgence of the Sergent propellant and of the overall design concept. A brief discussion of the implications of this case study for our understanding of invention, development, and innovation in the modern industrial research laboratory follows the interpretive narrative.

84 DEVELOPMENT OF RAMJET ENGINES IN THE SOVIET UNION
Shchetinkov Yevgueny S. - Merkulov Igor A. -
1974 - IAF/IAA A74-30 - vol 3 - AAS vol. 8 - pp. 109-118
abstract available only in Russian

85 THE ROLE OF MIKHAIL K. TIKHONRAVOV IN THE DEVELOPMENT OF SOVIET ROCKET AND SPACE TECHNOLOGY
Biryukov, Yu. V.
1974 - IAF/IAA A74-28 - vol 3 - AAS vol. 8 - pp. 343-349
abstract available only in Russian

86 LATENT U.S. NAVY DEVELOPMENTS CONTRIBUTING TO ASTRONAUTICS: A MEMOIR
Hoover, George W.
1974 - IAF/IAA A74-27 - vol 3 - AAS vol. 8 - pp. 181-206
abstract not available

87 EARLY HISTORY OF THE SKYLARK ROCKET
Dorling, E. B.

1975 - IAF/IAA A75-42 - vol 4 - AAS vol. 9 - pp. 163-189

The British SKYLARK sounding rocket has been the workhorses of the United Kingdom's rocket research programme since 1957.It had its origins in a study at the Royal aircraft Establishment, Farnborough (R.A.E), in 1953-54 of the performance of single and two stage solid-propellant rockets, the study leading to a detailed analysis ofthe performance of a single stage sounding rocket capable of carying instruments weighing 45 kg to attitudes in excess of 150 km. The rocket's purpose was two-fold to provide a high altitude vehicle for use in the research programme of the R.A.E.,and to make possible a programme of upper atmosphere research on collaboration with the Royal Society of London.Interest in upper atmosphere research in the United Kingdom had been stimulated by a meeting at Oxford in 1953 supported by a number of U.S scientists actively engaged in rocket research.In the summer of 1955 arrangements were completed between the Gassiot Committee of the Royal Society and the then British Ministry of Supply for a programme of high altitude rocket research which was to coincide with the International Geophysical Year of 1958. The rocket was provided by the R.A.E the launching facilities by the Weapons Research Estblishment in Australia and the actual upper atmosphere experiments by group from number of British Universities.The Gassiot Committee was assisted in its planning of the programme of experiments by a sub-committee under the chairmanship of Professor Sir Harrie Massey, Frs, head of the Department of Physics at University College London. The design and manufacture of the Raven solid propellant motor began towards the end of 1995, and an 80ft. gimballed launching tower was designed, built and erected, at Woomera, in the space of a year. Six rockets were prepared for the initial proving of the design. The first was launched on 13 February 1957, the remainder at intervals over the next fifteen months. No serious difficulties were encountered and on 17 April 1958 the high altiotude research programme commenced with the firing of Skylark 07. Since that time 240 British SKYLARK rockets, have been launched from Woomera and many others by ESRO, the Europëen Space Research Organisation, at other ranges. By the addition of a small booster and by the steady improvment of the Raven motor, performance has been increased so that to-day a total head weight of 300 kg can be lifted at 250 km. A three-axis Sun-ponting control system for solar studies was introduced in August 1964, and has since been developed for stellar studies. The funding of the rockets and their associated launching facilities was arranged through British and Australian Government channels. The University research group funding was passed to the Royal Society's British National Committee for Space research on its formation, and, in 1965, became, together with all management tasks, the responsability of the U.K. Science Research Council.

88 STRUCTURE OF NEUTRAL UPPER ATMOSPHERE AIR SAMPLES AND FALLING SPHERES

Jones Leslie M

1975 - IAF/IAA A75-39 - vol 4 - AAS vol. 9 - pp. 201-229

In 1946 when rockets became available forsounding the upper atmosphere the principal features of the distribbution of the structural parameters were known.A temperature profile to the lower thermosphere had been deduced from balloon, sound propagation and meteor drag observations combined with theory, the density and temperature were deduced.Less certainty attached to the composition and, consequently, the molecular weight.The leading question here was the altitude at wich diffusive separation becomes significant. The role of rockets was to verify the leading model of the atmosphere , rejecting radical departures, and to provide average and extreme magnitudes for the parameters.Many ingenious scheme were divised by many investigators for rocket instruments to probe the neutral atmosphere.By virtue of performance reliability and cost perhaps five or six have survived and over the years have contributed to models as well as to our knowledge of the details of solar control of atmospheric structure. At the University of Michigan department of Aerospace Engineering an early experiment was to collect samples of the upper atmosphere in steel vacuum bottles and analyze the content for nitrogen and the noble gases.The goal was to measure r, the seperation ratio which indicatedthe extent to which diffusion has overcome mixing to produce a partial or complete Daltonian atmosphere.Samples were collected from 55 to 106 km over a period of ten years with analyses being made at the Universities of Durham and Michigan.Separation starting variably between 60 and 93 km was detected.An exhaustive search for non-geophysical causes was carried out with negative result.The investigators conclude that separated air can exist as low as 60 km but probably must be convected there by an, as yet undescribed, circulation process. As aan engineering alternative to various complex aerodynamic techniques for air density, the Michiagn group dveloped the falling sphere drag experiment.First flights with a Dovap-tracked inflatable sphere took place in 1952.Other versions using accelerometers or radar tracking were developed and used.The sphere experiment has generated a large ammount of upper air data including specific phenomenological studies.During the 2-year IQSY, 170 sphere flights were carried out by various groups. A limited number of flights, none at Michigan, continue today.

89 UPPER ATMOSPHERE RESEARCH AND THE FIRST ROCKET EXPERIMENTS IN THE U.S.S.R.

Mirtov B. A.

1975 - IAF/IAA A75-37 - vol 4 - AAS vol. 9 - pp. 231-235

abstract available only in Russian

90 EARLY SCIENTIFIC HISTORY OF THE ROCKET GRENADE EXPERIMENT

Stroud William G.

1975 - IAF/IAA A75-43 - vol 4 - AAS vol. 9 - pp. 237-252

Beginning in the Spring of 1948, at White Sands, New Mexico (32°N), the U.S Army Signal Corps initiated a lengthy seriesof V-2 and Arobee sounding rocket firings carrying an experiment that ultimately became the rocket-grenade experiment.This research work was a result of the signal Corps responsibility for the development of meteorological instrumentation in the U.S.The experiment was intended to measure the temperatures and winds in theatmosphere above the capabilities of the standard balloon radio-sonde about 100, 000 ft.(35km) to as high sa 300, 000 ft.(90km).The basic idea of the rocket-grenade experiment is straight forward; determine the temperature of the atmosphere by measuring the velocity of a sound wave through a layer of the atmosphere defined by successive burst of high explosives ejected from the sounding rocket on the upward leg of its trajectory.In fact , the experiment turned out to be much more subtle, both in analysis and in execution.Still, it became a powerful tool for exploration of the upper atmosphere, yielding accurate temperature and wind profiles between 30 and 90 km.Over the years, until about 1973, it was extended to other lattitudes from 10°N to 60°N, other seasons and other times of the day so that a definitive picture of the dynamics of the middle atmosphere was established.To derive temperatures and wind from the measurements made by grenade experiment, three basic physical assumption were necessary.a)That the composition of the atmosphere was constant up to peak attitude.Thus it is assured that the temperature, T velocity of sound, c, relationship was valid -C=kT1/2 where k is a constant depending on the ratio of specific heats and the mean molecule weight of the gas. B)The acoustic wave front remains coherent as it propagates downward through the atmosphere - i,e., that the horizontal variation in temperature and wind are negligible over distances of 15 km.c) The vertical velocity of the wind is negligible.Through many tens of rocket-grenade experiments and much careful analysis, we always found these asumptions valid.The basic measurement necessary for the analysis were: a)The accurate position of the explosion in space ; in early firings this was determinated by ballistic camera triangulation against the star field.b)The time of the explosion; this was determined by photo-cells on the rocket which picked up the light pulse and telemetered the time to the ground.c)The times and angles of arrival of the sounds waves at the ground; this was determined by an accurately surveyed sound ranging array of five microphones located as nearly as possible directly under the explosions.d) The surface air temperature from which the acoustic velocity at the surface was obtained.The early V-2 firings (Nos, 25, 33 and 56 in April and September, 1948, and November, 1949) carrying the grenade experiment produced no temperature or wind dat because of failures to obtain accurate times of the explosions (sounding rocket telemetry was not very reliable in those days).Instrumentation of the Aerobee rocket with the grenade experiment started with a firing in March 1950 followed bi successfull firings in July, October, two in December and then in June and November 1951.For the first time, precise values of the basic parameters were available and their reduction to atmospheric temperatures and winds made possible. However it was not until the summer of 1953 that the first definitive results of the successfull Aerobee firings of 1950, 1951 were published.2, 3, 4 The difficulty in the analysis was the correction of the acoustic wave travel times between layers for effects of the horizontal wind; therefore, obtaining the wind speed and direction.The breakthrough occured when one of our coleagues suggested the concept of a "virtual source"for the explosion, i, e, the position at which the explosion at which the explosion at a height Z would have oocur if there were no wind below z in order that it sound wave arrive at the origin from the measured direction?Physically, this could be interpreted as the actual location of the source in a coordinate system fixed in a uniformly moving atmosphere.Some 32 values of temperature and winds for the atmosphere above White Sands (32°N)were obtained from the six Aerobee firings of 1950, 51.At the lower end at 30km the fit with the baloon-radio sonde data was excellent.The temperature peaked at 270°K at 50km, falling to 210°at about 80 km.No pronounced seasonal effect in the temperatures was measured.However the winds showed a strong seasonal effect, being generally westerly in october, November, and December, and easterly in June and July. In both cases velocities up to 90km/sec in the 50 km altitude region were measured.By 1965, the rocket-grenade experiment had been conducted in Australia, Japan, Sweden, Italy and France and the U.S program had been extended to include foirings in Guam (10°N), Churchill(60°N), Wallops Island (40°N)with simultaneous firings from Wallop Island, Churchill and Ascension.It was possible with these extensives sets of data to draw a definitive picture of the global stratosphericans mesospheric circulation systems.

91 EARLY FRENCH UPPER ATMOSPHERE RESEARCH USING ROCKETS

Vassy, Arlette

1975 - IAF/IAA A75-38 - vol 4 - AAS vol. 9 - pp. 253-259

(*abstract only in French*) - L'utilisation des fusées pour l'exploration scientifique de la haute atmosphère a débuté en France en 1949 au sein d'un groupe réunissant scientifiques et techniciens civils et militaires. Après les essais, le premier tir dans un but scientifique de l'engin Véronique eut lieu en 1954 ; E. Vassy a mesuré le champ d'émetteurs de radiodiffusion, en collaboration avec le prof. Rawer ; il n' y avait pas de télémesure. En atendant qu'une télémesure soit disponible, nous avons en 1960 fait des observations sur les éjections de métaux alcalins qui étaient réalisées par le prof. Blamont. Le programme de recherches présentés en 1954 au 5è congrès d'astronautique ne fut finalement réalisé qu'en février 1961 avec télémesure.. Certains mesures exigeant la connaissance de l'altitude de l'engin, une méthode de calcul de cette altitude à partir d'un trièdre de capteurs magnétiques a été développée; cette méthode de calcul par continuité permettait de se passer d'un 3e paramètre fourni par un capteur auxiliaire, optique par exemple, utilisé par d'autres groupes de chercheurs.L'équipe scientifique était franco-allemande. Les altitudes atteintes par les fusées (Véronique) étaient comprises entre 120 et 180 km. Les résultats de 1961 étaient satisfaisants ; aussi nous avons pu compléter le programme pour les tirs d'octobre 1962 et d'avril 1963. Enfin, mon programme de mesure de la répartition verticale de l'ozone mis en œuvre en 1964 figurait déjà au programme français exposé en 1954. Les résultats sont d'autant plus intéressants, que même aujourd'hui cette mesure n'a été effectuée que rarement.Le capteur optique, réalisé au laboratoire, étatit une modification de l'appareil destiné aussi à la mesure de la répartition verticale de l'ozone et utilisé en ballons-sonde.L'altitude atteinte par la fusée (Bélier) était de 60 km.

92 DEVELOPMENT OF THE FIRST AUTOMATIC STATIONS FOR LUNAR FLIGHT IN THE U.S.S.R.

Maximov G. Yu.

1975 - IAF/IAA A75-40 - vol 4 - AAS vol. 9 - pp. 261-266

abstracts

abstract available only in Russian

93 EARLY UPPER ATMOSPHERIC RESEARCH WITH ROCKETS

Bergstralh, Thor

1975 - IAF/IAA A75-35 - vol 4 - AAS vol. 9 - pp. 135-161

In early in 1946 the Army Ordnance Department announced a plan to fire a considerable number of V-2 rockets from the White Sands Proving Ground and invited interested agencies to join in using rockets for upper atmosphere research. A V-2 Upper Atmosphere research Panel was formed a few weeks later to coordinate the research activities and ensure efficient use of the available boosters. The Panel consisted of representatives from the Air Materiel Command, the Applied Physics Laboratory, the Army Signal Corps Engineering Laboratories, Harvard University, Princeton University, the University of Michigan, the national Bureau of Standards, the general Electric Corporation, and the Naval Research Laboratory. In 1946 the capability of the V-2 to loft 2000 lbs of payload to altitudes of about 100 miles offered a unique opportunity for high altitude research. The V-2 warhead was replaced with a conical cast steel nose section capable of maintaining intruments under atmospheric pressure throughout the flight. Other instrumentation was located in the unpressurized control section immediately below the nose cone, between the fuel and oxider tanks amidships, and attached to various portions of the tail assembly. Assembly and firing of the V-2 was the responsability of the White Sands Proving Ground. Trajectory information was obtained by the Aberdeen Ballistics Laboratory and Army Signal Corps using optical, radar with beacon, and doppler means. Data recovery was primarily by means of a pulse-time modulated telemetry system developed by the naval resear Laboratory and furnished and operated by them for all agencies. The recovery of biological samples and films records was accomplished by causing an airburst of the rocket during reentry by severing the nose cone from the afterbody. The drag on parts of the missile was sufficient to cause low impact velocities so that instruments and records could be recovered. A total of 66 V-2s were assembled and launched at the White Sands Proving Ground between 1946 and 1954. Sixteen of the flights were instrument for upper atmosphere research by the Naval Research Laboratory. In addition, eleven Viking rockets built by the Glenn Martin Company and a number of Aerobee rockets werre used to augment the V-2 program. The program fulfilled its promise of providing new information on the upper atmosphere and extraterrestrial radiation. Atmospheric temperature pressure and density date were obtained to an altitude of 200 kilometers. Atmospheric composition was explored by means of sample collection techniques and rocket-borne mass spectrometers. Although the early experiments experienced difficulties due to sample bottle sealing problems and contamination by rocket outgassing, evidence was obtained showing that diffusive separation did not set in below 60 kilometers. Ozone measurements and the solar ultraviolet spectrum were obtained by grating spectrographs mounted in the aerodynamic tails fins of the V-2. The vertical distribution of ozone was found to be in good agreement with photochemical theory and provided the first experimental evidence of the formation of a "Chapman" layer. Hightly resolved solar spectra were obtained to 2100 angstroms, showing no absorption by rare atmospheric constituents other than ozone. Several techniques employng continuous wave and pulsed-radio transmissions and Langmuir probes were used in V-2s and Aerobees to obtain values of electron densities above the maximum ionization density layer. The rocket program offered an opportunity to obtain direct measurements on the primary cosmic radiation before it was altered by interactions with the atmosphere. The short flight time above the atmosphere and the mass of the rocket itself presented difficulties which had to be overcome by experiment design. The intensity of the primray radiation and the proton-alpha particle ratio were established with good agreement by the two groups of experimenters.

94 EARLY CONCEPTS OF AEROSPACE SYSTEMS

Ponomarev A. N. - Mikhailov V. S.

1975 - IAF/IAA A75-41 - vol 4 - AAS vol. 9 - pp. 37-40

abstract only available in Russian

95 ANALYSIS OF ROCKET CONSTRUCTION, DESCRIBED IN MANUSCRIPTS AND PRINTED BOOKS DURING THE 16TH AND THE 17TH CENTURIES

Subotowicz Mieczyslaw

1975 - IAF/IAA A75-44 - vol 4 - AAS vol. 9 - pp. 3-12

During the international Congress on thr history of Science in Moscow (1971) I have presented the paper on the development of the rocket techniques and the space research in Poland from the 13th up 20th century. In the paper were mentioned the books or manuscripts of M. Bielski (1569), W Sebisch about (about 1600), Andrea dell Aqua (1630-1635), K Siemenowicz (1650), J Bem (1820) and M Wolfke (1895-1903). Other authors from the 20th century were also quoted in the paper.In the present paper will be reported some new results in the similar investigations of the Polish contribution to the developmentof the rocketry in the 16th to 20th century. As the first i shall mention the manuscript of S.Sarnicki (1575-1577), 2, where the rockets were described to make fires in the towns.The different types of the rockets were described by the Anonymus(3)in the manuscript used as the handbook in 1624.There was translated into Polish and published in 1643 the book of the Spanish author, Diego Uffano (4), concerning the artillery with some war applications of the rockets. After the well known book of K.Siemienowicz(5)were published the books of I Bogaitko, 1747 (6) and W.Bystrzonowski, 1749 (7)on the rocket technology. In Wilno was published the Polish translation of the book of A.F.Frézier (8) in 1803.One can mention two articles published in 1820 and 1829 on the production on the production and use of the improved rockets of Congreve by eng.Scuhmacher (1820) and new tested rockets of Congreve built in England by Siever and Brockeden. The artillery of the Polish kingdom in 1815-1831 was described by R.Los (1969) (9) and in the memoirs of the general and J.Pradzyn ski (1831) where the reports on the activity of the Polish Rocket Corps were given (10).

96 ANALYSIS OF EARLY 19TH CENTURY SWEDISH SOLID PROPELLANTS

Hansson, Jan - Skoog, A. Ingemar

1975 - IAF/IAA A75-45 - vol 4 - AAS vol. 9 - pp. 15-28

A number of old solid propellant rockets originating from the time of the Swedish Rocket Corps (1833-1845)or shortly before, has been preserved in Sweden, still containing the original propellant.Three rockets of different configuration, a 2 inches Rocket Corps standard (Congreve type), a signal rocket with paper case and a Vaillant rocket with 3 delta-wings, were selected for investigation and analysis of their propellants. After a through determination of the outer dimensions including photographic documentation, each rocket ws x-rayed in order to determine the exct internal configuration of the propellant charge.The rockets were disarmed by means of drilling the propellant out of the casein a remotely controlled machine at the laboratory of the Research Institute of the Swedish National Defence. The propellant weight and its density when loaded in the rocket have been determined.A chemical analysis was performed to find out the composition of sulphur, salpetre and carbon for each type of rocket.The pressure rise as a function of the time was established in a combustion test showing the typical characteristics of slow burning powder . The burning rate under atmospheric conditions was determined by means of a combustion test in an open groove.The results are compared with the characteristics of modern propellant of similar composition.Some notes and reports on the manufacturing of rockets from the time of the swedish Rocket Corps and the years before that have been preserved.This enables a certain comparison of the documented charctristics of that time with the ones established in these anzlyses.

97 BEGINNINGS OF AIRBORNE AEROMEDICAL WEIGHTLESSNESS RESEARCH

Von Beckh Harald J.

1976 - IAF/IAA A76-37 - vol 4 - AAS vol. 9 - pp. 29-35

abstract not available

98 HARRY BULL: AMERICAN ROCKET PIONEER

Winter Frank H.

1976 - IAF/IAA A76-39 - vol 4 - AAS vol. 9 - pp. 291-312

abstract not available

99 HISTORY OF DEVELOPMENT OF FIRST SPACE ROCKET ENGINES IN THE U.S.S.R.

Prishcheps V. I

1976 - IAF/IAA A76-36 - vol 4 - AAS vol. 9 - pp. 89-104

abstract not available

100 BEGINNINGS OF ROCKET AND MISSILE ACTIVITIES IN SWITZERLAND

Schilep Nik A.

1976 - IAF/IAA A76-41 - vol 4 - AAS vol. 9 - pp. 107-120

The aerospace activities in Switzerland cannot be compared in its contribution with countries like the United States or the U.S.S.R.. Switzerland is one of the ten member states of the European Space Agency (ESA) whose industry is working on various satellite projects and the European launch vehicle Ariane. However, our country can claim to have played a rather important role after World War II in the field of rocket and guided missile development. Initial steps in rocket technology in Switzerland were made with systematic development and tests of a liquid propulsion system, using a self-made test layout, by the Swiss engineer J. Stemmer in 1956. He measured the thrust with a dynamometer on a movable sled as well as the velocity of the gasses in various expansion nozzles. Several propellants such as gasoline with oxygen and acetylene with oxygen were investigated. Chamber pressures up to 50 atm and mozzle exit velocities up to 3 800 m/sec were measured. Parallel to these static tests, first flight tests with a model airplane were made near Zurich in April 1941. The model, equipped with a rocket motor producing 23 kg thrust, reached a maximum speed of 193 km/h. He was a scientist and engineer, a man who worked with the right ratio of theoretical background and practical experience. He, as so many other scientists and experimenters, suffered from limited fundings.

101 OPERATION BACKFIRE: ENGLAND LAUNCHES THE V2

Sharpe Mitchell R.

1976 - IAF/IAA A76-35 - vol 4 - AAS vol. 9 - pp. 121-134

As World War II drew to an end in Europe, the British Army found itself in possession of a number of V2 rockets and ancillary support and launching equipment, as well as many of the thecnicians who developed the V2. Also in their hands were some of the German trrops who had assembled, checked out, and launched these rockets against England and targets on the European continent. The Royal Army conceived a plan to gain experience in building and launching the rocket from a location in Germany, while carefully documenting all procedures. The british named the project Operation Backfire.

102 ALBERT FONO: A PIONEER OF JET PROPULSION

Nagy Istvan Gyorgy

1977 - IAF/IAA 77-A-14 - vol 4 - AAS vol. 9 - pp. 277-281

The outstanding Hungarian engineer Albert Fono was one of the pioneers of jet propulsion. His first invention of this kind the "sertial torpedo" dates back to the World War I, to the year 1915. He wanted to get a solution for increasing the range opf filed-artillery guns. According to the inventor's conception the gun-launched projectile could be united wit a ramjet propulsion unit by which the body gained acceleration. By this means it was possible to attain a long range even at low initial velocities, and heavy shells could be fired from guns of small weight. Fono submitted his invention to the Austro-Hungarian Army H.Q. but the proposal was rejected. Long after the war Fono took up the problem of jet propulsion again. He elaborated in 1928 the "air-jet engine" which was suitable for high-altitude supersonic aircraft and applied for a German patent. In an additional patent application the propulsion unit was adapted for subsonic speeds too. The patent were granted in 1932 with the priority date of May 1928 as these are the earliest which cover all the essentials of present aircraft and missile air-breathing jet engines.

103 GENESIS OF LIQUID HYDROGEN PROPULSION THROUGH 1945

Sloop John L.

1977 - IAF/IAA 77-A-16 - vol 4 - AAS vol. 9 - pp. 79-87

Liquid hydrogen was the first fuel considered by Tsiolkovsky in 1903, and he was followed by Goddard in 1910. In the 1920's, Oberth correctly assessed the advantage of using liquid hydrogen in the upper stages of space vehicles. None of these rockets pioneers experimented with liquid hydrigen; the first person to do so appears to be Walter Theil at Kummersdorf during the late 1930's. In 1945 the United States Army and Navy both began sponsoring reserach on liquid hydrogen for rockets, work that led eventually to the United States space vehicles of the 1960's and 1970's.The data of German jet propulsion by the Allies during 1945 would appear to be the genesis of interest in the United States in liquid hydrogen for rockets but research so far indicates this is not the case. This paper recounts early interests in liquid hydogen for rockets, all of which appear to have risen independently.

104 COMPUTER ORIENTED DYNAMIC MODELING OF SPACECRAFT: HISTORICAL EVOLUTION OF EULERIAN MULTIBODY FORMALISM SINCE 1750

Roberson Robert E.

1977 - IAF/IAA 77-A-11 - vol 4 - AAS vol. 9 - pp. 41-59

The development of Eulerian dynamical formalisms for systems of interconnected rigid bodies is described qualitatively, from their single-body origin in the works of Euler, through the bootless efforts of the 19th Century to the modern computer-oriented dynamic simulations. Major emphasis is on the aerospace application area/later extyended to terrestrial vehicles/, but some parallel developments in biomechanics and the kinematics of mechanisms are included.

105 KEPLER'S "THE DREAM OR LUNAR ASTRONOMY" AS A PREDECESSOR OF SPACE RESEARCH

Horsky, Z.

1977 - IAF/IAA 77-A-09 - vol 4 - AAS vol. 9 - pp. 269-275

Isaac Newton laid the foundamentations of the scientific theory of space research in the 80's of the 17th Century. Nevertheless we are bound to recognize Johannes Kepler -1571/1630 - as the predecessor of all scientific work in this fields. The results of his investigation which are of primary importance are expressed in Kepler's "Somnium" / The Dream/ - Actually some of these draft experiments formed the main body of Kepler's unpublished thesis in 1593, but Kepler finally completed this study in prague /1600-1612/. Kepler's discussions with the philosopher J.M. Wacher of Wackenfels inspired Kepler to compile his experience in this study. Aware of the liability of publishing a work like "The Dream", Kepler added notes and a glossary and it was not published till after kepler's death in 1634. Although the main idea embodied in Kepler's work was in support of Copernicus's theory of heliocentrism and Kepler was often given to fantastic flights of imagination, " The Dream" is an exact analysis of a series of phenomena, which are bound to take place, as soon as man leaves Earth and starts to observe the Universe from space or from another body. These aspects of Kepler's work which in many ways was a forerunner to space research, are analysed in detail in the paper.

106 FIRST ROCKETS EXPERIMENTS FOR RESEARCH ON SOLAR SHORTWAVE RADIATION

Ivanov-Kholodny G.S.

1977 - IAF/IAA 77-A-10 - vol 4 - AAS vol. 9 - pp. 191-200

abstract available only in Russian

107 ORGANIZATION AND RESULTS OF THE WORK OF THE FIRST SCIENTIFIC CENTERS FOR ROCKET TECHNOLOGY IN THE U.S.S.R.

Merkulov Igor A.

1977 - IAF/IAA 77-A-13 - vol 4 - AAS vol. 9 - pp. 63-77

abstract available, only in Russian

108 S. P. KOROLEV AND SOVIET ROCKET TECHNOLOGY

Rauschenbach Boris V.

1977 - IAF/IAA 77-A-15 - vol 4 - AAS vol. 9 - pp. 283-290

abstract not available

109 HUNGARIAN LUNAR RADAR EXPERIMENTS, 1944-1946

Nagy Istvan Gyorgy

1978 - IAF/IAA 78-A-06 - vol 5 - AAS vol.10 - pp. 153-157

The early lunar radar experiments took a prominent part in the history of astronautics. For the first time these investigations furnished evidence that it is possible to establish and maintain radio communication with the projected spacecrafts. The Hungarian experiments, initiated in 1944, were connected with the name of professor Zoltan Bay. He and his fellow-reserachsers brought about their work with a radar system designed by them originally for military purposes. Because of the events of the war the experimental apparatus had to be rebuilt twice. In the calculations Bay used the reasonable assumptions that the microwaves of 2.5 m wevelength travel with negligible absorption through the ionosphere of the Earth, and that the reflection coefficient of the lunar surface is of order of 1/10. Then on the basis of the parameters of his system he concluded that the amplitude of the echoes could be expected to be about 1/10 of the rms noise fluctuations of his receiver. Ay devised a novel method which consists of repeating the experiments a large number of times, of preserving the feeble echo amplitudes undiminished in strength for the entire duration of experiments, and of summing the amplitudes and raising thereby the signal above the statistical sum of the noise amplitudes. He constructed a bank of water voltameters and connected these by means of a rotary switch to the output of the receiver. The voltameters operated in such a way that the amount of hydrogen liberated in each of them was proportional to the integrated output of the receiver corresponding to different range intervals along the time base Of the ten voltameters used, one received the noise plus signal, nine only the noise, in this manner the experimenters were able to detect the echoes.

110 THE SWEDISH FIRE ARROW: THE OLDEST ROCKET SPECIMEN EXTANT

Skoog, A. Ingemar - -

1978 - IAF/IAA 78-A-01 - vol 5 - AAS vol.10 - pp. 41-57

Probably the oldest existing rocket specimen in the world is also one of the most balling devices as well. It is the "fire arrow" found in the Kungl. Armemuseum (Roayl Army Museum) in Stockholm and is dated to late 16th Century. The discovery of this device led to a replica being made and ehibited in the National Air and Space Museum, Washington DC (USA). A study of this unique 400 years old rocket specimen is of the reatest value not only because it is the oldest remaining rocket artifact but also because it enables a better understanding of early rocket technology and may also provide clues in the general development and spread of the rocket up to that time. Military inventory records from the 16th and 17th century show the fire arrow as part of the oevrall Swedish artillery arsenal from 1565 until 1626. Records also show their use in battle and the widespread availability of this weapon throughout the Swedish Baltic empire. The actual origin and maker of the specimen itself is unknown. The fire arrow first came into the possession of the Army Museum in 1879 from the Stockholm Ammunition Depot but no other records exist on it. The specimen consists of three individual rocket tubes wrapped in a cheesecloth or muslin material and mounted on a 208 cm long wooden pole with a metal barb attached to the head. Grooves running the length of the sitck and two separated but equal dimater woode discs at the end of the stick suggests that the fire arrow was gun-launched. Nothing has been found as yet which describes how the fire arrows were launched, but a survey of contemporary military literature reveals similar rocket designs and ideas. These accounts are discussed and include the cannon-fired rocket of Leonardo da Vinci of c& 1495; and the "rocket guns" of Giambattistat della Porta of ca 1580, the Count of nasau, 1610, and Andrea Dell(Aqua, 1613. Other works are also examined to determine the general construction of rockets at the time and include Konrad Kyeser, 1405, Conrad Haas, ca 1555-1580; Johan Schmidlap, 1608; and John Bate, 1654. The fire arrow is frequently discussed in rocket history literature. Yet, ist exact nature has hitherto been unexplored. The present paper provides a better understanding of this projectile and its place history of overall rocket technology.

111 FROM CELESTIAL MECHANICS TO SPACE FLIGHT MECHANICS: HISTORICAL NOTES ON THE DEVELOPMENT OF ASTRODYNAMICS

Schulz Wernher

1978 - IAF/IAA 78-A-02 - vol 5 - AAS vol.10 - pp. 79-95

The development of space flight mechanics draws from three roots by making use of the methods and results of celestial mechanics, of ballistics and of flight mechanics of aircraft and missiles. The aim of this lecture is to examine more clmosely the application of indings in celstial mechanics to space flight mechanics, the origins of which go back to the 17th century, i.e. to Kepler and Newton who revealed the nature of the planetary system and laid the foundations for celestial mechanics by the laws they discovered. In the 18th century the development of celestial mechanics is closely related to Euler and Lagrange. Euler was the first who made use of analytical methods in the field of mechanics instead of applying the geometrical-synthetic procedures which had been used before. In 1744 Euler published a theory of the motion of planets and comets. A further major achievement of Euler is the development of the calculs of variations originating from the conception of the Bernouilli brothers - Lagrange's contribution lis in developing the methods of analytical mechanics. He was able to write down immediaetly the equations furnishing the solution of extremum problems. The Lagrangian equations are an indispensable tool for investigating the motion of a system of mass points under constraint…

112 THE CONTRIBUTION OF SOVIET SCIENTISTS AND ENGINEERS TO THE TECHNOLOGY OF ROCKET LAUNCHING

Mikhaylov V. P.

1978 - IAF/IAA 78-A-07 - vol 5 - AAS vol.10 - pp. 105-110

In the world wide process of the development of the technique for the launching missiles three distinctive periods may be marked out:

a) the period of the development of unguided missile launchers (1905-hiherto),
b) the theoretical and experimental period, when mainly the theoretical reequisites for the carrier launchers were developed (1903-hitherto),
c) the period of the development of carrier launching systems (1955- hitherto). In all three periods the Russian scientists made avluable contributions to the missile launching technique. In the first period which began in Russia since 1732 Russian engineers developed several methods of the launching and designs for the launchers including underwater launchers (1834), filed launchers of four types matching the requirements of the rocketry of that time. At the beginning of XX century new projects were proposed, while in 1937-1945 high effective aircraft and mobile field rocket launchers were created in the course of the development of which, all problems were decided.

3) In spite of the fact that the Russian scientists and engineers began to work in the first period later than in other countries, their works in the XX century predetermined the begining of the second and the third periods. In the K.E. Tisolkowsky's scientific work (1903) the first recommendations are given for the launching space rockets with liquid propellant ones developed by him in the subsequent works. These recommendations are comprising the following principles the using of the means for boosting a rocket on the Earth, a climb of the rocket in the upper air and many other questions of static and dynamic methods of launching. The great contribution was made by Ju. V. Kondratyuk, who proposed a separate launching of the passenge rockets and a cargo rockets (1918). In the early thirties in the U.S.S.R. the successes were acheived in the launching of the experimental liquid-propellant rockets.

4) It was the sential contribution of the Soviet specialists in the launching technique in the third period that a number of the complex scientific and engineering problems were decided which led to the creation of the cosmodrom of "Baïkonour", of the launching complex of the "Vostok" booster, the firts launchings of manned and unmanned spacecrafts which opened the cosmic era

and also to the development of space-rocket vehicles starting from the moon-surface.

113 THEORETICAL AND EXPERIMENTAL INVESTIGATIONS IN THE FIELD OF ROCKETRY IN THE U.S.S.R. (UP TO THE EARLY FORTIES)

Merkulov Igor A.

1978 - IAF/IAA 78-A-03 - vol 5 - AAS vol.10 - pp. 113-114

In a number of papers on symposium on the History of Astronautics investigations in the field of the reocketry, which are carried out in the U.S.S.R. from the early twenties, were considered as well as some Soviet scientist's transactions. In the present raport the general information of creative achievements of the Societ rocketry pioneers is represented as well as it is shown that in the U.S.S.R. in the early thirties, in the period of industrialisation of the country and of extensive developments of science and engineering, a great number of scientists, designer and inventors took part actively in developing the scientific conceptions of K.E . Tsiolkovsky and made valuable contributions to the developments of theoretical problems of cosmonauts and fundamentals of the astronautics technology. In the reports of the transactions are considered which maily have a priority nature, for example, the creatment the first in the whole world or in the U.S.S.R. rockets or reaction engines of several types, foundation and developments of new concepts of cosmonautics, theoretical developments of some new engines or rockets, publishing fundamental transactions founding the base for any sections of cosmonauts. Comtemporaneous successes of astronautics, as is generally known, are indebted to creative work of a great number of specialists the transactions of which, undeoubtedly, deserve deep investigations. In the present report the investigations of the rocketry pioneers which began to work in this field up to the early forties are considered only.

114 REACTION MOTORS NCORPORATED. THE FIRST LARGE SCALE AMERICAN ROCKET COMPANY: A MEMOIR

Shesta, John

1978 - IAF/IAA 78-A-05 - vol 5 - AAS vol.10 - pp. 137-150

I shall not dwell n detail upon the early work of the Amrican Rocket Society as it been ably covered elsewhere by G. Edward Pendray. Suffice it t way, that at the time, during the early 1930's, rocket motors were comprised of rather heavy-walled combustion chambers of conductive combustion. These materials and methods worked-after a fashion. After a few seconds of operation, chambers and nozzles were so badly scarred by melting and erosion as to be unusuable after one run. High melting point materials such as nichrome and stainless steel were tried and gave better results but were still unsatisfacory. We felt in the American Rocket Society that the future of rocket motors was not too promising. In the October 1936 issue of the Society's journal "Astronautics" appeared an article by Eugen Sänger of Austria entitled "The Rocket Combustion Motor", Sänger proposed a revolutionary solution to ver-heating - arocket motor cooled by its own fuel. We determined to follow the smae paths. James H. Wyld of the Society's Experimental Committee finally succede in constructing his own engine of this type which he called a regeneratively cooled liquid rocket motor. It was a much simplified version of Sänger's original design, and it worked, well. Wyld's motor was tested for the first time on 10 December 1938. In that test it gave good performance and suffered no damage from the heat of combustion. Well, almost no damage. There was some evidence of erosion and incipient melting of the inner jacket at the head end, otherwise, the damage was not serious.

115 A MAN OF THE FIRST HOUR: JOHANNES WINKLER

Engel, Rolf

1978 - IAF/IAA 78-A-04 - vol 5 - AAS vol.10 - pp. 271-284

It is now twenty years since the space age began, an almost inclaculable number of satellites and probes have been sent off into space, public interest ha slong since dropped below the "sensation" level, a satellite launch is a best briefly noted in the trade press, and even manned flights only rate the third or fourth page in the dailies. On the other hand, growing interest is being shown in historical reviews by many who want to know how all of this could have happened in so short a time and who the men were who provided the drive to carry the space idea forward.

116 V.V. RASUMOV'S EFFORTS IN THE FIELD OF ROCKETRY

Aleksandrova, L.M.

1978 - IAF/IAA 78-A-11 - vol 5 - AAS vol.10 - pp. 285

The report is concerned by the Societ scientist V.V. Rasumov's efforts in the rocketry field. It describes Rasumov's biography briefly. His activity in the rocketry field during the 30th years is shown in detail. Rasumov's contribution to the matter of uniting the rocketry enthousiasts in Leningrad and organizing Leningrad GIRD is noted. Rasumov's activity as a chiarman of Leningrad GIRD anad as a guider of projecting-developing work in Leningrad GIRD is described. In the period of 1932-1934, 8 rocket projects were developed in Leningrad GIRD under Rasumov's guidance: 5 powder rocket and 3 liquid- propellant engines. 7 rocket projects were developed by Rasumov personally. The report contains a summary table, concerning rocket developments in Leningrad GIRD and a brief description of rockets designed by Rasumov. Rasumov's design and propagandistic activity is a considerable contribution to the matter of development of the ideas of rocket technology in the U.S.S.R.. One of the craters on the reverse side of the Moon was named after V.V. Rasumov to recognize his merits in the rocketry field.

117 MAURICE J. ZUCROW AND ROCKET RESEARCH AT PURDUE UNIVERSITY

Ehresman, C. M.

1978 - IAF/IAA 78-A-09 - vol 5 - AAS vol.10 - pp. 303-311

Although the essential elements of jet propulsion, by either airbreathing or rocket engines were known prior to World War II, their real potential came to the forefront during that war. Athe close hostilities it was evident that a new era had danwed in the propulsion of vehicles in the earth's atmosphere and that the exploration of space was a distinct possibility. The pressing need for qualified engineering gradutes to continue the development of the technology base and actual functional hardware was recognized by the government,, the country's industries and the educational community, Dr. Maurice Zucrow, a qualified expert in the area of jet propulsion, answered an invitation from Purdue University in 1946 to join the faculty and organize an academic program to prepare undergraduate students and graduate students to fill the many positions with the government and industry. He developed courses of instruction and since no curent textbook existed at the time, he undertook to write one to fill the needs of his courses. With the academic program underway he set about the devlopement of approriate research laboratories to support his graduate program and to be sure that a significant contribution could be made to the then avialable technology. In 1948, Dr. Zucrow was able to convince a governement agency and Purdue University to provide financial support for the construction of the first laboratory at the University to be dedicated to rocket research. It ws at this laboratory that one of the most significant liquid rocket research programs began. It involved the operationof rocket engines at high chamber pressure. It ws here through the late 40's and 50's that much of the technology base for film cooling was established at chamber pressures up to 2000 psia. Coincident with this work, research was conducted in propellant ignition delay including both open cup and simulated engine starts. The Jet Propulsion Center as it was to be continued to grow under the direction of Dr. Zucrow from the original $40 000 rockets facility built in 1948 with the addition of a Comubstion Laboratory built in 1953 and the Solid propellant laboratory and Gas Dynamics Laboratory added in 1954. The additional facilities permitted expansion of research into the area of rocket engine combustion which included basic work in combustion instability and droplet combustion. As the problem of combustion instability was of serious national concern at that time, a considerable effort was expended in that direction in the early fifties. Research projects included a study of a three-phase electromagnetic flow meter for measuring the nonsteady flows and a "gas-gas" rocket for studying the effects of nonsteady chemical reactions. Although Dr. Zucrow's primary research interests were in the areas of the liquid rockets, he recognized the potential of the solid rocket by initiating in the late fifties, research programs for studying the serious problems of erosive burning and combustion instability. At tje time of his retirement from Purdue University in 1968, Dr. Zucrow had been responsible for the education of many students who have contributed much toward advancement of rocket propulsion technology. Many are in positions of responsability for the direction of this country's continuing efforts in this field. The presentation will be illuistrated with 16 mm movies showing the early (1948) construction of the laboratory. In addition, selected 16mm movie film cplis will be shown of some of the early experimental work.

118 SCIENTIFIC INVESTIGATIONS CARRIED OUT BY THE FIRST SOVIET SATELLITES AND THEIR RESULTS

Vernov S. N.

1979 - IAF/IAA 79-A-52 - vol 5 - AAS vol.10 - pp. 159-163

The flights of the first Soviet artificial earth satellites permitted scientists to start direct exploration of the near terrestrial space which marked the beginning of a radical revision of earlier views and development of the modern space concept. The most significant result of the first satellite flights was the discovery of the external radiation belt of the Earth and determination of the composition of radiation belts. The obtained data made it clear that the radiation belts constitute a sphere of operation of a powerful acceleration mechanisms generating electrons with energies up to several MeV. As to the high-energy protons in the internal zone, they were found to be generated by cosmic rays. The data obtained by the first Soviet artificial earth satellites served as a basis for the concept of magnetosphere - the external Earth's envelope whose properties are determined by the interaction of the solar wind and geomagnetic field. The concept of magnetosphere provided an explanation for a number of geophysicial phenomena. During the past few years it aws found out that the movements of plama in the magnetosphere generate powerful currents along the lines of force that

119 ORIGIN OF THE BASIC EQUATIONS OF ROCKET DYNAMICS

Andjelic, Tatomir J.

1979 - IAF/IAA 79-A-** - vol 5 - AAS vol.10 - pp. 97-103

Besides for scientific truth, history of the development of individual scientific ideas and theories and origin of particular relations are of essential importance for a better understanding of the science itself and for further successful work at its problems. From this point of view, it is of interest to see how the basic equations from the mechanics of the body of variable mass have been arrived at, for, without any doubt, they are the basis of the contemporary rocket dynamics. By the body of variable mass is meant, as we know, sucha body whose mass changes by simple mechnical attaching or detaching of parts and not in relativitics sense, in dependance of velocity. The mass of many natural bodies changes in this sense mechanically: the mass of the Earth in consequence of the fall of meteorites; the mass of theSun in consequence of cosmic dust and radiations, that of the meteorits themselves during the flight through the atmosphere on account of separating of parts and combustion. On the other hand, there are many bodies whose mass is artificially changed on purpose, e.g : with aerostats by throwing away the ballast and with the rockets by simply throwing away parts or by exhausting the burnt out gases, etc.

120 THE ANTECEDENTS OF THE SPACE SHUTTLE

Hallion, Richard P.

1979 - IAF/IAA 79-A-49 - vol 5 - AAS vol.10 - pp. 227-244

The lifting reentry concept data to the early twentieth century. Starting in the 1930's, serious researchers began examining ways to permit space vehicles to retrun to earth using aerodynamic lift. These effort, blending a variety of technologies and with roots in various programs, eventually led to such projects as the Sänger-Bredt study, the X-15, the X-20 Dyna-Soar, project Start and international studies for the logistical support of manned orbital stations using rocket propelled orbital transport systems. This background of interest and technology has culminated in the present-day Space Shuttle. Historical analysis reveals that the technology base thus derived was multinational and interdisciplnary in scope ; as the lmevel of technlogical sophistication increased, so did the sophistication and capabilities expected of such vehicle, as reflected in their estimated design and performance specifications. However, economic and political considerations forced redefeinition of the mission roles, configuration choices, and performance capabilities envisioned for such reentry vehicles.

121 THE FOUNDING OF THE INTERNATIONAL ASTRONAUTICAL FEDERATION: A MEMOIR

Ananoff, Alexandre

1979 - IAF/IAA 79-A-50 - vol 5 - AAS vol.10 - pp. 261-268

(Abstract in French) Après avoir analysé dans son ouvrage publié chez Blanchard, en 1978, les diverses difficultés soulevées par l'astronautique française, Alexandre Ananoff, examine point par point les difficultés rencontrées par la fondation de la Federation International d'Astronautique.

122 THE GENESIS OF THE ROCKET IN CHINA AND ITS SPREAD TO THE EAST AND WEST

Winter Frank H.

1979 - IAF/IAA 79-A-46 - vol 5 - AAS vol.10 - pp. 3-23

The first rockets are generally attributed to the Chinese of the Sung Dynasty over 1000 years ago. However, certain aspects of these developments have been little studied. The transference of rocket technology to the West and especially to the East has been particularly neglected. This paper attemps to correct this gap and also present new data on Chinese rockets of the 1èth to 19th centuries so that a better overall assesment of Chinese contribution is possible. This study therefore presents a brief capitulation of what is presently known of Chinese rockets, though hopefully provides new interpretations and also adds much new mateiral.

123 WALTER HOHMANN'S CONTRIBUTIONS TOWARD SPACE FIGHT: AN APPRECIATION ON THE OCCASION OF THE CENTENARY OF HIS BIRTHDAY

Schulz Wernher

1979 - IAF/IAA 79-A-47 - vol 5 - AAS vol.10 - pp. 287-301

The extension of technology in the 19th century caused people to no longer just contemplate and dream about uplifting oneself into the air, leaving the Earth and travelling to other stars but to think about ways and means in order to realise this age-old dream. Towards the end of the 19th century the german Hermann Ganswindt and the Russian Konstantin E. Tsiolkovsky developed scientificly correct ideas with regard to the realisation of space flight by means of rocket propulsion without, however, being able to gain public interest for such far-ranging ideas. During the first two decades of the 20th century hermann Oberth and Max Valier were engaged in solving the problem of the technical realisation of the space flight: In 1923 Oberth published his book "Die Rakete zu den Planetenraumen ", in 1924 Valier's book "Der Vorstoss in den Weltraum" appeared while in the USA already a few years earlier, in 1919, Robert H. Goddard reported on his rocket experiments in a publication entitled "A Method of reaching Extreme Altitudes". Altogether different from the publications just mentioned was a book which was pulished in 1925 by the same oublihing company - R. Oldenburg, Munich/Berlin - which had published the books of Oberth and Valier.This book was entitled "Die Erreichbarkeit der Himmelskorper" with the subtitle "Studies on the Space Flight Problem".Its author was Dr. Ing. Walter Hohmann, born 18 March 1880, civil engineer for the city authorities of Essen. Already in World War I he made calculations as to the amount of fuel, initial mass and flight time necessary for flights from the Earth to other planets. His aim was to demonstrate by

124 DEVELOPMENT OF METHODS OF COOLING LIQUID PROPELLANT ROCKET ENGINES (ZHRDS), 1903-1970

Salakhutdinov G.M.

1979 - IAF/IAA 79-A-53 - vol 5 - AAS vol.10 - pp. 115-122

The methods employed for cooling liquid-propellant rocket engines have been developed till nowadays within the framework of ideas put forward by pioneers of rocketry Tsiolkovsky K.E., R. Goddard, E. Zenger and others, but even at present the scientific and technical literture contains certain inaccuracies in relation to these ideas. For instance, some authors refer Tsiokolwsky's formulation of the idea of the external regenerative coolong to wrong dates, gave an incorrect assessment of R.

Goddard's contribution to the solution of the cooling problem, etc. Up to now broad circles of investigators are not familiar with relevant works of S.S. Nezhdanosky, F. Zander and some other researchers…

125 TECHNOLOGICAL STEPS TO LIQUID HYDROGEN PROPULSION

Sloop John L.

1980 - IAF/IAA 80-IAA-04 - vol 5 - AAS vol.10 - pp. 177-189

Over a half century elapsed between the proposal to use liquid hydrogen for a space rocket and the launching of such a rocket.The interval was marked by a series of waxing and waning of interest in liquid hydrogen for propulsion. The high potential performance was responsible for the interest; the physical properties and hazards dimmed this interest.During these cyclic periods, a series of technological developments overcame the disadvantages of liquid hydrogen and cleared the way for its successful use in space boosters.These development were: 1) the liquefaction of gases, their storage and handling; 2) the demonstration that a liquefied gas (liquid oxygen) could be used successfully in rocket flights; 3)the development of lightweight and large rocket structures; and 4)aircraft and rocket experiments with liquid hydrogen. These developments and their implications are discussed.

126 ORIGINAL RESEARCH ON A ROCKET ENGINES WITH MULTIPLE COMBUSTION CHAMBERS DEVELOPED IN ROMANIA BETWEEN 1940-1944

Zaganescu Florin

1980 - IAF/IAA 80-IAA-10 - vol 5 - AAS vol.10 - pp. 123-136

Some points of view regarding the Romanian rocket engines history between 1940-1944 are introduced Long before the development of the space shuttle main engine, the Romanian specialist Nicolae Vaideanu patented, built and partially tested one of the new-coming rocket engines, with multiple combustion chambers. Nicolae Vaideanu's Romanian patent was a rocket engine named "Udovilul", able to achieve to a speed of 3200 km/h, by using the principle of liquid propergols, burning in a multiple combustion chambers (Romanian patent 33354/19 May 1942). In the frame of its main patent, the Romanian inventor patented several devices which are all original, e.g: "Electromechanic Selector of Electromagnetic Waves for the Rocket Tracking" -Romanian patent 33269/ 5 December 1941);

"Gas Turbine with Reaction Buses as a Rocket Inner Auxiliary Power Supply for the Propergol Pumps" - Romanian patent 33723/ 23 December 1944 and Romanian patent 38083 / 10 October 1945, etc. The technical solution of this pioneering work in rocketry was able to assure a thrust of about 2000 kilos after 60 seconds running, the inventor stated in its scientific report.

127 EARLY EXPERIMENTS WITH LIQUID ROCKETS AT HIGH CHAMBER PRESSURES

Osborn C. - Warner, C.F.

1980 - IAF/IAA 80-IAA-09 - vol 5 - AAS vol.10 - pp. 165-176

In the years immediately following the Second World War, considerable importance was attached to improving the performance of liquid roket motors. The primary concern of the early researchers was to increase significantly the value of specific impulse by improving the combustion processes in the chamber of the liquid rocket motor. In addition, the serious problem of heat transfer to the combustion chamber walls was of concern. Recognizing a need for investigating the performance and heat transfer characteristics of the bipropellant rockets at thrust levels on the order of several thousand pounds. The first liquid rocket motors was tested late in 1948 under the direction of a distinguished professor, Dr. M. J. Zucrow, Professor of Gas turbines and Jet propulsions. Upon the successful testing of that liquid bipropellant rocket engine at a combustion pressure of 300 psia, it was proposed to the newly organized Project SQUID of the Office of naval rsearch to determine experimentally the volume of specific impulse and heat transfer at chamber pressures of 300, 500, 700, 1000, 1500 and 2000 psia. It was suggested that increasing the combustion pressure was the practical method for increasing the specific impulse…

The paper describes the early experimental facilities briefly. The rocket motors are also described along with the experimental results produced, specific impulse and heat transfer results. The paper presents the pioneering work of the

128 THE PACIFIC ROCKET SOCIETY AND THE FOUNDING OF THE INTERNATIONAL ASTRONAUTICAL FEDERATION, 1944-1960 - A MEMOIR

Sawyer Edmund V.

1980 - IAF/IAA 80-IAA-07 - vol 5 - AAS vol.10 - pp. 245-259

The Pacific Rocket Society was founded on February 8, 1946 in South Pasadena, California, USA, as a change of name of the South Pasadena Rocket Society wchich had been founded on August 14, 1944. Between 1944 and 1953 the efforts of the Society were divided between experimental rocket work and a public astronautical educational program. The Society built, ground tested and launched 29 rockets during this period, of which 23 flights were considered successful, though the altitudes reached were only between 190 and 2630 meters. All rockets employed liquid oxygen and most were fueled with a hydrocarbon related to petrol.Ground and flight tests were carried out in the Mojave Desert at a site adjacent to the land which later becme Edwards Air Force Base aned The Air Force Rocket Propulsuion Laboratory.The Pacific Rocket Society sought to bring astronautical information to the attention of the public through radio and television programs, newspaper publicity, public meetings, rocket demonstrations, lectures, installation of space and rocket exhibits and by the distribution of the Society Journal, Pacific Rockets and the Bulletin. In 1946 an exchange relationship was established with the British Interplenetary Society which led to the proposal to form an International Astronautical body.In 1947 contract was made with the German Gesellschaft für Weltraumforschung which gave strong support for the formation of a non political federation. The preliminary congress of the International Astronautical Federation took place in Paris in 1950 followed by the inaugural congress which convened in London in 1951.

129 LIQUID ROCKET PROPULSION SYSTEM ADVANCEMENTS, 1946-1970

Murphy J. M

1980 - IAF/IAA 80-IAA-08 - vol 5 - AAS vol.10 - pp. 191-201

The development of liquid rocket propulsion systems in the United States has made tremendous advancements since the end of the Second World War. This paper traces the evolution of liquid rocket propulsion systems used for space launch systems by the propulsion group of the Martin Marietta Corporation during the period 1946 through 1970. The technological advancements discussed are in the area of the propulsion system and do not concern the rocket thruster. The following areas are covered: space launch vehicle propellant tankage, space Launch vehicle feed systems, and space launch vehicle rocket propellants. Space launch vehicles are traced from the German V-2 to the Viking high-altitude research rocket, the Vanguard orbital rocket, and the Titan 1, 2 and 3.The liquid rocket propulsion system advances of the 1950's and 1960's provided the technological base for the propulsion successes of the 1970's such as the Titan T-34D space launch vehicles and the space shuttle system in the 1980's.

130 ROCKET RESEARCH AND TESTS AT THE NACA/NASA WALLOPS ISLAND FLIGHT TEST RANGE 1945-1959 - A MEMOIR

Shortal Joseph Adams

1980 - IAF/IAA 80-IAA-06 - vol 5 - AAS vol.10 - pp. 203-225

This paper covers the first fifteen years (1945-1959) of rocket research and test at the Wallops Island flight test range with special emphasis on accomplishments in the field of astronautics.It begins with the establishment of the test range by the National Advisory Commitee for Aeronautics (NACA) and extends through the first year under the National Aeronautics and Space Administration (NASA) as the Wallops Flight Center. The paper describes the 6-stage Trailblazer solid rocket vehicle developed to provide a small reentry object at speeds of Mach 26. Such an object, a 12.5 cm sphere, attained the highest speed of any object in this period and its blazing reentry was recorded by radar and camera. The material in this paper was taken from the much more detailed NASA publication by James Adams Shortal "A New Dimension.Wallops Island Flight Test Range" - the first fifteen years "NASA Reference publication 1028.

131 JOHANNES KEPLER AND HIS LAWS OF PLANETARY MOTION

Schulz Wernher

1980 - IAF/IAA 80-IAA-03 - vol 5 - AAS vol.10 - pp. 61-77

The three Keplerian laws or planetary motion form the basis of space flight mechanics. Johannes Kepler who was born on the 27th of December 1571 at Weil der Stadt, Wurtemberg, and who died the 15th of November 1630 at Regensburg having had been Imperial Mathematician on three emperors discovered these laws by evaluating Tycho Brahe's observation of the planet Mars. He had been actuated by his early conviction that there must be harmonies in the sense of Plato's and the Phythagorean's natural philosophy that would allow for the discovery of the cosmic order. Unlike other astronomers he was not content to watch the sky in order to predict future celestial events, but like a philosopher asked for the causes of the phenomena. Thus, he became aware of the fact that the planet's motions were caused by a force derived from the Sun. His way of deriving at conclusions is a remarkable example for the inductive procedure in science. With his work he helped the Copernican heliocentric system to win recognition. After a short outline of the most important steps in the curriculum vitae of Johannes Kepler and a brief description of his scientific work, attention is drawn to Kepler's three major astronomical works: "Mysterium cosmographicum", "Astronomia nova" containing the two first Keplerian laws, and "Harmonici mundi" containing the third law. The significance of the laws of planetary motion was not yet recognised by Kepler's contemporaries.A full appreciation was not achieved untill the advent of Newton's law of universal gravitation.

132 ROCKETS AND ROCKET PROPULSION DEVICES IN ANCIENT CHINA

Fang-Toh Sun. - -

1980 - IAF/IAA 80-IAA-02 - vol 5 - AAS vol.10 - pp. 25-40

Rockets are generally believed to have been invented in ancient China. Fragmentary articles on early Chinese rockets are numerous in Western litterature, and many stories or conjectures were told by various western authors, whose works were based largely not on the information in original Chinese writings, but on translated materials.The purpose of this article is to report the findings of development of rockets and rocket propulsion devices in the long history of China, based mainly on the original Chinese documents and books, so as to verify, correct, or supplement those stories or conjectures about the rocket in ancient China. The employment of the "fire arrow", a popular weapon in ancient China, which was not a rocket in modern sense, but somewhat related to it , is traced in Chinese history from the early Three Kingdoms (221-265Ad) to the Sung Dynasty (960-1279AD). Another technological advancement, essential to the solid propellant rocket, is the discovery of gunpowder, whose evolution is also traced in about the same period in Chinese history. The historical developments of these two preludes to the invention of the first military rockets in action, occuring in the battle of Pienking (1232 AD). This re-examined from the Chinese official historical records and fairly confirmed. Accounts of other rocket-like devices operated on reaction basis found in Chinese literrature, such as the firework, which was mainly festival, and the liitle known defense weapon, called "Wen-jen-di", which unlike the conventional rocket, went on rotating instead of going forward; are also briefly reviewed. Several drawings found in ancient Chinese books are reproduced. As the primary sources of information of this article are in Chinese, a seperate list of references of Chinese literature is provided along with the list of other references; and to facilitate the reader, titles of the Chinese books and articles and the names of their authors are given in Chinese characters together with their English translations.

133 SCIENTIFIC FOUNDATIONS FOR THE IMPLEMENTATION OF HUMAN SPACE FLIGHT

Yazdovsky V. I.

1981 - IAF/IAA 81-325 - vol 6 - AAS vol.11 - pp. 145-146

Scientific foundations of the possibility of the man's flight into space and its implementation has been worked out systematically by a large team of Soviet scientists for many years. The results of the first studies (1948-1952) showed, that the sealed cabin of small volume with life support system during the rocket flight up to the altitude of 100 km, created necessary conditions for animals to stay in cabin for up to 3 hours. The effect of flight factors (overload, weightlessness, cosmics rays, etc.) did not practically cause changes in behavior and conditions of separate physiological functions in animals. When carrying out the second stage of objects like those, which were in flight on the second soviet spaceship Sputnik. After successful accomplishment of necessary scientific research, which lay foundations for the possibility of man spaceflight and as a result of testing of all space flight safety systems and termination of selection and training of cosmonauts, Soviet scientists prepared themselves for the implementation of the dream of mankind - man's flight into space. All this has made it possible for the Soviet Union to carry out for the first time in history, a space flight with man aboard spaceship, Vostok.

134 SPACE RESEARCH IN POLAND AFTER 1958

Subotowicz Mieczyslaw

1981 - IAF/IAA 81-318 - vol 6 - AAS vol.11 - pp. 161-162

abstract not available

135 EARLY EXPERIMENTS WITH EROSIVE BURNING IN SOLID ROCKETS

Murphy J. M

1981 - IAF/IAA 81-323 - vol 6 - AAS vol.11 - pp. 129-140

In the years immediately following the Second World War, considerable research and development attention was focused upon the liquid rocket motor. At that time, little effort was expended developing the solid rocket primarily due to its comparatively low performance and its reputation for hazardous operation. However, in the early and mid-fifties with the advent of the composites having the newer blinder systems, the solid rocket motor was recognized as a visible alternative to the research and development efforts in the area of solid rocket propulsion were icreased resulting in an increase in the performance as well as increase in the number of problems unique to the solid rocket motor…

136 M.V KELDYSH AND THE DEVELOPMENT OF SOVIET COSMONAUTICS (MVK 70TH ANNIVERSARY)

Rauschenbach Boris V.

1981 - IAF/IAA 81-324 - -- - -- - --

abstract not available

137 ARY STERNFIELD: PIONEER OF SPACE NAVIGATION

Geisler Wladyslaw

1981 - IAF/IAA 81-302 - vol 6 - AAS vol.11 - pp. 209-217

Ary Szternfeld was born in the 1905 in a little town Sieradz in the Polish land. He went to a secondary school in Lodz / the town nearby / and then he started his studies in 1923 at the Jagliellonian University in Cracow. He has moved to France next to continue the studies at the University in Nancy where he became a mechanical engineer in 1927 with the second position among the 31 persons passing the examination. He has been interested in mechanics, astronautics and space flight from the early youth and he was sure that people will soon begin the space penetration. Willing to take the Doctor's degree at the Sorbonne University he notified the topic of the interplanetary flights as the theme of his doctor thesis. The theme has been accepted by the University authorities so Stzernfeld began regular studies in librairies of all the writings dealing with cosmonautics and heavenly bodies motion. He was ready with the fundamental conception of his doctor thesis in 3 years. But at that time the professords suggested him to give up the adopted theme. According to their opinion it was not practical and it was the theme of too far future. They suggested him another subject of disertation and proposed also a high scholarship untill the thesis will be ready…

138 THE HISTORY OF EXTRAVEHICULAR ACTIVITY (EVA) IN U.S. HUMAN SPACEFLIGHT

Millican Scott R.

1981 - IAF/IAA 81-322 - vol 6 - AAS vol.11 - pp. 147-159

The spectacular role of man in space has been recorded through photography and also televised to the world as astronauts performed tasks in free space and conducted experiments on the lunar surface. What is the real significance of Extravehicular Activity (EVA) in U.S. manned spaceflight? What reasons did NAS management have for attempting such a bold and hazardous effort so early in the Gemeni Program? Who were the early motivators?…This paper documented the history of EVA in U.S. manned sapceflight from original conception to the present time. Successes, failures, crewmen, elapsed time, and tasks are recorded for each flight in charts and dialog. Spacesuits, life support equipment, EVA ancillary hardware, training, and simulation are described and appropriate photographs included.

139 ON THE DESIGN OF N. I. KIBALCHICH'S FLYING MACHINE (ON THE 100^TH^ YEAR OF ITS DEVELOPMENT)

Vinitsky A. M.

1981 - IAF/IAA 81-317 - vol 6 - AAS vol.11 - pp. 3-4

abstract not available

140 ORIGINS OF MAGNETOSPHERIC PHYSICS

Van Allen, James A.

1981 - IAF/IAA 81-320 - vol 6 - AAS vol.11 - pp. 59-74

A brief account is given of the discovery of the radiation belts of the earth in early 1958, the prompts confirmations of this discovery, and the beginnings of the now flourishing science of mangetospheric physics.

141 NIKOLAI ALEXEYEVICH RYNIN (1877-1942), SOVIET ASTRONAUTICAL PIONEER: AN AMERICAN APPRECIATION

Winter Frank H.

1981 - IAF/IAA 81-319 - vol 6 - AAS vol.11 - pp. 175-193

Nikolai Alexeyevich Rynin is little known outside of his native U.S.S.R., save for his pasterpiece, a nine volume encyclopaedia of spaceflight and the world's firts space encyclopedia, Mezplanetnyie soobsheniva (Interplanteray Communications), published in moscow and Leningrad from 1928-1932. Fortunately for Western historians of spcaflight, the former historian of the U.S.'s National Aeronautics and Space Administration (NASA), Dr. Eugene Emme, arranged for this work to be translated into English at the suggestion of Derek de Solla Price, Professor of the History of Science and technology at Yale University. Rynin's books appear as NASA TT's (Technical Translations) F-640 to F-648. They were published from 1970-1971 in Jerusalem by the Israeli Program for Scientific Translations. …

142 THE SUPERSONIC WIND TUNNEL INSTALLATIONS AT PEENEMÜNDE AND KOCHEL AND THEIR CONTRIBUTIONS TO THE AERODYNAMICS OF ROCKET-POWERED VEHICLES

Hermann, Rudolph

1981 - IAF/IAA 81-321 - vol 6 - AAS vol.11 - pp. 39-56

The first section deals with the puprpose , the design and operation of the supersonic tunnel facilities. The goal in 1937 was to build an aerodynamic-ballistic research institute,c apable of furnishing - in a resaonable time - all aerodynamic, stability and heat transfer data needed for the development of numerous projects, such as supersonic projectiles, rocket powered supersonic vehicles with wings and fin-assemblies or delta wings. This required the design and construction of supersonic wind tunnels of hightest obtainable Mach No…The second section describes the aerodynamic data for the supersonic tunnels and some basic research conducted. The wind tunnel nozzles have tje task to produce uniform flow within each cross section and along the axis in the so-called measuring rhombus….

143 KONSTANTIN EDUARDOVICH TSIOLKOVSKY AND THE PRESENT TIMES

Kosmodemiansky Arkady A.

1982 - IAA 82-276 - vol 6 - AAS vol.11 - pp. 165-173

The present brief paper is concerned with the analysis of the forecast stemming from the fundamental discoveries and designs made by Konstantin Eduardovich Tsiolkovsky - a famous scientist and a patriot of our Motherland. K.E. Tsiolkovsky was born on the 17th of September 1857, in the family of a forester, the birthplace being a village called Izheskoye, district of Spassk, Rjazan province. Recalling his chilhood, Tsiolkovsky wrote in his autobiography as follows - " I loved reading passionately, and I read whatever books available… I indeed liked to immers myself in dreams…In my dreams I was taking high leaps, climbing up poles or ropes like a cat. Absolute lack of gravity was my dream…

144 THE CONTRIBUTION OF ROBERT ESNAULT-PELTERIE TO ASTRONAUTICS

Contensou, Pierre

1982 - IAA 82-283 - vol 6 - AAS vol.11 - pp. 195-199

The pioneering work of Esnault-Pelterie in astronautics, both theoretical and experimental covers astrodynamics, propulsion, including cryogenic propellants, materials, piloting, navigation. The article describes in some detail his ideas on attitude control and inertial navigation. *(abstract and text in French).*

145 ROMANIAN PROFESSOR ELIE CARAFOLI: FIFTY-FIVE YEARS OF DEVOTION TO MODERN AERONAUTICS AND ASTRONAUTICS

Zaganescu Florin

1982 - IAA 82-280 - vol 6 - AAS vol.11 - pp. 201-207

Romanian Professor Elie Carafoli's activity is reffering at much more 150 scientific works on fluid mechanics, aerodynamics and applied astronautics, a lot of them translated into English, French, Chinese, German and Russian languages. His works "High Speed Aerodynamics" (1956), "Wing Theory in Supersonic Flow" (1969) and "Fluid Mechanics" (1981-1982) were appreciated as reference works in this field of engineering. His contribution on aerodynamics and fluid mechanics ref, to : the profile theory, the finite-span wing theory, supersonic flows around various forms of wing and wing-fuselage assemblies; conic and quasiconic motions theory etc. In his activity he was awarded with many orders and medals (Gauss,tec.), he his member of many academies and important societies as Honorary Fellow of the Royal Aeronautical Society, London; member of the International Academy of Astronautics, International Astronautical Federation etc., Prof. Carafoli lead from 1961the Commission on Astronautics of the Romanian Academy, and from 1958 the technical Sciences Department of the Academy. In the perido 1968-70 he was president in action of the IAF. An aerodynamic airfoil class for aircraft wings and two performant aerodynamic winds tunnels are associated with his name, Prof. Carafoli is the founder of the Romanian school on aerodynamics, he is councellor at the Ministry of Machine Building Industry.

146 FUNDAMENTAL SCIENTIFIC QUESTIONS IN THE EARLY PERIOD OF ROCKET PROPULSION DEVELOPMENT

Summerfield Martin

1982 - IAA 82-275 - vol 6 - AAS vol.11 - pp. 141-143

This memoir may be regarded as a sequel to the series of memoirs presented at previous Congresses of the IAF/IAA by Dr. Frank J. Malina, the Amrican pioneer in rocketry who died during the past year. It is dedicated to his memory. The author had the good fortune to be his professional collaborator in rocketry during the early critical phase in the USA, as well as his personal friend. Both Dr. Malina and Dr. Von Kármán, a founder of the Academy and its first Prseident, had important roles in shapng USA rocketry and space explorations, indeed their roles acquired world significance as the years went by. To those of us were participants in the search for solutions to the many prblems that arose in those years, and who are therefore sensitive through experience to the various alternatives, it is immediately evident that today's rocket propulsion technology flows, in major ways, directly from the results of the work of the team that those two men formed and led. We have only to take a quick look at the types of liquid propellant rocket engines in use - the injectors, the chamber configurations, the nozzle designs, the cooling techniques, etc., in the case of liquid propellant engines, and the types of solid propellant, the grain configurations, the igniters, etc., in the case of solid propellant types - to appreciate immediately the clear line from those early years.

In this paper, I present some of the critical issues that arose in the very earliest stage of liquid propellant rocket development.

147 REACTION MOTORS INC: A CORPORATE HISTORY, 1941-1958 - PART 1 - INSTITUTIONAL DEVELOPMENTS

Ordway III, Frederick I. - Winter, Frank H.

1982 – IAA 82-277 - vol 6 - AAS vol.11 - pp. 75-100

see Part 2 - abstract 151

148 ROCKETRY PERSONAL TRAINING IN THE U.S.S.R., 1924-1936

Moshkin E. K. - Nistratov A.F.

1982 - IAA 82-278 - vol 6 - AAS vol.11 - pp. 33-37

the paper reveals the reasons why the public organizations were established in the U.S.S.R. to popularize rocketry and to study the interplanetary travel possibility. Nmaes of the most prominent scientists and popularizers who promoted initial rocketry progress are noted. The activities of groups, circles and individuals for space travel entusiast's unification in 1924-199 period are described. It is shown, that by 1930 the substantial basis was created in the U.S.S.R. to start with fundamental works both theoretical and experimental. The attention is concencentrate on the education system of the thirties. The necessty of rocketry personnel training is proved. "Special courses" (1931-1934) activities and achievements are decribed. Programs, educational standards and graduate work subjects are analysed. Information on students entered "Special courses" in 1936 is given. The "Reaktivnoe dvijenie (jet propulsion)" 1935-1938 issues are reviewed briefly. The development of GIRD orgnization and GIRD member activities in post GIRD researches and rocketry personal training are analyzed.

149 EVOLUTION OF SPACE FICTION IN FILM

Ordway III, Frederick I.

1982 - IAA 82-279 - vol 6 - AAS vol.11 - pp. 13-29

A survey is given of the evolution of the space flight theme in motion pictures from the turn of the twentieth century to the beginning of the Apollo lunar expeditions of the late 1960s. The survey covers both major and minor productions, from 1902's pioneering, 16-minute long silent Moon voyage of George Méliès in France to the epochal 2001: A Space Odyssey whose special effects and realism set new standards for the genre. Films are examined within the context of contemporary science fiction literature and parallel advance in man's thinking on lunar and planetary travel as expressed in the non-fiction literature and by events. The survey is acomplished by illustrations and a comprehensive bibliography.

150 THE ORIGINS OF THE INERTIAL NAVIGATION IN SPACE

Ishlinsky, A. Yu.

1982 - IAA 82-274 - vol 6 - AAS vol.11 - pp. 6-11

Modern inertial navigation is a vivid example of realization of an idea, which at first had looked like a pure fantasy, but nowdays is on its way to wide practical application…General features of the inertial navigation problem are well understood now. There exist systems, which provide guidance or rockets, piloting of aircrafts, navigation of ships and spacecrafts. First's authors claims in the early history of the inertial navigation those of Carrie (USA, 1903), Alekseev (Russia, 1911); Sweeny (USA, 1911) contain a description of the method for solving navigational problem autonomously for the motion along the Earth surface by means of two free gyroscopes and a pendulum; they do not use the concept of double integration of accelerations with which subsequent development of the idea is closely connected…In twenties the concept of double integration of acceleration signal as a possible approach to the solution to the navigation

151 REACTION MOTORS INC: A CORPORATE HISTORY, 1941-1958 - PART 2 - RESEARCH AND DEVELOPMENT EFFORTS

Winter Frank H. - Ordway III Frederick I.

1982 - IAA 82-277 - vol 6 - AAS vol.11 - pp. 101-127

The history of a pioneering American rocket propulsion enterprise is presented from its early beginning as the entrepreneural outgrowth of liquid propellant rocket experiements conducted by the American Rocket Society in the 1930s to its eventual acquisition by Thiokol in 1958. Among the projects covered are the 3000-pound thrust liquid oxygen-gasoline assisted takeoff unit for for the World War II PBM-3C flying boat, the 350- and 620-pound thrust, units for the Gorgon and Lark missiles, the four-chamber 6000- pound thrust powerplants for Air Force and Navy experimental aircraft, the 8000- pound engine for the MX-774, and the 20 000-pound engine for the Viking high-altitude reasearch rocket. Later projects typified by the XLR-99 engine for the X-15 extreme altitude experimental airplane and "rocket-on-rotor" experiments are also summarized.

152 REACTION MOTORS DIVISON OF THIOKLOL CHEMICAL CORP: AN OPERATIONAL HISTORY (1958-1972) - PART IV

Ordway III, Frederick I. - Winter, Frank H. -

1983 - IAA 83-289 - vol 7 - AAS vol.12 - pp. 137-173

See abstract n°174 - this paper has two parts

153 CONTRIBUTION OF THE ROMANIAN INVENTOR ALEXANDRU CHURCU TO THE DEVELOPMENT OF THEORETICAL AND PRACTICAL ASPECTS OF REACTIVE MOTION IN THE 19TH CENTURY

Zaganescu Florin - Burlacu R. - Stefan I.M

1983 - IAA 83-290 - vol 7 - AAS vol.12 - pp. 85-91

The main concept and technical achgievements, developed both in Romania an d France by the Romanian inventor Alexandru Ciurcu (1854-1922) aided by Frenchman Just Buisson concerning a very interesting and original "Jet Propulsion Engine" are presented. Built, installed and tested - on a small boat and on a little railwayrover - in Paris in the period 1886-1887, Ciurcu and Buisson's "jet propulsion Engine" was patented under the French title "Le propulseur à réaction" with 179001/ 12 October 1886 by the Ministry of Commerce and industry of the republic of France and, later, in Germany, United Kingdom, Belgium, Italy and United States. This patent was discovered and commented by Romanian scientist-writer I.M. Stefan aided by Frenchman Guy Buisson, just in 1982, both Romanians Zaganescu and Stefan being in touch concerning comments on Ciurcu's life and achievements.

154 COMMUNICATIONS SATELLITES: THE EXPERIMENTAL YEARS

Edelson, Burton I.

1983 - IAA 83-302 - vol 7 - AAS vol.12 - pp. 95-108

Six years, 1958 to 1964, were particularly fruitful ones for the development of communications satellites. The period started with the launch by the Soviet Unin of Sputnik-1, 4 October 1957.This event startled most of the world by demonstrating a capability to place artificial satellites into Low Earth orbit.However, some telecommunications engineers had anticipated the space age.Arthur C Clarke, then an RAF officer, described in 1945 how a "space station" in a geostationary orbit migh be used for global television broadcasting. Then in the early 1950's, John R Pierce of Bell Laboratories in the Usa, designed several system configurations using communications satellites in both medium altitude and geostationarry orbits.These systems promised to provide great benefits over terrestrial microwave relay and underses cables.With the dawn of the space age, immediate attntion was given by both military and civil research organizations to developing the technology and testing the concepts to realize the concepts of Clarke and Pierce.Very rapidly, projects by the name of Score, Carrier, Echo, Telsatr, Relay, and Syncom were pursued : satellites built and launched; ground stations constructed; and transmission systems developed completely setting the stage for commercial operation of communications satellite systems-all in six years!

155 THE BRITISH INTERPLANETARY SOCIETY: THE FIRST FIFTY YEARS (1933-1983)

Sheperd, Leslie R.

1983 - IAA 83-286 - vol 7 - AAS vol.12 - pp. 35-55

The origins and history of the British Interplanetary Society are outlined. The part palyed by the Society in the foundation of the International Astronautical federation and other international activities of the BIS are indiceted. In addition to providing a forum for the discussion of astronautics and conducting its educational, publishing, and archival activities, the BIS has often inspired preliminary work on advanced projects subsequently realised by industrials or governmental adoption. The Society made cogent recommendations to various UK governments on the need for a British Space programme, for European Cooperation in space, and for the establishment of a unified European Space Agency.

156 THE FOUNDING OF THE JET PROPULSION RESEARCH INSTITUTE AND THE MAIN FIELDS OF ITS ACTIVITIES

Rauschenbach Boris V.

1983 - IAA 83-297 - vol 7 - AAS vol.12 - pp. 31-34

abstract only in Russian

157 UNITED STATES SPACE CAMP AT THE ALABAMA SPACE AND ROCKET CENTER

Buckbee, Edward O.

1983 - IAA 83-296 - vol 7 - AAS vol.12 - pp. 209-214

Yougsters from any nation on Earth now have the opportunity to spend a week learning about how people train to be astronauts and participating in a simulated Space Shuttle mission. It is the united States Space Camp, conducted each summer at the Space and Rocket Center in hunstville, Alabama (USA). Space Camp grew out the desirs of Dr. Wernher von Braun to interest youngtsers at an early age in aerospace technology. He asked, "Why not have a science camp like others have sports camps?". That discussion with Space Museum Director Edward O. Buckbee resulted in a pilot program in 1981 that helped shape material for the first camps in 1982.

158 REACTION MOTORS DIVISION OF THIOKOL CHEMICAL CORPORATION: A PROJECT HISTORY (1958-1972) - PART III

Winter Frank H. - Ordway III Frederick I.

1983 - IAA 83-289 - vol 7 - AAS vol.12 - pp. 175-201

See abstract n°174 - this paper has four parts

159 LIQUID PROPELLANT ROCKET DEVELOPMENT BY THE U.S NAVY DURING WORLD WAR II - A MEMOIR

Truax Robert C.

1983 - IAA 83-298 - vol 7 - AAS vol.12 - pp. 57-67

Liquid propellant rocket development sponsored by the U.S Navy during World War 2 is traced from its origins in 1941 through the end of the war. Navy in-house work at the U.S Naval under contracts with Reaction Motors, Inc and the Aerojet Engineering Corp, are reviewed by the author, who was closely associated with these developments.

160 A LIFE DEVOTED TO ASTRONAUTICS: DR OLGIERD WOLCZEK (1922-1982)

Subotowicz Mieczyslaw

1983 - 83-292 - vol 7 - AAS vol.12 - pp. 217-231

Born in Torun 3.04.1922 dr Olgerd Wolczek died in August 24, 1982in Warsaw.From 1971 he edided the scientific-popular Polish bimonthly "Astronautyka"and also from 1973 - the scientific journal of the Polish Astronautical Society/Pas/"Postepy Astronautyki"/Progresses in Astronautics/ He was one of the founders of Pas/1954/, then its general Secretary for 10 years and later-the deputy of the President of PAS for 15 years. He was very active also in the field of scientific research in astronautics and space physics.The scope and with of his knowledge can be seen in his 22 books and 34 papers papers in astronautics and space physics, 10 books and 14 papers in nuclear physics and other subjects.He published also several hundreds papers in popular journals, and took part several hundred times in radio and television programme.His phD-degree/1963/ was based on his resarch in nuclear spectroscopy. But astronautics became the main interest and aim of his life…Dealing with almost all astronautics ans space physics on popular level, his scientific of qualitative character can be placed in following four subjects: 1)nuclear energetics in rocketry 2)impact of astronautics on science, our civilization and mankind: various non-selcted problems in astronautics, 3)evolution of matter in the Universe: planetology, 4) life in the Universe. During his several last years dr Wolczek was ealing mainly with subjects 3)and 4)scientific papers of Dr Wolczek according to the above classification were reviewed. Full list of Dr Wolczek's scientific papers was included.

161 LEONHARD EULER'S IMPORTANCE FOR AEROSPACE SCIENCES ON THE OCCASION OF THE BICENTENARY OF HIS DEATH

Schulz Wernher

1983 - IAA 83-300 - vol 7 - AAS vol.12 - pp. 19-28

Leonhard Euler, who was born 15 April 1707 in Basel and who died 18 September 1783 in St Petersburg, was the most important mathematician of his time.In view of the extraordinary adversity of his work, almost all branches of mathematics as well as mechanics and their related fields of applied research-celestial mechanics, fluid dynamics, ballistics, naval sciences, and engineering, owe basic findings to him. His productivity was quite unbelievable. The edition of his complete works, which was begun in 1911, has not been finalised till this day.

162 PAGES FROM THE HISTORY OF THE HUNGARIAN ASTRONAUTICAL SOCIETY

Nagy Istvan Gyorgy

1983 - IAA 83-295 - vol 7 - AAS vol.12 - pp. 203-207

Dealing with the history of the host-society of the 34th International Astronautical Congress, this the paper summaries some data about Hungarian activities in the first half of our century in the field of jet propulsion, rocketry and astronautics. In the middle of the 1950s it became clear that the launch of the first artificial satellites was approaching. An initiative originated from the Astronomical Section of the Society for Dissemination of Scientific Knowledge to set up a comitee of astronautics of as a basis of a later scientific society. In May 1956 the Hungarian Astronautical committee, the predecessor of the present society was instituted. In those days the propagation astronautical knowledge was the main task of the commitee. Some committee members composed the first Hungarian book about astronautics in 1957. In 1958 the first astronautical symposium in Hungary was organised by the commitee. With the participation of several committee members the permanent optical and radio observations of satellites commenced. The enlarged tasks demanded the institution of a society to continue the work within a broader range. In its new form the Hungarian Astronautical Society was set up in December 1959. Three years later the HAS has joined the IAF. Several members of the Society work for the organs of the IAF, IAA and IISL. The residence of the HAS is in Budapest, local sections are active in four other cities in Hungary.The society is active in four other cities in Hungary. The Society has formed various working-committees for satellites geodesy, remote sensing, space biology and medicine exploration of the Solar System, history of astronautics, space law, and space technology. Some members of the HAS composed a comprehensive space encyclopedia in 1981.

163 A COMPARATIVE STUDY OF THE EVOLUTION OF MANNED AND

UNMANNED SPACEFLIGHT OPERATIONS

Lattu Kristan R. - Hugues Frank E

1983 - IAA 83-294 - vol 7 - AAS vol.12 - pp. 125-136

The paper compares some aspects of the evolution of spaceflight operations and ground control in the United States manned und unmanned space programs.The history is characterized by a shared beginning, a divergence in organiztional management and operations techniques, followed by increased capability of ground and spacecraft systems leading to staffing reductions and standardization of operations. Although many differences are inherent in the nature of supporting manned flights compared to unmanned Earth-orbiting or deep space missions, a distinct trend of convergence seems to be occuring between the two operational disciplines.

164 SOME VIGNETTES FROM A EARLY ROCKETEER'S DIARY: A MEMOIR

Smith Bernard - Ordway III Frederick I.

1983 - IAA 83-303 - vol 7 - AAS vol.12 - pp. 69-84

The story of Bernard Smith begins with an announcement in late 1932 that the American Interplanetary (later, Rocket) Society would hold a meeting at New York's American Museum of Natural History and ends by recounting his plan a quarter of a century later to place into Earth orbit a small airplane-boosted satellite. Smith's involvment with building and firing ARS rockets numbers 2 and 3 is recounted, giving rise to his description of an amteur rocket's construction as something that was "accumulated".On 14 May 1933, Smith became, one day before his birthday, the first lad in America to launch publically a liquid rocket (ARS number 2 from Great Kills, Staten Island). ARS 3, tested in September 1934 at the same location, was a failure; it later went on display at the 1939 New York World's Fair. After four year of prepartion for the transition from amateur to professional, he joined the United States Navy in 1948 as a civilian scientist and devoted the next decade to the development of rocket-propelled weapons.The paper concludes by summarizing immediate Sputnik 1 plans developed by the Navy to launch a small satellite. The first stage was to be a Navy fighter bomber, which would relase a 3,000 pound five stage rocket at 40,000 feet altitude in the proper direction and at the right inclination and velocity. The ignition of each successive stage would be accomplished by timers and horizon scanners, and the flight path in each case would be ballistic. A small orbiting radion beeper would be released from the final stage. Three launch attempts were made.

165 PROJECT ROVER: THE UNITED STATES NUCLEAR ROCKET PROGRAM

Dewar, James A.

1983 - IAA 83-301 - vol 7 - AAS vol.12 - pp. 109-124

From 1900 onwards, the space pioneers speculated that atomic energy could provide an inexhaustible source of energy which would make the exploration of space a reality. Their thoughts through were only speculations. In the mid-1950's the United States initiates a Nuclear rocket programm called Project Rover which would last till 1972, cost over $1, 5 billion, and have several potential missions.However while the nuclear rocket had great potential, it never had a fully approved or defined mission and this in the final analysis caused its termination. This study analyzes the Rover program from technical, managerial, and political perspectives, examines how successes or failures in one of these areas affected the other, and evaluates whether the program was beneficial to the nation.

166 A STUDY OF EARLY KOREAN ROCKETS (1377-1600)

Yeon Seok Chae

1983 - IAA 83-291 - vol 7 - AAS vol.12 - pp. 3-16

This study of early Koraen rockets, including details of the structure of military rockets and rocket launcher used in the period around 1448. This information was obtained from the "Kuk-Cho-Ore-Soye" (Introdutory Remarks on National Rituals) published in 1474 and the "Cho-Sun-Wang-Cho-Silok" (Authentic Record on National Rituals) which isdiscussed. The former was a very detailed description of all firearms that were developed between 1448-1452. Drawings were made from the description of the "Firearms Illustration" to reproduce all of them. Some of the firearms were constructed from these plans and fired in January 1981. Korean learned to make firearmes and black powder from China before 1377. The first Korean rocket was called "running-fire" (ju-hwa) which was used between 1377-1447. In 1448, it was replaced with "magical-machine-arrow". This rocket was built in 4 sizes, small, medium, large and multiple-bomlet-magical-machine-arrow, 70cm long, 9.5 cm in exterior diameter. It was attached to a 5.3 m (17.4 ft) bamboo guiding stick. The warhead or explosive was attached to the head of the propellant case. It is believed to have had a range of about 1500 m (4900-6500 ft.). Medium and small-magical-machine-arrows were launched from the multiple rocket launcher of "fire-cart" which was scientifically designed to launch 100 medium or small-magical-machine-arrow in groups of 15 at a time, in quick succession. The angle of launch was controllable from zero to 43 degrees. These are believed to have been used as weapons to fight against the northern Chinese and southern Japanese.

167 COMPARATIVE ANALYSIS OF THE DEVELOPMENT IN THE ACTIVE AND REACTIVE METHODS OF PROJECTION.

Mazing G. Yu

1984 - IAA 84-263 - vol 8 - AAS vol.14 - pp. 139-147

From an historical viewpoint, the report considers the development of the technical possibilities of active and reactive launching methods in the context of their correlation based on a common quantitative criterion expressed as coefficient "R" ("effective distance"), which is the length of the flight trajectory multiplied by the ratio between the static and kinetic masses. The report also covers the annual change in the R coefficient for both launching methods. Consideration is also given to the nature of the occurrence of the critical situations in the above-mentioned phases. Resumably, in future, the priority given to any given launching method will depend on progress made with new sources of energy and long-distance energy transmission.

168 EARLY ROCKET-WEAPONS IN CHINA

Fang-Toh Sun

1984 - IAA 84-258 - vol 8 - AAS vol.14 - pp. 3-15

It is generally believed that the Chinese were the first to employ rockets as war weapons; and particular reference is usually made to the so-called "flying fire lance" (fei-huo-tsiang) used in the battle of Khai-feng-fu, by the garrison force of the Tartars against the Mongols in 1232. But there has been also some doubts about the true nature of such early Chinese weapons like the flying fire lance, as whether it could be regarded as the reaction- propelled rocket in the modern Western sense. In this paper the multitudes of the rocket-like gunpowered firearms under various names appeared in China since the battle of Khai-feng-fu up to the late years of the Ming dinasty in the early 17th century are examined and their true nature is explored, mainly from original Chinese sources. The progress of Chinese gunpowder during the same period is also breifly reviewed. It is hoped that, through the evidence brought forth from such study, the prevailing doubts mentioned above could be cleared up, and our general belief, on the origin of the war rockets, be reasonably ascertained.

169 THE CONTRIBUTIONS OF K.E TSIOLKOVSKY AND OTHER NATIVE SCIENTISTS TO THE TECHNOLOGY OF THE ROCKETS LAUNCHING

Mikhaylov V. P.

1984 - IAA 84-255 - vol 8 - AAS vol.14 - pp. 67-72

Five characteristic periods can be singled out in the development of rocket launching techniques. Russian and Soviet scientist have made an essential contribution to the techniques of rocket launching in all five periods. The first mentions launching rigs in Russia dating from 1705. Russian specialists developed several launching methods and also produced a number of designs for launching rigs. If native specialists began work on the first stage later than in other countries, the work of Russian and Soviet scientists in the 20th century did in point of fact predetermine the beginning of the third and fifth periods. The major contributions of Soviet specialists in the field of space rocket launching techniques during the fifth period are the solution for the first time of the groups of scientific and engineering problems leading to the construction of the Baïkonour space centre, the launching complex for Vostok carrier rockets, the realisation of the first launches of unmanned and manned space vehicles which opened the space age, and also the rocket powered space vehicles launched from the Moon's surface.

170 THE ROCKET DEVELOPMENT OF ISAAC LUBBOCK AND GEOFRREY COLLIN

Griffiths, J.

1984 - IAA 84-254 - vol 8 - AAS vol.14 - pp. 51-64

This paper traces the development of the first British liquid fuel rocket motor, affectionately called "Lizzy", originally designed as an assisted take-off unit for the Wellington bomber. It was built under a Ministry of Supply contract, dated 1941, which was awarded to the Asiatic Petroleum Company (now Shell International Petroleum Limited). The development team consisted of 11 personnel, led by Isaac Lubbock, the total money made available from the Ministry being only £10 000 per annum. The original specification was for a rocket motor having a thrust of 1000 lbs for a duration of 20 seconds. Since little was known at the time of the other liquid rocket work being undertaken in America and Germany, Lubbock and his team had to solve many of the fundamental problems associated with motor development. The paper discusses these problems and look at the solutions he and his team applied. The group built a pilot motor with a thrust of 60 lbs, which was extensively tested at Chessington. "Lizzy" was built during the later of these tests and underwent her testing at Langhurst. These tests are presented and discussed. Extensive use has been made of the Gollin archives at Churchill College Cambridge which enabled the author to preserve in this paper a detailed account of this very important but little appreciated aspect of liquid fuel rocket development.

171 BRITISH ROCKETRY DURING WORLD WAR II

Becklake, John E.

1984 - IAA 84-253 - vol 8 - AAS vol.14 - pp. 117-126

The development of the rocketry received little attention in Britain from the late 19^{th} century, following the work of Congreve, Hale and others, until the mid-1930's. Works was restricted by the Explosives Act of 1875, which effectively prohibited rocket testing by members of the general public. Thus no grass roots work on rocketry occured in Great Britain as it did in Germany, USA and U.S.S.R.. However, with the gathering of the clouds of war, Sir Hugh Elles, Master General of Ordnance, called a meeting at the War Office in December 1934 to "review our present knowledge of rockets in general". This led to the development of the 2 inch and 3 inch UP rockets which saw many varied uses in World War II. This paper traces the development and use of these rockets; but concentrates mainly on the work, begun in 1943, aimed at producing a surface-to-air missile. Several such projects (Brakemine, Stooge, Little Ben, Lopgap) were begun under the auspices of various establishments and, although none of these reached the operational stage, they provided valuable experience and test beds for postwar developments. The work carried out on these projects up to the end of 1945 and the co-ordination role of the GAP (Guided Anti-Aircraft Projectile) Committee is discussed.

172 SOME IMPORTANT ASPECTS ON THE THREE CENTURIES OLD HISTORY OF ROMANIAN AEROSPACE TECHNIQUES

Zaganescu Florin

1984 - IAA 84-250 - vol 8 - AAS vol.14 - pp. 109-116

The Romanian people has had a valuable traditions in designing and constructing aircraft and aircraft engines, contributing with inventions which have helped to the birth of aviation, while its interests in jet engineering - rockets - go back as far as the Middle Age…(The paper presents a general survey of the pioneers of Romanian aviation and astronautics.)

173 NINETEENTH CENTURY ROCKETRY IN FRANCE

Moulin Hervé - Ordway III, Frederick I.

1984 - IAA 84-256 - vol 8 - AAS vol.14 - pp. 17-41

A survey is presented of the development of rockets in France during the 19^{th} century. It is shown that even though rocketry did not assume the importance in France that it did in Great Britain, Russia and Austria - a reflection of the moderate interest existing among most artillery generals and ordnance planners at the time - work was pursued vigourosly by a cadre of enthustiastic individuals. This work was undertaken for the most part between 1810 and the early's 1860's and, it is shown, consisted of rocket research and development, including propellants, warheads and launchers. In turn, the paper surveys the strong base established in France of pyrotechnic rocketry, reviewing work of Frezier, Perinet d'Orval, Morel and Ruggieri; the portions of Congreve rocket technology to France; the studies of d'Arcet and Montgery; experiments undertaken in Hamburg; rocketry during the Restoration period; the work of the transplanted Englishman Bedford; rocketry at Metz; and summaries of various military campaign during which rockets were involved. Some attention is devoted to livesaving rockets.

174 THE LEGACY OF SCHIAPARELLI AND LOWELL - PART I

Ordway III, Frederick I

1984 - IAA 84-259 - vol 9 - AAS vol 15 - pp. 33-53

See abstract n°152

175 THE SMALLER BRITISH SOCIETIES DEVOTED TO ASTRONAUTICS AND INTERPLANETARY FLIGHT - 1935-1945

Burgess, Eric

1984 - IAA 84-252 - vol 8 - AAS vol.14 - pp. 73-78

The interplanetary movment began in the United Kingdom in October 1933 when P.E. Cleator of Wallssey founded the British Interplanetary Society. The resultant publicity triggered enthusiam among isolated individuals not only to apply for membership in the new society but also to form small groups of enthusiasts in other localities. Among the small societies was one formed by Eric Burgess in June 1936, after corresponding with Cleator following and advertisement about the B.I.S. in the British Science Fiction magazine. This was the Manchester Interplanetary Society. Just after the formation of the M.I.S. a London Group of the B.I.S. was inaugurated and Professor A.M. Low became president of B.I.S. upon the transfer of its headquarters to London shortly afterwards. Just after formation of the M.I.S., Burgess was able to meet with Robert Esnault-Pelterie at his Boulogne-sur-Seine laboratory, from whom he obtained much inspiration about the possibilities and potential of astronautics and a great amount of encourgament. Esnault-Pelterie made suggestions for "cellular partitioned" solid-propellant rockets to control thrust, a principle which Burgess later tried in his experiments.

176 ANATOL ARKADIEVICH BLAGONRAVOV AND SOVIET COSMONAUTICS (FOR THE 90TH ANNIVERSARY OF THE BIRTHDAY).

Frolov, K.V - Parkhomenko, A.A.

1984 - IAA 84-251 - vol 8 - AAS vol.14 - pp. 197-203

This paper is devoted to the contribution made to Soviet astronautics by the well-known scientist and eminent organizer of Soviet science, Academician A.A. Blagonravov. This paper examines A.A. Blagonravov's role in the development of international scientific cooperation.(COSPAR, COPUOS…). Also his extensive activities in scientific literature and as a historian of science and technology, and the works on Tsiokolvsky, and the study of the scientific achievements of Soviet astronautics. As a prominent specialist in the fields of science and technology, Academician Blagonravov was at the beginning of the nineteen-fifties appointed chairman of the Committee for Research into the Upper Layers of the Atmosphere established by the Academy of Sciences of the U.S.S.R..

177 A HISTORY OF HEAT SHIELDS FOR U.S. MANNED SPACECRAFT

Ronquillo Leon.

1984 - IAA 84-262 - vol 8 - AAS vol 14 - pp. 185-188

no abstract available

178 FUNCTION, FORM AND TECHNOLOGY: THE EVOLUTION OF SPACE STATION IN NASA

Fries, Sylvia Doughty

1985 - IAA 85-454 - vol 8 - AAS vol.14 - pp. 79-83

Analysis of four major space station designs developed by NASA and its contractors during the agency's first twenty-five years indicate that changing space station configurations have been a result of changing (i) space station functions and (2) available or anticipated technology capabilities.

179 REACHING FOR THE PLANET MARS: HUMANKIND'S EVOLVING PERSPECTIVE

Johnson, Stewart W.

1985 - IAA 85-456 - vol 8 - AAS vol.14 - pp. 95-104

In a previous paper Johnson and Leonard discussed the evolution of concepts for a lunar base. This paper review humankind's view of Mars, of the Martin environment, and the possibilities of life on Mars. The quest for an understanding of Mars is viewed as a drive fro man to better understand himself and his home planet Earth.

180 SOTIR CHERKEZOV: THE INVENTOR OF A DEVICE FOR RESCUING SPACEMEN

Simeonov A.

1985 - IAA 85-461 - vol 8 - AAS vol.14 - pp. 105-106

The paper presents the life and the works of the Bulgarian inventor Sotir Petrov Cherkezov, born in 1883.

181 A BRIEF HISTORY OF THE U.S. JATO FLIGHT TESTS OF AUGUST 1941 - A MEMOIR

Boushey, Homer A.

1985 - IAA 85-453 - vol 8 - AAS vol.14 - pp. 127-137

A brief narrative history of the first JATO (Jet Assisted Take-Off) tests in the United States, conducted by the Army Air Corps during August of 1941, is presented by the pilot. The tests verified the unique capabilities of rockets. Take-off distances and take-off times were reduced by half. This was trus for both normal weight and overloaded conditions. The tests concluded with a short flight of the airplane, powered solely by rocket thrust. Dr. Theodore Von karman, who headed the California Institute of technology Aeronautics Laboratory where the rockets were developed, in a letter to general Boushey twenty years after the tests wrote, "I will never forget our busy collaboration in the eraly days of rocket development in the U.S. It was not exactly Space Age yet, but a necessary introductory step".

182 ENGINES AND PROPULSION UNITS FOR SPACE VEHICLES CONSTRUCTED BY ALEXEY M. ISAEV

Tavzarashvily A. D.

1985 - IAA 85-459 - vol 8 - AAS vol.14 - pp. 151-157

This paper has no aim of depicting to the full extend all of the A.M. Isaev's works. The paper is an attempt to give in chronological sequences an account of all that was made by Alexei Mikhailovitch and his collgues on creating liquid-propellant engines and power plants for dynamically active space vehicles.

183 A SURVEY OF WORLD METEOROLOGICAL AND ENVIRONMENTAL SATELLITES - 1960-1985

Schnapf Abbraham

1985 - IAA 85-460 - vol 8 - AAS vol.14 - pp. 159-183

TIROS I (Television and Infra-Red Observation Satellie) launched on April 1, 1960, ushered in a new era in weather observation and forecasting. In the twenty-five years since the successful orbital operation of TIROS I a total of over 130 meteorological and envirnmental satellites have been launched. The remote sensing of this planet's weather and environment has evolved where today a number of experimental and operation systems are in service.….

This paper will trace through the early beginnings of the development of the meterological satellites, their growth, and the future plane. The TIROS family of satellites in the past quarter century have evolved through four generation of design. TIROS I-X Research and Development and semi operatioonal system 1960-1965; ESSA 1 to 9 the first global operational system 1966-1969; ITOS-1/NOAA-1-5 the improved operational system 1970-1977; and the current TIROS N/NOAA 6-9 environmental operational system 1978-1985. The Nimbus 1-7 technology satellites, launched from 1964 to 1978 were configured witha number of experimental sensors. A number of sensors were adopted for use on the opérational TIROS satellites. The DMSP (Defense Meteorological Satellite Program) satellites were developed by the Department of Defense to provide meteorological data to DoD's world wide installations.

184 THIRTY YEARS OF THE POLISH ASTRONAUTICAL SOCIETY

Geisler, Wladyslaw

1985 - IAA 85-451 - vol 8 - AAS vol.14 - pp. 189-194

In this paper there are presented the main datas of the history of the Polish Astronautical Society, the names of the members who had a considerable influence on the activity and the development of this association, the participation of the PAS in the works of the IAF, IAA and IISL, the main aims of the internal activity of the PAS, i.e. the self-education and investigations in the scientific institutions, having an wointerest in astronautics and popularization of space achievements in the entire Polish community, especially among the young people.

185 ON THE WORKS OF V.A. ARTEMSEV IN THE FIELD OF ROCKETRY (FOR THE 100TH ANNIVERSARY OF HIS BIRTHDAY)

Aleksandrova, L.M. - Erokhin, B.J. - Prodnikov, A.E.

1985 - IAA 85-455 not published

This paper was presented, but no abstract, no preprint and not reproduced in the proceedings

186 SOME FEATURES OF LIFESAVING ROCKET DEVELOPMENT IN THE 19TH AND EARLY 20TH CENTURIES

Mikhaylov V. P.

1985 - IAA 85-457 - vol 8 - AAS vol.14 - pp. 43-50

The achievements of rocket technology in the 19th century is closely connected with the development and succesful employment of lifesaving rockets, however, in the works published up to now analysis of their development was not paid much attention to. Among the works on lifesaving rockets one by M.R. Sharpe is worthly of note: it gives the most fully various data on lifesaving rockets, i.e. their certain characteristics, number of persons rescued, present state of lifesaving rockets, biographic data of their makers, etc. However the work does not also pay much attention to general technological problems of lifesaving rockets as one of the directions of the rocket engineering technique development of that time, and the ways of solviong the problems are not shown.

187 ANALYSIS OF K.E TSIOLKOVSKY'S IDEAS ON SPACE INDUSTRIAL DEVELOPMENT AND EXPLOITATION

Zhelnina T.N

1986 - IAA 86-502 - vol 9 - AAS vol.15 - pp. 65-71

In K.E Tsiolkovsky's works, much attention is paid to questions of the industrial exploitation of space. Up to the present time the study of this trend in the scientist's creative activities was fragmented and superficial; thus, much is still not known concerning this subject, not only to foriegn, but also to many Soviet researchers. However, today in connection with the growing scale of extraterrestrial industry developments, Tsiolkovsky's ideas and proposals in the field of space industrialization acquire special urgency. Science and technology historians are faced with the task of studying them profoundly with the aim to comprehend and master. It seems reasonable to examine these ideas in action, and also as a total summary of more than 50 years of the scientist's creative work, this being a necessary prerequisite for research into the heritage of the founder of cosmonautics with a view of appreciating the importance of his works.

188 THE LEGACY OF SCHIAPARELLI AND LOWELL -- PART 2

Ordway III, Frederick I.

1986 - IAA 86-501 - vol 9 - AAS vol.15 - pp. 33-63

This concludes a two-part paper, the first part of which was presented at the 35th Congress at Lausanne (paper IAA-84-259) in October 1984. It summarized events from the discovery over a century ago by Giovanni Virginio Schiaparelli of markings on Mars he referred to as canali, to the establishment of an observatory by Percival Lowell in Arizona, USA, to study them, to the reaction of the literary community to the proposition that the markings were canals built for irrigation and related purposes by sentient being. Here, in Part 2, the reaction of the public and scientific community to the Mars canal debate is reviewed. It is shown that while some press reviews were favorable and some astronomers and other scientists were convinced by Lowell's tireless enthusiasm, many were not. As evidence against his thoeries grew, so he ever more stubbornly defended them. Eventually, the weight of astronomical observations became overwhelming; and, following Lowell's death in 1916, the artificial canal proposition became widely discredited.Particular attention is given to an interesting book published in 1907 by Alfred Russel Wallace. Entitled Is Mars habitable? it critically examined Lowell's book Mars and Its Canals and offered an alternative explanation. Salient features of Wallace's arguments are covered.

189 YURI ALEXEYEVICH GAGARIN - HIS UNIQUENESS, TYPICALNESS AND WEALTH OF PERSONALITY

Kardashev Tsvetan D.

1986 - IAA 86-500 - vol 9 - AAS vol.15 - pp. 423-425

An attempt is made to present the synthetic image of the personality of the first cosmonaut on the basis of a scientometric investigation of more than 200 literary sources, published in Cyrrylic script (books, articles, comments, notes about and by Gagarin).

190 THE BEGINNINGS OF THE U.S. SPACE PROGRAM - A MEMOIR

Pickering William H.

1986 - IAA 86-492 - vol 9 - AAS vol.15 - pp. 211-221

Although in the very early history of rocketry, one finds references to the use of rockets for space travel, especially to the Moon and beyond, it was not until World War I that practical rockets began to appear. The use of rockets for scientific research of upper atmosphere phenomena soon followed. From the high altitude sounding rockets to the Earth orbiting satellite was a relatively small step. At the end of the war, rocket research and development in the United States followed two paths. One aimed at producing simple, short-burning rockets for military applications. The other concerned larger, long-burning rocket engines with applications rangins from guided weapons to satellites. The work of Robert H. Goddard demonstrated the concept of the long-burning liquid-propellant rocket; but most of the development of useful rocket engines came from other sources...

191 WERNHER VON BRAUN AND COLLIER'S MAGAZINE MAN IN SPACE SERIES

Liebermann Randy

1986 - IAA 86-497 - vol 9 - AAS vol.15 - pp. 235-242

Since antiquity, the idea of manned space travel has captured the imagination of mankind, but prior to the last quarter of a century, our technological abilities to accomplish that goal had fallen short of our capacity to dream about its realization. The fictional writings of some early prophets of space travel, such as Jules Verne and H.G. Wells, have helped in fueling the fire in the minds of modern rocketry's early theorists and experimentators: Tsiolkovsky, Goddard, Oberth, and Esnault-

Pelterie. But when did the average man in the street first become aware of the real possibilities of space travel? For several years after the Second World War, the United States' nascent and as yet undeclared space travel program chirfly consisted of launching captured German V-2 rockets from the White Sands proving Ground in the desert of New Mexico. Among the engineers and scientists vital to the success of these launchings was a group of Germans who, after World War II, had been brought over the America by the U.S. Army. The same Germans had designed and built the V-2 for the Third Reich's war machine. Leading the group in America, as in Germany, was the brilliant, young, charismatic visionary Wernher von Braun...

192 CAMERA ROCKETS AND SPACE PHOTOGRAPHY CONCEPTS BEFORE WORLD WAR II - PART 2

Winter Frank H.

1986 - IAA 86-503 - vol 9 - AAS vol.15 - pp. 165-180

The first part of this paper appears as "Camera Rockets and Space Photography Concepts Before WWI" in IAA vol.3, AAS History Series, vol.8, Chap. 7, pp.73-102, 1989. In the author's earlier paper, wa saw that between 1901 and approximately 1915 Alfred Maul of Saxony, Germany, designed, constructed, and successfully tested a series of several sophisticated camera rockets, which took single-frame photos of Earth from altitudes up to 800 m (62(ft). Maul's rockets were meant for reconnaissance. They were designed for the Army of Saxony, who provided Maul with soldiers as assistants and may also have helped finance the research. Several other individuals produced their own concepts and projects along these lines during this period (1930). One of the more exotic was the suggestion of television transmission from space. Other projects are also mentioned such as R.H Goddard, M. Valier, and Hermann Noordung…

193 SCIENTIFIC AND TECHNOLOGICAL PREREQUISITES FOR THE FIRST MANNED SPACECRAFT

Rauschenbach Boris V.

1986 - IAA 86-498 - vol 9 - AAS vol.15 - pp. 73-78

When today one looks back at the path covered by cosmonautics, partuclarly when one remembers the first decade, béginning from the creation and launching of the first Sputnik, the "explosive" character of the initial period of its development seems surprising. Indeed during that period there were launched in the Soviet Union three Sputniks, three Luniks, some Sputnik prototype of piloted spacecraft, the communication Sputnik "Molniya" sent towards the Mars and Venus, and so on. Only three and a half years had passed from the first launching of the Sputnik (which was actually, only a small-size sphere with the simplest equipment aboard) to the flight of Yuri Gagarin into space ; this fact, which now seems nearly fantastic, may serve as a vivid example, illustrating the "explosive" character of the development of space technology…

194 GEORGY NIKOLAEVICH BABAKIN'S CONTRIBUTION TO THE DEVELOPMENT OF THE AUTOMATIC SPACE STATION

Ivanovsky, O.G. - Fainhstein M.B

1986 - IAA 86-493 - vol 9 - AAS vol.15 - pp. 417-421

G.N Babakin's 70th birthday anniversary was in 1984. He was the chief designer of the automatic space station for exploration of the Moon, Venus, and mars. He was a hero of Socialist Labour, a Lenin Prize winner, and a corresponding member of the Academy of Sciences of the U.S.S.R.. Under his direct leadership, and with his personal participation, new types of space stations were created, which solved many very complicated tasks in the study of celestial bodies, that became ever more complicated with every step, and with every new project…

195 THE APOLLO GENERATION: A PROFILE'S OF NASA'S FIRST ENGINEERS

Fries, Sylvia Doughty

1986 - IAA 86-495 - vol 9 - AAS vol.15 - pp. 223-234

The study described in this paper originated with the perception that the single most important event now occuring in the U.S. space program is the passing of technological and managerial leadership from one generation to the next. Although the space shuttle Challenger accident of January 1986 and the intense public scrutinity resulting from that tragedy have captured the headlines, a leadership transition during the next descade will affect the future of the U.S. space policy and technology, just as the first "pioneering" Appolo generation supplied the ledearship, which helped to shape not only U.S. policies for space exploration, but the technology and management strategies used to implement those policies. This judgment does not disparage the roles of the U.S. Congress and the White House in determining U.S. space policy; rather, it assumes that national policy for space is a continuous balancing between the technologically possible and the potentially desirable, and that what is technologically possible is determined for any given era by its engineers.

196 FIRE AND THRUST : EXPERIENCES WITH THE UNITED STATES VANGUARD SATELLITE PROJECT - A PERSONAL MEMOIR

Stehling K

1986 - IAA 86-494 - -- - -- - --

presented but without abstract, manuscript and was not reproduced in the proceedings

197 THE PROPELLANT CHEMISTS' CONTRIBUTION TO MODERN ROCKET FLIGHT - A PERSONAL MEMOIR

Klager Karl

1986 - IAA 86-491 - vol 9 - AAS vol.15 - pp. 201-209

One of the most significant efforts of Theodore von Kármán and his associates was to replace black powder as a rocket propellant with a gas porducing organic material, asphalt, and perchlorate salt mixtures. Artillery officers' expérience, transmitted from generation to generation over centuries, was thus replaced with the application of scientific principles in the development and use of rocketry. The 50th anniversary of this fundamental change will be in 1988. U.S. Navy rocket experts worked on the use of the single and double base propellant and are credited with the application of the field of artillery rocket Bazooka. The recognition that the combustion chamber is a chemical reactor, in which chemical reactions follow the laws of thermodynamics, made it possible to calculate the energy release for a propellant composition. Thus, within a single decade following World War I, the theoretical specific impulse of composite solid propellants increased from about 80 sec for black powder to 186 sec for asphalt-type propellants, and finally to today's high energy composition exceeding 273 sec under standard complishments of many branches of science and technology, made it possible to increase flight distance and payloads…

198 THE CONSTRUCTION OF A REPLICA OF ROBERT H. GODDARD'S FIRST SUCCESSFUL LIQUID FUELLED ROCKET

Ball, I.M

1986 - IAA 86-496 - vol 9 - AAS vol.15 - pp. 181-194

In 1985, following the London Science Museum's decision to prepare a major new gallery dealing with the exploration of psace, a number of items of hardware werre selected for modeling or full-size replication. Among the initial requirements was a full-size replica of Robert Goddard's first successful liquid propellant rocket as launched on March 16th 1926 at Auburn, Massachusetts, USA. The Science Museum is not entirely self reliant for the manufacture of replicas or models, and much excellent work has been provided from external sources. Nevertheless some curaors have a marked preference for key items to be manufactured in the museum's own workhsops, and in this case, as it appeared that a reasonable amount of support information had already been assembled early on in the project, in-house manufacture was decided upon. The museum's facilities must be among the finest available for this sort of work, and the technicians employed enjoy a deserved reputation for superlative skills and dedication.

199 K.E TSIOLKOVSKY AND THE DEVELOPMENT OF 20TH CENTURY ANTHROPOCOSMISM

Kardashev Tsvetan D.

1987 - IAA 87-647 - vol 9 - AAS vol.15 - pp. 161-162

The world outlook principles of anthropocosmism are defined and an idea is given about its historical development from the ancient Thracian mythology until the 20th century. The interpretations of this principle with the philosophical and general scientific methodology, as well as with the development of the scientific picture of the world, are oulined. The formation of K.E. Tisolkwosky's world outlook is examined as a balance of the traditions of natural-scientific materialism, of the controversial influence of N.F. Fedorov, as well as of the practical melioristic single-mindedess characteristics of Tsiolkovsky himself. In spite of the limited nature of all these sources, under the conditions of the concrete-historical horizon of Tsiolkovsky's world outlook, nevertheless it comprises invariants of the entire spriritual development of the 20th century...

200 SPECULATIVE SPACECRAFT (1610-1957)

Miller Ron

1987 - IAA 87-667 - vol 9 - AAS vol.15 - pp. 115-136

The paper discusses some of the many pre-spaceflight schemes to leave the earth in manned spacecraft. These were shaped by the science, technology and aspirations of their time, and were influential in creating and maintaining the desire to explore space and ultimately inspiring those who eventually made spaceflight a reality.

201 BRENNSCHLUSS OVER THE DESERT - V2 OPERATIONS AT WHITE SANDS MISSILE RANGE, 1946-1952

London III John R.

1987 - IAA 87-654 - vol 9 - AAS vol.15 - pp. 335-367

The German-designed V-2 missile and White Sands Proving Ground, New Mexico, are forever linked in the annals of space history. From 1946 to 1952, V-2 operations at this remote site in the southwestern United States contributed significantly to the advancement of knowledge in number of engineering and scientific disciplines. The V-2 provided training in the handling and firing of large missiles, acted as a test-bed for missile research and development, and served as a means to carry experiments and test equipment into and beyond the upper atmosphere. When the last V-2 was launched in 1952, American missile and atmospheric science programs had experienced a quantum jump in progress. This paper gives a detailed look at White Sands V-2 operations to foster a better understanding of the impact of this weapon-turned-research tool on American space technology. Primary information sources were the White Sands Missile Range Technical Librairy and Public Affairs Offices archives.

202 DEVELOPMENT OF THE THEORY OF CORRECTION MANOEUVERS FOR THE FIRST TRANSFER TRAJECTORIES TO MARS AND VENUS

Kazakova R.K - Platonov, A.K

1987 - IAA 87-653 - vol 9 - AAS vol.15 - pp. 147-160

The study concerning the correction characteristics was initiated in the U.S.S.R. by Academician M.V. Keldysh in the late 50s in connection with the preparatory stage of the project of interplanetary transfers to Mars and Venus. Successful accomplisghment of the Moon fly-by missions with a purpose of photographing the lunar far side provided a required base of the theory and software in order to put a feasible problem of the interplanetary trajectory corrections and a choice of necessary algorithms. Morever, premises were created for developing the hardware of correction systems since a most difficult problem - a correct oreintation of spacecraft in space - has been solved.

203 FROM HF RADIO TO UNIFIED S-BAND - AN HISTORICAL REVIEW OF THE DEVELOPMENT OF COMMUNICATIONS IN THE SPACE AGE

Wilkins E.B

1987 - IAA 87-652 - vol 9 - AAS vol.15 - pp. 305-333

In the early years of space exploration recovery of telemetry and tracking data from stations located at great distances from the control centres proved to be a most difficult task. The primary method of long-distance communications at the time of the Sputnik-1 launch in October 1957 was HF-radio teletype. This paper will examine the situation as it existed in 1957 and will comment on the development of communications systems needed to support early space exploration, but especially the impact on the NASA Manned Space Flight Programme. The importance of communication satellites and the use of digital data transmission for telemetry tracking and command functions will be examined and the essential nature of these systems to the success of the first lunar landing will be discussed at some length.

204 PROJECT MANHIGH: A BALLOON-BORNE PREDECESSOR FOR PROJECT MERCURY

Kennedy Gregory P.

1987 - IAA 87-651 - vol 9 - AAS vol.15 - pp. 293-303

Project Manhigh, one of the most ambitious aerospace medical efforts of 1950s, used balloons to transport humans to the edge of space. Managed by the Aeromedical Field Laboratory at Holloman Air Force Base near Alamogordo, New mexicoM, Manhigh can be viewed as a precursor to NASA's first manned space effort, Project Mercury. This paper traces the development of high-altitude balloon research at Holloman Air Force Base and the origins of project Manhigh. The conduct of the program and hardware development are examined, and parallels to Project Mercury are highlighted. To reinforce the connection between Manhigh and Mercury, the contributions of Manhigh participants to the later space program are discussed.

205 AN ANALYSIS OF THE YU. A POBEDONOSTSEV'S SCIENTIFIC AND TECHNICAL ACTIVITY

Erokhin, B.T - Mazing G.Yu - Prodnikov, A.E.

1987 - IAA 87-650 - vol 9 - AAS vol.15 - pp. 195-198

Prof. Y.A. Pobedonostsev, Doctor of Technical Sciences and corresponding member of International Academy of Astronautics, is well known in broad circles of Soviet intelligentsia and abroad as the supervisor of the team of GIRD that created the first in the U.S.S.R. supersonic aerodynamic tunnel, the solid-propellant ramjet engine and as the founder of the theory of solid-propellant rocket engine who made an invaluable contribution to the development and creation of reactive powder missiles - "Katyusha". Together with the staff of the RNII set up the end of 1933 Y.A. Pobednostsev took an active part in theoretical designing and experimental work over reactive powered missile. The first fundamental investigations on the problems of RDTT interior ballistics were carried out by Y.A. Pobedonostsev.

206 PEENEMÜNDE AND LOS ALAMOS: TWO STUDIES

Tarter Donald E.

1987 - IAA 87-662 - vol 9 - AAS vol.15 - pp. 377-393

World War II produced two great and memorable scientific and technological teams; the German Peenemünde rocket team under the direction of Dr. Werhner von Braun, and the Amrerican Los Alamaos atomic bomb team under the direction of Dr. J. Robert Oppenheimer. Taken together, the contributions of these teams created the post-war capability for intercontinental nuclear warfare. These teams, though working in different countries under radically different political systems, encountered severe political difficulties during and after the war. Each, in its own way, had to live with its deeds, endure public suspicions, and bear the judgment of history on its efforts. On the basis of thirteens hours of interview recently completed with members of the Von Braun Peenemünde team, together with an analysis of several hours of video interviews of members of the Oppenheimer Los Alamos team, the author seeks to present a meaningful contracts and description of the environments and the pressures under which each worked.

207 PERSONAL RECOLLECTIONS OF THEODORE VON KÁRMÁN

Kit Boris

1987 - IAA 87-648 - vol 9 - AAS vol.15 - pp. 427-431

The author of this presentation recollects his meeting with Dr. Von karman in the last five years (1958-1963) of his life. The first meeting took place in Amsterdam, Netherlands, during the IAF Congress in 1958 when he agreed to write the foreward to the author's textbook on rocket propellants. (Kit Boris and Evered Douglas "Rocket Propellant Handbook", Macmillan Company, New York, NY, 1960). Subsequently, the author met Theodore von Kármán frequently either in his AGARD (Advisory Group for Aeronautical Research and Development, NATO) Office in the Palais de Chaillot, Paris, France, during the author's trips to Europe, or in Washington, DC's, Mayflower Hotel, during von Kármán's visits to the USA. A warm and friendly relationship developed between them. Occasionally, the author assisted von Kármán by providing him with research material for his publications, memorial lectures and testimonies in the U.S Congress. This paper consists of two parts: a brief biography of Dr. Von Kármán and the personal recollections of the author's meetings with him.

208 CONGREVE ROCKETS REVISITED

Turvey P.

1987 - IAA 87-663 - vol 9 - AAS vol.15 - pp. 25-30

The paper present several contemporary accounts of Congreve rockets in action. It also describes an extant Congreve whalling rocket and launcher, and recently-discovered contemporary models of Congreve's life-saving rocket equipment.

209 LUNAR SURFACE PHOTOGRAPHY - A STUDY OF APOLLO 11

Arnold, H.J.P.

1987 - IAA 87-646 - vol 9 - AAS vol.15 - pp. 259-284

The Apollo 11 lunar surface photographic plan is reviewed and the results examined. One Hasselbald image that includes Neil Armstrong (in shadow and at some distance) has now been identified reliably - but the failure to ensure that at least a small number of original, still, high quality photographs of the first man to walk on the Moon were obtained (what night be called the historic space pictures that were never taken) is analysed in depth.

210 APOLLO SCIENTIFIC INVESTIGATIONS OF THE MOON

Compton, Wm. David

1987 - IAA 87-645 - vol 9 - AAS vol.15 - pp. 243-258

see abstract - *This paper was not presented in 1987, but in 1988. For undetremined reason it is reproduecd in 1987 and 1988 AAS Proceedings volume.*

211 PROJECT HORIZON: AN EARLY STUDY OF A LUNAR OUTPOST

Ordway III, Frederick I. - Sharpe, Mitchell R. - Wakeford, Ronald C.

1987 - IAA 87-659 - vol 9 - AAS vol.15 - pp. 79-105

This paper reviews Project Horizon, an ambitious proposal for the establishment of an outpost on the Moon undertaken at the end of the 1950 decade by the United States Army. Historically, it was a pioneering and carefully developed study of the myriad factors involved in travelling to and from the Moon and making possible the permanent presence of man on its surface. Among the many subjects considered are lunar outpost design and construction, scientific programs proposed to be undertaken on the Moon, launch and transfer vehicles on Project Horizon are also described.

212 USING MATHEMATICAL MODELS IN RESEARCHING THE HISTORY OF ROCKET-SPACE TECHNOLOGY

Mikhaylov V. P.

1987 - IAA 87-660 - vol 9 - AAS vol.15 - pp. 107-113

At present, mathematical models are widely used for research in different fields of science and technology. Numerous domestic and foreign literature is declicated to the models construction (and calculations on their basis) and it contains different model definitions. This work considers any object which may substitute an investigated phenomenon in such a way that its investigation would give the information about this phenomenon as a model. For all this we shall distinguish the problem of a model construction from the problem of modelling, which wa do not consider in this report...

213 THE FRENCH SE 1900/1910 ROCKET SLEDS

Jung Philippe

1987 - IAA 87-661 - vol 9 - AAS vol.15 - pp. 395-414

This paper retraces the story of perhaps the best looking accelerating device yet realized. Conceived after the World War II by the French company SNCASE (now Aerospatiale) in its Cannes factory, the SE 1900/1910 track was supposed to launch various missiles. Built in a town better known for its film and recreational activities, this sled was tested in a place where plans call for the European spaceplane Hermes will to land: Istres, near Marseille. There, in March 1952, it established a new world speed record for tracked vehicles, at 328 km/h (later beaten by French locomtives BB and CC). A technical

214 THE DEVELOPMENT OF SPACE FLIGHT THEORY BY SOVIET SCIENTISTS

Rauschenbach Boris V. - Sokolov, V.N

1987 - IAA 87-666 - vol 9 - AAS vol.15 - pp. 141-146

This brief report being can not embrace all scientific ideas, tehoretical research, and preliminary designs of the late 1920s and early 1930s, which were devoted to substantiate the possibility to fly into space with the use of jets. Limiting this report to the works of the most prominent scholars of that time - K. Tsiolkovsky, F. A.Tsander, and Y. Kondratyuk -, I'll try to evaluate the level of their forseeing through their contribution to the development of the space machinery and the fundamentals of the space theory at its initial stage. It is inevitable that some of their ideas to be utilized in future will not be covered in the paper.

215 THIRTY YEARS OF ASTRONAUTICS WITH MCDONNELL AND DOUGLAS

Walker Charles D.

1987 - IAA 87-665 - vol 9 - AAS vol.15 - pp. 369-375

Today, the McDonnell Douglas Astronautics Company is one of the largest U.S. suppliers of space products and services. But, in 1957, the company was two -- the McDonnell Aircraft Company and the Douglas Aircraft Company. Both were military and commercial airplane manufacturers on the brink of providing the means for exploring outer space. Douglas built space launch vehicles and McDonnell built the free world's first manned spacecraft. In 1967, McDonnell bought Douglas, and the combined space activities and employees became the McDonnel' Douglas Astronautics Company. Today, the company's space programs include a commercial launch service and the preparation of space shuttle payloads. McDonnell Douglas is also competing to build a part of NASA's space station and to build elements of the National Aerospace Plane.

216 THE "BOUN BANG FEI" ROCKETS OF THAÏLAND - POSSIBLE KEY TO DETERMINING THE SPREAD OF ROCKETRY IN THE ORIENT

Winter Frank H.

1987 - IAA 87-664 - vol 9 - AAS vol.15 - pp. 3-24

In 1977, the author witnessed an unsual and colorful annual custom in northeastern Thailand, which is also celebrated in Laos. This was the Buddhistic-animistic "Boun Bang Fei" festival in which huge gunpowder rockets are launched to propitiate the rain gods to insure a good rice harvest. The custom is believed by popular tradition to have begun 1,000 years ago. Using French, English and Thai-language sources, an attempt is made to determine the historic flow of the rocket from China or India into Thailand (formerly Siam) and othe southeast Asian countries in which the Boun Bang Fei rockets are a key. Technical details of these rockets and their construction are covered.

217 INTERNATIONAL GEOPHYSICAL YEAR TO INTERNATIONAL SPACE YEAR

Friedman, Herbert

1987 - IAA 87-649 - vol 9 - AAS vol.15 - pp. 285-291

The International Geophysical Year (YGI) was the third milestones in a series of international cooperation in solar-system research. The First International Polar Year (1882-83) involved a collaboration amongst eleven nations bordering on the Artic region to study the influence of Arctic ice on weather. Fifty years later radio science had come of age and plans were implemented to conduct a Second Polar Year (1932-33) to study the ionosphere. With the end of World War II, American, British, French and Soviet teams undertook high altitude research with rockets. The idea of a grand campaign of ground based, combined with space based studies of the terrestrial environment motivated the organisers of the International Geophysical Year. Under the aegis of the International Council of Scientific Unions, a Special Committee for the IGY was established with Sydney Chapman as president and Lloyd Beckner as vice-president. The formal dates of the IGY were mid-1957 to the end of 1958. Over 40 000 scientists and technicians from 67 nations worked at 4000 observing stations covering the Earth from pole to pole. Hundreds of rockets were launched, but the crowning achievements were the

Soviet Sputnik in 1957 and the U.S Explorer 1, that discovered the Van Allen Belt in 1958. The success of the IGY has prompted contemporary geoscientists to consider the possibility of a new generation IGY to which they have given the name International Geosphere-Biosphere Program (IGBP). Special emphasis will be given to understanding atmospheric pollution and biogeochemical cycles and the links between geophysical and biological processes in general. Momentum is now gathering to restore a broad gauged international cooperation in space research and exploration in the historical context of Columbus' landing in America 500 years ago. 1992 has been designated an International Space Year (ISY). The ISY will be a celebration of the initiation of a golden age of space science, exploration and applications. European and Japanese space programs will be flourishing and the U.S. should have moved from post Challenger depression to courageous new initiatives. The Soviets, spurred by their new policy of Glasnost, could become welcome partners to Western science.

218 THE SCIENTIFIC FOUNDATIONS OF SPACE FLIGHT IN NEWTON'S "PRINCIPIA" (1687)

Subotowicz Mieczyslaw

1987 - IAA *** - vol 9 - AAS vol.15 - pp. 137-139

In 1987 we celebrate the 30th anniversary of the space era. In October 1957 the first flight of Russian Suptnik was realized, the first artificial satellite of the earth. In this connection the names of many important scientists, engineers and technicians contributed to the realization of the first flights of the artifical satellites were mentioonned as K. Tsiolkovsky, R. Goddard, R. Esnault-Pelterie, H. Oberth, W. Hohmann, A. Sternfield, W. von Braun, S.P. Korolev and many others scientists and engineers. In this connection I would like to present few remarks on the contribution of I. Newton /1687/ to the fundamental maws and fundamental ideas formulation concerning the possibility and realization of the reactive/jet/ propulsion or rocket propulsion ansd that of artifical satellites and space flight. This is also connected with the celebration of the 300th anniversary of the publication of the distinguished Isaaack Newton's bokk: "Principia Mathematica Philosophiae Naturalis".

219 THE BRITISH BLACK KNIGHT ROCKET

Becklake, John E.

1988 - IAA 88-607 - vol 10 - AAS vol.17 - pp. 165-181

Black Kinight was a liquid fuelled, initially intended as a research and development vehicle for the British Blue Streak Missile Programme. After the cancellation of this programme in 1960, Black Knight's value as a general purpose high altitude research rocket was recognised and flights continued until 1965. Work began on Black Knight in 1955, the first flight was in 1958 and in all 22 successful launches were made from Woomera in Australia. The basic Black Knight vehicle, 10.2 meters high and 0.9 meter in diameter, was used as a single stage rocket or with a solid fuel upper stage. One of its main roles was to test re-entry body shapes and materials but many other scientific experiments were flown. Black Knight technology also formed the basis for britain's only satellite launcher, Black Arrow. This paper describes the Black Knight vehicle, its development and variants and reviews the experimental results obtained from its flights. The various proposals produced from the use of Black Knight as an upper stage for various British satellite launch vehicle are also discussed.

220 THE ROLE OF MIKHAIL KLAVEIYEVICH TICHONRAVOV IN CREATING STAGE ROCKETS, 1947-1953

Yatsunsky I.M

1988 - IAA 88-599 - vol 10 - AAS vol.17 - pp. 451-456

The bright pages of the creative biography of the pioneer of Rocket technology and cosmonautics M. TOKHONRAVOV to be his activity on finding out the possibility of creating composit rocket, which he carried out personally and collectively by guiding a group of specialists. This paper presents the Organisational and Scientific and Technical aspects of this work carried out during the period between 1947-1953. Reasearch activity in this direction started already in the year 1947-1948 under the guidance of M.K. Tikhonravov. In summer 1948 the scientific council of the Institute along with Mikhail Kladevich discussed the feasability of creating composit Rockets based in this work. From the end of 1949 the activity of creating composit Rocket continued (under the guidance of M.K. Tikhonravov) by a group consisting of G.U. Maksimov, L.H. Soldatov and others. In 1950 the design of the various system of the composit Rocket with simultaneous and sequential separation was completed based on S.P. Korolev's work related to weight analysis in mathematical method, improved method of selecting structural and abllistic parameters of the composit rockets, the problem of the structural joints of the various stages, question of launch,etc. Research work on the ballistic problems were carried out in the active zone of the trajectory and also the movement of the artificial satellites of the earth. In the year 1951, partly the Mathematical solutions were found for optimistic design of the simple rockets and also for more complex systems of the composit rockets. Further optimistic activity was carried out under the leadership of M.V. Keldish in the Department of Applied Mathematics of the Mathematical Institute, Academy of Sciences, U.S.S.R. named after V.A. Steklova. Based on the work of M.K. Tikhonravov in the end of 1933 it was possible to open a scientific research wing with two years course, which deals with vcreating of artificial Earth satellites. Activities carried out within tge fram work of this topic does not include the period 1947 to 1953 which need to be analysed separately.

221 THE X-20 SPACE PLANE - PAST INNOVATION, FUTURE VISION

Sunday T.L - London III John R.

1988 - IAA 88-598 - vol 10 - AAS vol.17 - pp. 253-284

In November 1957, the United States Air Force initiated an aerospace development project that became one of the most innovative concepts of its day, and also provided a startlingly accurate glimpse into the future. The X-20 space plane, popularly know as Dyna-Soar, never achieved operational status - it was cancelled in December 1963. But even though it never flew, the diminutive vehicle laid the foundation for a variety of reusable manned space systems that followed, including some as new as tomorrow's headline. This paper examines the history of the X-20 program.

222 THE SE 4400/4401 FAMILY: A HYPERSONIC RAMJET IN THE FIFTIES

Jung Philippe

1988 - IAA 88-597 - vol 10 - AAS vol.17 - pp. 131-151

France has long been a staunch proponent of the ramjet, with such famed names as LORIN and LEDUC pioneering the concept. André TURCAT, later test pilot for Concorde, also was honored with the HARMON trophy for its late fifties flights at Mach 2 on the ramjet powered Nord 1500 Griffon. Now it can be revealed that in the fifties the SNCASE company was also launching in the Sahara Desert dozen of its anti-bomber ramjet missile, the SE 4400. Achieved performance was outsanding: maximum speed reached was Mach 3,5 and maximum altitude was 70 000m. This paper covers a research dealing not only with a history of this program and a description of the vehicle, but also with an attempt to establish its place within ramjet technology evolution.

223 THE AERODMEDICAL FIELD LABORATORY OF SPACE MEDICINE

Kennedy Gregory P.

1988 - IAA 88-596 - vol 10 - AAS vol.17 - pp. 389-403

Throughout the 1950's, the Aeromedical Field Laboratory at Holloman Air Force Base near Alamogordo, New Mexico, was the site of many advance in space medicine. The laboratory's program during that period included Project MX-1450R, Physiology of Rocket Flight; Project 7851, Human Factors of Space Flight; Project 7857, Research in Space Bio-Sciences; and Project 7850, Biodynamics of Human Factors in Aviation. Within these projects, subtasks included animal and human high-altitude balloon flights, biological rocket flights, and rocket sled research. An extremely important result from the rocket sled research was the development of automobile seat belts. This paper includes interviews with Dr. John P. Stapp, Dr. David G. Simons, and other former Aeromedical >Field Laboratory personnel as the major activities of the laboratory prior to 1961 are discussed.

224 MAJOR DEVELOPMENT TRENDS OF ORBITAL SPACE STATION

Feoktiskov, Konstantin, P.

1988 - IAA 88-595 - vol 10 - AAS vol.17 - pp. 203-207

In this article describes the major differences between the Orbital static "MIR" and other earlier space stations of second generation from the structural and functional point of view and also it describes the future path of progress in the field of development of the orbital stations. The main differences of the space station "MIR", compared to "SALYUT-6", "SALYUT-7" space stations are possibility of conducting advance research programmes in the orbital flight, maximum automatization process of the station, almost doubled the power availability, more economic like supporting systems, possibility of increasing the capacity of the station. Addionaly this multipurpose orbital station (like space station "MIR" which is like a laboratory in the space), has the provision of using the station for various purpose like using of the station for solving special problem (viz, Remote sensing of natural resources), creating a space platform for servicing spacecrafts in the orbit, creating a space fabrication platform on which big Radio Telescope could be assembled and facility od space manufacturing. Special attention was given towards the usage of remote control manipulators inside and outside the station for carrying out vairous work. The idea of creating a special orbital station (are of the possible space station) is getting formulated named as "OBLAKA" (means cloud) consists of few modules, floating in space at a distance of few kilometers from each maintaining the distance constant among themselves.

225 THE AMERICAN ROCKET SOCIETY (1953-1963): A MEMOIR

Harford, James J.

1988 - IAA 88-605 - vol 10 - AAS vol.17 - pp. 209-216

Monday, October 3, was a doubly auspicious date for me. It was the 35th anniversary of the day that I took offices as Executive Secretary of the American Rocket Society. It was also, coincidentally, the day I turned over the job as Executive Director of AIAA to my successor, Cort Durocher. I couldn't help but reflect on some of the dramatic differences between the circumstances of the two dates 35 years apart. The office which I have relinquished at 370 L'Enfant Promenade in Washington, in AIAA's brand new headquarters building looks out grandly through six large curved window panes at Washington National Airport, the Jefferson memorial, the Washington Monument, the Smithsonian Institution, and once can even catch glimpses of neighboring NASA, the Congressional offices, and the Capitol itself. AIAA has a $15 million budget, a staff of 189 people in Washington, New York and Los Angeles, has 40,000 members, 63 local Sections, 127 Student Branches, 58 Technical Committees, published 6 journals, holds about 25 conferences per

226 A LEGACY FOR THE FUTURE - PRESERVING SPACE-RELATED HISTORIC SITES

London III John R.

1988 - IAA 88-608 - vol 10 - AAS vol.17 - pp. 63-83

The period from 1945-1975 marked a unique, epochal time in history. During these thirty years, the ear of space exploration was born, nurtured, and brought to a level of fruitition by the successful accomplishments of various national manned and unmanned programs. Museums around the world have done a credible job in preserving various historic artifacts from this period, primarily of a flight hardware nature. However, very little has been done to preserve the actual sites where many historic space events took place. The preservation of these historic sites certainly presents difficulties not experienced with the preservation of most artifacts. Nevertheless, as these heady days of early space exploration recede into the past, their historical significance will continue to grow. It is vital that steps be taken to review various historic site preservation options available so the right choices and appropriate commitments can be made to protect our space legacy for years to come. The difficulties of preserving and providing public access and interpretation of historic sites are well known to historic preservation organizations worldwide, and space-related historic sites present a unique set of challenges over and above what a typical site usually requires. Many space sites have large, complex structures that are difficult to maintain, and this is especially true of launch structures exposed to the corrosive effects of ocean salt spray. The location of these sites also creates difficulties since many are on active government installations with restricted areas. Many sites operational requirements. Public access causes unique safety hazards because of the design characteristics of many sites. All of these factors add up to help create the biggest challenge of all - high cost for initial development and long-term support. In the United States, the National Park Service has been developing various options for the long-term preservation of a prioritized set of historic space-related sites and structures. These priorities have been formally codified in the Service's Man in Space-Study of Alternatives. This document has been produced to comply with Public Law 96-344, which directed the study. High an the list of valued properties are the Apollo Eleven Launcher - Umbilical Tower and the historic launch sites that are part of the Air Force Space Museum. Action must now be taken by Congress to select appropriate options for the protection of these one-of-a-kind, irresplaceable landmarks. National space-related organizations in the United States should review the Park Service Study and develop a consolidated position. Internationally, space-related organizations must emphasize the importance of preserving historic space sites, so the various spacefaring nations can take steps to insure our international space heritage is protected. Preservation of these historic sites would allow future generations to not only study more about our civilization's initial steps into space, but to see, touch, and experience this part of our history in a more personal way.

227 THE ACTIVITIES AND THE ROLE OF VLADIMIR PETROVICH VETCHINKIN IN THE FIELD OF ROCKETRY

Belov, B.L.

1988 - IAA 88-609 - vol 10 - AAS vol.17 - pp. 457-460

The creative activity of V.P. Vetchinkin could be considered as one of the rare, if not toatlly exclusive example in fthe first quarter of 20th century, when repeted scientists of old generation and higly specialised in traditional scientific and technological field exchanged views with enthusiasm regarding the possibility of conducting inter connectory flights, Vetchinkin himself carried out original work in the field of rockteing. During his 40 years of activity he was also directly connected with various research groups like Gas dynamics, Structural Mechanics, Theory of flying objects,etc. In ddition to this V.P. Vetchinkin was heading the general Theroretical Department of TSHAGI for few years, because of his well known capability for holding the moral high among the pioneers of the space technology and direct participation in preparing various publication in the field of Rocket Technology. V.P. Vetchinkin participated actively in promoting the idea of space flight, by giving series of lectures on this thematics. He was one of the initiater in the U.S.S.R. from 1924 onwards…

228 WILLIAM CONGREVE AND THE CITY OF TOULOUSE

Escalettes, Jean-Paul - Jung Philippe -

1988 - IAA 88-610 - vol 10 - AAS vol.17 - pp. 13-32

Toulouse is well know as probably the biggest European aerospace concentration with such names as Aerospatiale, Dassault, Thomson, Matra, Cnes, Air France and many others. What is less known however is that nearly two centuries ago an early rocketry pioneer, William Congreve, had his rockets used in anger during the Toulouse battle. Even more interesting, he later happened to stay in the Languedoc capital while trying to find his way to Nice on his own boat : death caught him there before he could reach his final destination. This paper explains the significiance of the use of Congreve rockets during the Toulouse battle, which was actually the last Napoleonic combat. It salo elanborates on the research trying to clarify the many unknowns about Congreve's stay in Toulouse at the end of his life. This includes a search for his grave since the original one has been displaced .

229 ARIEL 1 - THE WORLD'S FIRST CO-OPERATIVE SATELLITE VENTURE

Willmore A.P.

1988 - IAA 88-611 - vol 10 - AAS vol.17 - pp. 183-196

Ariel 1, launched on April 26th, 1962, was the first satellite to be buyilt and launched following an offer by Nasa to establish a new programme for international collaboration in space science. Five satellites have been built as part of the U.S.-UK programme established as a result of NASA's initiative. The last satellite in the Ariel series, Ariel VI was no part of this programme. Ariel 1 was highly successful scientifically, and was a major factor in the development of space science in the U.K. Its development, construction and results are reviewed.

230 INDO-ARYAN TRADITIONS AND HISTORY OF ASTRONAUTS

Pinotti Roberto

1988 - IAA 88-600 - vol 10 - AAS vol.17 - pp. 3-12

In several Indo-Aryan poems and traditions we may find strange descriptions of different mythological flying devides, called "vimanas" in Sanskrit. After a brief analysis of such myths and their necessary comparison, the paper faces the problem of the impressive and detailed descriptions of these flying devices in the light of an advenced science, undergoing their possible conncections with today's aerospace technology.

231 APOLLO SCIENTIFIC EXPLORATION OF THE MOON

Compton, Wm. David

1988 - IAA 88-602 - vol 10 - AAS vol.17 - pp. 405-419

President John F. Kennedy's decision to make a manned lunar landing the foundation for the United States's space program owed nothing to any scientific interest in the Moon. The main purpose of Project Apollo was to restore the Nation's prestige, which in the opinion of many had seriously declined as a result of the Soviet Union's early successes in space flight. Equally important, the technological advances, facilities, and organization necessary to send maen to the moon and back would give the U.S. the capability to operate in space whatever purposes suited the national interest. Finally, the very difficulty of landing men to the moon appealed to Kennedy's conviction that a commitment to great things would be good for the nation's soul. In proposing the lunar landing to Congress he justified his choice, in part, on the ground that no other space project would be "so difficult or expensive to accomplish"; and in a speech a year later he remarked, "we choose to go to the moon in this decade and do the other things, not because they are easy, but because they are hard" [emphasis added]. ….

232 AMERICAN MANNED PLANETARY MISSION STUDIES, 1962-1968

Dixon, Franklin P.

1989 - IAA 89-729 - vol 10 - AAS vol.17 - pp. 421-448

A number of mission and system studies were conducted during the period starting in 1961 and concluding with an integrated examination of future manned mission objectives available for post-Apollo applications in 1967. Some of the results and persons involved are identified. Key technological considerations are rported, as they were developed in this timeframe, and some little known events are reported as they occured to help identify historical experimences that might be of future interest for planetary planning. From the EMPIRE Studies to the integrated Interplanetary-Planetary Joint Action Group in 1968 elements of NASA planning are covered from an evolving interest to the point of concentration on the near-term Apollo Applications Program for extended use of Saturn and Apollo for earth orbital manned flight. Current international considerations are addresses for future manned mission planning to explore our solar system, starting with the nearby planets.

233 THE COLLABORATION OF WERNHER VON BRAUN AND FRED FREEMAN

Liebermann Randy

1989 - IAA 89-744 - vol 10 - AAS vol.17 - pp. 35-39

In this paper the author will focus on the working relationship between Fred Freeman, one of three "Collier's" illustrators, and one of America's greatest historical and technical artists, and Wernher von Braun, perhaps history's most influential astronautical engineer. During a period of about ten years, Freeman and von Braun collaborated on several projects. For the purpose of this paper, I will concentrate on their "Collier's" collaboration

234 PRESERVING CHAPTERS IN AEROSPACE HISTORY

Thomas Shirley

1989 - IAA 89-743 - vol 10 - AAS vol.17 - pp. 41-61

This is a critical point, historically, in the evolvment of the space age. We have missed the opportunity to document it through videotaped interviews with some of the leaders such as Dr. Wernher von Braun, who chartered our courses into the universe. We must act now to get interviews with the early and present figures. A collection of such material provides a primary source of information that is crucial to writers, students, and historians for both today and in the future. The Aerospace Historical Committee of the California Museum of Sciences and Industry has instituted the project Chapters in Aerospace History to gather in-depth videotaped interviews and to make them available to other museum or requesters. This paper peers into the next 40 years of space development through statements by some of the people interviewed in this project. The author issues a call to action in which a national and international program will be established to videotape interviews with leading figures of aerospace. This we owe to those who will, in the next 40 years, be writing about today's space activities.

235 A BRIEF HISTORY OF THE GERMAN ROCKET SOCIETY

Kit Boris

1989 - IAA 89-742 - vol 10 - AAS vol.17 - pp. 217-220

The author of this paper presents a brief history of the Hermann Oberth Society of germany from the time of its establishment to the present time. The hermann Oberth Society (HOG), member of the International Astronautical Federation (IAF), was founded in 1952, in Bremen under the name of the German Rocket Society (Deutsche Raketen Gesellschaft) and was renamed in 1963 to the Hermann Oberth Society in honour of Hermann Oberth, one of the greatest German and world space pioneers, living today in the city of Feucht near Nuremberg. Taking on objectives of fostering the astronautical research and development for peaceful applications in Germany, this society soon was joined by many distinguished rocket scientists and engineers, former members of the Peenemünde team. They assisted greatly by bringing in expertise, tradition and enthusiasm for space researchh work. Soon after, the HOG was transformed into one of the most effective national astronautical organizations. Today the HOG can be proud of many accomplishments, one of which is the influence upon the public opinion as well as the government concerning the necessity of greater involvment in the development of German and international space projects.

236 MERCURY PRIMATES

Kennedy Gregory P.

1989 - IAA 89-741 - vol 10 - AAS vol.17 - pp. 319-339

Primate rocket flight began in 1948 with the launch of small monkeys aboard four V-2 rockets at White-Sands proving Grounds in New mexico. These led to later experiments with Aerobee rockets, then the Able and Baker flight with a Jupiter intermediate range ballistic missile. In the late 1950s, NASA managers decided that before Mercury, America's first manned spacecraft, carried humans beyond the atmosphere, it was to be thoroughly tested with primate passengers. This decision led to three suborbital and one orbital flight using rhesus monkeys and chaimpanzees. The rhesus monkey flight were made during Mercury abort tests with the Little Joe rocket. Flowm from Wallops island, Virginia, these flights provided data on physiological response to the accelerations anticipated during an abort. The last two animal flights used the Redstone and Atlas boosters, the launched vehicles scheduled for manned missions. On January 31, 1961 a chimpanzee named Ham flew aboard a Redstone on a 15-minutes suborbital flight. Although another unmanned flight was added to the schedule after Ham (the MR-BD mission), Ham's flight was seen as the final test of the spacecraft performance and life support capability before it carried a human pilot on a suborbital flight. Likewise, in November 1961, NASA managers used a chimpanzee to prove the spacecraft under orbital conditions. In this flight, the primate's name was Enos. As dress rehearsals for the manned missions, the chimpanzee flights attracted considerable public attention. Theirsuccesses were the last hurdles which needed to be cleared to qualify the Mercury spacecraft for manned flight.

237 MERCURY-REDSTONE: THE FIRST AMERICAN MAN-RATED SPACE LAUNCH VEHICLE

Burkhalter, Betty B. - Sharpe, Mitchell R.

1989 - IAA 89-740 - vol 10 - AAS vol.17 - pp. 341-388

This paper descrobed the development of the Mercury-Redstone launch vehicle used by the United States in 1961 to project two manned spacecraft along suborbital ballistic trajectories. It shows that progress in ballistic missile technology dating from World War II contributed to the development of the Redstone missile, which itself was adapeted for the mercury spacecraft launch missions. Among other subjects, the proposal to use a modified Redstone as a manned launch vehicle in the proposed project Adam is recounted as is the role played by the hermes C-1. Particular attention is focused on the engineering adaptations and rigid reliability program of the redstone missile to fulfill the requirement of launching man. The process of "man-rating" the Mercury-Redstone for this category of mission is explained. Also described are the design, development, and testing procedures developed for Mercury-Redstone. Key points in the design process and decisions made to insure mission success and astronaut safety are reviewed. Finally, the results of the flights of the Mercury Freedom 7 spacecraft piloted by Astronaut Alan B. Shepherd on 6 may 1961 and the Mercury

238 THE ATLAS AND CENTAUR "STEEL BALLOON TANKS" - A LEGACY OF KAREL BOSSART

Martin R.E.

1989 - IAA 89-738 - vol 10 - AAS vol.17 - pp. 285-317

The propellant tanks which are serve as much of the primary structure for Atlas and centaur launch vehicles are a unique design of pressure-stabilized, thin-steel, monocoque structure witha common intertank bulkhead - a "steel-balloon". They were conceived in 1946 during project MX-774 by Karel J. "Charlie" Bossart, known as the father of the Atlas, and fully implemented in 1955 at the start of the Atlas program. This paper summarizes the development and flight history of the concept - design solutions, developmental testing, analytic techniques, and special handling requirements. Over the 32 years and 567 stage-flights since first flight in 1957, the structural design is nearly unchanged, but significant advances in utilizing ist capabilities have been made. Data presented indicates that its efficiency in terms of the ratio of propellant volume carried to tank structural weight is still unsurpassed. This efficiency has significantly controbuted to the competitiveness of the Atlas I and II family of launch vehicles, which will likely be produced into the 21st Century - a longer production period than that of the venerable Model T Ford automobile or DC-3 airplane.

239 THE SE 4100 FAMILY, AN EARLY FRENCH EXPERIENCE IN ROCKETRY

Jung Philippe

1989 - IAA 89-731 - vol 10 - AAS vol.17 - pp. 103-129

The impact of the German rockets during the second world war was such that soon their use was foreseen for every application in the aircraft industry. One of those was the defence against intruding aircraft. Two countris launched early research programs in this direction, the United States and France. So secret was this work that today not much is known about them. However, from the American way of numerically designating their programs, it can be seen that an extensive activity was performed before operational SAM-N-6 Talos and SAM-A-7 Nike Ajax were put into service. Recent research has shown that France, with much more limited means, also went into the same filed, but with only one program, the SE 4100 family. Launched as early as in september 1949, this liquid/solid propellant rocket vehicle actually provided Société Nationale de Constructions Aeronautiques du Sud Est (SNCASE) with its very first experience in rocketry. Testing different guidance systems, the SE 4100 was used in no less that 14 different configurations for a total of 80 shots until 1956, up to 11 km height and 1000 km/h speed. This paper is a first attempt to describe this pioneer program until now veiled in a cloud of secrecy. It also tries to establish the historical significiance of the SE 4100 which was one of the first such rockets, if not the first, in the world.

240 THE FIRST CONTROL SYSTEM FOR SPACE VEHICLES

Rauschenbach Boris V.

1989 - IAA 89-728 - vol 10 - AAS vol.17 - pp. 197-201

The paper provides information on the history of development of attitude control system for space vehicles "Luna-3".

241 "BLACK BETSY" : THE 6000C-4 ROCKET ENGINE 1945-1989 - PART 1

Winter Frank H.

1989 - IAA 89-726 - vol 10 - AAS vol.17 - pp. 221-252

Part I of this paper covered the background, development, and early uses of the 6000C-4 rocket engin (nicknamed "Black Betsy"") in the Bell X-1 and advanced X-aircraft. This period lasted from 1945 to 1958.

See part II in 1990 under reference abstract 466

Part II concludes the history of the engine and treats its use as a very successful powerplant in the Douglas D-558-II Skyrocket and XF-91 airplanes. Also treated are miscellaneous early applications of the 6000C-4 and modifictions of the engine for use in the important MX-774 test rocket, as the Interim Powerplant for the X-15 reasearch plane, as landing rockets for several flifting body aerodynamics test vehicles (which palyed a role in the development of the Space Shuttle), and as the propulsion for the current Sonic Wind Project, a supersonic ice-sled. This period continues the history of the 6000C-4 until the present.

242 BRITISH ROCKETS EXPERIMENTS IN THE LATE 50'S/EARLY 60'S

Becklake, John E.

1989 - IAA 89-727 - vol 10 - AAS vol.17 - pp. 153-164

The flight of scientific experiments on high altitude sounding rockets provides an excellent proving ground for the development of satellites payloads, as well as, producing valuable data in its own flight. By the mid-1950s Britain has begun the development of three large rockets - Blue Streak, intended as thr British medium range ballistic missile; Black Knight, a research vehicle to flight test systems required for Blue Streak, and the smaller Skylark, a high altitude sounding

243 THE EVOLUTION OF LIQUID PROPULSION IN FRANCE IN THE LAST 50 YEARS

Villain Jacques

1989 - IAA 89-737 - vol 10 - AAS vol.17 - pp. 87-102

The account hereunder describes the history of liquid rocket propulsion in France through the last 50 years. It shows in particular that the work which truly started on the morrow of World War II in a strictly national scope and for military applications, gradually became European and todate relate only to civil space purpose.

244 THE LEGACY OF HERMES

Braun, Julius H.

1990 - IAA 90-625 - vol 11 - AAS vol.19 - pp. 135-142

United States explotation of WWII German rocket development was a multi-phased effort carried out primarily under the Army Ordnance Department's Hermes contract with the General Electric (GE) Company. The first phase was the acquisition - capture - of people, rocket hardware and information. This was followed by interrogation of the developers and translation of documents followed by a massive technology transfer to the U.S. rocket and missile community. Next came a learning period with U.S. crew launching captured V-2 rockets carryingscientific payloads to high altitudes. During this phase industry was contracted to cpoy and improve on subsystems and components as a first step toward designing complete new hardware using the latest postwar technology. Finally new progress evolved from the acquired knowledge and were carried through to feasability demonstrations. The Hermes II was such a program. Range extension and accuracy improvement had been high priority goals of the V-2 program in Germany and this work was resumed in the U.S. under the GE contract.

245 THE SE 4300 GUIDED ROCKET PROGRAM

Jung Philippe

1990 - IAA 90-620 - vol 11 - AAS vol.19 - pp. 153-191

Working in conditions of great secrecy during the Second World War, French Army Colonel Barré could little imagine the consequences of the launch of his EA-41 rocket near Toulon on 15 March 1945, a few weeks before the Armistice. A vast array of rocket programs was to be initiated in France, as well as by the two big powers, in which he was to be also involved. The first one was however a production of the aircraft industry: following a launch on 29 September 1949, the SE 4100 went on to a probable 80 flights in 17 different configurations. With such a wealth of basic data, the Cannes factory of SNCASE could then proceed to new SA or "Sol-Air" (Ground to Air) programs to refine launch, propulsion, stabilization and guidance techniques:

- the high subsonic liquid propellant SE 4300 firts launched on 27 February 1954 (SA11 program);
- the low hypersonic ramjet propelled SE 4400 first launched on 9 April 1954 (SA20 program).

The SE 4300 story, cloaked in the same secrecy affecting the other contemporary SNCASE rockets, is told here for the first time. A technical description is followed by an account of the evolution of a program which saw the biggest quantity of such rockets to be built by SNCASE, to the extent of subcontracting ist manufacturing to the Toulouse factory of the company. In conclusion, a table lists all 125 launches up to June 1957, at a time of high level governmental decision leading to an ending of such a type of activities.

246 THE ROLE OF S.P. KOROLEV AS A DESIGNER OF LAUNCHERS FOR SPUTNIK AND VOSTOK

Mishin Valery P.

1990 - IAA 90-635 - vol 11 - AAS vol.19 - pp. 295-300

abstract not available

247 "BLACK BETSY": THE 6000C-4 ROCKET ENGINE, 1945-1989 - PART II

Winter Frank H.

1990 - IAA 90-634 - vol 11 - AAS vol.19 - pp. 237-258

Part I of this paper covered the background, development, and early uses of the 6000C-4 rocket engin (nicknamed "Black Betsy"") in the Bell X-1 and advanced X-aircraft. This period lasted from 1945 to 1958. Part II concludes the history of the engine and treats its use as a very successful powerplant in the Douglas D-558-II Skyrocket and XF-91 airplanes. Also treated are miscellaneous early applications of the 6000C-4 and modifictions of the engine for use in the important MX-774 test rocket, as the Interim Powerplant for the X-15 reasearch plane, as landing rockets for several flifting body aerodynamics test vehicles (which palyed a role in the development of the Space Shuttle), and as the propulsion for the current Sonic Wind Project, a supersonic ice-sled. This period continues the history of the

248 6000C-4 UNTIL THE PRESENT. - ENGINEERING DEVELOMMENT OF THE APOLLO LUNAR MODULE

Gavin Jr., Joseph G.

1990 - IAA 90-633 - vol 11 - AAS vol.19 - pp. 225-236

This paper does not dwell on Apollo mission planning, architecture or operations, the subjects of many reviews, but rather highlights several cases of engineering development-- design and testing-- that provide insight into the seemingly endless effort required to assure that Apollo's Lunar Module was reasonably designed of its mission and that, indeed, it was ready for launch….The paper concludes by reviewing briefly change control, the rejection of random failures, the discipline of pre-mission readiness reviews, and the primacy of mission safety.

249 EMPIRE: BACKGROUND AND INITIAL DUAL-PLANET MISSIONS STUDIES

Ordway III, Frederick I. - Sharpe, Mitchell R. - Wakeford, Ronald C.

1990 - IAA 90-632 - vol 11 - AAS vol.19 - pp. 3-62

In 1962, the National Aeronautics and Space Administration prepared a work statement for the study of manned scientific missions to Mars as well as to Venus. The ground rules stated that the studies would be based on projected state-of-the-art early 1970s nuclear propulsion technology, and would consider a number of missions (Mars and Venus flybys, Mars and Venus orbital reconnaissance, and Mars orbital reconnaissance and surface landing). The total duration was not exceed 1-1/2 years on any mission; and nuclear propulsion was to be used for escape from Earth orbit, for braking into planetary orbit, for escape from planetary orbit, and for any propulsive nraking required when returning towards Earth. The studies were only to concern Earth launch vehicles insofar as they were dictated by spacecraft requirements. The crew was to be completely integrated into vehicular systems, and the spacecraft designs were to take into account experience gained in the Mercury, Gemini, nd Apollo programs and on-going space station studies. Mars surface landing missions were to be accomplished using a planetary excursion module. Building on studies conducted in the 1950s and early 1960s by government, industrial and individual researchers, in May 1962 NASA's George C. Marshall Space Flight Center slected three contractors to undertake 6-month studies that became known as EMPIRE (Early Manned Planetary-Interplanetary Roundtrip Expeditions). The companies were Aeronutronics Division of Ford Motor Co., General Dynamics/Astronautics, and Lockheed Missiles and Space Co. The results of these studies revealed that manned missions to the two planets appeared feasible during the 1970s. It was assumed that launch into orbit from the surface of the Earth would be accomplished by either of two booster configurations then under study: the Saturn C-5 or the Nova. The primary topics addressed by this paper are mission requirements and spacecraft configurations for each of the three contractor studies. Crew and environmental considerations are also covered as well as proposed scientific investigations.

250 ALFRED MAUL, A PIONEER OF CAMERA ROCKETS

Rietz Frank. E.

1990 - IAA 90-619 - vol 11 - AAS vol.19 - pp. 261-275

At the beginning of the 19th century the German engineer Alfred Maul experimented successfully with camera rockets. Using his method, he could photograph great areas of the earth from high altitude. Maul's extensive work in this field results in seven patents between 1903 and 1908 and many articles in Saxony newspapers during this time. Maul described experimental researches to find flight characteristics of rockets, worked out different shutter releases of the cameras, designed six variants of rockets, used gyrostats for stabilization of camera rockets. The advantage of Maul's rockets versus balloonn photography is as follows: technical and economical requirements were very little. This was an important aspect concerning military application. Maul's camera rockets losed their meaning withe possibility of taking photos from aircrafts. The following three facts made Maul to a pioneer of rocketry:

- first practical used of rockets for remote sening,
- return of payloads to earth,

- use of gyrostats for stabilization of rockets

Alfred Mazul was born in Poessneck (Thuringia) in November 27, 1870. He lived in Dresden till 1942 as a civil engineer. He died in August 27, 1942.

251 ON THE HISTORY OF ROCKETRY IN THE U.S.S.R. IN THE FIRST YEARS AFTER THE SECOND WORLD WAR.

Bork, P. - Sadovoj

1990 - IAA 90-623 - vol 11 - AAS vol.19 - pp. 143-152

After the end of World War II the Soviet Union had to define the new directions for the dévelopment of missile technology. Using the experience of the 1930-ies and 40-ies, Soviet scientists and engineers resumed the development of liquid-propelled rockets, which had been interrupted during the war, and achieved considerable results within a relatively short period of time. In this respect it is interesting to investigate the role played by German rocket specialists working for the U.S.S.R. in that period - a question which has not been so far assessed objectively in Soviet publications. The report deals with the activities of German experts from 1945-1947. Information is given about the concepts of the Soviet military leadership concerning the use of missiles and the employment of German experts. The report descrobes the tasks of the experts and the extent to which they were able to convey theoretical knowledge and practical know-how to the U.S.S.R.. The authors try to explain why, starting with 1950, the Soviet leaderzship did not deem it necessary to employ German experts any more, and why their activities did not have a major impact on the Soviet missile programme and have not been

252 THE R-3 ROCKET PROJECT DEVELOPED IN THE U.S.S.R. IN 1947-1959 AS A BASIS FOR THE DEVELOPMENT OF THE FIRST SPACE LAUNCHERS

Biryukov, Yu. V.

1990 - IAA 90-627 - vol 11 - AAS vol.19 - pp. 193-199

abstract not available

253 THE ORIGIN OF GRAVITY-PROPELLED INTERPLANETARY SPACE TRAVEL

Dowling, Richard L. - Kosmann William J. - Minovitch Michael A.

1990 - IAA 90-630 - vol 11 - AAS vol.19 - pp. 63-102

Prior to 1961, astrodynamicists assumed that the minimum energy trajectory for traveling to another planet was an elliptical arc, traversing 180° around the sun, and tangent to the orbits of the launch planet and target planet. The orbits of the launch and target planets were assumed, for simplicity, to be circular and co-planar. This trajectory was discovered in 1925 by Dr. Walter Hohmann and became known as the famous "Hohmann trajectory" for interplanetary space travel. It was invetigated by numerous astrodynamicists and many analytical papers were published proving that this ideal trajectory did indeed represent the minimum energy trajectory for traveling to another planet. It became one of the most universally accepted principles of astronautics. Almost every book published on interplanetary space travel had a diagram illustrating this famous trajectory, and its geometrical properties. Unfortunately, since "Hohmann" trajectories required several decades of travel time to reach the most distants planets, only a relatively small portion of the Solar system near the eccliptic plane could be reached and explored with conventional chemical rocket propulsion. It was believed that high perfromance nuclear and/or electric propulsion systems were required to reach more distant regions, such as the orbits of Uranus, Neptune, or Pluto. This was the technical foundation upon wich the plans for the United States Interplanetary space programm were based at the beginning of the 1960s prior to the invention of gravity propulsion. Since this foundation was itself based upon decades of research, there was no expectation that anything would damage. In 1961, Michael Minoivitch, then a graduate student in mathematics with no prior experience in astrodynamics, developed a numerixcal technique for solving one of the most difficult problem in Celestial Mechanics that existed at that time -- the restricted three-body problem….This paper is intended to provide an accurate historical account of the origin and early development of gravity propulsion with respect to the state of the art that existed at that time. In order to achieve a high degree of historical accuracy, numerous reference are used. These references include published papers, unpublished documents such as JPL Inter-Office Memorandum, Technical memorandums, personal letters, and numerous other unpublished documents from the University of California, Los Angeles (UCLA) such as office notes and FORTRAN ciomputer program listings and dated computer trajectory computations. Detailed recorded interviews with Dr. Minovitch and other researchers were also made in the preparation of this paper. The paper also compares the work of Minovitch with that of Kondratyuk, Tsander, Lawden, and Crocco who also investigated gravitational perturbations but concluded that the minimum energy trajectory to another planet was still represented by Hohamnn's trajectory. This paper represents the first of several historical papers that chronicles the work of Dr. Minovitch and how the various NASA gravity-propelled missions originated from it.

254 THE EVOLUTION OF THE TITAN ROCKET - TITAN I TO TITAN II

Adams Laurence J.

1990 - IAA 90-631 - vol 11 - AAS vol.19 - pp. 201-223

The Titan Intercontinental Ballistic Missile project was initiated in 1955 as a backup to the Atlas ICBM program during the period of the perceived "missile gap" between the Soviet Union and the United States. This high priority project proceeded rapidly and with frequent spectacular test failures to a culmination with the activation of 54 operational missiles stored in ready state in silos. This cryogenically fueled system required fueling after a launch start alert and suffered from frequent down times due to reliability problems in the fairly complex system….

255 MODERN ROMANIAN AEROSPACE ACHIEVEMENTS: DEEP ROOTS

Ispas, Stefan - Zaganescu, Florin

1990 - IAA 90-*** - vol 11 - AAS vol.19 - pp. 105-115

abstract not available

256 **JEAN-JACQUES BARRÉ: FRENCH PIONEER OF ROCKETS AND ASTRONAUTICS**

Villain Jacques

1990 - IAA 90-621 - vol 11 - AAS vol.19 - pp. 277-293

Jean-Jacques Barré was the first French to make a liquid propellant rocket fly on March 15, 1945. But his work, that started in the mid 1920s, went much beyond the mere scope of rockets. His fields of interest covered at the same time astronomy, liquid, nuclear and electric rocket engines, as well as ramjets. He further took interest in nuclear power. It is therefore the life and work of jean-Jacques Barré taht form the subject of this paper.

257 **FROM VAHRENWALD VIA THE MOON TO DRESDEN**

Dannenberg, Konrad K.

1990 - IAA 90-622 - vol 11 - AAS vol.19 - pp. 119-134

The author became interested in rocketry after Max Valier had given a presentation about rockets and space travel. My interest increased in June 1928 when Fritz von Opel sponsored several starts of rocket driven railroad car at Burgwedel near Hannover. These events and an increase in public intesrest led Albert Pullenberg in 1931 to establish the Gesellschaft für Raketenforschung (GfR) of which I became a member. This organisation was one of a number of pre-Peenemünde groups of rocket amateurs located across Europe. We had been given a small patch on an Army training base in the Vahrenwalder Heide just North of Hannover. Eartrhen storage bunkers provided safety for our static test firings of liquid propelled rocket engines. Our projects included postal rockets to carry mail to provide propulsion systems for sail-planes and to build simple liquid fueled rockets for public displays and demsontration purposes to earn some badly needed funds in support of our activities. All members were throughly familiar with Hermann Oberth books "Die Rakete in den Plantenraum" and "Wege zur Raumschiffhart". We used his formulas and performance data for our studies and proposals. Our big problem was how to convince the public of the benefits of space travel, just as it is today!Another group of rocket amateurs had moved from breslau to berlin and established the rocket field at Reinikendorf. It was headed by Rudolf Nebel with Hermann Oberth as scientific adviser a number of other experienced rokecteers and especially a young student Wernher von Braun. The German Army became aware of the successful efforts of this group and finaly offered Federal employment to Wernher von Braun and a few others. They were transferred to an Army Arsenal at Kummersdorf with the assigment to develop and build liquid propelled rockets for the Army to replace heavy artillery. Tests became more and more impressive and in order to accomodate larger and larger units the Army relocated these efforts to Peenemünde a small fishing village on the Island of Usedom in the Baltic Sea. There the key development was the A-4 later on renamed the V-2. When these war time development had been assigned a high priority for materials and personal Wernher von Braun could eventually also invite Hermann Oberth to join the team. He was assigned work on advanced projects for future applications of improved and succesively larger rockets....

258 SEGMENTED ROCKET DEMONSTRATION - HISTORICAL DEVELOPMENT PRIOR TO THEIR USE AS SPACE BOOSTERS

Klager Karl

1991 - IAA 91-687 - vol 12 - AAS vol.20 - pp. 159 - 187

In the late fifties it became obvious that the evolution of astronautics exploration programs needed very large rocket motors. Trust capabilities inthe range of several million pounds and duration of over 60 seconds will be required. The best candidates to deliver large trust appeared to be from solid composite rocket motors. These would be cheaper and faster to develop than corresponding liquid fueled rockets. Because motors loaded with propellants for extremely big sizes would cause transportation problems form point of production to the point of launching it was obvious that segments of such rocket motors would eliminate this problem. Assembly would be performed at the launch site. This concept was demonstrated at the Aerojet general Corporation in 1957 with a further development program sponsored by the U.S. Air Force inthe following years. The demonstration of the feasability of such an approach led ultimately to the strap on boosters for Titan and Shuttle used in U.S. space programs. The advantage of simplified hardware fabrication facilities including heat treatment of segments vs full scale motors with monolythic grains, conventional propellant manufacture and controls would give greater reliability, less rejection and thus less cost overall. Each segment could be inspected and qualified, inter exchangeability of segments would also give gretaer flexibility in applications. The program feasability was demonstrated by cutting a 20 in diameter 4KS 115000 Regulus II Booster rocket into three pieces and by means of a look wire locking design ans device made a three segment rocket. Using the same propellants as in the Regulus Booster and nozzles it was static fired meeting the specifications of the Regulus Booster motor. This program was followed wit a Minuteman first stage motor, 65 inches in diameter, which was cut in half and after applying again a lock wire device was loaded and successfully fired. After the initial demonstration in subsubsclae motors a 100 inch program was undertaken in which motors having one, two three and five segments were fired. In all acse the joint was working without any problems. In a three segment firing in which a Titan engine was piggy back strapped on in order to measure vibration had a nozzle failure which shortened the firing by a few seconds. All other rockets fired successfully. The presentation will be highlighted by a number of photographs, discussion of the materials and propellants used and performance data presented, including the application of trust vector control devices using two liquids for injection to measure their effectiveness. The U.S. Air Force sponsored 100 inch demonstration program led ultimately to the development and application to space boosters of the Titan and Shuttle. Through the experience gained with handling and processing these large motors resulted in the demonstration program of three 260 inch diameter rocket motor firing demonstrations.

259 NASA SPACE AGE INFORMATION PROGRAM

Day, M.S.

1991 - IAA 91-691 - - not published -

From its beginning, the NASA Scientific and Technical Information Program has been internationalized to ensure that knwoledge developed by NASA program is shared broadly with scientists and engineers aorund the globe. Starting in 1960 the NASA Technical Information Office pioneered in the development and application of new phototypesetting and electronic publishing systems; in the design, creation, and maintenance of end-user oriented aerospace information database systems and networks; and in the design and production of a micropublishing medium that has became universally adopted. NASA has shared with ESA (and its predecessor organizations, ESRO and ELDO) this information technology in addition to more than 300 000 reports and other publications produced by NASA and its contractors, plus the world's most comprehensive aerospace bibliographic database and supporting online search and retrieval software. A hallmark of the NASA information program is the overriding requirement that all of its products and services be user oriented. For the past 30 years an aerospace and astronautics profesional socizety has had a key role in the design as well as the execution of this program. This paper will provide a comprehensive review of this program, a discussion of the key role of the community of aerospace and astronautics profesionals in the program; and a report on the heavy involvment of the international community.

260 THE ROLE OF ACADEMICIAN SERGEI P. KOROLEV IN THE DEVELOPMENT OF SPACE ROCKET VEHICLES FOR LUNAR EXPLORATION WITH THE HELP OF MANNED SPACESHIPS

Mishin Valery P.

1991 - IAA 91-674 - vol 12 - AAS vol.20 - pp. 247 - 255

The paper discusses some points of the U.S.S.R. Moon Programme which so far has been hushed up by the Soviet mass media. The research team supervised by S.P. Korolyov was the first to initiate projects fro Moon exploration. He was the first who suggested the approaches in cosmonautics enabling future astronauts to circle the Moon, to land on the Moon and to return back to Earth. His whole life was devoted to the fulfilment of this aim. Korolyov's premature death prevented his form realization of his plans which were later on worked out by his colleagues. But they could not accomplish his projects either. The paper discuss the causes of the ceasure of the Moon programme development. The paper makes comparison between U.S. Moon programme Saturn V-Apollo and U.S.S.R. NI-13 and its modification NI-13M. The characteristics of the blocks making up rocket-space complex NI-13M are presented. The paper answers the questions: Could the U.S.S.R. pioneer in manned landing on the Moon and recovery? Why had the U.S.S.R. never done it at all in spite of it's having all the potentials for the realization of the Programme?

261 THE ROMANIAN INVENTOR PAUL POPOVATZ'S CONTRIBUTION TO JET PROPULSION THEORY AND PRACTICE

Ispas, Stefan - Zaganescu, Florin - Ispas S.

1991 - IAA 91-680 - vol 12 - AAS vol.20 - pp. 109 - 118

The contribution of the Romanian inventer Paul Popovat, mathematician, physicist, Navy Commander and ex-director of the Romanian commerciazl marine, to the fundamentlas of the jet propulsion theory, is outlined

262 CORALIE - THE FORGOTTEN ROCKET

Rothmund Christophe

1991 - IAA 91-678 - vol 12 - AAS vol.20 - pp. 189 - 214

This paper describes the story of Coralie, the second stage of the Europa launchers and also the first European launcher stage to use the storable propellant UDMH and N204. After briefly outlining the Eldo launcher programme, the author deals in detail with Coralie, describing the stage and its main systems such as the structure, the propulsion system and the control subsystems. The development of the stage is then described, with particular emphasis on the propulsion tests. Then, the operation of Coralie is dealt with, relating the flights from Australia (Woomera) as well as the little known launches of the Cora test rocket which became the only European rocket to be launched from the European continent. Finally, the legacy of Coralie is detailed, together with some of the innumerable launcher projects which envisoned Coralie

263 GRAVITY PROPULSION RESEARCH AT UCLA AND JPL, 1962-1964

Dowling, Richard L. - Kosmann William J. - Minovitch Michael A.

1991 - IAA 91-677 - vol 12 - AAS vol.20 - pp. 27 - 106

This paper is the second in a series of IAF papers describing the origin of gravity propulsion, Michael Minovitch's early work in developing it, and how the various NASA gravity-propelled missions originated from it. The first paper (IAA-90-630) was presented at the 41st IAF Congress, Dresden, germany, Oct. 6-12, 1990.

264 ACTIVITIES OF FORMER PEENEMUNDERS WHO REMAINED IN GERMANY

Kit Boris - Heinz B.

1991 - IAA 91-676 - vol 12 - AAS vol.20 - pp. 319 - 323

The German rocket development center known as Peenemünde and a team of the most brillaiant German scientists and engineers called Peenemunders are important and well known names in the history of rocketry and astronauticsd. The reason for this fame is that during the World War II they succeed to develop and launch the first large guided rocket called V-2 or A-4 and this is to be considered as the beginning of a new rocket and astronautics age in the history of humanity. The Peenemunders, after World War II, were able to conitnue their rocket research and development work. One group of them went to the USA, another to the U.S.S.R., and still another remained in Germany. All these former Peenemunders contributed greatly in the futher development of rocketry and astronautics, especially in the USA and U.S.S.R.. It is not the objective of this presentation to discuss the work and achievements of ex-Peenemunders in the USA and U.S.S.R.. The authors of this paper discuss the postwar activities of the former Peenemunders who reamined in Germany. The paper descrobed the organization of the ex-Peenemunders in Germany, their participation in the postwar Germany's missile, rocket and space programs and their participation in the present german astronautical societies. Some of the most oustanding ex-Peenemunders in germany, their short biographies and contributions to the German's space efforts are being discussed in this presentation.

265 PROJECT FARSIDE

Singer, Fred S.

1991 - IAA 91-675 - vol 12 - AAS vol.20 - pp. 145 - 149

Project Farside, sponsored by the U.S. Air Force Office of Scientific Research during the period 1955 to 1958, was designed to furnish a low-cost method for penetrating the earth's magnetosphere and even reach beyond the Moon. It was based on a four stage, solid-propellant balloon-launched rocket vehicle, using available rocket motors. The initial phase was to have reached an alitude of 4000 miles (6400 km), or one earth radius. Under contract to the AFOSR office in Pasadena, I carried out the basic design in 1955, and built an instrument package containing a single Geiger counter at the University of Maryland. My proposal was to measure the increase with altitude of the primary cosmic radiation and to look for the existence of particles trapped in the earth's magnetic field, i.e., radiation belts. Aeronutronics Corporation, later a division of Ford Mortor Comapny, carried out the engineering and construction, and supervised the launch activities. These were speeded up greatly after the launch of Sputnik-1 in 1957, and took place in great secrecy in late 1957, from the island of Eniwetok. Unfortunately, most of the launch attempts failed, according to what few reports became available. The two succesful launches did not carry the Geiger counter instrument, and no scientific results were transmitted to the University of Maryland.

266 DEVELOPMENT OF THE JUPITER PROPULSION SYSTEM

Braun, Julius H.

1991 - IAA 91-673 - vol 12 - AAS vol.20 - pp. 133 - 144

The Jupiter propulsion system was developed under a crash program that paid off with the first missile launching accomplished just over on year after assignment of the missile contract.

Such rapid progress was possible because the major engine components were already in an advanced stage of devlopement under the Navaho and Atlas missile program. Initial production of Jupiter rocket engines was at the Rocketdyne main plant in Canoga Park, California. In the fall of 1958, production of engines for operational missiles was transferred to Rocketdyne's plant in Neosho, Missouri, while research and development activities on advanced versions remained in Canoga Park. Development problems resulted from uprating the engine thrust level with consequent overloading of some critical components. Minor design changes, resolved those problems and the transition from prototype to production proceeded smoothly.

267 CONSTRUCTION AND TESTING OF THE FIRST SOVIET AUTOMATIC INTERPLANETARY STATIONS

Maximov G. Yu.

1991 - IAA 91-690 - vol 12 - AAS vol.20 - pp. 233 - 246

abstract not available

268 THE NAVAHO CRUISE MISSILE - A BURST OF TECHNOLOGY

Myers D. D.

1991 - IAA 91-679 - vol 12 - AAS vol.20 - pp. 121 - 132

At the end of the World War II in Europe, a small group of aeronautical experts headed by George Schairer of Boeing went into Germany looking for technical data supporting the immense technology thrust that had developed near the en of Germany's struggle. The V-2 is the most famous, but the ME262 swept wing, axial flow turbojet fighter, the Wasserfall anti-aircraft missile, and the rocket powered ME 163 intercepetor all demonstrated technologies well beyond the U.S. capability.

./… North American Aviation, in 1945, seraching for a means of holding a corer of it's best engineerts, strated two programs. One was to build a civil four passenger aricraft, called the Navion. The other was to form a group called Aerophysics, to deal with the new interest in advanced technology. The decision to establish Aerophysics led to the NAVAHO supersonic cruise missile, and also led to the establishment of new departments at North American Aviation called Autonetics, Rocketdyne, the Missile Division, adn Atomics International. This paper will describe the origin of the reqquirements, and the spectacular technologies that were spawned from the program.

269 THE EXPERIENCE OF HERMANN OBERTH

Elder, J.

1991 - IAA 91-688 - vol 12 - AAS vol.20 - pp. 277 -318

Hermann Oberth began his life's mission in 1905, at age eleven. His useful contribution has ended by about 1930. Once capt. Dornberger hired young Wernher von Braun to develop rockets at Kummersdorf Proving Ground, the action shifted decisively from Oberth's theoretical work to the von Braun team's engineering achievements. Yet Oberth died in 1989 at the age of 95. He spent some 65 years isolated from the real spaceflight action. Oberth was the only original space pioneer who lived to see his dreams come true. But his was nevtheless a frustrating life and a very lopsided career. In this paper, I try to convey Oberth's experience of his own life. Understanding his experience of his own life leads to a better understanding of his role in the history of spaceflight. The first section focuses on Oberth's experience of reading Jules Verne's "From the Earth to the Moon" at age eleven. His response shows some of the traits that defined Oberth's key role in space history. The section takes us through his solitary researches, up to the publication of "Die Rakete von zu den Planetenraumen", in 1923. The second section covers Oberth's experience of contact with others who believed in space flight, contact brought on by the unexpected success of "Die Rakete" and then by his second book, "Wege zur Raumschiffahrt". Here I discuss how these books reflect Oberth's anture and personality as well as his ideas, and how it was his nature as well as his ideas which had such an impact on young readers such as von Braun. Contact with other theoreticians and with organizations of enthusiasts brought to light the character trats which limited Oberth's role in space history. In this section, we also see the beginnings of Oberth's work in theology and philosophy. To him, these were major parts of his life, though they are given little or no consideration in English(language writing about Oberth. Section three covers Oberth's experience of the end of his important role, as he is largely exclued from the wxork at Peenemünde. He also suffered many personal losses during World War II. Section four describes Oberth's experience of the 44 years of his life following the war. The spaceflight movement he had done so much to create left germany and succeeded in the United States, again without him. For a while he was in a limbo, working on peripheral rocketry projects and writing books that had none of the impact of his earlier books. Later, he experienced a steady stream of attention and honior, though he often seemed withdrawn from it. He also shifted more and more of his effort into philosophical and political writing and into his interestr in an alien race with which he believed he was in contact. He seems to have felt that he was once again at the forefront, waiting for the world to catch up with him, as had been the case with spaceflight.

270 FROM THE DEVELOPMENT HISTORY OF THE VOSTOK SPACECRAFT

Rauschenbach Boris V.

1991 - IAA 91-686 - vol 12 - AAS vol.20 - pp. 151 - 158

no abstract available

271 FRENCH ROCKETRY 1739-1872

Jung Philippe

1991 - IAA 91-684 - vol 12 - AAS vol.20 - pp. 3 - 24

The arrival in France in 1739 of the Italian Ruggieri brothers was the starting point of intense rocket activities. However, even the spectacular burning of the Ottoman fleet in Otchekow in 1788 by Colonel Prévot rockets could not prevent artillery, still improving, to stay at the forefront. The pioneer conutry by the turn of the 18^{th} century was India, where the State of Mysore had an impressive corps of rocketeers of 5000 men. They were active during the battle of Srirangaptna in 1792, where both French (allied to Sultan Tipu) and English could witness and feel the effects of the 1 km range weapon. Back in France, General Belair thus made proposals to the Revolution. Actually, a flurry of tests were made or proposed by many individuals to a well disposed Comité de Salut Public. However, it came to an English man, William Congreve, to obtain from his Government the use of its own 3km range rockets. They were fired agianst Napoleon fleet in Boulogne in 1806. In the midst of technical and ethical controversies, the Emperor waited until 1810 to establish rocketry in the Grande Armée. Congreve had in the meantime kept improving his product. The seeds of a more coordinated approach to the new field were at last sown in 1824 with the creation in Metz of Ecole Centrale de Pyrotechnie. Rationalization and progress were to reach their apogee in 1852 when Colonel Susanne gave a decisive impulse. Already in use in Algeria, 7 km range rockets would now be fired by tens of thousands in Italy, Morocco, Senegal, China, Mexico and during the Crimean War. With the defeat of 1870, Metz came under German rule, and the Ecole was displaced to Bourges. Significant artillery in the 60s (breech loading, grooving) then dealt a final blow when the decision was taken in 1872 to suspend all rocket activities in France.

272 VELA - A SPACE SYSTEM SUCCESS STORY

London III John R.

1991 - IAA 91-683 - vol 12 - AAS vol.20 - pp. 215 - 232

The Vela satellite system comprised the first space-based nuclear detection capability ever deployed. First conceived during the Geneva conference on the Discontinuance of Nuclear Weapons Test in 1958, Vela would become a monitoring system initially optimized for nuclear burst detection in both near-earth and deep space environments. Feasability studies were started by the Advanced research Project Agency in September 1959. The first development contract to TRW Systems Group was signed in June 1961, and a Full Scale Development/Production contract for ten spacecraft was issued in April 1962. First flight and Initial Operational Capability occured in October 1963. The satellites were launched in pairs, initally on Atlas Agena D launch vehicles from Cape Canaveral. The satellites were deployed 180 degrees apart in 38 degrees inclination, 100 000 kilometers orbvits. The satellites' on-board X-ray, gamma ray and neutron detectors could monitor for nuclear detonations in near-earth space out to 1 600 000 kilometers. Each satellite weighed 224 kilograms at lift-off, including an apogee injection motor. A second and third pair of Velas were launched on 17 July 1964 and 20 July 1965, respectively. An advanced Vela satellite was developed to address the requirement for nuclear detection in the earth's atmosphere as well as space. The spacecraft were three-axis instead of spin stabilized and included a pair of optical flash detectors. Advanced Vela pairs were launched in April 1967, May 1969, and April 1970. Vela's legacy was one of meeting requirements quickly and inexpensively. The first satellite pair launched in 1963 reached orbit only six dyas fater the limited test ban treaty went into effect. A total of 155.2 million then-year dollars was expended from Spetember 1959 through April 1970. The initial spacecraft design life was six months, but satellites typically exceeded ten times this period. A collateral benefit of Vela was the contribution the system made to space science. In particular, Vela pioneered the field of X-ray astronomy, with a number of significant discoveries to its credit. The Vela satellite system was a success story from start to finish, helping to monitor nuclear testing and compliance with the milited ban treaty.

273 BLACK ARROW - THE FIRST BRITISH SATELLITE LAUNCHER

Gould, R.D. - Harlow John

1991 - IAA 91-689 - vol 12 - AAS vol.20 - pp. 257 - 273

A syposium on the development of the Balck Arrow launcher and the payloads it carried was held in October 1990 at the British Interplanetary Society, London. This paper is based mainly on that symposium and will cover technical details of the launcher and payloads and the politics of the programme. Black Arrow used liquid propellant engines from Black Knight for the first two stage and a solid propellant third stage was developed at Westcott. Black Arrow successfully placed into orbit the Prospero satellite in 1972, and the satellite has been regularly switched on and checked until quite recntly. Prospero carried a wide range of experiments form UK Universities and Laboratories and was also used for satellite

technology development. Full details of the experiments and their place in history will be covered.

274 PROJECT DYNA-SOAR. THE ROOTS OF SHUTTLE - A MEMOIR

Walter W.C

1992 - IAA 92-193 - vol 13 - AAS vol 21 - pp. 317-350

The paper discusses the historical background of the USAF DYNA-SOAR project from its foundations in NAZI Germany to its cancellation as the USA's first approved space vehicle development program. Dr Walter Dornberger's contribution is presented as are the pioneering team. What transpired during the study program period that led to the approval of DYNA-SOAR as a hardware development program before Sputnik flew is presented through the eyes of the people who managed the program in the WPAFB project office. The remembrances related here span a time period from 1951 through 1963, the pioneering days of winged, hypersonic, boost-glide vehicle system technology in the USA. The roots of the United States Space Shuttle program which, like the

275 ORIGINS OF THE MOUSE PROPOSAL

Singer, Fred S.

1992 - IAA 92-200 - vol 13 - AAS vol 21 - pp. 295-300

The concept of MOUSE (Minimum Orbital Unmanned Satellite of the Earth) seemed a natural outgrowth of high altitude reserahc using rockets, which began in 1946 at White Sands, NM, with captured German V-2 rockets. The initial MOUSE design, as published in the Journal of the British Interplanetary Society in 1952, just forty years ago, visualized a spin-stabilized basketball-size satellite carrying miniaturized instrumentation. The invention of the Bell Labs solar photovoltaic battery in 1954 gave great impetus to the concept by solving the problem of a light-weight power supply. Still, the idea seemed strange to a public that believed in space travel and in huge manned space stations, as described then in popular magazines. Many investigations followed from the MOUSE design, including the first calculations of orbital lifetime and of equilibrum temperature……

276 A WARNING OF TECHNOCRATIC FAITH: NASA AND THE POLITICS OF THE SPACE SHUTTLE DECISION, 1967-1972.

Launius Roger D.

1992 - IAA 92-199 - vol 13 - AAS vol 21 - pp. 179-196

This paper analyzes the decision to build the Space Shuttle as part of a broader public policy trend away from a deference technical experts and toward greater politization of traditonally apolitical issues. At the begining of the 1960s U.S leaders had a strong faith in the ability of technology to solve most problems. By 1970 this commitment to technological answers had waned and a resurgence of the right of elected officials to control technical matters was gaining currency. The lenghtly and bitter Shuttle decision-making process was part of a much broader shuft in the formation of public policy, played out in other arenas as well, aimed at the reemergence of direct political management of technological and scientific affairs by politicians.

277 EISENHOWER: OPEN SKIES, AND FREEDOM OF SPACE
Hall, Cargill R.
1992 - IAA 92-184 - vol 13 - AAS vol 21 - pp. 41-74
During World War II, America's civilian and military leadership embraced scientific research for a multitude of advanced weapons. Indeed, at war's end in 1945, general H. H. Arnold, commander of the Army Air Forces, could confidently assure Secretary of War Robert patterson that the United States would shortly build long-range ballistic missiles to deliver atomic explosives and "space ships capable of operating outside the atmosphere". Thirteen years later, both of the programs that Arnold forecast were underway. This period, the immediate prelmude to the space age, spawned America's civil and military space program -- programs that were in the begining opposite sides in the same coin. Elements of these programs, authorized and framed by one American president, would become instrumental in forewarning of surprise attack, monitoring compliance with international treaties, and maintaining a dedicate peace bteween the Soviet Union and the United States. For contemporary reasons of national security, the executive action that shaped this enterprise and the space policy that President Dwight D. Eisenhower and his advisors created for it were obscured even to many of those directly involved.

278 GOING UP FROM DOWN UNDER: AUSTRALIA'S SPACE HISTORY AND HERITAGE
Dougherty, Kerry
1992 - IAA 92-198 - vol 13 - AAS vol 21 - pp. 107-118
Australia is a country which has a long history of involvement with space activities. This paper outlines that history and the heritage of surviving artefacts and documents which record it. It considers Australia's involvement with the various launcher programs at the Woomera Rocket Range in South Australia, its contribution to NASA and other space tracking programs and the development of indigenous space programs during the 1960s. Australians involvement in space science, industry and international programs is also briefly considered. Regrettably, little physical evidence of Australia's space history survives, and what does is mostly outside the control of bodies dedicated to the preservation of such artefacts. These few technological relics are discussed and issues relating to their long-term preservation and custodianship raised for consideration.

279 THE DEVELOPMENT OF THE BOOSTER-LAUNCHERS IN THE U.S.S.R
Mishin Valery P.
1992 - IAA 92-197 - vol 13 - AAS vol 21 - pp. 223-228
abstract not available.

280 LIQUID HYDROGEN TECHNOLOGY WAS PIONEERED ON CENTAUR 30 YEARS AGO
Heald, D.A
1992 - IAA 92-196 - vol 13 - AAS vol 21 - pp. 205-222
The initial flight of a Centaur, yhe high-energy upper stage for Atlas, occured on May 8, 1962. It was the first flight of a large liquid hydrogen/liquid oxygen rocket.

Durint he early development phase there were serious concerna bout hydrogen due to its very low liquid temperature, rapid boiloff, high flammability, and low-surface tension. Early design solutions are presented for the centaur hydrogen propellant system, insulation, and vent systems. Some of these approaches were succesfull while others required major changes to evolve to the current systems. Thermdynamic and fluid dynamics characteristics of the vent systems during ascent and coast was emphasized. Liquid hydrogen technology is well understood today, although challenges are inherently greater than those for liquid oxygen systems…This paper will focus on the early problems and solutions for the liquid hydrogen system, using AC-4 as the nominal early configuration.

281 HEYLAND'S ROCKET CARS AND THE V-2. AN UNKNOWN CHAPTER IN THE HISTORY OF ROCKET TECHNOLOGY

Winter Frank H. - Neufeld Michael J.

1992 - IAA 92-185 - vol 13 - AAS vol 21 - pp. 41-73

The spectacular rocket car stunts conducted in the late 1920s and early 30s are often considered a frivolous and unscientific phase in german military documents shows clearly that one of these experimenters, Dr. Paul Heylandt, actually played a key, albeit brief role, in the start of the German Army's development of the A-4 rocket wihch later became famous as the V-2.

282 AGATE AND THE FOREBEARS EARLY FRENCH "PRECIOUS STONE" ROCKETS

Jung Philippe - -

1992 - IAA 92-194 - vol 13 - AAS vol 21 - pp. 229-268

The fifties witnessed a flurry of military rocket activities in France, the better cooridnated oness being those of Armée de l'Air, its Service Technique relying mainly upon the vehicles built in hundreds by the Cannes factory of SNCASE (Societe Nationale de Constructions Aeronautiques du Sud Est). With the decision to build a national strategic missile, this company naturally became the nucleus of activities which later branched out into both nuclear vectors and satellite launchers, the first ones after the two "Super Powers". These poorly known original activities are retraced in this paper.

283 THEORDORE VON KÁRMÁN'S CALTECH STUDENTS

Thomas Shirley

1992 - IAA 92-191 - vol 13 - AAS vol 21 - pp. 3-40

A focus on Theodore Von Kármán's students requires three overlays on a six decade look back into history. The firsqt overlay concerns the state of the world in the late 1920s when Dr. Von Kármán was persued to move from the University of Aachen to join a small but ambitious young school called the California Institute of technology. The second overlay reveals the state of aeronautics - the filed in which his students would specialize - in that period when flight had just come of age from its birth at Kitty Hawk. The third overlay concerns the environment at Caltech: It had been carefully constructed by astronomer George Ellery Hale and celebrated chemist Arthur Amos Noyes, and was being meticously nurtured by Nobel

Laureate Robert A. Mlillikan. The Hungarian scientist Dr. Von Kármán, an aerodymicist of great achievemnt, was a man destined for Caltech…

284 EARLY LUNAR BASE CONCEPTS: THE LOCKHEED EXPERIENCE - PART 1

Stroup T. L. - Allen R. D.

1992 - IAA 92-190 - vol 13 - AAS vol 21 - pp. 301-316

Among aerospace firms, Lockheed Missiles & Space Company (LMSC) has a rich of planning and design studies related to the exploration and colonization of the Moon. Even before President John F. Kennedy committed the United States of America to the ambitious Apollo program to land a man on the Moon, intense study of lunar base concepts were already underway. In 1961 through 1963, LMSC engineers and scientists combined These engineers focused on post Apollo lunar outposts of 60 days and longer. They conceived innovative cylindrical modular habitats that could be either vertically or horizontally oriented. Unique spherical surface transportation vehicles designed to operate singly, in tandem, or in groups of four, came to life on their drafting boards. They imagined a ballistic rocket transport that would carry astronauts to distant craters on the Moon. Along more practical lines, they did detailed analysis of how different building materials would survive on the lunar surface. With a strong emphasis on life support systems and environmental controls, these reports also studied indepth sich other areas as surface transportation, base design, and communications. The surprising breadth of coverage included site selection, space suits, nuclear power, human factors, meteorite protection, and resulted in a Lunar Base Development Program that culminated in the occupation of a permanent base in 1975. Until now, this heritage of information, concepts, and ideas has remained generally unavailable to today's planners and designers. The purpose of this paper is to highlight those aspects of these early LMSC lunar base studies which are considered to have on-going validity for international Moon/Mars Missions contemplated in the near future. Previous work and new work an a major project in the design and analysis of lunar bases called Extended Lunar

285 HISTORICAL ASPECTS OF SPACECRAFT TECHNOLOGY AND ITS DIFFUSION IN SOCIETY IN JAPAN

Mitsuma H

1992 - IAA 92-188 - vol 13 - AAS vol 21 - pp. 163-178

This paper presents some results of research on the progress and diffusion of space technology in Japan. Japan's space research activities began in 1955 at Tokyo University, with the development of sounding rockets. Since, then, space technology development was institutionalized with the establishment of the National Space development Agency of Japan (NASDA) in October, 1969. The University of Tokyo and NASDA shared efforts to develop space vehicles and satellites incollaboration with the industries. Progress of general-purpose, technologies, such as electronic, power systems, and structural materials, has provided a fertile environment for this space technology development. The industries has also made afforts to apply these general-purpose technologies into the development of space equipment. The following are a short history of organizations for space development and a analysis of the diffusion of the technology in the society.

286 THE "BURYA" INTERCONTINENTAL CRUISE MISSILE

Rauschenbach Boris V.

1992 - IAA 92-187 - vol 13 - AAS vol 21 - pp. 199-204

In 1954-1957 intercontinental cruise missile "Burya" was designed, constructed and successfully tested in the Soviet Union. Here is a concise history of its building.

287 EARLY LUNAR BASING CONCEPT OF THE U.S. AIR FORCE

Allen, R.D.

1992 - IAA 92-189 - - not published -

Early concepts déveloped between 1956 and 1961 - Rand Lunar base Planning Studies, Military vs. Civilian uses(The Boushey Controversy) - Air Force Lunar base Study Requirements - Early Lockheed Lunar Base proposals.

288 FRANCE AND THE PEENEMÜNDE LEGACY

Villain Jacques

1992 - IAA 92-186 - vol 13 - AAS vol 21 - pp. 75-106

At the end of the Second World War, as the United States, the Soviet Union and Great Britain, France benefited from work carried out by Germany in the field of rockets. Many engineers and technicians from Peenemünde and other laboratories and companies came to work in France. Therefore, it is the contribution of these engineers to the development of the French space and missile industry which is examinated in this paper.

289 THE EARLY DAYS OF LOX/LH2 ENGINES AT SEP AND MBB

Hopmann, H. - Rothmund, Christophe - Kirner

1992 - IAA 92-195 - vol 13 - AAS vol 21 - pp. 269-292

In the early 1960s, two leading European companies, the French SEPR and the German Bölkow, pionnered totally new fields in space propulsion : cryogenics propellants….Starting in 1959, SEPR was awarded a research contract from the Ministry of Defense resulting in first hot runs of thrust chambers….In 1956, Bölkow was awarded by the German Ministry of Defense a research contract wich led to the design of the P111….

290 A SURVEY OF ROCKETRY FOR SPACE SCIENCE IN JAPAN

Matogawa Yasunori

1993 - IAA 668 - vol 14 - AAS vol.22 - pp. 203-224

Thiry five years have passed since a rocket group of University of Tokyo carried out flight experiments of a series of tiny test rockets called "Pencil". The "Pencil" was 1,8 cm in diameter, 23 cm in length with the weight of 200 g., employing double base propellant. Passing through, the development of "Baby", "Kappa (K)", "Lambda (L)" and "Mu (M)", solid propellant rockets in Japan have now reached the latest version, M3SII, which can carry payloads of 770 kg into low earth orbit. The history of development of Japanese solid propellant rocket has been one which has kept step with the rapid development of space science in Japan. Thus space science in Japan, which gave a first cry in a small laboratory, has attained results fruitful enough to go beyond the earth gravitation into heliocentric space in 1985 for Halley's comet exploration. This paper will make a review on this development effort, introducing typical educations during the process. Before going on the main subject, an introdutory description will be given on how space development in Japan is being organized. Following the histroical survey, a new launch vehicle under development and some future projects of ISAS (The Institute of Space Science and Astronauticzal Science), a core organization for space science in Japan, will also be given.

291 THE HISTORY OF THE UFA ROCKET

Rohrwild Karl-Heinz - -

1993 - IAA 666 - vol 14 - AAS vol.22 - pp. 3-26

The story of the UFA-rocket is almost unknown. In dodays books you only will find that it was 2m in length and should be able to fly about 40 km in altitude. New research of the correspondance of Oberth with Nebel, Ufa, VfR brings new aspects into the story.

292 ALPHA, BETA AND RTV-1: THE DEVELOPMENT OF EARLY BRITISH LIQUID PROPELLANT ROCKET ENGINE

Harlow, John - -

1993 - IAA 676 - vol 14 - AAS vol.22 - pp. 173-201

The history of the Alpha, Beta and RTV-1 rocket engines and associated hardware are traced through to their use as propulsion units in early British Test Vehicles. Propulsion units based on solid propellants could not fulfil the burning time or total impulse requirements at that time and the reasons for this are briefly discussed. The RTV-1 vehicle derived from early 1940's work on a liquid oxygen petrol engine called Lizzie. Evolving through a series of designs to produce a highly successful test vehicle, derivatives of RTV-1 formed the backbone of the understanding in the U.K. of successful design of ground to air missiles. The flight history of the motors is also discussed.

293 CNES: THE FRENCH SPACE AGENCY: 1962-1992

Laidet Louis - Carlier Claude - Gilli Marcel

1993 - IAA 669 - vol 14 - AAS vol.22 - pp. 281-296

A brief story of the French Space Agency fom its foundation in 1962 to its 30th Anniversary

294 ON THE HISTORY OF SPACE NAVIGATION DEVELOPMENT

Ivashkin, V. V - Vjacheslav, V.I

1993 - IAA 670 - vol 14 - AAS vol.22 - pp. 271-280

A brief review of the development of psace navigation methods and systems for determination of spacecraft motion paramters and subsequent space flight control is presented in the paper as experienced by the author himself. Basic attention is given to autonomous navigation.

295 THE ROCKET RESEARCH INSTITUTE, 1943-1993 - 50 YEARS OF ROCKET SAFETY, ENGINEERING AND SPACE EDUCATION PROGRAMS

James, George S. - Piper, Charles G.

1993 - IAA 671 - vol 14 - AAS vol.22 - pp. 343-399

This paper summarizes highlights of the past 50 years of the Rocket Research Institute, Inc. The RRI Inc, celebrating the 50th Anniversary of its founding in January 1943, is a non-profit consulting organization of engineering, education, and safety professionals who volunteer their spare time to participate in the Institute's research programs, experiential science motivation activities, rocket safety coordination and education efforts, worshops and seminars.

296 THE SE 4200: FIRST RAMJET MISSILE ?

Jung Philippe

1993 - IAA 672 - vol 14 - AAS vol.22 - pp. 115-155

Soon after the end of World War II, France embarked upon a comprehensive rocket program, mainly under the aegis of Amée de l'Air, the Frenc Air Force. Very active in this field, it went as far as specifying a ground to ground guided weapon, the SS-40 of 100 km range, something one would have rather seen under the Army tutella. The winning entry, the NC 3510 of SCAN in Paris, revealed itself to be a somewhat revolutionary vehicle as it took the shape of a ramjet propelled flying wing. It now has been found that, pretty much like the Sanger tests of 1941, various shapes of ramjet intakes were tested on a truck on the Monthlery speed ring, before selecting a circular design over an elliptical one. When the concentration of the French aeronautical industry led to the folding of the Centre, its able rocket team was save by incorporating it into the other center of excellence in this field, the Cannes group of SNCASE. Now name the SE 4200 the missile was first launched on February 8, 1950 from the beach near Saint-Tropez, a town not yet famous…At the time the first ramjet weapon in Europe, the SE 4200 soon evolved into an operational system, the second ramjet one in the world after the Plover drone of Martin in the USA; its entry into service was marked by the launch on June 8, 1955 of the SE 4263 version. Two Army groups, the 701 and the 702 GAG were to use them, many being actually fired. This paper deals into the details, both historical and technical, of the SE 4200 series of which no less

297 LUNAR ROVING VEHICLE: HISTORICAL ORIGINS, DEVELOPMENT AND DEPLOYMENT

Burkhalter, Betty B. - Sharpe Mitchell R.

1993 - IAA 673 - vol 14 - AAS vol.22 - pp. 227-261

The technical history of the Lunar Rover Vehicle from con,cept to use on the Moon is recounted. Several concepts from science are described as a prologue to the story of the design, development, and testing of the vehicle deployed on the Moon by the astronauts of prject Apollo. Also briefly described are Lunar surface vehicles proposed by heramnn Oberth, Arthur Clarke, Georg von Tiesenhausen, and others. Engineering problems that arose during the program are presented as well as their solutions. Special attention is given to the innovative navigation and mobility subsystems of the Lunar Rover. The performance during the Apollo 15, 16 and 17 missions to the Moon is tabulated and analyzed. In conclusion, the point is tsressed that this complex engineering task took only 18 months from drawing board to finished vehicle.

298 THE GREAT RESULTS AND PERSPECTIVES OF THE DEVELOPMENT OF ROCKETS AND SPACE ENGINEERING

Mishin Valery P.

1993 - IAA 674 - vol 14 - AAS vol.22 - pp. 107-113

The paper examines the significance of space technology for the science, industry ans defence. From the first ideas of K.E. Tsiolkovsky and other pioneers of theoretical astronautics to the first artificial satellite launch which open the new Era for the Mankind all the periods of development of space technology are reviewed. The main results of development of space technology are summed up. The possibilities of cosmonautics in solving ecological, economical and resource problems of Mankind are examined. The perspective of further development of space technology are reviewed too. It is stressed that the principal trends are:

high-effective orbiting systems development and expansion of international cooperation in solving problems of research and peaceful use of space.

299 THE HISTORY OF THE VIKING ENGINE

Rothmund Christophe

1993 - IAA 675 - vol 14 - AAS vol.22 - pp. 297-319

In November 1991, the 500th Viking rocket engine was rolled out at the Vernon plant of the Societe Europeenne de Propulsion, becoming the most produced european liquid propellant rocket engine. But the history of this successful rocket engine family started as early as 1966…..

300 KLAUS RIEDEL AT PEENEMÜNDE

Tresp H - Peter, Prole - Rohrwill KarlHeinz

1993 - IAA 664 - vol 14 - AAS vol.22 - pp. 41-51

Ongoing research about K. Riedel at Peenemünde, his work, manners and live. New research about his death. Research are done at the BKA (Bundeskriminalrat) and Imperial War Museum.

301 THE HISTORY OF THE FIRST STAGE OF SPACECRAFT CONTROL SYSTEMS DEVELOPMENT IN U.S.S.R.

Rauschenbach Boris V.

1993 - IAA 677 - vol 14 - AAS vol.22 - pp. 263-269

The start of cpntrol system development took place in the U.S.S.R. in the 1955, two years before the Sputnik was launched. These works were concentrated at three bodies: Leningrad Polytechnical Institute, Institute for Applied Mathematics (Moscow) and Institute for Heat Processes (Moscow). At first time the works were theretical ones only. From 1957 the manufacturing began at the third above-mentioned body where the first attitude control system for the Space "Luna-3" (for photography of the far side of the Moon) was created.

302 THE DEVELOPMENT OF SPACE STATION OBJECTIVES

Robinson D.W.

1993 - IAA 678 - vol 14 - AAS vol.22 - pp. 323-341

Typical overviews of the history of space stations dwell upon either the configuration and design features of each new concept or the politics surrounding each space project. This paper will explore the history of space stations in a new way by tracing the development of "technical objectives" and "national objectives". Technical objectives are the new scientific fields and space travel possibilities that space stations open while national objectives are the reasons why building a space

303 HIGHLIGHTS OF FIFTY YEARS OF AEROJET: PIONEERING AMRICAN ROCKET COMPANY (1942-1992)

Winter Frank H. - James George S.

1993 - IAA 679 - vol 14 - AAS vol.22 - pp. 53-104

The recent celebration of the 50th Anniversary of Aerojet provides an ideal opportunity to recount the history of this pioneering American rocket company. Aerojet's accomplishments are so numerous, however, entailing not only rocket engineering but in diverse fields as electronics and ordnance, that this paper will only concentrate upon the company's leading rocket projects.

304 GERMAN ENGINEERS: THEIR CONTRIBUTION TO BRITISH ROCKET TECHNOLOGY AFTER WORLD WAR II

Becklake, John E.

1993 - IAA 665 - vol 14 - AAS vol.22 - pp. 157-172

At the end of World War II, Britain, along with the other countries involved in the conflict, was acutely aware of the potential of rocket powered weapons. She investigated and ran Operations Backfire, an exercise to assemble and fire V-2's from Cuxhaven, and she employed a number of German rocket scientists and engineers to work on her infant rocket technology programme. These were employed in several groups: Dr. Schmidt and his team of 12 engineers who worked at the rocket development sit at Westcott; Helmut Walther of Walter werke, Kiel and his team who worked for a relatively short period at Viclers Armstrong at Barrow; and the larger group of aerospace specialists who were assigned to the Royal Aircraft Establishment at Farnborough. This paper will investigate the contributions made to British rocketry by these German engineers.

305 ROCKET CENTER PEENEMÜNDE - PERSONAL MEMORIES

Stuhlinger Ernst

1993 - IAA 663 - vol 14 - AAS vol.22 - pp. 27-39

The German Army began developing rocket missiles in 1929. Two years later, General becker contacted von Braun who experimented with rockets in Berlin, gave him a contract in 1932, and - jointly with the Air Force - in 1936 built the rocket center Peenemünde, where von Braun developed the A-4 (V-2) rocket under Army auspices, while the Air Force developed the V-1 (buzz bomb) and guided bombs. Hitler neglected and, in fact, ridiculed the A-4 project until 1942 when he began to give it support, expecting that it could turn the fortunes of war for him. He drastically increased the work force, allowing the transfer of soldiers from the front to the Peenmünde works; that was when the author, in 1943, came to Peenemünde as a Pfc.-Ph.D. Later that year, Himmler wrenched the authority over A-4 production out of the Army's hands, put it under SS command, and forced production of the immature rocket at Mittelwerk, and its military deployment against targets in France, Belgium and England. The author, working as a scientist-engineer on the development of guidance and control systems, descrobes his personal impressions and experiences during his assignment at Peenemünde, the technical problem that had to be solved, the gradual success of the big rocket, the strange mixture of an engineer's work with his soldiery duties, and the vigourous, decisive influence of von Braun's personality on the Peenemünde rocket project.

306 THE SE 1500: PRELIMINARY FRENCH MISSILE TESTS

Jung Philippe

1994 - IAA 2.2.621 - vol 15 - AAS vol 23 - pp. 173-201

While the rocket had not changed much over the centuries up to Goddard experiments. It is the German effort during the second World War which ushered the age of modern rocketry. Roaming in Souththern Germany after the Armistice to find whatever could be used, the Air Force component of the French mission apply concluded in the end that the best course to follow would be to start fromscraztch building various types of what was then callzd "engins spéciaux" (literally translated "special devices"). Conservatively, they howewer were to be equipped, whenever useful or necessary, with German hardware. A wide ranging specification thus was written by Service technique de l'Aéronautique and sent to all French aircraft manufacturers of the time. One such category was that of the air to ground vehicles (air-sol or AS types), which conveniently allowed to skip the propulsion aspect of experiments by being launched from an aircraft in flight. It thus could be possible to sort out the first preliminaries in the new field of automatic huidance by using test vehicles of conventional and well-lnown configuration. SNCASE (Société Nationale de Constructions Aéronautiques du Sud Est) answer to this specification was the SE 1500, a winged vehicle to be built in 13 diffrent versions. This paper summaries the development and use of this stepping stone in the progressive building of rocketry experience in France. Furthermore, on 28 October 1948, SE 1500 9 had the distinction of inauhuring the new test range of Colomb-Bechar/Hammaguir in Sahara, from which years later the thirs space

307 FROM SEPR TO SEP, 1944-1994

Rothmund Christophe

1994 - IAA 2.1.612 - vol 15 - AAS vol 23 - pp. 351-373

Created in 1944, SEPR (Société d'études de la propulsion par reaction) was the first european company to be solely devoted to rocket propulsion activities. It designed storable liquid rocket engines for aircraft and missiles, cryogenic engines for launch vehicles as well as solid rocket motors for ballistic and tactical missiles and for space applications (launchers, sounding rockets). Among the many achievements of SEPR, we can distinguish the rocket engines fitted to the Trident interceptor prototype, the only operational liqui-propellant rocket engine for fighter-aircraft performance enhancement (SEPR844) fitted to the Dassault Mirage 3C, the first european cryogenic engine HM4, and the first large european solid propulsion motors. The merger in 1969 of SEPR with Space Division of Snecma resulted in the creation the SEP (Société Européenne de Propulsion). This new company had two main fields of activities : cryogenic engines and solid motors. Two years later, a further merger in 1971 with the LRBA Space Activities created SEP as we know it today, bringing a third field : large storable propellant engines.

308 THE HISTORY OF ROCKET-SPACE TECHNIQUES DEVELOPMENT IN THE IN THE UKRAINE

Prisniakov V. F. - Sanin, F.P.

1994 - IAA 2.1.613 - vol 15 - AAS vol 23 - pp. 245-253

In 1965 an article by Prof. G.V.Petrovich appeared in "U.S.S.R. Academy of Sciences Bulletin" 10. That was a pen - name of V.P. Glushko the founder of the soviet rocket engine - building who was born, brought up and studied in the city of Odessa. G.V. Petrovich writes: " The first work out of a space vehicle for manned flights was initiated by N.I. Kibalchich the famous member of "Narodnaya Volya", a revolutioner, a son of the Ukrainian people." N.I. Kibalchich wrote his work in prison before being executed in 1881. In 1916-1919 a Ukrainian scientists, a person of natural gifts Yu. V. Kondratyuk (his fate is complicated and tragical) worked out the basics of jet propulsions irrespective of K.E Tsiolkovsky. And in 1929 he published a book " Interplanetary space conquest". His work were thoroughly studied in the USA and used while the flying scheme to the Moon was being worked out. S.P. Korolyov who was brought up and studied in Zhitomir, Odessa, Kiev, started working in the space rocket engineering in the early thirties. He was building gliders and used them for flying in the sky of the Crimea….

309 THE HISTORY OF THE BAÏKONOUR LAUNCH BASE

Villain Jacques

1994 - IAA 2.1.614 - vol 15 - AAS vol 23 - pp. 533-546

The need to have a launch base wider than the former Kasputin Yar base appeared in Soviet Union in 1953-54 for the tests of the new R7 intercontinental ballistic missiles and for the launch of satellites. This paper describes the reason of the choice of Baïkonour and the beginning of the works in 1955.It also relates the growth until yhe apogee around mi-1980. The roles of the general constructors, S.P Korolev, M.K Yangel and V.N Tchelomei are indicated with a lot of information about their daily life on the site. Successes and accidents at baïkonour will also be evoked. In fine, civil and military zones will be described.

310 THE ROLES OF INDIVIDUAL SCIENTISTS AND SCIENTIFIC SCHOOLS IN THE DEVELOPMENT OF COSMONAUTICS

Chertok, B. E.

1994 - IAA 2.1.616 - - not published -

not available

311 KRAFF EHRICKE'S EXTRATERRESTRIAL IMPERATIVE: A MEMOIR

Freeman, Marsha

1994 - IAA 2.1.617 - vol 15 - AAS vol 23 - pp. 163-172

This paper deals with a little-known or understood concept in the literature of astronautics: Krafft Ehricke's Extraterrestrial Imeprative. It is based on the idea that it is mankind's capacity to reason that enables growth and development. Ehricke criticised those promoting the idea that there are "limits to growth" and proposed uinstead that there are no limits to human creativity, which is what enables growth. He demonstrated that space exploration creates an "open world", which can solve any ecological or other crisis mankind faces along the path of development. It can supplement the Earth-bound economy with energy, resources, and raw materials from extraterrestrial sources, and push forward the frontiers in every field of science. To make concrete this role of space technology, he described the optential for economic growth through applications of space technology ranging from orbital space mirrors for night light, to Earth-orbital micro-gravity hospitals. In the final years of his life, Krafft Ehricke land out an extensive plan for the colonization and industrialization of the Moon. He proposed that the development of this "seventh-continent" of Earth include establishment of lunar city

312 ON ALGEBRAIC COMPILERS AND PLANETARY FLY-BY ORBITS

Battin, R. H.

1994 - IAA 21618 - - not published -

This paper reports on two major technology events of great significance in the field of Astronautics which were conceived and developed at the MIT Instrumentation Laboratory during the decade of the fifties. It is a personal memoir by the author on two important topics which should be a part of the written history of our field. Part one of the paper documents the conception and development by Dr. J. Halcombe Laning, Jr. Of "George", the world's first algebraic compiler for use on MIT's first-all-digital experimental computer called project Whirlwind. In part two of this paper, the author explores the early concepts of energy exchange between a spacecraft and a planet during a close encounter of these two celestial objects.

313 THE FIRST MANNED LUNAR LANDING SPACECRAFT: ITS DESIGN, MANUFACTURE, GROUND TEST AND MISSION

Fleisig, R.

1994 - IAA 2.1.611 - vol 15 - AAS vol 23. pp. 327-350

This paper reviews the development, production, testing and flight of the first successful manned lunar landing spacecraft and will serve as a technical benchmark and a point of departure for current national and international studies of spacecraft that may be developed for the future return of people to the Moon. In July, 1969 during the NASA Apollo 11 Mission, two U.S. astronauts flew in Gruman Lunar Module Number 5 (LM-5) from lunar orbit to the moon's surface, conducted exploration there and returned safely to lunar orbit for rendez-vous and docking with its mother craft. The Saturn V launch vehicle and its payload, the Apollo spacecraft, are first briefly described. The spacecraft consisted of the Command, Service and Llunar Modules. In separate illustrations, the physical characteristics of the LM are presented in terms of a three-view drawing with major dimensions, the breakdown of weights on earth for its ascent and descent stages, and the location of electrical, electronic, mechanical and fluid systems hardware. Gruman LM test articles and facilities are reviewed including mockups, hardware breadboards, propulsion rige, the spacecraft assembly and test clean room and the integrated system test center. Photographs are shown of most of these engineering, manufacturing and testing facilities. In the early development phase, LM functional system specifications were based on detailed performance analyses. As breadboard hardware and early software became available, performance estimates from math models were replaced by equipment test results. Later, the hardware was integrated, subsystem and subsystem, enabling a hybrid simulation of LM functional performance. This approach led to the full mission engineering simulator in which prototype flight control hardware units, including the coded computer, were interconnected and tested to demonstrate satisfactory closed loop functional operation. Apollo trajectories are identified for each mission phase. Photographs are presented of the astronauts, the Apollo 11 launch scene, astronaut Aldrin stepping down the LM-5 ladder to the lunar surface, and the LM-5 ascent stage approaching the Command and Service Modules in lunar orbit with the earth in the background and the lunar surface below.

314 ASSESSING THE IMPLICATIONS OF THE 1987 SALYUT TUG FLIGHT FAILURE

Oberg James - -

1994 - IAA 2.2.620 - - not published -

On May 15, 1987, the first flight of the Soviet Union's Energiya super-rocket occured. Although, it was hailed as a great success. Moscow later admitted that a "full-scale mockup" test spacecraft had not gone into orbit as intended due to a problem with its kick stage. No details or imagery about that mockyup or kick stage were ever officially released during the remaining lifetime of the Soviet Union. Meanwhile, recent negociations between the Amrican and Russian space agencies have resulted in agreement to construct an International Space Station Alpha (ISSA) based ion launchings of Russian and Amrican pieces for assembly in orbit. The base module of this station will be a modified "Salyut Tug" vehicle, designated the Salyut FGB", built at the Khrunichev Plant in Moscow. This "Tug" spacecraft has been identified by the Russian space agency as a component of many previous successful orbital missions since 1977, including missions to the Slayut 6, 7 and Mir space stations.The "Tug" vehicle is now to provide initial guidance and control for the ISSA during critical early assembly phases. Sources within the Russian space program, along with Moscow press reports, have now identified the vehicle which failed on May 15, 1987 as another "Salyut Tug", carrying a space station module named "Polyus". Extensive details about the mission intent and the ultimate failure mode have now been released. Although the failure in the spacecraft's guidance and control system in 1987 might be considered to impact its reliability for serving as the base block of the ISSA, both American and Russian space officials now insist in public that the 1987 mission was successful and that no such failure occured. This question of recent space history will address what really happened in 1987 and what is now happening with "historical revisionism" of that event in 1993-94. The public policy implications of poor "space history" will be assessed.

315 THE RACE TO THE MOON A LOOK FROM BAÏKONOUR

Sokolov O.A.

1994 - IAA 2.1.610 - vol 15 - AAS vol 23 - pp. 459-466

The article is the memoirs of a common participant of the ex-Soviet lunar manned programme the ultimate aim of which was the lunar manned landing. The article contains a detailed description of the programme, its aims and process of realization. The on-site impressions of the participant of these events give additional details about dramatic competition between Russian engineers and their American colleagues. Interaction of separate directions such as "Lunokhod", "Luna" and "Zond" programmes and NI-L3 main programme is described. The author gives an analysis of the events. In the conclusion the author shows possible ways of the development of the astronautics in future.

316 THE U.S AND SOVIET SPACE SYSTEMS DEVELOPMENTS AS DRIVEN BY THE COLD WAR COMPETITION

Tarasenko M. V.

1994 - IAA 2.2.622. - vol 15 - AAS vol 23 - pp. 477-487

The paper analyses program histories for a variety od space systems, studied and/or developed in the United States and the former Soviet Union along the Cold War. Shown, how the space projects of one side stimulated responsive developments of another one. A set of new characteristic examples is discussed, including development of anti-satellite systems, the MOL and Almaz orbital stations, early warning satellites, etc. Comparative study reveals, that a typical path for many space projects was : - in American case: motivation by a perceived Russian threat ->study -> cancellation or development,- in Soviet case: motivation by learning about American study -> development -> commissioning for operations or abandonement. Wherever a real practice demand was behind, appropriate systems were eventually developed and deployed by both sides. Projects, where motivation by thret was predominant or cost overweighted performance, in American case, were usually cancelled at early stages (the SAINT satellite inspector, the MOL orbital station). The Soviet approach was more inertial and less concerned about cost-effectiveness. The U.S.S.R. typically continued development until at least testing phase the Almaz orbital station, the Buran shuttle) or even all the way up to an operation (the ASTP system). In latter cases, the second round of provocation could occur, with Americans reacting to a new Ruissian development, which originated as a response to earlier American threat. A general programmatic cause for such "Catch 22" developments were differeences in project philosophy and staging, in commitment criteria and procedures, and, not the last, in security procedures and information avalability. These differences caused misinterpretations of intentions and capabilities, with the Cold War providing a necessary background for technical responses.

317 THE PERSONALITY OF THE ROCKET PIONEER PROFESSEUR HERMANN OBERTH

Roth-Oberth E.

1994 - IAA 2.2.623 - vol 15 - AAS vol 23 - pp. 203-208

On June 25, one hundred years ago, the natural scientist, philosopher and pioneer of space travel, Professor Hermann Oberth was born. His homteown was Hermannstadt, today known as Sibiu, in Transylvania/Romania. His parents were the well knwon surgeon Dr. Julius Oberth and his wife Valerie, who was the daughter of the free-thinking socialist and doctor of medicine Friedrich Krasser. The ideas and technings of the latter young Hermann adopted already as a child. Thsi philosophy culminated in the thought that only a solid knowledge and the recognition of truth will free mankind of errors that may lead them to violence and destruction. One of the cardinal problems of that time, as a present, were the dwilling resources, which Oberth hoped to alleviate by conquering and exploiting other celestial bodies. Perhaps, the most famous of his ideas was the development of a space mirror to gather the energy of the sun. The article is narriating the astonishing development of an exceptionally bright child, who had no technical stimuli in his own backwardish home country, to the well knwon rocket pioneer. This development is shown by anecdotes, as well as letters by collegues, friends and parents.

318 ABOUT THE DEVELOPMENT OF THE MEANS OF PUTTING PAYLOADS INTO LOW-EARTH ORBITAL

Mishin Valery P.

1994 - IAA 2.2.624 - vol 15 - AAS vol 23 - pp. 375-379

Close inherent connections between humanity and cosmic space can be traced in history of mandkind as legends, fiction literature and astrology. Doctors always were in vanguard of upper atmosphere and space exploration. The first laboratory biological experiments aimed at future manned spaceflights were conducted in the late 19 an early 20 centuries - long before creation of spaceflight missiles (K.E. Tsiolkovsky, N.A. Rynin, A.A. BiKhachev, G.D. Generalesa, Wernher von Braun)…..

319 SOME HISTORICAL MILESTONES OF SPACE MEDICINE FORMATION

Gurijan, A. A.

1994 - IAA 2.2.625 - - not published -

The first laboratory biological experiments aimed at future manned spaceflights were conducted in the late XIX and early XX centuries - long before creation of spaceflight missiles (K.E Tsiolkovsky, N.A Rynin & A.A. Likhachev, C.D Generales & Wernher Von Braun). The monkey Albert was the first mammal which on June 18, 1948 was launched in a rocket but unfortunately died. The first rocket flight to the height of 88,7 km and the successful landing was fulfilled by dogs Tsygan and Dezik, on June 22, 1951. The next milestone on the way to space was the orbital flight of the dog Laika aboard the second artificial satellite on November 3, 1957 and the suborbital flight of the chimpanze Ham aboard Mercury-Redstone missile in January of 1961. Very important were successful returns from orbit of Discoverer satellites capsules with cellular biological subjects in 1960 and of the second spaceship-satellite cabin with dogs Belka and Strelka and many other diverse biological subejcts after the flight on August 18-19, 1960. Finally the successful returns to Earth of the dogs Chernuska and Zvezdochka in March of 1961 and of the Chimpanze Enos in November of 1961 after their orbital flights in cabins - the prototypes of future manned spaceships "Vostok" and "Mercury" - opened the way to space for Soviet cosmonauts an American astronauts. Biology and medicine not only fulfilled the reconnaissance of space routes for manned flights, but also set foundation for the new branch of science - space medicine. Also, in our paper we examine organizational aspects and premises of space medicine formation, first publications, terminology and systematic bibliography.

320 THE EVOLUTION OF THE INSTITUTIONAL STRUCTURE OF THE UNITED STATES MILITARY SPACE PROGRAM

Day, D.A.

1994 - IAA 2.2.627 - vol 15 - AAS vol 23 - pp. 489-503

Since 1960, the United States has maintained three national space programs; one civilian, one military, and one intelligence. The military and intelligence space programs account for over half of all U.S. government spending on space. A product of the Cold War, their complicated policy-making apparatus has been veiled in secrecy and virtually unknown outside official channels. Although some key aspects of the complex process by which the U.S. military and intelligence communities establish goals and policy for their activities in space remain classified, the overall structure of the policy-making and operations management of the U.S. military space program can now be outlined. Furtermore, the dramatically changed geopolitical environment has precipitated the declssification of some elemnts of the intelligence space program, including the existence of the National reconnaissance Office (NRO). This paper will detail the organizational structure of such entities as U.S. Space Command, ist constituent service commands (i.e Air Force Space Command, Army Space Command, Naval Space Command), the Ballistic Missile Defense Organization (formerlyknown as the Strategic Defense Initiative Organizatiuon), the Advanced Research Projects Agency (ARPA), the NRO, and the National Security Agency. It will highlight the differences between operational control of U.S. military space assets; and planning, procurement, and budgeting for current and future systems. Additionally, it will stress the role that personalities, traditions, and unofficial power structures have played in the formulation of military space policy. Finally, it will examine the changing nature of the U.S. military space program as technology and threats evolve in the post-Cold War world.

321 THE SOVIET MOON SURFACE EXPLORATION PROGRAM (1966-1976)

Rauschenbach Boris V.

1994 - IAA 2.2.626 - vol 15 - AAS vol 23 - pp. 527-531

The successful Soviet Moon Surface Exploration Program is discussed. Ten years of the Program are covered. The use of space probes in Moon surface samples delivering to the Earth is described.

322 M. K YANGEL THE UNKNOWN PAGES OF BIOGRAPHY

Konyukhov, S.N. - Andreyev L.V.

1994 - IAA 2.2.619 - vol 15 - AAS vol 23 - pp. 467-475

The authors attempt to trace creative development (1954-1971) of Mikahil K. Yangel, the Chief designer of space-rocket systems. His name is closely connected with the history of formation of Yushnoye Design Office which is been named after Yangel. At the same time, this is the history of space rocketry development in Ukraine. His rate of development and perfection of the developed systems are characteristic of the activity of Chief designer and the Design Office headed by him. Within the unprecedented term in propulsion history, not only the creative collective with its style of work was formed, but also the new principal trend was chosen in designing rocket complexe which use storable propellants and independent inertial control system. How and why this became possible, what the role of Chief Designer was-these and other questions connected with Yangel's activity are analysed by the authors. The paper highlights main stage of the space-rocket complexes development, from SS-4 to SS-9, and traces continuity and updating of further projects up to SS-18. Great attention is given to development of launch-vehiclaes and spacecrafts of the Cosmos, Intercosmos, meteor series. The authors analyse the development of load-bearing structural arrangement, the use of new materials, the improvement of technological processes. Against this background, the authors attempt to find the key of explane the phenomeon of Yangel as an ideologist, organizer and the manager of large-scale technical projects from the viewpoint of philosophy and pioneer

323 ROLES AND IMPACTS OF RAND IN THE PRE-APOLLO SPACE PROGRAM OF THE UNITED STATES

Augenstein, Bruno W.

1995 - IAA 2.1.05 - vol 15 - AAS vol 23 - pp. 505-525

RAND, in Santa Monica, California, performed a seminal function in the early years of the U.S. Space Program, not only in landmark science, technology, and operational/programmatic studies which helped to shape U.S. endeavors in space, but also by the diffusion of key study participants into industry and government, where they helped reach many of the initial goals set. The salient RAND work now declassified is described here from the viewpoint of a deeply involved participant. Where possible, this work's is discussed in the context of Former Soviet Union activities.

324 ETUDE 4212: THE FIRST FRENCH LARGE LIQUID ROCKET PROJECT

Rothmund Christophe

1995 - IAA 2.2.03 - vol 15 - AAS vol 23 - pp. 73-90

From 1946 to 1949, the LRBA developed a large liquid rocket, the first large French liquid rocket. This project was a large ballistic missile (range 2000 km), powered by two different engines : a pressure-fed 25 ton thrust engine and a 40 ton turbopomp-fed one. The propellants used were of two kinds : either nitric acid/kersoene for the pressure-fed version or kerosene/nitric acid or liquid oxygen/kerosene for the turbopomp-fed ones. Further versions of the R2 were to be boosted by two or four fin-mounted ramjets. Retaining the extrior appearance of the German V-2, because such a shape had proven ist ability to "fly", it was nevertheless an entirely new vehicle. The tanks were structural, the internal arrangement very simple, with tanks fitted with anti-sloshing plates in order to ensure proper engine operation. In the years 1946 until 1949, the entire vehicle was designed by the initial team of LRBA. But also the operation of the rocket was taken into consideration, with mobile launchers being studied. The "4212" as it was named was a contemporary of the U.S "Redstone" missile", and much more advanced than the Soviet R1 and R2 V-2 derivatives. Therefore, France was in those years totally equal to the other allied powers dealing in rocket technology.Unfortunately, the project was cancelled in 1949.

325 THE HISTORY OF THE SPACE LAUNCH VEHICLES DEVELOPMENT

Konyukhov, S.N. - Paschenko, V.A.

1995 - IAA 2.2.09 - vol 15 - AAS vol 23 - pp. 451-458

The development of the space technology in Dniepropetrovsk began with the commission to Yangel to duplicate the work of Korolev on the artificial Earth satellite. The decision was made to develop the lmaunch-vehicle on the basis of combat missile. Yhis allowed to reduce the terms and the cost of development and operation. The work was not stopped and resulted on March 16, 1962 with the launch of the Kosmos-1 satellite by a new launch-vehicle derived from the R-12 rocket by addition of the second stage. The same design philosophy was applied during developing the Intercosmos launch-vehicle for which Design Office used the R-14 combat missile as the first stage. Yuznoye Design Office developed the Lunar Spacecraft lander module of the N1-L3 Space System. The R-36 combat missile gave life to two space launchers: the two stage Tsiklon 2 in 1967 and the three-stage Tsiklon 3 in 1977. Only two failures out of more than 100 Tsiklon 3 launchers make this launcher a reliability lmeader among the known launch-vehicles. One of the recent developments of Yuznoye Design Office is the most perfect by its construction and the automated prelaunch preparation the two stage Zenit launch-vehicle. This launcher is a basis to develop the whole family of perpesctive light and middle class launch-vehicles.

326 A-1, FIRST FRENCH SATELLITE

Moulin Hervé

1995 - IAA 2.2.01 - vol 15 - AAS vol 23 - pp. 51-72

In 1965, the France became the third nation to prove ist ability to launch an artificial satellite. On November 26th, 1965, from Hammaguir in Sahara desert, the success of the first Diamant's flight has conducted to the satellisation of the small technological satellite, called "A-1". The French satellite program called "Diamant" was born fewx years before by a political decision. This first launch was the work's concretisation of small teams which depended from several organisations and industrials, such as : Centre national d'études spatiales, Société d'Etudes et de realisations d'Engins Balistiques, Matra and Army. This paper summarizes in first part, origins and the context of the launch, the organisation and management of the project. The second part will present, the satellites and its devices, as well as the main modifications which transform the balistic missile Saphir in a launcher Diamant. It will also highlight the system developed by Matra, which autorized the satellisation. The launch operation will conclude this paper. This paper is based on documents, archives pictures and on interviews according by persons who where involved in differents steps of the project.

327 EVOLUTION AND ACCOMPLISHMENTS OF THE SUPERVISION OF YOUTH RESEARCH EXPERIMENTS (SYRE) SUBCOMMITTEE OF THE IAF EDUCATION COMMITTEE

James, George S. - Moulin Hervé

1995 - IAA 2.3.09 - vol 15 - AAS vol 23 - pp. 3-34

This paper presents the history of the Supervision of Youth Research Experiments (SYRE) Subcommittee of the Education Committee of the International Astronautical Federation, began in 1968. This paper contains a reference bibliography of selected papers relating to the Supervision of Youth Research experiments and other space education topics presented at IAF Congresses from 1964 to 1994.

328 DR. HOMER JOSEPH STEWART, RECOLLECTIONS FROM 1934 TO 1980

Thomas Shirley

1995 - IAA 2.3.08 - vol 15 - AAS vol 23 - pp. 223-243

Stewart experienced and helped write a span of aerospace history that bridges from Piccard's stratospheric balloon research in 1934 to major NASA projects through 1980. He enrolled in the California Institute of technology (Caltech) to earn his doctorate, then remained a professor. When the Jet propulsion Laboratory was founded, he divided his time between the two until his retirement. He made a significant contribution to the airfoil theory, testing of the Corporal rocket, an analysis of the dirigible Macon's accident, among other activities. He was a theoreticien and an experimentalist….

329 THE SE 4500 NUCLEAR MISSILE

Jung Philippe

1995 - IAA 2.2.08 - vol 15 - AAS vol 23 - pp. 425-450

With the French Government decision to start in 1955 a nuclear bomb program, Groupe technique de Cannes, then the leading european rocket group, naturally thought about the possibility to deliver this weapon with a ground to ground missile. It was all the more logical as its similar SE 4263 flying wing had hjust become the world's first operational ramjet weapon system. Cannes engineers thus began to enquire about the bomb dimensions, then estimating - wrongly as it later transpired - that it would be quickly miniaturized. Marcellin Laurent design for the carrier was the SE 4500, a SE 4200 scaled up in 4/3 ratio. This ramjet propelled missile of 1,9 ton weight, cruising at Mach.8, was to carry a 700 kg bomb over a 100 km range. Acceleration was provided by two SEPR solid propellant boosters. This paper sumamrizes the development of this final SNCASE missile of the fifties, before a switch was made to the "precious Stones" experimental rockets, from Agate to Diamant. The more than one thousand examples of these SE 4000 - series made a momentous contribution to European space activities. They now clearly appear as the starting point for later SEREB/Aerospatiale missiles and launchers.

330 THE DELTA PROJECT - EARLY LOX/KEROSENE ENGINES IN THE UNITED KINGDOM

Harlow, John

1995 - IAA 2.2.07 - vol 15 - AAS vol 23 - pp. 91-105

Delta was the fourth in a series of liquid propellant rocket engine development programmes carried out at the then Rocket Propulsion Establishment, Westcott, United Kingdom. Building on the experiences of previous work on Lizzy, the Alpha, Beta and Gamma engines, thsi programme was the first in the United Kingdom to employ Liquid Oxygen and Kerosene in large chambers. The origins and develomment of the programme are discussed along with the design evolution, which eventually led to the building of a 185,000 lbf thrust, single chamber design. In parallel with the engine development efforts were underway to identify the optimum parameters for a proposed ballistic missile propulsion system. In the event, the timescales required for the qualification for the engine were too protracted to satisfy the urgent needs of Blue Streak and an American design was adopted by Rolls Royce for incorporation into this programme. The effect of this adoption was effectively to terminate all LOX/kerosene work at Wetcott. This, along with some of the design differences between the engines is also discussed.

331 EVOLUTION OF THE SOVIET SPACE INDUSTRY

Tarasenko M. V.

1995 - IAA 2.1.01 - vol 15 - AAS vol 23 - pp. 383-392

Reports and publications about histories of particular projects, institutions or personalities of the ex-soviet space program naturally tend to emphasize the role of a respective institution or personality in the overall program. This study will for the first time survey the overall évolution of the Soviet rocket and space industry (which could not be done until all available individual pieces of history were combined, cross-checked and analyzed from a "non-aligned" standpoint)…. Personal relations palyed a particularly important role in this process and they can not be ignored in analyzing the evolution of the soviet space industry (nor one can fully understand this aspect from a limited number of "unilateral"

332 THE GRANDE CENTRAL ROCKET COMPANY

Bartley, C. - Bramscher R.G

1995 - IAA 2.1.02 - vol 15 - AAS vol 23 - pp. 267-277

The Grande Central Rocket Company was founded in 1952 with temporary facilities at Pacoima, California, and in 1954 moved it's headquarters and plant operations to a 1,000 acre site in Mentone, just east of Redlands, California. The firm specialized in solid-fueled propulsion motors. Early in March, 1956, the Martin Company placed a purchase order with Grand central for the thrid stage of the Vanguard Rocket. The contract provided for a rocket that was to be bottle-shaped, 55,45 to 57,5 inches long and 18 inches in diameter….The costs for the company significantly increased as the emphasis shifted to large solid rockets and, as result, Grand Central was forced to obtain financial assistance from outside sources. It ceded a major interest to tennessee Gas Transmission. In 1958 the company became an affiliate jointly owned by FMC Corp and Tennessee Gas. This change in ownership resulted in management change.

333 THE SAN MARCO PROJECT

Buongiorno, C.

1995 - IAA 2.2.06 - vol 15 - AAS vol 23 - pp. 303-313

The San Marco Project steems form an original idea put forward in the year 1961 at the Centro Ruicerche Aerospaziali (C.R.A.) of the University of Rome, Italy under the direction of professor Luigi Broglio. The main objective of the project was to create a mean for a quick introduction of the italian scientific and technological communities into the new field of the space activities in a framework of close cooperation with the United States.

334 THE HISTORY OF THE FOUNDATION OF THE SOVIET COSMODROME BAÏKONOUR

Shatalov D. V.

1995 - IAA 2.1.04 - vol 15 - AAS vol 23 - pp. 393-399

At the beginning of the 50-s in the Soviet Union there was a great need in the foundation of cosmodrome for the space shot of the ballistic missiles, because the resource of cosmodrome Kasputin Yar did not satisfy the growing requirements of cosmic industry. In 1954 according to the resolution of the Soviet Government there was made the Committee and its aim was to find out the palce for the building of the new cosmodrome. Later it would become known in the West as cosmodrome Turatam. It was called after the railway station in the region of cosmodrome. It's chariman was the General-Liuetenant Voznujk V.I. The committee had to take into consideration the following factors:

1. During the space shot in the east direction the start complex had to be nearer to the equator.
2. The remoteness from the populated areas, in order to avoid great sacrifices and guarantees of secrecy.
3. The presence of the railway or other means for transporting of equipment, building materials, fragments of rocket-carriers and so on. Karmakcha in Kzil-Orda region in Kazakhstan has become the most suitable place for these purposes.

335 "PENCIL" ROCKET AND HIDEO ITOKAWA-PIONEERING WORK OF JAPANESE ROCKETRY

Matogawa Yasunori

1995 - IAA 2.2.05 - vol 15 - AAS vol 23 - pp. 121-132

There wera high level pioneering efforts in rocket technology in Japan before and during the World War II. The continuation of the technology to after-the-war, however, was not necessarily guaranted due to complcated situation. Thus the history of Japanbese rocketry is thought to start from a horizontal flight test of a tiny rocket called "Pencil" by young engineers of University of Tokyo in April 1955. The test was carried out at Kokubunji in the siburbs of Tokyo. This unique horizontal flight was proposed by prof. Hideo Itokawa who had organized a rocket team AVSA (Avionics and Supersonic Aerodynamics) in 1954. This paper describes the efforts of japanese rocketry in its initial stage and the conspicuous leadership of Hideo Itokawa to establish a team with a tight scrum which has lasted long years since then.

336 APOLLO AT 25 : A RETROSPECTIVE

Ordway III, Frederick I.

1995 - IAA 2.1.06 - vol 15 - AAS vol 23 - pp. 279-291

A review is given of Apollo anniversary coverage by newspapers, general magazine, and space-oriented journals, relevant books and other publications, video and film productions released during 1994, and celebrations and exhibits that reflected public response to the epochal event. Extracts of recollections, analyses and other reactions are provided. The 25th anniversary took place at a time when no firm commitments existed anywhere for a manned return to the lunar surface much less for an expedition to the logical follow-on target, Mars. The 35th anniversary is shown to have been a period of lowered expectations for travel into space beyond routine shuttle flights and preparations for the international space stations project. Neverthless, efforts to promote a space-faring civilization in general and proposals for establishing outposts on the Moon and exploratary expeditions to Mars continued to what some felt was an all-too-limited extent. The Apollo anniversay gave rise to debate as to the origin of the decision to go to the Moon and as to wether the method employed - sprint missions relying on lunar-orbit rendez-vous-- was ultimately benefical to the long-term exploration by humans of the Moon and neighboring planets. By taking the short cut to the Moon, the need for extensive Earth-oriented orbital operations awas sidestepped by the United States, except for the launch of a single Skylab orbital station, and only now is being addressed by the international space station whose construction is to begin in 1997.

337 DNIEPROPETROVSK SPACE - ROCKET COMPLEX IN THE 70'S AND 80'S.

Prisniakov V. F. - Sanin, F.P. - Gorbulin B. P.

1995 - IAA 2.1.07 - vol 15 - AAS vol 23 - pp. 293-302

Powerful space rocket complex forming part of design bureau "Yuzhnoe" (D.B."Yu") and experimental serial "Yuzhny" <Machine-Building Worksd, was established in Dniepropetrovsk in the fifties. It became the largest space rocket complex not only in Europe, but in the whole world. In 1964 Mikahil Kuzmich Yangel, 43, who by the time had already gained great experience in the field of aviation an rocket technology took the leadership of DB"Yu". After repofiling "Yuzhny" for rocket production, a telented organizer Leonid V Smirnov became its director for about a ten-year period.…

338 CLEVELAND ROCKET SOCIETY (1933-1937)

Ciancone, M. I.

1995 - IAA 2.1.08 - - not published -

This paper sumamrizes the history of the Cleveland Rocket Society (CRS) during its short-lived exsitence from 1933 to 1937, and briefly discusses recent activities to heighten awareness of their activities and acomplishments. Te CRS was founded in 1933 by Ernst Loebell, a German immigrant who envisioned the practical application of rocket technology for terrestrial uses, such as the delivery of mail and medical supplies over long distances. Along with Charles St. Clair and Edward "Ted" Hanna, they enlisted the support of a few dozen other enthusisats, consisting primarly of high school and college students, and managed to perform a series of static tests of increasingly sophisticated liquid-fueled rocket motor designs. In addition to their experimental activities, the CRS published a newsletter which documented their activities and kept members abreast of rocket activities around the world. In an effort to generate membership (and funds), the CRS at one point proposed a rocket mail flight, which infortunately progressed no further than the drawing board. However, they did receive international recognition of their work at the Paris International Exhibition in 1937. Nonetheless, like many other early rocket societies they suffered from, and eventually succonbed to financial hardships.

339 EVOLUTION OF THE MANAGEMENT OF SOVIET SPACE ACTIVITIES

Golotyuk, S. V.

1995 - IAA 2.1.09 - - not published -

The paper describes the genesis, in the late 1950s, and evolution through the late 1980s, of both the managing bodies and the procedures used for managing space activities in the Soviet Union. Memoirs unvailable until now, and the author's interviews with former Soviet officials were used as the main data source. Joint decrees of the Central Committee of the CPSU (Communist Party of the Soviet Union) and of the U.S.S.R. Council of Ministers were a standard mode of adopting any large-scale, long-term commitments (suchs as a five year plan for development of a rocket and/or space system) for the whole period in question. The sequence of procedures during preparation and adoption of such descrees, as well as other important documents, is described. The country'z top decision-making bodies (e.g. Politburo or Presidium of the central Committee of CPSU; U.S.S.R. Defense Council, etc.) were involved in the decision-making process during planning and implementing space missions and space technology development. Evolution of the bodies (both the structure and the responsabilities thereof) is characterized in short. Other institutions, down to the level of so called Main Directorates (Gus) and Directorates inside the ministires, which (Main Directorates and Directorates) were administrative bodies standing just one hierarchical level above the "rank-and-file" R&D centers, production plants, etc., are characterized in a similar way. Interactions between the institutions are analyzed. Special attention is paid to an analysis of the directions, mechanisms, and results of the influence of the management system's peculiarlities on U.S.S.R. space activities and space technology.

340 ALBERT PULLENBERG AND THE GESSELSCHAFT FUR RAKETENFORSCHUNG (GEFRA): A MEMOIR

Dannenberg, Konrad K. - Sharpe, Mitchell R.

1995 - IAA 2.3.01 - vol 15 - AAS vol 23 - pp. 107-120

Recounted are Albert Pullenberg's contributions to rocketry in the late 1920's and 1930's. His career is traced from the 1931 founding of the GEFRA (Society for Rocket Research) in Hannover. Germany through his involvement with the Wernher Von Braun group during the World War II, and the post-war perido. He was test engineer responsible for the development and production packaging of the steam generator which decomposed hydrogen-peroxide to provide steam for the turbopomp, which geenrated the high pressure for both liquid propellants of the A4 (V-2) missile under high pressure. His task also included testing of such associated components as the heat exchanger, the turbine and eventually the entire turbopomp unit, working as a system with the generator. His efforts before World War II to perfect such non-military systems as rocket-assist (Jato) units for sail-planed are covered, and more importantly the development of a postal delivery rocket which he continued after the War in Bremen, Germany. Pullenberg declined to join Wernher Von Braun's rocket team in the United States. He returned instead in Bremen, where he continued his own rocket design and development efforts after the end of World War II. An automobile accident in the late 1950's handicapped him and he had to discontinue physical rocket development work. But for many years he travelled the

341 THE EXCLUDED: HERMANN OBERTH AND RUDOLF NEBEL IN THE THIRD REICH

Neufeld M. J.

1995 - IAA 2.3.03 - vol 15 - AAS vol 23 - pp. 209-222

The role in Peenemünde of veterans of the Weimar spaceflight movement, led by Wernher Von Braun, is well-known. In building up its super-secret ballistic missile program begining in 1932, the German Army attempted to capture what limited rocket development experience already existed among the Weimar groups like the Raketenflugplatz. At the same time, however, Army Ordnance officers used the Gestapo and other arms of the new Nazi state in 1933-34 to suppress any private rocket developmment in Germany. As a result, certain prominent individuals in the weimar movement judged by the Army not to be useful to its program were excluded from any activty in rocketry for many years or throughout the short history of the "Thousand-Year Reich". The two most notable examples of this were Hermann Oberth, the intellectual pioneer of the Weimar movement and Rudolf Nebel, the head of the Raketenflugplatz….

342 ANOTHER DESTINY OF ROCKETRY IN JAPAN - FESTIVAL ROCKETS IN JAPANESE SHRINES

Matogawa Yasunori

1995 - IAA 2.3.04 - vol 15 - AAS vol 23 - pp. 315-326

The first encounter of Japanesewith rockets is unable to be clearly defined. The possibilities are (1) in 1274 when Mongolian and Korean armada invaded the souththern part of Japan, and (2) in 1595 when Lord Leyasu Tokugawa imported rocket arrows from China. Since some day after the possible encounter, though the process is under the veil, techniques and skills to manufacture and launch solid propellant rockets have been mastered by Japanese specialists and conserved over several hundred years, and are now enjoyed by the public once a year on the occasion of traditional and religious festivales at several Japanese shrines. This paper first described the situation of above possible encounters. Then a typical example of such festival rockets will be introduced with a special focus on its origin and manufacturing process.

343 THE "TRIP TO THE MOON" AND OTHER EARLY SPACEFLIGHT SIMULATION SHOWS, CA 1901-1915

Winter Frank H.

1995 - IAA 2.3.05 - vol 15 - AAS vol 23 - pp. 133-162

Several previous History of Astronautics Symposia papers have examined cultural as well as technical aspects of the history of astronautics. The author has recently discovered the "Trip to the Moon" (and Mars and Venus) entertainement shows which appeared ca. 1901-1915 in the United States and were the world's first large-scale simulated spaceflight rides for mass audiences. Since several million people attended these shows, the notion of the concept of spaceflight being only confined to or disseminated by books, articles, and some short films of the period, may be easily dispelled. This paper also examines procursors, dating back to the 18th century.

344 MAIN FIELDS ON THE CURRENT STUDIES ON THE HISTORY OF ASTRONAUTICS

Rauschenbach Boris V. - Sokolov, V.N

1995 - IAA 2.3.07 - vol 15 - AAS vol 23 - pp. 255-266

In this paper the present stage of the investigation on History of Astronautics and the main tasks the historians of astronautics have to solve are described. The following questions are discussed:

- about the necessity to make more wide and more depp the investigations on History of Astronautics, which are caring out at the present;
- about the International scientific cooperation in the field;
- about the methods of collecting, storage and analyzing of hitorical materials;
- about the training of the scientific research cadres
- about teaching the history of astronautics in high school.

The attention is also paid to the investigation of the creative work of single noted scientists and constructors and to the analysis of the activities of the scientific schools and colelctives headed by them. Even in a brief introduction of the mentioned problems shows what a significant and difficult tasks the historian of

345 LAUNCHING EUROPE INTO SPACE: THE ORIGIN OF THE ARIANE ROCKET

Russo Arturo

1995 - IAA 2.1.03 - vol 15 - AAS vol 23 - pp. 35-49

This paper traces the historical evolution of the events which led, in 1973, to the decision to build the satellite launcher Ariane in the framework of a cooperative European undertaking. The analysis is centered on the history of the European Launcher Developement Organization (ELDO), created in the early 1960's with the aim of building a heavy satellite launcher based on available technology in

Europe. ELDO had great difficulties in realizing its objectives, and the question wheter Europe should really pursue a launcher development programme became the most divise issue in the discussions about the space policy to be followed by Europe. France and Britain led the opposite camps, the former insisting tha a space policy without an independent launch capability was meaningless, the latter arguing that a European launcher would be much too costly as compared with American vehicles. The resolution of these conflicts was achieved in 1973 with a "package deal" which provided a basis for the creation, in 1975, of the European Space Agency (ESA). The Ariane program awas on e of the elements of this package deal.

346 WHAT THE RUSSIANS LEARNED FROM GERMAN V-2 TECHNOLOGY

Harford, James J.

1995 - IAA 2.2.02 - vol 15 - AAS vol 23 - pp. 401-424

Not only the technology of the V-2, but some of the advanced ideas of the German experts captured by the Russians at the end of World War II, were exploited fully in the U.S.S.R.'s development of a broad space program. Sergei Pavlovich Korolev, the dominant figure in Soviet space until his death in 1966, was among the Russians who went to Germany after the war to round up engineers, scientists and technicians. The German, when brought to Russia, were carefully separated from their Soviet peers, but Koroelv continued to communicate with them. The Soviets soon went beyond the V-2, in developing their own rocket engines and launch vehicle technology, but their debt to the German, who where sent home in 1952-53 is now acknowledged.

347 JAPANESE SOLID ROCKETS IN THE WORLD WAR II

Matogawa Yasunori

1996 - IAA 2.2.07 - vol 16 - AAS vol 25 - pp.123-136

The rocket development in Japan in the World War II rose to one of the highest level in the world. The research as weapons can be dated back to 1931, when Japanese Army and Navy began the developmental effoirt almost at the same time. It resulted in a rocket-propelled car, and the success of the car was followed by rocket bombs launched by ordinary guns around 1934-1938. Then the launcher system was devised for a variety of winged rocket bombs whcih could acquire the prospects for practical use about 1940 by the application od spinning and solventless powder. The outbreak of the World War II in 1941 and the subseuqnet development of the War imposed upon Japan enormous shortage of ordinary guns to be disposed to the troops deploying in the Osuth Pacifi, and rockets guns, which are much easier to produce and carry than ordinary ones, attracted considerable attention. Thus the rocket bomb and its launcher were approved to be a set of official weapons, and were called "Funshin-dan" and Funshin-ho", respectively. At the last stage of the War, Japanese Navy succeeded in the flight test of a kind od surface-to-air missile "Funryu-2" without any influence on the outcome of the War. This paper will follow the tracks of above development of solid propellant rockets in Japan before and during the World War II. The special attack plane

"Ohka" (called Baka Bomb by Americans) equipped with solid rockets will also be touched on briefly.

348 THE ROCKET FLIGHT STABILITY PROBLEM: A HISTORY OF MISCONCEPTIONS

Rauschenbach Boris V.

1996 - IAA 2.3.09 - vol 16 - AAS vol 25 - pp.251-256

Some attempts to achieve a vertical climbing rocket stable flight in the course of launching small rockets in the 1930s are discussed. These mainly erroneous efforts ultimately resulted in the development of the A-4 rocket perfect control system.

349 THE D1 FRENCH SATELLITES PROGRAM

Moulin Hervé

1996 - IAA 2.3.06 - vol 16 - AAS vol 25 - pp.235-250

In february 1966, two months after the launch of its first satellite, France puts into orbit a scientific satellite called D1-A, developed by the new French space agency, the Centre national d'études spatiales (CNES). Launched from the Saharian Launch Center of Hammaguir with the second Diamant A launcher, the D1-A satellite was the first from a program including three similar satellites. his program dedicated to the geodesy had allowed to develop the first elements for the conduct of a scientific space program including launch tracking and scientific facilities. The launch of D1-D satellite marked the end of the Diamant A launcher program and was also the last launch conducted

350 GERMAN ROCKETS IN AFRICA: THE EXPLOSIVE HERITAGE OF PEENEMÜNDE

Pirard Théo

1996 - IAA 2.3.05 - vol 16 - AAS vol 25 - pp.201-234

This paper reviews the technical development and the political impact of two "intelligence affairs" with German rocketry in African countries: Egypt and Libya, during 60s and 70s.

351 SOME PAGES OF HISTORY OF THE FIRST RUSSIAN BIOLOGICAL EXPERIMENTS ABOARD ROCKETS AND ARTIFICIAL EARTH SATELLITES

Gurijan, A. A. - Seyapin, A.D

1996 - IAA 2.3.04 - not published

The first mammalians who successfully flew on 22 of July, 1951 in two-seater pressurized cabin of the rocket "R-1" to the height 88,7 km were doges Tsygan and Dezik. In 1951 there were fulfiled 6 such flights with 12 dogs. Four of the flights were quite a success. In 1954-1956, 9 flights more with 18 dogs in non-pressurized cabin of rocket "R-1D" and "R-1E" to the height of about 100 km took place. The dogs were dressed in pressurized suits with removable helmets, catapulted in turn at the heights of 75-90 km and 35-50 km having landed with parachutes. During the flights monitoring of certain physiological paramters and filming took place. In 1957-1960, 15 experimental flights with 30 dogs (as well as in some case with mice, rats and rabbit) in pressurized cabin of rocket "R-2", "R-4" and "R-5" were accomplished to the heights of 220 and later on up to 475 km. Some of dogs flew several times. On the 3rd of November 1957 the first orbital flight of the dog Laika took place. In the second half of 1960 and at the beginning of 1961 there were fulfiled 6 experiments aboard spaceships-satellites with dogs (Belka and Strelka, Pchelka and Mushka, Alpha and Zhulka, Chernushka, Zwezdochka) as well as with numerous biological objects of differents levels of organization. The U.S.S.R. and USA biological researches in space opened the way to piloted spaceflights. This paper contains new facts and details of the first biological space experiments fulfiled under the guidens of V.I. Yazdovsky at the Institute of Aviation and Space Medicine.

352 SNCASE CANNES ROCKETS OF THE 1950S

Jung Philippe

1996 - IAA 2.3.03 - vol 16 - AAS vol 25 - pp.153-200

Historical research in the archives of the satellite plant of Aerospatiale in cannes has progressively revealed an amazing amount of work performed during the fifties in the field of what was then called "Engins spéciaux". This paper using the latest unearthed informations as well as the cosequent understanding elaborated over the last years, is a now well needed first attempt at building an overall picture of the cannes saga, which unfolded secretly in the frame of contracts won from ministère de l'Air. It also puts these efforts in a global perspective, since the results obtained by the small Cote d'Azur team included several world firts. It now appears that Groupe technique de Cannes trulyt the French "Skunk Works", was the most important rocket team in Europe during the fifties. Its members actually became the initiators of the "Pierre Précisues" rockets, the last one of which was the Diamant sspace launcher.

353 THE DEVELOPMENT OF SOLID ROCKET MOTOR IN CHINA

Jianding Huang - Dingyou Ye

1996 - IAA 2.3.02 - vol 16 - AAS vol 25 - pp.145-151

China has undertaken to research and develop composite solid propellant rocket motors since 1958. At the request of the development of space technology, composite solid propellant rocket motor has developed from small to large, step by step. For the past thirty eight years, much progress has made, many technical obstacles, such as motor design, case mateirlas and their processing technology, propellant formulations and manufacture, nozzles and thrust vector control, safe ignition, environment tests, non destructive inspection and quality assurance, static firing test and measurements,etc,. have been solved. A serial of solid rocket mortors have been offered for China's satellites launch. The systems of research, design, test and manufacture of solid rocket motors have been formed.

354 DEVELOPMENT OF THE CHINESE LONG MARCH LAUNCH VEHICLE SERIES

Hui Yan - Shilu Chen

1996 - IAA 2.3.01 - vol 16 - AAS vol 25 – pp.109-121

This paper was joined with the paper abstract n°357

In this paper, historical progress and development of space technology and its education in China are reviewed. The paper summarizes the progress and development of Chinese space activities, including designs and launches of artificial satellites, and launching vehicles, mainly Chinese Long March vehicle series. Moreover, some principal space organizations and research institutes are briefly described. Finally, universities and colleges of aeronautics and astronautics are introduced.

355 THE HISTORY OF THE BEGINNING OF THE RUSSIAN PLESETSK COSMODROME

Shatalov D. V. - -

1996 - IAA 2.2.08 - vol 16 - AAS vol 25 - pp.137-144

There are three main dates in the history of the beginning and foundation of cosmodrome Plesetsk, each of which more or less may be considered as the brithday of cosmodrome.

356 REDSTONE'S FIRST FLIGHT - SUCCESS OR FAILURE?

Braun, Julius H.

1996 - IAA 2.1.01 - vol 16 - AAS vol 25 - pp.81-91

First flights of new missiles, no matter how successful, invariably are traumatic affairs. Any subsystem failure is immediately pounced on as proof that the whole program is faulty and should never have been initiated. The U.S. Army's extremely reliable REDSATONE ballistic missile was no exception. It first flew on August 20, 1953. During final preflight preparations, a minor and inadvertent human error by an overzealous guidance system technician caused what otherwise should have been a routine first launch to be an apparent disaster. Propulsion people blamed guidance/control and vice versa. Telemetry records were interpreted by each who then placed blame elsewhere, but none were completely confident of their own analyses. The lack of an acceptable explanation became intolerable with the second test missile approaching readiness for launch. Dr. Von Braun insisted that everyone who had anything to do with pre-launch activities repeatedly recount what they had done until some clues surfaced. Finally the guidance system technician recalled doing what he had considered at the time an insignificant precautionary action. His simple explanation of his deed was quickly verified in the laboratories as the culprit, preventative measures against a recurrence were devised and the Redstone went on to become one of the most relaible ballistic missiles ever produced.

357 HISTORICAL PROGRESS AND DEVELOPMENT OF SPACE TECHNOLOGY AND EDUCATION IN CHINA

Shilu Chen

1996 - IAA 2.2.05 - vol 16 - AAS vol 25 - pp.109-121

This paper was joined with the paper abstract n°357

In this paper, historical progress and development of space technology and its education in China are reviewed. The paper summarizes the progress and development of Chinese space activities, including designs and launches of artificial satellites, and launching vehicles, mainly Chinese Long March vehicle series. Moreover, some principal space organizations and research institutes are

briefly described. Finally, universities and colleges of aeronautics and astronautics are introduced.
(*Cf* also IAA.2.3.01)

358 THE FLIGHT THAT NEVER HAPPENED : THE STORY OF THE FIRST WOMAN COSMONAUT
Ponomareva Valentina - Faktor D.D.
1996 - IAA 2.2.03 - vol 16 - AAS vol 25 - pp.307-318
The world's first team of women cosmonauts was born, so to say, twice. For the first time, in 1962, five young Soviet women found themselves in the cosmonaut training center where Yuri gagarin had been shortly before his historic first flight. They trained in secret, their identities hidden from the world, as cosmonaut candidates. One of them would be the first woman to fly in space; on June 16, 1963, Valentina Tereshkova rode in orbit. This team disbanded in 1969, with little or no mention of the other four candidates, theri backgrounds, or experiences. The original team of five returned from non-existence in 1985 due to the efforts of the Scientific Research Center of Space Documentation, when an employee published an article in the magazine "Rabotnitsa". This signified the team rebirth: for the first time, the public came to know the original five women cosmonauts who trained at the beginning of the space era. Along with Tereshkova, the dientities of Tatiana Kuznetsova, Valentina Ponomareva, Irina Solovyeva, and Zhanna Yorkina were release. In this paper, Ponomareva, now retired, tells her story to Ms. Debra D. Faktor, a fellow woman engineer and Chief of Russian Operations fro ANSER's Center for International Aerospace Cooperation. The story is not only of a young woman cosmonaut in training, but of the history of women in the former Soviet space program, and the myths and realities of women's participation in the eraly Soviet space missions.

359 ARIANE : THE STORY OF A SUCCESSFULL COOPERATION
Villain Jacques
1996 - IAA 2.2.02 - vol 16 - AAS vol 25 - pp.67-80
Story of the Ariane Launcher Development.

360 THE STUDY OF THE HISTORY OF ROCKETRY AND ASTRONAUTICS IN THE INTERNATIONAL ACADEMY OF ASTRONAUTICS
Sokolsky Victor N. - Durant III Frederick C. - Ordway III Frederick I.
1996 - IAA 2.2.01 - vol 16 - AAS vol 25 - pp.51-63
A review is presented of the origin and evolution of studies of the history of rocketry and astronautics within the International Academy of Astronautics. The question of undertaking studies in these areas first arose in 1961 shortly after the founding of teh Academy. During its first regular meeting on 3 october 1961, Chairman of the Founding Commitee and First President Theodore Von Kármán was "authorised to establish within the Academy a Committee on the History of the Development of Rockets and Astronautics, whose task would be the stimulation of the preapration of scholarly studies of various aspects of these developments in different countries from earliest times". The paper examines some of the considerations that faced members of the new committee : how best to

stimulate historical research in the fields of rocketry and astronautics; how such research should be coordinated; what would be the most effective way to exchange information on the state of research in different countries; and would the regular exchange of books and articles prove feasible? The first session of the Committe took place in Paris in October 1963 and the second in Athens two years later. It was that the decision was made to organize henceforth regular symposiua on the history of rocketry and astronautics. From 1967 in Belgrade, such symposia have been held pn a yearluy basis. This paper review 30 years of progress during which hundreds of history presentations have been given covering subjects ranging from the developments of rockets in antiquity to their use centuries later in the exploration of the Moon and planets. The paper concludes with a review of the annual history of Astronautics Symposia according to subject, period and focus, countries represented and trends in content during the past three decades.

361 MAN'S NOW GOING TO GO TO THE MOON: PROFESSOR FRANK COTTON AND AUSTRALIA'S CONTRIBUTION TO THE ORIGINS OF THE PARTIAL PRESSURE SUIT

Dougherty, Kerry

1996 - IAA 2.1.08 - vol 16 - AAS vol 25 - pp.335-352

The history of the pressure suit development in the United States is well known, but recently-recovered artefacts and archival material from the University of Sydney, Australia, have brought to light the forgotten aero-medical work of professor Frank Cotton, Research Professor in the Department of Physiology during the Second World War, to whom American pressure suit research owes a great, if indirect, debt. Prof. Cotton's fundamental physiological research and his practical work on the development of the first pneumatic 'anti-g' suit paved the way for the development of the first U.S. partial pressure suites. Professor Cotton's war time aero-medical work has remained largely unknown until now, due the security classification which surrounded his original research and his early death in 1955, which prevented him from publishing his work, as he had intended.

362 K.E TISOLKOWSKI AND HIS CONTRIBUTIONS TO THE SPACE LIFE SCIENCES

Gazenko, Oleg G.

1996 - IAA 2.1.07 - vol 16 - AAS vol 25 - pp.45-49

The paper discussed the significance of K.E Tsiolkovsky's creative power in the process of setting and evolution of astronautics and is role in grounding of the problems of space sciences dealing with the life.

363 THE RAE VICKERS ROCKET POWERED TRANSONIC AIRCRAFT MODEL, 1945 TO 1948

Becklake, John E.

1996 - IAA 2.2.04 - vol 16 - AAS vol 25 - pp.93-108

As world war II progressed, fighter aircraft were flying faster and faster and were beginning to encounter the strange aeroydnamic effects associated with velocities approaching the speed of sound. By the end of the war all the main Allied countries were beginning, with varying degrees of enthusiasm, to investigate the possibility of producing a supersonic fighter or a least an aircraft capable of lying faster than the speed of sound. The development of the rocket and the jet engine had provided the designers with the potential sources of power to drive aircraft at such speeds.

364 THE "TRIP TO THE MOON" AND OTHER EARLY SPACEFLIGHT SIMULATION SHOWS CA. 1901-1915: PART 2.

Winter Frank H. - -

1996 - IAA 2.1.03 - vol 16 - AAS vol 25 - pp.3-28

Part 1 of this paper documented the history of the "Trip to the Moon" lunar flight simulation attraction created by Frederic Thompson and presented first at the pan-Amrican Exposition in Buffalo, New York, in 1901, then at the seaside resort of Coney Island, New York, where it appeared between 1902-1907 and from 1910-1912 as "A Trip to Mars by Aeroplane". Part 2 covers carnival and other incarnations of the Trip to the Moon shows up to 915. These higly popular shows were simple, non-scientific, and technically primitive productions compared to what is possible in our high-tech, computrized age today. Yet they demonstrate that there was a remarkably high interest in spaceflight during the early part of the century which was spread into both small and large towns througought the U.S. and Canada and therefore offer us a new perspective in the history of spaceflight and popular culture. By the same token, it is seen that this period was part of the fantasy phase of astronautics, although it involved mechanical and electrical secnic effects, and that a Part 3 of this study is now contemplated that may help us better define the evolution of popular conceptsd of astronautics from fantasy to the introduction of the idea of the space rocket into the

365 SOVIET SPACE DESIGNERS WHEN THEY WERE SECRETS

Lardier Christian

1996 - IAA 2.2.09 - vol 16 - AAS vol 25 - pp.319-334

In the Soviet Union, from 1957 to 1991, the conquest of space was a complete state secret, because it was under the control of the defense industry, in other words the military-industrial complex. What the Western world knew about the Soviet Union space program was the official version through the TASS press release published in Pravda. Meanwhile, the Americans spread another version, unofficial, which was intended to clarify the many mysteries behind the Soviet Union space program. The lack of information was an open door to disinformation….

366 THE APOLLO FIRE AND INVESTIGATION: FACTS NOT CONSIDERED

Thomas Shirley

1996 - IAA 2.1.06 - vol 16 - AAS vol 25 - pp.267-306

The fact surrounding Apollo 1 were as incongruous as they were catastrophic. The amgnificently designed spacecraft that was created with enormous effort for a journey to the Moon instead was consumed by fire while undergoing a supposedly routine ground test. Three astronauts - Virgil I. Grissom, Edward H. White and Roger B. Chaffee - eminently qualified for the ultimate lunar adventure, were trapped inside the spacecraft. Apollo had emerged as the product of an unprecedent gigantic research, development, and production effort. Unmanned, flight tests manned flight, there was a final ground test on Pad 34 on january 27, 1967. Then, in moments, a raging conflagration reduced all of these aims to smoldering ashes. In all, about 1200 people churned out 3000 pages of reports. The final report, to paraphrase the Bard, was "full of sound adn fury…". To complete the pharse, the report did not "signify nothing", but it omitted the major factor in the fire. Apollo 1 was undergoing a test with an internal pressure of 16.7 pounds per square inch. The significant point is that this internal pressure was being generated by pure oxygen whereas, for the ground operation, it could and should have been ordinary air. In space, oxygen filling the spacecraft poses no danger but on the ground, an oxygen filled craft was a potentiel inferno awaiting any spark. Lessons can be gleaned from the tragedy only if all the facts are presented. That is the aim of this paper.

367 REALISED AND NON REALISED PROJECTS OF THE SOVIET MANNED LUNAR PROGRAM

Sokolov O.A.

1996 - IAA 2.1.05 - vol 16 - AAS vol 25 - pp.259-266

A history of the unsuccessful Soviet manned lunar program establishement, including preceding projects is examinated from point of view of a potential for a realization and following prospects. Some reasons of this program cancellation are discussed and the non-adopted projects of its possibility of technical realization in the present time and in a near future. It is noted that most of projects had a mark of political aims and practically cannot be adopted for current and future purposes of the Moon exploration and use. A suggestion was made that a scheme with an assembly of interplanetary spacecraft at near-Earth orbit would be more suitable for future manned luanr missions and it was notes that some early Soviet projects had approched to their realization.

368 THE LEGACY OF THE OBERTH ROCKET OF 1935

Rohrwild Karl-Heinz

1996 - IAA 2.1.04 - vol 16 - AAS vol 25 - pp.29-44

In 1933, Wernher Brugel published the book "Men of the Rocket". It was a treatise of the young science of space-travel written by their creators. Hermann Oberth was also among the contributors. His article contained the sketch of a new experimental rocket, whose function was briefly described, but details were not given. Another 50 years passed, before hans Barth, in his biography of Oberth, again mentioned this rocket. Barth cites a 1933 letter to Otto Wiemer in Germany, in which Oberth writes about a "half-completed" model of a rocket. He also reports that Oberth in 1948 had written to Willy Ley that he had flown his first small liquid rocket in 1935. Ley, sort of ignored this short statement of Oberth, with the result, that little became knwon of this rocket.

369 WERNHER VON BRAUN'S DOCTORATE - THESIS. A SCIENTIFIC BASIS FOR TYPE "A" ROCKET

Zaganescu Florin

1997 - IAA 2.1.03 - vol 17 - AAS vol not issued -

In 1934, at the University of Berlin, Wernher von Braun (1912 - 1977), having as a scientific guide prof. Schumann, backed up before the Faculty of Sciences

Council, his Doctorate-Thesis entitled: "Theoretic and experimental contribution to the Liquid Rocket problem". This paper develope a scientific comment on Thesis's Features having the traces as follows :

a) a theretical research, practical calculations and static tests carried out by von Braun for a lot of combustion chambers of a Rocket-Prtotype named AGGREGATE I;
b) the first running on the Test Rig of a liquid rocket full endowed and assembled, but unfitted for a start;
c) the first seting out of a chamber-nozzle assembly manufacture technology, mened for a serial production, which is compulsory in case of military purposes;
d) the Von Braun's demand for a correct stability calcuulations.

This paper's authors commented also some scientific aspects of Von Braun's Thesis, detailed in its six main sections, and a lot of original contributions of Von Braun….

370 LE PRIEUR AND THE FIRST AIR LAUNCHED ROCKETS

Moulin Hervé - Jung Philippe

1997 - IAA 2.2.03 - vol 17 - AAS vol not issued -

While the first rocket already was launched by the Chinese in the 10th century, it took another ten centuries for the first signification evolution to occur and for the Space Age to begin, with the great pioneers and the first liquid rocket. The reign of the black powder rocket can be stated to have ended - with panache - during the Big War. In spite of the efforts of Susanne in Metz during the second part of the 19th century, the rocket seemed to have finally given way worldwide in 1872 to the grooved cannon with breach loading, even though France had been at the time this staunchest supporter of this weapon. It however reapparead there for a revolutionary application : quite naturally for the biggest aeronautical nation in the world at the time, naval officer Yves Le Prieur had the idea of mounting rockets on fighters, to be used against all types of balloons and even some ground targets. They thus were the first air-to-air and air-to-ground missiles in history, decades before the widespread use of this type of armament the world over. History was made on 2.2. May 1916, whgen 8 Nieuport Bébé biplane fighters, each armed with 8 rockets in two groups of four mounted on their interplane struts, fired them in a volley. One of the pilots was French ace Nungesser. A few seconds later, 6 German Drachen balloons went down in flames, the first ever aerial victories for missiles. This paper retraces the full story of this unique and final use of "Chinese rocket", before the appearence of the modern rocket. The brainchild of Le Prieur (1885-1963), a genious who also invented the scuba diging suit, it witnessed applications from many French, Belgium and British planes, a special squadron even being created in France. Crudely stabilised, and of course unguided, these rockets were effective only against big targets. To become established, the air launched missile had to wait a few decades for the new sciences of aerodynamics and guidance to be developed.

371 TSIOLKOVSKY'S "ALBUM OF SPACE VOYAGES": VISIONS OF A SPACE THEORIST TURNED FILM CONSULTANT

Finney, B

1997 - IAA 2.1.02 - vol 17 - AAS vol not issued -

During the early 1930s the space theorist Konstantin Tsiolkovsky consulted with Mosfilm Studios on the production of a science-fiction film. "Cosmic Flight", about the first spaceflight to the Moon. As part of his duties, he prepared an illustrated primer called " Album of Space Voyages", which featured his prescient drawings. At a time when the first experimental liquid-fuel rockets were just beginning to be developed. Tsiolkovsky was able to leap ahead in his imagination and realistically draw staged rockets for reaching space, orbiting habitats and numerous scene of how people would one day live and work in space. Many of his visions, such as those featuring acrobatics in micro-gravity, sleep restraints, airlocks and tethered spacewalks, have already come to realized aboard Voskhod, Gemini, Saliut, Skylab, Mir, Space Shuttle and other spacecraft.Others such as orbiting "plant nurseries" for recylcing human wates into oxygen and foods crops, remain to be developed. These visions from the lasting legacy of Tsiolkovsky's brief career as a film consultant, not the resulting film, a lighthearted tale about a round-trip voyage to the Moon and the adventures of the space travelers on the Moon's surface.

372 VLACHESLAV KOVTUNENKO - HIS LIFE AND HIS LANDMARK IN THE HISTORY OF ASTRONAUTICS

Prisniakov V. F.

1997 - IAA 2.1.04 - vol 17 - AAS vol not issued -

Vlacheslav Kovtunenko (1921-1995) made the significant contribution to the problem of space exploration in the Soviet Union (later in Russia). Almost 50 years of his profesional life he devoted to design of ballistic rockets and space vehicles. After graduation from leningrad University he began his career 1946 as an engineer in one of the research institutes. Later he become the chief designer of various spacecrafts, serving differents purposes. The creation of KOSMOS series satellites, coordination of several INTERKOSMOS programs, design of spacecrafts for outer space missions to Venus, Mars and halley comet -- these are only basic facts of his profesional biography. This paper intends to illuminate Kovtunenko's main ahievement in the field of aeronautics and astronautics.

373 MITCHELL R. SHARPE, JR, AEROSPACE HISTORIAN

Dannenberg, Konrad K.

1997 - IAA 2.1.01 - vol 17 - AAS vol not issued -

Mitchell R. Sharpe, contributed in a major way to aerospace history. These memoirs relate his education in English Literature and his involvement in space events that allowed him to become an active participant during the most formative years of the space age. He combined a wonderful writing ability with a wealth of personal experiences to leave us a legacy

374 THE U.S NAVY'S HYDRA PROJECT, AND OTHER FLOATING-LAUNCH ROCKET PROGRAMS

Draim, J.E.

1997 - IAA 2.2.02 - vol 17 - AAS vol not issued -

abstract not available

375 JAPANESE LIQUID ROCKETS IN THE WORLD WAR II

Matogawa Yasunori - -

1997 - IAA 2.3.02 - vol 17 - AAS vol not issued -

The only Japanese rocket fighter "Shusui" originated in German interceptor "Me 163B". It was manufactured for trial on the basis of drawings which were brought back by a submarine from germany by Commander Iwaya in July, 1944. The developmental effort waw begun by Mitsubishi Heavy Industries Company under the sponsorpship of Japanese Navy. The historical firts test flight was carried out on July 7, 1945 by Lieutenant Inuzuka. The rocket engine suddenly stopped burning on its ascent phase, and touched a building just before the emergency landing. Shusui crashed, and was completely wrecked. The investigation found out that a trouble of one of fuel tanks cut off the supply of fuel. The effort of the second test flight was begun. The War, however, ended right in the middle of its preparation. On the other hand, the liquid rocket technology developed for Shusui, was tried to be transferred to the development of "Funryu-4", a surface-to-air missile which followed its solid propellant verion "Funryu-2". The test flight was scheduled on August 16, 1945, but the War ended on the previous day of the flight, when the liquid engine was on the way of air transportation from nagasaki to the foot of Mt. Asama. We now have photographs of Funryu-4. This paper reviews these efforts in the Navy, referring to the efforts by japanese Army, including the devleoment of guided missiles for attacking enemy warships.

376 SOVIET WORKS ON RAMJETS FROM 1929 TILL NOW

Lardier Christian

1997 - IAA 2.3.03 - vol 17 - AAS vol not issued -

Rocket propulsion in Soviet Union is well known in the field of liquid rocket engines, but not so much in the field of ramjets or solid rocket engines. This paper presents the history of the ramjet's development in U.S.S.R. from the work of Boris Stetchkin in 1929 until now…..

377 SOURCES OF FIRST SOVIET WEATHER SATELLITE CREATION

Pappo-Korystin V.N

1997 - IAA 2.3.05 - vol 17 - AAS vol not issued -

This year, humanity celebrates 40th anniversary of firts staellite injection and CIS scientific community celebrates 35th anniversary from beginning of near Earth systematic researches under Cosmos program.In this connection, history of Soviet Weather Satellite System creation represents some interest. Necessity of weather equipment injection into space was obvious in that years Academician E. Fedorov wrote. It is necessary to know atmosphere state over while terrestrial globe for a long time. Only weather satellite surveillance can give such information efficiently and operatively. SDO Yuznoye was charged in 1961 develop Meteor satellite in composition of Voskhod space-rocket complex with SL-8 launch vehicle on the basis of SS-5 military rocket. Preliminary development of special geophysical, magneto-metrical, radiometrical and optical equipment which was ingredient of the weather complex, as well as supporting systems for attitude control, attitude control by means of flywhells, solar battery orientation and so on was carried out on Cosmos satellites developed by SDO Yuzhnoye.All-Union Electromechanical Scientific Research Institute (AESRE), which had neither experience no production base on development of mechanical constructions and aerial systems, was charges with development of Meteor satellite because SDO Yuzhnoye was hardly loaded with development of powerful military missiles and powerful P-56 launch cehicle for Loon program. As AESRE had no experience, SDO Yuzhnoye and Yuzhny Machine-Building Plant rendered direct assistance in development of design plans and specifications, production forms and records, and operational documentation as well as in manufacturing of body nodes, development of jet systems, assembly and quantitative production of satellites. Flight tests of single satellites afterwards were competed by creation of continually operated space weather forecasting system.

378 FIRE IN THE SKY: SPACE LASER DEVELOPMENT FROM 1968

London III John R.

1997 - IAA 2.3.06 - vol 17 - AAS vol not issued -

This paper trace the history of technology developments which could allow high energy lasers, based in space, to defend against hostile ballistic missiles during thir vulnerable boost phase. We begin with the ags dynamic laser, which was considered for space-based ICBM defense in 1968. By the mid- 1970s, the development of higher efficiency and shorter wavelength lasers spurred the Defense Advanced Reasearch Projects Agency to re-examine space strategic missions. The hydrogen fluoride combustion laser, associated optics, and pointing and tracking technologies were concentrated into a triad of major development efforts to demonstrate, at reduced scalse, the performance necessary to support the missile defense mission. In 1984 a set of objectives were laid out by the Strategic Defense Initiative Organization, building on the triad of programs begun earlier. These programs have recently reached the culmination of those objectives and have demonstrated integrated operations of key components at high power, including a megawatt-class hydrogen fluoride laser, a large four dimeter telescope, and the associated beam transfer and beam control system. The program is now planning for the construction of a Readiness Demonstrator space vehicle, for thorough ground testing and possible space flight qualification.

379 1947-1957, ROCKET MAIL AND HIGH PRIORITY CARGO DELIVERY BY ROCKET - 50 YEARS OF RESEARCH BY THE ROCKET RESEARCH INSTITUTE

James, George S.

1997 - IAA 2.3.08 - vol 17 - AAS vol not issued -

1997 marks 50 years since the initiation of rocketpost experiments by Rocket Research Institute members. To date, over 77 000 comemorative items have been carried during 46 experimental flights which is a world record for a non-governmental organization. Cargos containing principally commemorative envelops for collectors have been flown by the experimental cargo rockets primarly to evaluate systems for delivering high priority items without damage. Institute research continues because of the potential need for short range delivery by rocket of essential items such as medical supplies, when poor weather conditions or wartime siege situations, such as Sarajevo, during the recent conflict, prevent delivery by any other means. Although many of the RRI rocketposts have received excellent press coverage, this is the first paper to present characteristics of the solid propellant and steam propellant cargo rockets flown since 1947, which have avried in lenght from 5 to over 15 feet in ddiameter from 3 to 12 inches and in weight from 10 to 200 pounds, and to discuss the experimental cargo protection systems. Institute members began rocket post research to develop short range cargo rockets, shortly after the organization was founded in 1943. Four years later, on June 28, 1947? Following the development of a 10-foot long Micrograin solid propellant cargo rocket motor, two rockets were launched, using thes motors, carying a total of 650 special commemorative envelopes that celebrated the 10th Anniversary of the U.S. Postage Stamp, from Winterhaven, California, accross the Colorado River, to Yuma, Arizona. The research has been strongly motivated by the work of Friedrich Smiedl (1902-1994), the Austrian space and rocket mail pioneer, whose firts experiments occurred in 1920's.

380 "SPUTNIK TECHNOLOGY" - 40 YEARS AGO
Syromiatnikov

1997 - IAA 2.3.09 - vol 17 - AAS vol not issued -

On the 4 October 1957, Sputnik 1 came as a shock to the world, opening the space era for Mandkind. The event occured at a peak of the "Cold War" and the technical details were kept under heavy military secret. Though, the event was of paramount importance, a turning point in the evolution of life on Planet Earth. Sputnik Engineer Vladimir Syromiatnikov remembers his the glorious years at OKB-1 under the leadership of general Designer Serguei Korolev and how the "Most Simple Satellite" came to open the now called "Space Era". 40 years later, high school students from Russia and from France have undertaken a cooperation to give the world a reminder by building and launching a functioned scale model of the original Sputnik.

381 KONSTANTIN TSIOLKOVSKY AND THE ORIGIN OF THE SPACE ELEVATOR
Pearson J.

1997 - IAA 2.1.09 - vol 17 - AAS vol not issued -

The space elevator is a connection between a geostationary satellite and the Earth. It was invented by Yuri Artsutanov (1960) and indepently by Jerome Pearson (1975). Artsutanov did not publish in the technical literature, and so the Pearson invention brought the concept to the attention of the world-wide astronautics community. Since then, it has been noted that Konstantin E. Tsiolkovsky developed ideas that were precursors to the space elevator, and also to the use of tethers in space. Some authors have attributed the space elevator to Tsiolkovsky. A review of the relevant Tsiolkovsky writings reveals that he was seeking ways to nullify the force of gravity that binds us to the Earth. In 1895, Tsiolkovsky performed a "thought experiment" involving an extremely tall tower that would overcome gravity at its top by its angular velocity on the rotating Earth. In other thought experiments, Tsiolkovsky proposed using space tethers for launching payloads to different orbits. These Tsiolkovsky thought experiments and the manner in which he carried them out are examined. Tsiolkovsky's writing are compared with the Artsutanov and pearson space elevators, and with other concepts for space tethers. The paper concludes that Tsiolkovsky anticipated applications of space tetehrs payload launching, but thta the invention of the

382 DUSTING OFF THE ROOTS OF CONSISTENCY: ORIGINS OF BRITISH SPACE POLICY.

Millard D.J.

1997 - IAA 2.1.08 - vol 17 - AAS vol not issued -

This paper present briefly the Great-Britain policy during the early years of the space era, just after the launch of Sputnik I by the U.S.S.R...

383 KOROLEV'S " CIRCUS ACT": VOSKHOD

Harford, James J.

1997 - IAA 2.1.07 - vol 17 - AAS vol not issued -

In early 1964, with the spectacular flights of Voistok 1, through 6 behind him, Sergei Pavlovich Korolev, the "Chief Designer", was under pressure to continue demonstrating the Soviet Union's would leadership in manned space exploration. He was hard put to do this, however, since the American Gemini program, capable of carrying two astronauts, was well underway whiler his next generation spacecraft, Soyuz- originally destined to carry multiple cosmonauts on the Moon -- was still a long way from development. His clever initiative: strip the Vostok spacecraft eliminate space suits and launch-escape system, and pack three cosmonauts in. The result was more firsts for the Soviets-- first three man space mission in Voskhod 1, and first extra-vehicular activity from the two man Voskhod 2. This paper reviews the political circumtances which led Korolev to pursue the development of Voskhod, which was later described by Vassily Mishin, Korolev's successor,a s a "circus act". It also details the design history of the spacecraft and the EVA space suit used by Alexei Leonov, and discusses advanced Voskhod desgins not pursued.

384 THE IMPACT OF JU. V. KONDRATJUK INTO THE FOUNDATION OF THE THEORY OF SPACE FLIGHT

Sokolsky Victor N.

1997 - IAA 2.1.06 - vol 17 - AAS vol not issued -

Jury Vasiljevich Kondratjuk belongs to those scientists, whose works, by the end of the first quarter XXth century, laid the foundation of the theory of Space Flight….

385 EIGHTY-YEAR WAY OF KHRUNICHEV SPACE CENTER - FROM CARS TO SPACE VEHICLES

Sokolov O.A.

1997 - IAA 2.2.05 - vol 17 - AAS vol not issued -

The paper contains a summary of evolution history for one of largest in the world company of space/rocket industry - the Russian Khurnichev State Research and Production Space Center, 80 year anniversary of which was celebrated in 1996. Asteady increasing of experience for advanced developments in the field of aviation technology and increasing of production equipment are shown, these capacities let to transfer to a space/rocket technology exploration beginning from 1960. Initial developments of the Lhrunichev's launch vehicles, for exemple, the UIR-200 are described, they provided a possibility to create in short terms so known in the world examples like the "Proton launcher". The paper informes also about a process and results of the Khrunichev's huge work in a manned cosmonautics field - acreation of the TSK ferry spacecraft and modules of orbital stations (from "Salyut" and "Mir" to "Alpha"). The paper examines briefly the Khrunichev's modern advanced developments like the "Angara" heavy launcher, launch vehicles of light-qeight class and cargo spacecraft/modules on the FOB basis as well as a work in a field of small satellites developments. The paper contains an information on a present condition and further developments prospects of the Khrunichev's productional, test and launch bases as well as on the international relationshiop and cooperation of Khrunichev. The paper has references to exhibits being presented at the Khrunichev show in a scope of the Exposition being established together witrh the Congress.

386 THE HISTORY AND FORMATION OF THE FIRST SOVIET COSMODROME KAPUSTIN YAR

Shatalov D. V.

1997 - IAA 2.2.01 - vol 17 - AAS vol not issued -

not available

387 FIFTY YEARS OF ROCKET PROPULSION IN VERNON

Rothmund Christophe

1997 - IAA 2.3.07 - vol 17 - AAS vol not issued -

SEP's Large Liquid Rocket Engine Division located At Vernon not only celebrated in 1966 its 25th anniversary, but also celebrated the first 50 years of rocketry. Creat"d as the LRBA in may 1946, the establishment has the task of developing the first French large liquid propellant rocket: project 4212. This project was cancelled in 1949 but the experience gathered

388 X422 - THE FIRST CRUISE MISSILE IN HISTORY

Jung Philippe

1997 - IAA 2.3.01 - vol 17 - AAS vol not issued -

When France embarked upon ist Force de Frappe concept in 1959, to be evntually based upon the use of startegic missiles, it raised more than a few eyebrows in the world. Many though this was unrealistic for a small nation, apparently without known experience, even more when the decision to use submarine launch was taken: Actually, some people also had doubts in France, as an alternative was indeed considered to be a good precautionary measure, just in case technical failure would be around the corner. It came from Roger Betielle, at the time the technical director in the Cannes premises at Sud Aviation, and later became the respected father of Airbus. Fresh from its unique experience in Europe with 1.150 guided missiles launched, the Côte d'Azur plant was just turning to inertially guided vehicles and the first test vehicles for Force de Frappe, including the early Precious Stones like Agate. But Beteille also imagined a new and revolutinary type of missile : a lifting body, without any wings, would fly at Mach 2 at an altitude of only 50 meters to avoid radar detection. This wild concept is now known as a cruise missile. Actually, three X422 test vehicle fully validated the concept in 1967, nearly a full decade before any other comparable missile. To this day, there is still no knwon equivalent of such performance. This paper unfolds the complete story of this highly advanced program, which saw the study of many variations, from X411 to X420 to be air, sea or ground launched, even from Concorde.

389 TM-3: A JOINT SOVIET SYRIAN SPACE MISSION

Edelby, G.

1997 - IAA 2.2.04 - vol 17 - AAS vol not issued -

In the year 1947, teh Syrian Institute of Aeronautics came into existence as a part of the Syrain Air-Force. This Institute has graduated thousands of highly qualified jet pilots - One of them was General Muhammad Ahmmad Fares the Syrian cosmonaut, Mission TM-3 the joint Soviet Syrian Space Mission to orbit in July 1987. This paper speaks about the Joint Soviet Syrian Space Mission, as a part of the Syrian space program.

390 AIR-FORCE-OFFICE OF THE SECRETARY OF DEFENSE RIVALRY: THE PRESSURE OF POLITICAL AFFAIRS ON THE DYNA SOAR, X-20 PROGRAM, 1957-1963

Houchin, R. F.

1997 - IAA 2.3.10 - vol 17 - AAS vol not issued -

In the spring of 1952, the Bell Aircraft Co. And the USAF started talking seriously about an honest-to-goodness aerospace bomber capability….One of the most significant outcomes of these studies was Dyna-Soar (Dynamic Soaring), a military forerunner to the space shuttle.

391 U.S SPACE AND ROCKET CENTER HISTORY

Mauldin T.

1997 - IAA 2.2.06 - vol 17 - AAS vol not issued -

abstract not available

392 M.K. YANGEL AND HIGHER SCHOOL

Prisniakov V. F.

1997 - IAA 2.2.07 - vol 17 - AAS vol not issued -

abstract not available

393 ROCKETDYNE - A GIANT PIONEER IN ROCKET TECHNOLOGY: THE FORMATIVE YEARS, 1945-1955

Winter Frank H.

1997 - IAA 2.2.08 - vol 17 - AAS vol not issued -

Rocketdyne, the largest producer and developer of large-scale liquid-propellant rocket engines in the U.S., was created in

394 ORGANIZATION AND INITIAL PERIOD OF ACTIVITY OF THE ENTERPRISE ON DEVELOPMENT OF LIQUID PROPELLANT ROCKET ENGINES IN RUSSIAN FEDERATION

Sudakov V. S.

1997 - IAA 2.2.09 - vol 17 - AAS vol not issued -

Presentation of little-studied period of development of a Russian science and engineering, when the creation of propulsion engineering has become the important state problem is the prupose of the given hisorical research. It was the period of creation of scientific-industrial base for the future space-rocket industry, it was the starting paltform for a jump of mankind into space. The research-and-production association of power mechanical engineering (NPO Energomash) named after Academician V.P. Glushko is recognized in Russia and all over the owrld as the leader of liquid propellant rocket engine development….

395 BIRTH OF THE SUN SYNCHRONOUS SATELLITE

Genty, Robert

1997 - IAA 2.1.05 - vol 17 - AAS vol not issued -

In spite of the first Keplerain rule, the orbital plane of an artificial satellite of the Earth does not keep a constant orientation in space, referring to the fixed stars, but turns with a constant speed of a few degrees per day around the axis of the poles of the Earth in a negative direction. Astronomers have established the formula giving the angular speed, using the mathematical "perturbations" method, the perturbating element being the terrestrial equatorial bulge…..As soon as the early 60's, the author of these lines thought of a mechanical way of explanation through a vetorial analysis, to find again formula of the astronomers. This operation had the great interest to reveal the role of each rotation vector, component of the orbital rotation around the axis of the terrestrial poles. The author concluded from these results that the phenomena was essentially controllbale and he imagined the launch of a satellite towards the West for a rotation of the orbital plane in a positive orientation, instead of negative, that is with the same orientation as that of the "mean sun". He selected the parameters of the orbit in order for the value of the angular speed of rotation to be exactly the same as that of the orientation of the "mean sun". In a such system, the orbital plane would make a constant angle with the orientation of the "mean sun", thereby of course, conferring to the satellite undeniable borary advantages.

396 EARLY AUSTRALIAN SPACE EXPERIMENTS

Cartwight, D. G.

1998 - IAA 2.1.08 - vol 18 - AAS vol not issued -

In 1960, soon after the first artificial satellite had been launched, CSIRO's Upper Atmosphere Section conceived a satellite-borne experiment to observe naturally occuring very low frequency radio emissions above the ionosphere. A proposal was submitted to NASA Office of International Programs, which gave it in principle support, but stipulated that proof-of-concept experiments be flown on sounding rocket. Several avenues for doing this were explored, including "piggy-back" rides on British Skylark rockets flown from Woomera, but eventually the Australian-built experiments were flown on NASA-funded Aerobee 150's from

Wallops IslandThis paper provide the background to the sounding rocket experiments and discusses the fate of the satellite experiments.

397 AUSTRALIAN IN SPACE - THEN AND NOW

Heyman, Jos

1998 - IAA 2.2.08 - vol 18 - AAS vol not issued -

With the advent of the space age, Australia was involved in four different space programmes: the European Launcher Develomment Organization, the British Black Arrow test programme, the United States tracking network and Australia's own space effort, resulting in the launch of Wresat in 1967. During the seventies several government sponsored studies advocated the establishment of a satellite based communications system, resulting in the Aussat/Optus seris of communications satellites of which the first one was launched in 1985. Current Australian space projects incluse the FEDSAT technology satellite and the ARIES remote sensing satellites.

398 NIKOLAI M. BELYAEV - HIS CONTRIBUTION TO THE DEVELOPMENT OF SOVIET ASTRONAUTICS

Belyaev, N. N.

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Professor Nickolai M. Belayev (1928-1997), the Full member of the International Academy of Astronautics made large contribution both to the development of the Soviet Astronautics and teaching some genration of missiles designers. His name was well known among the Soviet specialists working in the field of designing liquid and solid propellant missiles but for some reasons his name is still not well known to the large international audience. The aim of this paper is to illuminate his contribution to the development of the Soviet Astronautics.N. M. Belayev's professional career was connected with two organizations. The first is the Dniepropetrovsk State University where he "passed the way" from the assistant to the Head of the Applied Gas Dynamics and heat and Mass Exchange Department. The other is Yuznhoje State Design Office (Dniepropetrovsk), the organization his scientific work was tighly connected with. Professor N. M. Belayev developed the new direction in the field of the thermodynamics - the thermodynamics of the changeable quantity of gas. This dirfection could form the theoretical basis for the investigation of the processes in the liquid propellant rocket fuel tanks. He developed the new effective methods of claculation and designing the gas generators, pressurization systems, reactive control systems of space - crafts, thrust vector control systems of the solid propellant missiles guarantee terms of rocket exploitation, optimum parameters of the space - craft fuel supply systems. His investigations were used for the development the fuel supply systems of the launch vehicle "Zeinth", and others multi-stage ballistic missiles. Professor N. M. Belayev published 25 books in the field of missiles and spacecraft designing. Among them are "The fuel tanks pressurization systems", "Calculation of the pneumatic and hydraulic rocket systems", "Thrust vector control systems", "Drying of rockets before liquid - proof tests", "Numerical simulation of the supersonic gas flows".

399 THE FIRST SOVIET SPACE FLIGHT ORGANISATIONS

Rauschenbach Boris V. - Sokolsky, V.N.

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In the beginning of the 20s of our century, under the influence of Tsiolkovsky, Goddard, Oberth, Esnault-Pelterie and other scientists who were working on the foundations of the space flight theory, the idea of man flight to the other space objects started to spread among the masses. There were attempts to unite those who was interested in Space flight problems. The question of the formation of such a union in the U.S.S.R. was set up for the first time by F.A Tsander, who clearly formulated in January 1924 that it is preferable to organize in Soviet Union the Society of the explorers of the interplanetary flights. In April, the same year, attached to the Military-Scientific society of the Academy of the Air Forces named after N.E. Zhukovsky, the section of interplanetary flights was created. The section put for itself the task to unite the people who were woirking in the U.S.S.R. on the problems of interplanetary flight, to collect the information about the similar works in the West, and to popularize the information about the situation in this field. It was decided by the section to conduct a competition for the best project of the small rocket for the exploration of the upper stratum of the atmospheric; also the work on the deep theoretical studying of interplanetary flight was carried out. The section with the staff of 25 people, has established a tight connection with K.E. Tsiolkovsky, a number of scientific reports, including the reports of V.P. Vetchinkin and F.A Tsander were presented at ist sessions. In May 1924 the Society of the Interplanetary FlightS Studying was crerated. The Society had about 200 members and was divided onto three sections: scientific-research division, popular-science division, and literary - propaganditic division. The popularization of the idea of the Interplanetary communications was carried on, the members of the Society gave public lectures. Understanding that for the future work the Society needs a periodical magazine, the leaders of the Society actively started to prepare for publishing the magazine "Raketa" ("Rocket"). Besides the Society of the Interplanetary Flights Studying there were several other groups of enthousiasts in the U.S.S.R., who popularized the idea of space flight. In 1925 in Kiev a group on World Space Studies was creeated, academician D.A Grave was a scientific sdupervisor of the group. This group organized in Kiev, an exhibition on problems of the exploration of the Space (the exhibition was opened on June 19, 1925). At the end of 20s the two groups were created in Leningrad - one in the Institute of the Engineers of Communications and another in technological Institute - both groups were also devoted to the problems on interplanetary flights and to the studying of the principles of the jet flight. N.A Rynin, Ja. I. Perelman and other Leningrad authorities in this field took part in the activities of these groups. In April 1927, in Moscow the international exhibition of the models of interplanetary apparatus and devices was organised. Many scientists from different counrties agreed to participate in this exhibition. The creativity of Tsiolkovsky, Goddard, Oberth, Esnault-Pelterie, Tsander, Hohmann, Valier, Ulinsky, and other scientists and inventors has been reflected in the exhibition. The materials given above in this report indicate of the a great work which has been conducted by the Society of the

Interplanetary Flights Studying and by sections and groups on the problems of Space Flight to popularize the ideas of space flight and also to find and consolidate people in our counrty who were interested in those problems.

400 AUSTRALIS: A HISTORY OF THE DEVELOPMENT OF THE AUSTRALIAN STUDENT-BUILT SATELLITE

Tonkin, R.

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The paper describes the origins, construction, operation and results of the AUSTRALIS amateur radio and technology development satellite also lnown as Oscar 5), Australia's second satellite, which was launched by NASA into low orbit in January 1970. Original text and photographic records maintained by the Project Australis team during the building of the satellite are drawn on to describe it's history, the scientific and engineering objectives of the mission and it's implementation. The co-authors were, respectively, the engineering manager of the project, who was an engineering undergraduate, and the project co-ordinator, who was a law student. Together, they provide a balanced narrative of this unique and important chapter in Autsralia's space development. The negineering results of the operation of the satellite's systems are discussed, including an innovative passive attitude control system, as the scientific results of observations by amateur radio operators around the world of the influence of the ionosphere on signals from the satellite's ten meters telemetry transmitter. The conclusions drawn from the project are discussed, including co-ordinating a disparate group of undergraduates and amateur radio operators with no previous spacecraft building experience to carry the program through to a successful

401 SOLID PROPELLANT ROCKETS IN SOVIET UNION

Lardier Christian - -

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The history of solid propellant rockets in U.S.S.R. began with the first powder rockets plant in 1680, the works of A. D. Zassiadko, K. I. Konstantinov and N.I. Tikhomirov in St Petersburg. The GDL merged with RNII in 1933 created the famous Katiouchas in 1938 which were mass produced during the WWII. In 1945 the NII-147 was created in Toulaz to continue the works on multiple launch rocket systems…..

402 2001 : A SPACE ODYSSEY - VISION VERSUS REALITY AT THIRTY

Ordway III, Frederick I.

1998 - IAA 2.1.02 - vol 18 - AAS vol not issued -

A retrospective is given of the now classic production "2001: A Space Odyssey" that premiered thirty years ago in 1968. Attention is focused on the film's scientific and technical projections and an assessment is given as to how these have held up in the intervening years. Most intriguing is the HAL9000 Computer, Production Number-3, which --according to Arthur C. Clarke in the published novel adaptation--became operational on 12 January 1997 at the HAL Plant in Urbana, Illinois, USA. In the screenplay, however, director Stanley Kubrick preferred to have HAL activated there on 12 January 1992. The year 1997 turns out to have been the far more logical date for HAL birth's-- why fit a state-of-the-art spaceship designed to undertake a pioneering mission to Jupiter with a nearly decade-old computer system? And, in any event, we now known that HAL's software could be downloaded in a few days, a feat not realized in the mid-1960s when production got under way in the MGM British Studios in Borehamwood, England. Progressing from this setting, 2001's thirtieth anniversary and the approach of the real year 2001 offer an excellent opportunity to reexamine the film and assess vision versus reality. Overall preparations for the scientific and technical aspects of the motion picture are reviewed, with focus on how the various vehicular systems and subsystems and other elements evolved within the mid-1960s look-forward-to-the-future framework. Among these are the Orion III space shuttle, Space Station , the Aries 1B spacecraft that was designed for travel from Earth orbit to the Moon, the Lunar Bus, Clavius Base, the Tycho Magnetic Anomaly-1, and the Discovery spaceship that undertakes the long interplanetary voyage to the giant planet Jupiter. For the HAL9000 computer, a number of areas are examined. These included voice output, speech recognition; vision, speech/lip reading; running a spaceship; reasoning, emotions and common sense; and raw computing power. It is held that in many areas 2001 holds up remarkably well three decades since the film premiered in Washington D.C., U.S.A. In others, the vision was flawed. To those of us working on the film, during the Apollo build-up era, it would have seemed inconceivable that manned spaceflight in the late 1990s would be limited to operations in Earth orbit; and, morever, that by the year 2001 we would presumably continue to be so confined, without even the ability to return to the nearby Moon.

403 RAND AND NORTH AMERICAN AVIATION'S AEROPHYSICS LABORATORY: AN EARLY INTERACTION IN MISSILES AND SPACE

Augenstein, Bruno W. - -

1998 - IAA 2.2.06 - vol 18 - AAS vol not issued -

The Aerophysics Laboratory and RAND collaborated in their early years in several major ways. RAND assigned to the laboratory a study of long range ramjet missiles; the North American study for RAND conducted in 1947, served as the preliminary design for the later Navaho missile. This early design of the Navaho formed the basis for the 1950 Air Force decision to develop an intercontinental Navaho III, a project subsequently pursued by North American. As part of this early effort, the stated requirements for 1 mile CEP accuracy spurred the Aerophysics Laboratory's work on inertial guidance. The initial emphasis of this work was on numerous theoretical questions, including the simmering debate on the role of Einstein's equivalence principle in the intrinsic feasability of inertial guidance. Aerophysics Laboratory studies resolved these interesting issues unequivocally, in a series of reports which continued after key theoretical personnel had migrated to RAND. A principal objective of the present paper is to summarize some of this new compelling history on the Navaho and inertial guidance which heretofore has been sketchy or absent entirely.

404 THE TEST OF MICHAEL YANGEL BALLISTICS MISSILES ON COSMODROMES KASPUTIN YAR AND BAÏKONOUR

Shatalov D. V. - Antipov V.N -

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At the beginning of the 50's during the "cold war" between the U.S.S.R. and the USA soviet military had acute shortage of interocntinental and middle-range missiles with high-boiling components of rocket fuel. Korolyov's designer's office was the main to solve this problem. Application of liqui oxygen as an oxyder was the special feature of Korolyov's strategical missiles. But that was a great defect in cause of military application. Because of its constant evaporation there were problems to keep and use. The military required rocket to be simple during employment and constantly refueled. Designer's office in Dniepropetrovsk, Ukraine, formed in 1954, brilliantly solved this problem. M. Yangel was its head. Later this office became knwon all over the world as "Yuzhnoe". In a short time designer's office "Yuzhnoe" worked out whole rocket series, which met military requirement best of all. They differed in principle from Korolyov's missiles because of fuel component, management system. They also had an advantage over Korolyov's missiles because of the minimum period of launching preparation and maximum tim in ready for action. The first to design were R-12 and R-14. They were tested on the proving ground Kasputin Yar in Astrakhan region and became later known in the world because they were placed on Cuba during Carribean crisis in October, 1962. Yangel's missiles of the next generation R-16, R-36, UR-36, R-36M were tested on cosmodrome Baïkonour. Their general designer academician M. Yangel died on his 60th anniversary, October 25, 1971. This paper deals with designer's office "Yuzhnoe" strategical programs of working out and test of military and space rocket complexes from 1954 to 1971, when academician M. Yangel headed its activity.

405 FESTIVAL ROCKETS IN THAILAND, LAOS, JAPAN AND CHINA : A CASE STUDY OF EARLY TECHNOLOGY TRANSFER? - PART 1.

Winter Frank H. - Kubozono Akira -

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Each year, perehpas for centuries, Thailand, Laos, Japan, and China jold higly colorful ritual rocket festivals, or parts of festivals, that are remarkably similar to each other in their basic purpose, practice, and gunpowder-based technology. Yet, in the case of Japan, these countries thousands of kilometers apart from each other. The historical origins of the festivals are unknown and are usually ascribed to legends. The objective of the present paper is twofold (1) to attempt to trace the true historical origins of the festivals; and (2) to determine if there is a connection between them to arrive at the bigger picture of determining the origin and spread of early rocket technology throughout Southeast and East Asia. Because this is a far more complexe story than first apperas and involves knowledge of the early histories, trade patterns, lingusitics, geography, topography, and other aspects of the relevant countries or regions, some background is first necessary. The backgrounds also serve to place the festivals, which are described afterwards, in their proper contexts.

406 OUKA: JAPANESE ROCKET-PROPELLED ATTACK GLIDER IN WORLD WAR II

Matogawa Yasunori

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The Ohka was a kind of manned rocket glider, which was carried under the belly of a bomber and was separated in the vicinity of the target to be operated and to hurl itself at enemy ships. The Ohka Model 11, the first type, was equipped with three solid propellant rockets which were fired to avoid attacks of enemy fighters or to accelerate into enemy ships. The Ohka was proposed by Ensign Ohta in August 1944, static-fired in September, drop-tested in November, and entered into mass production. The first Ohka unit left the Kanoya Base on March 21, 1945, to intercept an enmy mobile troop which raided the southern Kyushu. The unit, however, was shot down by carrier-based planes of the Allied Forces, and all of them never returned to the Base. The Ohka units made several other sallies till July, and made some military gains. Advanced types of Ohka were planned, and one of them was test-flown never to participate in actual fightings. This paper follows the developmental progress of Ohka, and reviews the technological level included in the development.

407 VE 111 - TOPAZE - THE FIRST FRENCH INERTIAL ROCKET

Jung Philippe

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In its march towards Force de Frappe, France's SEREB defined in 1959 a technological program, Etudes Balistiques de Base, in order to test and select the various solutions for its future ballistic missiles. As soon as in 1960, several Vehicules d'Essais (VE 8, VE 9, VE 10 Aigle, VE 110 Agate) thus were launched in quick succession, to fly recover noses cones and equipment bays at progressively higher speeds and altitudes. But then came the acid test of second phase VE's, around the basic VE 231 Saphir test vehicle: the VE 121 Emeraude first stage would experiment a powerful liquid motor, while the VE 111 Topaze second strage would introduce both the definite Isolane solid propellant and inertial guidance. Yto this end, the latter was equipped with four rotating nozzles, allowing three-axis control of the stage. The new propellant performance was such that, although Topaze was similar in size to Agate, including an identical 800 mm diameter, burn time jumped from 18 to 39 seconds.Progressing at an inredible pase, SEREB, only created in 1959, already had its first Topaze in flight in 1962. All 6 flights of the initial VE 111 C (C for Court, meaning "short") version were successful. To boost the performance of Spahir, it was decied to lenghtehn Topaze into a VE 111 L version, two of which were launched with aquel success. Such had been the achievements of the Cannes team, the most experienced in Europe, that the last four VE 111C, no longer needed, were transfomeed into VE 111Ci (i like "instable") to check the guidance of the submarine launched MSBS, the configuration of which was highly unstable. One of theme failed. While the liquid

Emeraude had entered the fray, uinitailly afflicted by the POGO effect, a final version of Toapze tested inertial guidance: on May 18th , 1965, VE 111 LG (G for "guidé") with inertial platform and computer, became the first French to be fully inertially guided. Flown 14 times, with only one failure, Topaze then duly became the Saphir second stage, but eventually eraned ist fame because of Diamant. On November 26th, 1965 the latter, a Saphir topped by a third stage, put Asterix into orbit, making France the third space power in the world. By the time the last Diamant B had been launched in 1973, no less than 38 Topaze had been flown. They also were the last rockets of the Cannes plant, the worlead of which could not indefinitely

408 THE RANGER PROJECT

Liepack Otfried

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In preparation for the first landing of a human on the Moon, several precursors missions were necessary to investigate its unknown environment. It was only 2 years after the launch of the first Soviet Satellite Sputnik, that Luna 1 passed the Moon. Ten months later the first Soviet spacecraft impacted on the Moon. All of these missions, whose objectives were not always scientific, were tentative steps towards landing a person on Earth's natural satellite. The Ranger missions 1 thru 9, which were flown from 1961 to 1965 were some of the first spacecrafts to have scientific objectives as well as technical experiments. In addition to providing Lunar environment information such as radiation measurementsn, they captured the first high-resolution pictures of the Lunar surface. The purpose of this paper is to compare Ranger differents versions, including their payloads, orbits and their scientific results. The planning and operations of those missions, that took place in the beginning of spaceflight, will be briefly described.

409 THE THIRD SPACE LAUNCHER OF THE U.S.S.R. - CREATION AND SERVICE PECULARITIES

Pappo-Korystin V.N - Konyukhov S.N. - Paschenko V.A.

1998 - IAA 2.2.09 - vol 18 - AAS vol not issued -

For the first time in the world space practice, a single rocket had placed in the Earth orbit at one time three spacecrafts "Cosmos-38", "Cosmos-39", "Cosmos-40". This had occured on August 18, 1964, at the first start of a new, already third space launcher of the Soviet Union, designated as SL-8. The necessity for development of the U.S.S.R. new launcher was dictated by ever growing demand of the space exploration and uitlization through regular launches of various new spacecrafts in the interests of both science and national economy. Employment for this purpose of existing launch vehicles: the heavy on SL-1 (on the basis of SS-6) or light one SL-7 (on the basis of SS-4) was in a number of cases either economically unadviseable or not capable to solve a task owing to their power potentiality. A mass-produced space launcher of the intermediate calss was needed. The successful experience of launch vehicles development on the basis of missiles predetermined both possibility and expediency of such launcher on the basis of the well proven SS-5 missiles, devised in the Design Office (DO) under leadership of the Chief Designer M.K. Yangel. The pecularity of this launcher creation was that designing and development of the launcher were performed by two DO'qs - one of M. Yangel in Dniepropetrovsdk and other of M. Reshetnev in Krasnoyarsk. The fruitful cooperation had resulted in development of the mass-produced multipurpose reliable space launcher, successfully operated on three cosmodromes and up to the present day leading in amount of the spacecrafts placed into the orbits (more than 700).

410 THE FRENCH-U.S. SPACE RESEARCH COOPERATION IN THE EARLY 1960'S

Moulin Hervé

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The paper proposes to discuss space research cooperation between France and the United States as it existed at the beginning of the 1960s. Among NASA's missions, wxhen created in 1958 was to conduct a policy of international cooperation. Great Britain and Canada responded rapidly to the NASA's proposals. With France, however the situation was quite different. At that time, Paris wanted develop a large scale space reasearch activities of its own. For this purpose, in January 1959, the French government created the "Comité de Recherches Spatiales" which ahd two missions: to organize the space research in France and participate in international space affairs. Although French research at that time was suffiently advanced in sounding rockets and military missiles to develop a program whose objective was to create a national launcher. France's scientists did not really have enough experience in satellite design, unlike most other countries involved in space research during this period. At this time, several cooperative programs were initiated between France and the United States, in fields such as rockets experiments, visual observation satellites and satellites tracking. However, the first major cooperative program between the two countries concerned the development of a scientifi satellite - later known as FR-1 which was launched in December

411 THE AUSTRALIAN ROCKET SOCIETIES : ROCKETRY PIONEERS OR ROCKET MAIL SIDESHOWS ?

Dougherty, Kerry

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By the early 1930s, international interest in rocketry and spaceflight had given rise to rocketry sciences in several countries. While many of these groups were involved in serious experimentation, some were little more than "rocket-mail" societies: philatelically-oriented groups interested in producing commemorative envelopes to be flown by rockets (often adapted firework or maritime maroon rockets, rather than experimental) as part of a then-popular philatelic fad. Between 1935 and 1941, two groups bearing the name Australian Rocket Society were founded in different Australian states. Little is known of any of these groups, although the earliest, the Australian Rocket Society, founded in Queensland in 1935, was heavily involved in rocket mail firings. This paper will present the results of preliminary research into the history and significance of the different Australian Rocket Societies, focusing on the Queensland group, which flew some of its rocket mail in experimental rockets designed and developed by the members of the society. It will present new information on the technical history of the Queesnland ARS rockets and put forward the suggestion that the Melbourne ARS may never have existed, except in name.

412 THE FRENCH SPACE BIOLOGICAL EXPERIMENTS WITH ANIMALS, BEFORE 1968.

Timsit C-A - Chatelier Gérard - Moulin Hervé

1998 - IAA 2.1.03 - vol 18 - AAS vol not issued -

During the WW II, progress in aeronautics has brought to scientists new observation means and very small sensitive data recorder, allowing researchers to obtain a best understanding of the human Physiology in air then in space. Under the impulse of Medicine-General Robert Grandpierre, who was succesfully director of the CEBA and the CERMA, many experiments with animals were achieved during parabolic flights or aboard sounding rockets (uromastix, frogs, rast and cats). Owing to Grandpierre team, brimming over imagination everay day to find solutions to resolve all technical problems, France will become the third nation able to send animals in space with its own rockets. This team has recorded many success, with rats (Hector 1961, Castor and pollux 1962), cats (Felicette 1963) and monkeys (Martine and Pierrette 1967). But, due to ^problems of rivalry, the program was stopped in 1967, and France had to wait nearly ten years before being involved again with Russians in new experiments with animals in space.

413 25 YEARS OF SPACE AT SURREY - PIONEERING MODERNE MICROSATELLITES

Sweeting, Martin N.

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Space at Surrey, has developed over 25 years from very modest beginings in 1974 to an international space centre by 1998. It has pioneered small satellites and succeeded in launching 14 low cost but sophisticated microsatellites over the course of two decades. In the 1990's, small satellites have become fashionable - but this was not always so! This paper describes the 25 years history of "Space at Surrey".

414 A TECHNICAL RE-APPRAISAL OF BLACK ARROW

Hempsell, C.M - Bond A.

1998 - IAA 2.3.07 - vol 18 - AAS vol not issued -

The paper first reviews Black Arrow (Britain's only independent launch vehicle) from an external (i.e non-UK) perspective. A technical evaluation of its capability and design features are shown to be strongly suggestive of a silo based missile system with an intermediate range that could be deployed within the U.K, and would be capable of reaching the Soviet Union. The history of the project is also reviewed. The rationale for Black Arrow has never been either obvious or well explained. Further the coincidence of timescales between Black Arrow and Polaris is circumtancial evidence consistent with a link between the programs. It is concluded that any external assessment of the Black Arrow programme, conducted on technical specifications and public domain material, would almost certainly conclude that Black Arrow's key purpose was as a back-up delivery system for the UK atom bomb should political or technical factors affect the deployment of Polaris. With this conclusion in mind the authors have researched the history of Black Arrow seeking confirmation of the project's rationale. This has revealed no direct evidence to support the contention it was a missile. Thus despite the technical and circumstantial evidence it seems certain that the rocket was only ever intented as a launch system to enable

415 UK TO SUPPORT SPACE TECHNOILOGY RESEARCH ON AN INDIGENOUS BASIS. THE CONTRIBUTIONS OF FRIEDRIKH TSANDER : A MEMOIR

Freeman, Marsha

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Soviet space pioneer Fridrikh Tsander (1887-1933) is a seminal figure in the earliest history of the theory and development of spaceflight. He saw himself as taking the theoretical groundwork laid at the turn of this century by Konstantion Tsiolkovsky, and extending it to the practical reality of taking man into space. Tsander combined the ability to generate creative concepts for accomplishing his goals, and the tenacity to perform numerous experiments, with a dedication to roganizing public support, aprticularly among youth, for his dream to go "Forward to Mars". Those young men he inspired and trained went on to make significant contributions to the Soviet space effort. The lack of knowledge today about his work is not due to any shortcomings on his part. Tsander died in 1933, at the age of 46, just at the moment govenrment support for large-scale rocket experiments was being could be made. Lacking such support throughout his life limited what Tsander was able to practically realize, but visionary concepts he originated are still being worked on today, such as the "combining" of aircraft and rockets for spaceflight. Those who worked with Tsander, and continued after him, including S.P. Korolev, readily acknowledge Fridrikh Tsander's central place in the history of astronautics.

416 THE CONQUEST OF THE MOON : 1958-1969 - THE RACE BETWEEN THE SOVIET UNION AND THE UNITED STATES OF AMERICA

Villain Jacques

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As from 1955, Space began to be a political and scientific stake between the Soviet Union and the United States. The Space Conquest was one aspect of the Cold War. As soon as 1958, after having launched their first satellite, the two superpowers are going to fight for the conquest of the Moon. In this field as well as in the one of space in general, the Soviet Union will dominate its opponent until around 1985. The first big ones - impact, soft landing, first photographs of the Moon - are Soviet. Conscious of his country inferiority in the space field, President John Kennedy intends to hold up his head. Morever, he wants to guild the political image of his country, image which is tarnished at the international level by the flop of the Pig Bay landing in Cuba. In 1961, he "bets" on the landing of an American on the Moon before the end of the sixties. One will have to wait until August 1964 for the reaction of the Soviets to the Apollo program with two programs : The

Proton/Zond program for the flying over the Moon and the N-1/L-3 program for the landing of a cosmonaut on the Moon. The supremer battle will then between the two countries and will last until 1969. This conference recounts the story of this Lunar competition between the Soviet Union and the United States, firstly with automatic probes and then with manned flights.

417 FORTY YEARS OF NASA-AUSTRALIAN COOPERATION

Baltuck, M. - Cooper D. - Holland P

1998 - IAA 2.2.03 - vol 18 - AAS vol not issued -

NASA and its predecessors have enjoyed over forty years of cooperation with Australia in space-related activities. From the launch of the first U.S. satellite in 1958 during International Geophysical Year to the Lunar Prospector and beyond, Australia has played a critical role in NASA's successes. The most prominent part of this contribution has been in the aera of tracking and communications, and there have been over a dozen NASA tracking facilities around Australia. Over the years most of these facilities have been consolidated at Tidbinbilla in the Australian Capital Territory (ACT). Here the Camberra Deep Space Communication Complex (CDSCC) holds pride of place as the Southern Hemisphere member of the Deep Space Network. From is thre sites in Australia, Spain and California, the Deep Space network provides tracking and communications for all NASA's missions that leave Earth orbit. NASA sounding rocket and scientific balloon experiments have also gravited to Australia as the location of choice in the Southern Hemisphere. NASA's Earth Science Enterprise has enjoyed programmatic and scientific cooperation for nearly as long as the original tracking arrangements. The internaztional satellite laser ranging (SLR) network was developed by NASA in concert with some twenty international partners in the 1970's and 1980's to study solid earth dynamics. The two SLR stations in Australia (NASA's Western Australia "MOBLAS 5" site and the Australian Surveying and Land Information group (AUSLIG)'s ACT site "Orroral") by have consistenly been among the top performers from over forty stations. In more recent decades NASA and Australian scientists and engineers have found common interests in technology and applications development aimed at environmental studies. From individual scientists participating in NASA flight project science teams the extent and scale of cooperation has grown to NASA-Australian orchastrated aircraft campaigns which overfly a dozen countries in Oceania and South East Asia in 1996 and 1999. In 1996 this blossomed into discussions of cooperation in earth observation flight projects where NASA i, the junior partner to Australia. The Cooperative Research Centre for Space Systems and NASA are documenting such an arrangement for Australia's FEDSAT flight project (2001 launch).

418 AN OVERVIEW OF FRENCH ASTRONAUTICAL ACTIVITIES IN THE 1930S

Rothmund Christophe

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If American, British, German and Russian astronautical activities in the pioneering years of the 1930s are quite well known and documented, this does not apply to the French ones. Very little remains, and little is known about French space pioneers, like Damblanc, Ananoff or Esnault-Pelterie, although modest in comparison with their cotemporaries abroad, have had a lasting influence. It is little-known story that the present paper will briefly outline. Initally, the first French rockets were military ones, being used until battles in Mexico. In World War I, a ferench invention, the Le Prieur rockets, were the first air-to-air missiles used in operation. But large scale activities began in 1930s. Among the first civilian uses, one can quote Amédée Denis and his invention of an aerial photography rocket in 1888 or Just Buisson who built a rocket-boat. But the main field of solid propulsion was fireworks. The well-known firm of Ruggieri, being already established in this field. But other civilian applications: anti-haitstorm rockets adn ships and crew recovery rockets. The first moderne times French pioneer was Louis Damblanc was a real inventor who, after dealing with aeronautics and car engines, got interested in rocketry and devoted many years to the study of solid propellant rockets. He studied three types of rockets: ship recovery rockets, anti-hailstorm ones and a small military one. He remains as the inventor of the staged-rocket: his patent was recognized by the american government in the 1950s and it is said that Damblanc received royalties on this patent ! Robert Esnault-Pelterie, initially an aeroplane pioneer, later become intimately involved in Franch astronautics. A famous conference lecture, he also performed some of the most initial scientific works on space, astronautics and rocket propulsion and travel. He published the first French book as astronautics (L'Astronautique, 1935) and experimented the first French liquid propellant rocket engines. His student, J.J Barré, contributed to Esanult-Pelterie's work and later was awarded contracts by the French military to study rocket shells and later a sounding rocket. This rocket EA14, was built and ground tested for the first time on November 15, 1941 in the Larzac military camp. The circumstances delayed the develoment and although numerous tests of the engine were made, the first flight of France's first liquid-propellant rocket could only take place on march 15, 1945 from Toulon. Finally Alexandre Ananoff was the indefatigable propaganist of space in the 1930's and later. He began his career in 1929 with a speech on interplanetary travel and was a writer and publisher who did much to popularize space. Being more interested in astronautics than in rocketry, he was among the first to have a system-oriented thinking. He envioned astronautics as a whole, covering not only propulsion, but also trajectories, life-support systems, navigation, design of spacecrafts,etc. Today, very little remains. Most pioneers are long forgotten by the public, their laboratories or hardware no longer exist. But these early works paved the way to the successes the French rocketry gained after the war.

419 CONSERVATION OF THE GERMAN WWII ROCKET COLLECTION AT THE AEROSPACE MUSEUM, COSFORD, ENGLAND

Mc Lean A. - Davies C - Becklake John E.

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The relics of the pioneering days of German rocketry during the Second World War (WWI) are becoming few in number. This paper describes the conservation work being carried out on comprehensive collection of german WWII rockets and components at the Aerospace Museum, Cosford in England. A Practical approach to conservation work on a V2 rocket is explained in detail and a listing of the interesting rocets in the collection and of the V2s still existing in the world is given.

420 LITTLE KNOWN PROJECT OF SUPER HEAVY SPACE ROCKET

Paschenko, V.A. - Konyukhov S.N. - Drobakhin O.I.

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After conducting the multi-daily cosmonaut flights in multi-man spacecraft in near-Earth orbit which were accompanied by the cosmonaut's exatrvaehicular activities as well as test development of ship manoeuvring and docking processes in orbit, the cosmonautics could already propose the problem of the Moon's "expeditions", spacecraft's dispatching to the solar system planets and beyond the its boundaries. But power capabilities of the most powerful available rockets Vostok and Atlas for these purposes were insufficient. A development of the more powerful launch vehicle was begun in USA and U.S.S.R. during the sxties. The Soviet Union's three Design Office have presented their Heavy Class Space Rocket Projects. The Yuzhnoye's Design Office Project has contained a variety of original technical solutions, proposed to develop the launch vehicle which would make possible to implement the problems to bring the adjacent and far-out space during many decades with minimum costs providing with that a maximum reliability.

421 FLIGHT TERMINATION OF THE FIRST LARGE SOLID PROPELLANT ROCKETS

Braun, Julius H.

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Flight testing of the first large solid propellant Thiokol rockets presented unique problems for safing, arming, activation and thrust termination not experienced with large liquid propellants rockets. Protection of nearby populated areas from falling rockets and flaming debris was the driving consideration in the design of early flight safety systems. An unfortunate incident just as the Cape Canaveral, Florida, Air Force Missile test Center began the shift from aircraft-type cruise missile to vertically launched ballistic missiles could have permanently shut down the range. The Army Ordnance/G.E/Thiokol HERMES RV-A-10 rocket, the first of the large solids, was not enthusiastically received at the range safety office. There was no experience on which to base a new flight termination system. A universal law governing systems engineering states that "if something can go wrong, it will". During the launch of the second RV-A-10, it did. A virtual Rube Goldberg flight termination system had been assembled from available components and was intended to cover every possible contingency. At launch, most of it worked as postulated, however, a spurious emission from an unshielded camera motor and a minor compoenent design flaw in the safing and arming circuit combined to render inoperative the flight termination system. Next, a wind gust just at launch caused the unguided rocket to veer to the right and fly parallel to the Florida coastline. Range safety personnel attempted in vain to destroy the out-of-control rocket which subsequently impacted just offshore of Vero beach, Florida. Fortunately, there was no damage, the incident was hushed up, and soon forgotten.

422 THE FIRST FRENCH EXPERIMENTS OF SPACE BIOLOGY DURING PARABOLIC FLIGHTS

Timsit C-A - Moulin Hervé - Chatelier Gérard

1999 - IAA 2.3.08 - vol 19 - AAS vol not issued -

The first French experiments od space biology with biological constants recording have been led by the team of the Pr. Robert Grandpierre in the course of two parabolic flight campaigns undertaken in 1961 and 1962 on board of a "Vautour" French hunting plane.

423 SCIENTIFIC EXPERIENCES USING ARGENTINAN SOUNDING ROCKETS IN ANTARCTICA

Sanchez Peňa M.

1999 - IAA 2.3.05 - vol 19 - AAS vol not issued -

Argentina in the sixties and seventies, had experience for developing and for using sounding rockets and payloads to perform scientific space experiments. Besides they have several bases in Antarctica with adequate premises and installations, also duly equipped aircrafts and trained crews to flight to the white continent. In february 1965, scientists and technical people from the "instituto de Investigacion Aeronautica y Espacial" (I.I.A.E.) with the cooperation of the Air Force and the Tucuman University, conducted the "Matienzo Operation" to measure X- radiation and temperature in the upper atmosphere, using the Gamma centauro rocket and also using big balloons. The people involved in the experience, the launcher, other material and equipment flew from the south of the tip of Argentina to the Matienzo base in Antarctica, in a C-47 aircraft equipped with skies and additional jet engine Marbore 2-C. Other experiences was performed in 1975 in the "Marambio" Antarctica Base, using the two stages solid propellant sounding rocket Castor, developed in Argentina. The payloads was developed in cooperation with the Max Plank Institute of germany. It consist of a special mixture including a shape charge to form a ionized cloud producing a jet of electrons travelling from Marambio base to the conjugate point in the Northern hemisphere. The cloud was observed by several ground stations in Argentina and also by a NASA aircraft with TV cameras., flying at East of new York. The objectives of this experience was to study the electric and magnetic fields in altitude, the neutral points, the temperature and electrons profile. The objectives of both experiments were accomplished satisfactorily.

424 HISTORY OF THE FRENCH SOUNDING ROCKETS - PART 1: VERONIQUE AND VESTA - THEIR DEVELOPMENT AND THEIR OPERATION

Rothmund Christophe - Lafon Jean-Louis - Moulin Hervé

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Fifty years ago, the LRBA started the development of a new rocket project: study 4213, soon renamed Veronique. This small sounding rocket became the most used european liquid-propellant rocket (before Ariane)/ Initially designed for lofting payloads of 60 kg to an altitude of 60 km, Veronique rapidly became more capable, its altitude being increased up to over 220 km in the early 1960's. It carried dozen of scientific experiments such as biological flights with rats and cats, bryum/natrium cloud experiments, astronomy experiments. The last of the veronique was launched from Kourou on May 31, 1975. Based on Veronique, a large sounding rocket, Vesta, was developed in the early 1960s. Capable to carry payloads up to one ton to altitudes up to 300 km, it saw only limited uses. But it did carry two small monkeys in 1967, as well as an astronomical payload for its final flight in 1969.

425 LIQUID ROCKET ENGINES IN SOVIET UNION

Lardier Christian

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The first liquid rocket engine (LRE) was tested by V.P. Glouchko in 1931 then, LRE from GDL, GIRD and RNII were used on rockets until 1946. The thrust reached 300 kg for ORM-52, 500 kg for ORM-57 and 600 kg for ORM-58. Glouchko was using NH3-Kerosene, and Douchkine was specialized in LOX-Kerosene propellant. In 1938, Glouchko went in prison and was replaced by Doucjkine. The last developed the combined engine KRD-600 and the D1-A-1100 which was modified by A. M. Isaiev in 1943. In 1945, Glouchko, Douchkineand Isaiev went to germany. Glouchko had been in charge to rebuild the V-2 engine in the OKB-456 of Khimi in 1946….

426 THE TRUE BEGINNINGS OF FRENCH ASTRONAUTICS - PART 1: 1938-1959

Jung Philippe

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The widely-held opinion about the origins of French space activities is that it all started quite modestly during the fifties with the emblematic Veronique, followed up in 1962 by the Precious Stones rockets and the creation of CNES. Nothing could me more remote from reality. A first attempt at analysing rocket activities in France in the aftermath of World War II just reveals a bewildering array programs. All three Frenc arms lost no time after the Victory to develop missiles, as a consequence of German achievements in that field. There were two main lines of thrust: the medium range ground-toground missile, alternative to the tactical bomber, and the very much sought after anti-aircraft missile, with the horror of the Coventry and Dresde terrot bombing still resonating. However, everybody followed its own route. The Army tried to remake the V-2. The Air Ministry decided to start from scratch and to launch a vast prototype policy, covering all missions for all users, including the Army and the Navy. The latter adopted an intermediate position, first building german missiles, before switching to its own products. All told, an incredible 70 programs probably reached the flight status from 1939 to 1959! It truly was la Furia Francese something unearthed for the first time in this paper. Thus, when De Gaulle came to power, and before CNES creation, the French armies already had mastered the full spectrum of rocketry, with the single exception of inertial guidance.

427 RD & PE ZVEZDA " JSC: HISTORY OF CREATION OF THE RUSSIAN SPACE SUITS, ESCAPE AND LIFE SUPPORT MEANS FOR SPACE VEHICLE AND SPACE STATION CREWS

Severin G.I. - Abramov I.P. - Doudnick M.N..

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The paper presents brief history of "RD&PE Zvezda" JSC, the leading Russian company in creation f escape, survival and rescue means for crews of flying vehicles, including space suits and portable life support systems for cosmonauts. Since 1957, "RD&PE Zvezda" JSC had been developing the above technology for all Soviet and Russian space vehicles: from the animal capsules of the first satellites to the crew gear and onboard equipment for suche programs as Vostok, Voskhod, Soyuz, Salyut, Mir, Buran and L-3 Lunar program. The paper describes the history of creation of such unique items as Gagarin's space suit and ejections eat (1959-1961), the first EVA space suit and airlock (1964-1965), ejection seat for the BURAN space shuttle (1987-1991), a family of semi-rigid ORLAN-type space suits (that are still in operation), cosmonaut's space maneuvering unit (1988-1990) et al. The paper also informs about Zvezda's creation of cosmonaut prophylactic means to prevent unfavorable effects of weigthlessness. The comany structure, its scientific and engineering potential and unique test facilities make it possible to perform a comprehensive approach to all stages of technology creation: research, design, manufacture, development testing and scientific and engineering support of all equipment operation. The paper briefly describes the current Zvezda's activities, which first of all can be characterized as an active participation in creation of the space suits and systems to provide for space crew safe and efficient operation in the International Space Station (ISS) being created now.

428 ON THE CONNECTIVITY BETWEEN THE FRENCH AND HAMILTONIAN APPROACHES TO CELESTIAL MECHANICS

Bainum, P.M.

1999 - IAA 2.1.05 - vol 19 - AAS vol not issued -

This research attempts to determine the connectivity from an historical viewpoint between the French school of (Celestial) Mechanics of the late 1700's - first part of the 1800's and the Hamiltonian School of (Celestial) Mechanics. The French School produced many well known mathematicians and scientists who applied the techniques of classical mecahnics to study the perturbation problems of planetary motion in the solar system as well as the motionand stability of the moons of the Earth and other planets. Among these were d'Alembert, Laplace, Poisson, Poincare and Lagrange, often associated as the "Dean" of all French celestial mechanicians. Lagrange died when Sir William Rowan Hamilton was only eight years old. Hamilton was a member of the Royal Irish Academy, the Astronomer Royal of Ireland and was eventually knighted in 1835. It appears that Hamilton actually met poisson in Liverpool at a meeting of the British Association (Mathematics Division) and also was acutely aware of the mathematical contributions of Cauchy, who earlier in his career was a protégé of Lagrange.

429 HAMILTONIAN SCHOOLS OF CELESTIALS MECHANICS WHICH FORM THE BACKGROUND OF CONTEMPORARY ORBITAL MECHANICS THEORY. JOHN LELAND ATWOOD - BIOGRAPHICAL MEMOIR

Thomas Shirley

1999 - IAA 2.1.01 - vol 19 - AAS vol not issued -

For over half a century, John Leland "Lee" Atwood was a dominant figure in the fields of aviation and space. His contributions were vastly enhanced because he held a degree in structural design engineering. At Douglas Aircraft Co., in 1930, he contributed to the historical DC-1 and DC-2. He then joined James "Dutch" Kindelberger at North American Aviation (NAA). Lee later became president and then also CEO. In World War II, by 1941, the British had dire need for more fighter planes. Lee and his team designed and built in an incredibale 117 days the P-51 Mustang, which had a 20 to 30 mil speed advantage over the Messerschmidt. NAA built the B-25 that became famous in the Jimmy Doolittle raid over Tokyo. Popst-war, a procession of planes emerged from NAA: in 1945, the B-45; then the T-28, F-86, the F-100, yhe awesome B-70, the X-15 rocket plane, and the Navaho guided missile, which advanced major technologies that facilitated space flight. For project Apollo, NAA supplied the engines for all three stages of Saturn 5, the command and service modules, and was named principal Contractor for Apollo, the greatest industrial task in history. With Atwwod at the helm, NAA won NASA's next major project, the Space Shuttle.

430 BLACK PRINCE

Millard Doug J.

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The paper outlines the design of Black Prince and summarises the project's history and location in the wider context of Britain's space launcher policy. In October 1959 Saunders-Roe was commissioned to work with the Royal Aircraft Establishment to design a satellite-launching vehicle based on a combination of Blue Streak and Black Knight technologies. Blue Streak was Briatin's strategic intermediate range ballistic missile then under development, and Black Knight its test vehicle.Black Prince's first stage wxas to have comprised a Rolls-Royce RZ12 LOX/Kerosene engine producing 270 000 lb thrust (1 201 500 N) and a specific impulse of 280 seconds; the second stage a Bristol Siddeley Gamma 301 High Test Peroxyde/Kerosene engine producing 25 000 lb thrust (71 200 N) and a specific impulse of 28 seconds; and the third stage the new Bristol Siddeley PR 38 HTP/Kerosene engine producing between 1000 lb and 2 000 lb thrust (4 450 N to 9 900 N) and a specific impulse of 260 seconds. Three principle launching missions for Black Prince were envisaged : 1 000 lb (450kg) to a near circular 300 miles (483 km) orbit; 300 lb (135 kg) yo an elliptical orbit, perigee 300 miles (483 km) and apogee 7 000 miles (11 270 km); and 100 lb (45 kg) to an elliptical orbit, perigee 300 miles (483 km) and apogee 100 000 miles (161 000 km). During 1960 the project was given considerable attention by the respective industrial and government establishments in the UK and Australia but was eventually swept aside by the momentum developing behind the incident ELDO (European Launcher Development Organisation) and its own employment of Blue Streak. The one new engine for Black Prince, the PR-38, was eventually used as an auxiliary propulsion unit for the Mk 3A air-breathing Jindivik drone.

431 SHUSUI: JAPANESE ROCKET FIGHTER IN WORLD WAR II

Matogawa Yasunori

1999 - IAA 2.3.01 - vol 19 - AAS vol not issued -

The Shusui was a Japanese version of Me-163, a rocket fighter developed in Germany in the second World War. The development of Shusui started in July 1944 on the basis of some technical documents transported from germany to Japan with a grave risk under a serious situation of the World War. The trial manufacture involved many technical problems, and the main points must have been following: achievement of performance such as the rate of climb, flying range and armaments, production and handling of propellants of Tokuro-2 rocket engine, reduction of th etime for trial manufacture. The engineers worked day and night, and the first model completed in early December 1944. In late December 1944 and early January 1945, gliding tests were successfully carried out in Ibaraki, and a Shusui Corps was organized in the Navy at Yokosuka in February 1945. On July 7, 1945, the first flight test of Shusui was done installed with a Tokuro-2 engine, but it resulted in a failure. The Shusui did not participate in actual fightings in the end.

432 DR. IRENE SÄNGER-BREDT : A LIFE FOR ASTRONAUTICS

Zaganescu Florin - Zaganescu, R. - Popa G.

1999 - IAA 2.1.04 - vol 19 - AAS vol not issued -

Irene Bredt (b. 1911 at Bonn) obtained in 1937 her Doctorate in Physics; in the same year she became a scientific reseracher in the German Research Center for Aviation at Trauen, leaded by Prof. Dr. Eugen SÄNGER. Soon, the young and efficient Dr. I. Bredt became the first assistant of Dr. Sänger, who married her (1951). During 1973-1978 period, Dr. Bredt was in correspondance with prof. Dr. Zaganescu and helped him to familiarise the Romanian readers with prof Sänger's life and achievements. Concerning Dr Bredt's life, herself specified three main periods of her activity: the 1937-1942 period, she was researcher in charge with thermogasdynamic problems of liquid fuelled rocket engines at trauen; the 1942-1945 period, she was Senior researcher in charge with ramjet in flight test performance at Ainring and, also she was co-author of the Top Secret technical Report entitled "A Rocket Engine for a Long Range Bomber", finished in 1941 and edited in 1944 only; the past world war II period, she was scientific counselleor or director at various civil aznd military institutions, universities, etc. Dr. Irene Sänger-Bredt helped her husband to develop many scientific works including the Ramjet Tehrmodynamic Theory, the Photon Rocket Theory and also the establishment of IAF and IAA (1959). In 1970, Dr. Irene Sänger-Bredt

433 RECOVERING ROCKETS FROM THE DESERT

Henwood, R. - Dougherty Kerry -

1999 - IAA 2.1.06 - vol 19 - AAS vol not issued -

Despite ist long involvement in space activties, very little opf Australia's space heritage remains today. The most significant collection of surviving artefacts is that held by the Woomera heritage Centre, the community-run museum of the Woomera Rocket Range. Among these artefacts, visitors to the Woomera taownship taoday can see two unique exhibits: rocket stages from the Sparta/Wresat and Europa F-4 launch vehicles, recovered from the Simpson

Desert in the 1990s. Both vehicles are significant in the history of space activities at Woomera: the Sparta/Wresat was the rocket which launched this country's first satellite, Wresat, while the F-4 véhicle was the first Europa rocket to be launched in the complete three stage configuration. The location and recovery of these two rockets has been major logistical undertaking, carried out by a team of volunteers from the Defense Support Centre Woomera, with support from the Australian Defence Forces. This paper will outline the rationale for the recovery programs and the process by which each of the rockets was first located, identified and then ultimately recovered. It will provide an insight into the complex lohistical operations required to recover material of astronautical heritage significance from a harsh environment, like that of the Simpson Desert. In addition to the two recoveries already carried out, the current recpovery program, focussed on the Europa F-5 launch vehicle, will also be discussed.

434 THE EFFECT OF GRAVITY-ASSISTED INTERPLANETARY SPACE TRAVEL ON THE EXPLORATION OF THE SOLAR SYSTEM: HISTORICAL SURVEY, 1960-2000

Kosman W. - Uphoff, C. - Rideroune R.

1999 - IAA 2.1.08 - vol 19 - AAS vol not issued -

This paper is the third ina series of papers describing the origin of Dr. Michael A. Minovitch's invention of gravity-propelled interplanetary spoace travel (gravity-assist trajectories), his early work in developing it, and how the various NASA gravity-propelled missions originated from it. The primary aim of the present paper is to describe the effect of the invention and to show thazt it was not anticipated. This will be achieved by defining the invention as having two primary components, the use of free-fall multiplanetary trajectories and the use of gravitational perturbations, and showing that each component was proved to be impractical prior to the invention. A technical analysis of the invention is also presented to show that is represented a fundamental new theory of space travel distinctly different from the classical theory based on reaction propulsion developed by Tsiolkovsky, Goddard and Oberth. It was Minovitch's theory, a mathematical theory of space travel based on finding a numerical solution for the unsolved Restricted Three-Body Problem for motion through the Solar System, and not the classical theory based on reaction propulsion, an engineering theory, that made it possible to break the high-energy barriers of interplanetary space travel and open the entire Solar System to exploration with instrumented spacecraft.

435 THE NETHERLANDS IN SPACE: HOW IT GOT STARTED

Olthof H. - de Koomen J.A.

1999 - IAA 2.2.01 - vol 19 - AAS vol not issued -

This paper describes the development of the space activities in the netherlands. The creation of the NVR and the GROC is addressed. The process that led to the realization of the two Dutch satellite missions, ANS and IRAS, is elaborated.

436 APOLLO THIRTIETH ANNIVERSARY: TWO VIEWS PART 1 : WAS THE APOLLO PROGRAM A DEAD END? - PART 2: APOLLO IN AMERICAN MEMORY AND MYTH

Launius Roger D. - Freeman M.
1999 - IAA 2.2.02 - vol 19 - AAS vol not issued -

This paper presents an historical perspective on the importance of project Apollo from the perspective of the end of the twentieth cenuty and the millenium. After thirty years, it is only now becoming possible to assess the significance of the lunar landings, accomplished between 1969 and 1972, with any degreee of historical perspective. This essay discusses the key elements of the American public's memory about Apollo and why it was important, and is suggestive of the myths that have emerged since the landings and how they have affected the course of American society.

437 MULTI-TUBE AND MULTI-STAGE ROCKET IN ANCIENT CHINA

Lai-Chen Chien - Youn-Chiung Liou - Yu-Jen Su
1999 - IAA 2.2.03 - vol 19 - AAS vol not issued -

Gunpowder is one of the great inventions in ancient China. It is the main material of weapons. Originally, the gunpowder is bounded on the arrows head so that it can set fire to burn barns and hurt enemies. During the period of Hsung Dyansty (1227-1279), cannons and nozzle propulsion rockets had been invented. Later, the equipments are adopted by Mongolian. This is the power for Mongolian to conquer over Asia and Europe. After hundred years improvement, rockets are popular weapons during Ming Dynasty (1368-1644). In this investigation, we shall review multi-tube and multi-stage rocket applied in the military purpose during Hsung and Ming Dynasty. The performance and configuration of these weapons are going to present.

438 HISTORIC EVOLUTION OF ASPHALT ROCKET PROPELLANTS FROM WORLD WAR II - JPL/AEROJET RESEARCH POSTWAR SPIN-OFFS BY THE ROCKET RESEARCH INSTITUTE

James, George S. - Bluth J. - Piper Charles G.
1999 - IAA 2.2.04 - vol 19 - AAS vol not issued -

This paper traces the evolution of asphalt-based solid propellant rocket motors from their beginnings prior to World War II, to their post-war engineering evolution by the Rocket Research Institute, and to their continuing potential for lofting educational student-prepared payloads to multi-mile altitudes.

439 THE "ARTIFICAL SATELLITE" QUESTION IN THE MID-FIFITIES: THE FIRST APPROACH OF THE FRENCH SCIENTIST

Moulin Hervé
1999 - IAA 2.2.06 - vol 19 - AAS vol not issued -

In this presentation, we will describe early advances in French science towards the creation of an artificial satellite. French interest in this question, which dates back to the mid 1950s, is directly linked to the parallel growth of international activity in the aera. Following a review of the decisive action which, in connection with the preparation of the International Geophysical Year, would lead to the realization of the first artificial satellites, we will consider both the form and context of the French approach to this question. The study conclude with a brief outline of the

Meteor project, which, at this point in our reasearch, has emerged as the only such enterprise of the period to have reached even the early stages of execution.

440 THE EAST PARKING LOT ROCKET EXPERIMENTS OF NORTH AVIATION - 1946-1949

Winter Frank H.

1999 - IAA 2.2.07 - vol 19 - AAS vol not issued -

An earlier paper by the author, "Rocketdyne - A Giant Pionner in Rocket Technology : The Earliest Years, 1945-1955," presented at the 48th IAF Congress, covered the history of Rocketdyne Division of North American Aviation from the earliest rocketry work of North American, Inc., including its East Parking Lot experiments, up to the actual formation of the Rocketdyne Division in 1955. This paper goes into more detail on the Parking Lot tests especially since these modest experiments ultimately led to the formation of the world's leading developer and producer of large-scale liquid-fuel rocket engines including those that powered the Saturn V vehicle which took the first astronauts to the Moon.

441 HISTORY OF THE COMMERCIAL SATELLITE SERVICES INDUSTRY

Engel, M.

1999 - IAA 2.2.08 - vol 19 - AAS vol not issued -

The commercial satellite services industry is currently experiencing explosive growth and it seems likely that the industry will sustain double-digit growth rates for the next ten years. The current market for commercial satellite services is about $20 billion per year. Futron Corporation projects that the market will grow to as much as $100 billion in the next decade. What has brought about this remarkable growth in satellite communications, What are the origins of satellite communications and, in particular, the commercial service markets, Which programs were instrumental in the success of this industry, Why were the contributions of the original pioneers so important to the future of commercial satellite communications? This paper answers these questions by examining the origins and evolution of the commercial satellite services industry. The paper concludes with a quantitative and qualitative evaluation of the current commercial satellite services market.

442 THE LARGER SOLID PROPELLANT ROCKET MOTORS OF THE UNITED KINGDOM.

Harlow, John

2000 - IAA 2.3.05 - vol 20 - AAS vol not issued -

For many years it could be said that the UK was at the forefront of the development of large solid propellant rocket motors. This situation began during the second World War with the development of the 5 inch diameter and the designs employing clusters of 3 inch diameter motors. With the pressure to supply propulsion for ever higher performance missiles, the subsequent development of the solid propellant motors in the United Kingdom until about 1955 was arguably ahead of that of the rest of the World. This lead was not to be maintained. The development of 17 inch diameter Raven and Rook motors for sounding rocket and test vehicle use required propellant masses of about 1 tonne and although early plans were afoot to develop 24 inch diameter replacements, these never came to fruition. Only a limited numer of 24 inch motor designs were ever developed and fired in the U.K and even these never saw service use. By the early 1960's the development of 36 and 54 inch diameter motors designs were already lagging behind similar work being carried out in the U.S.. One specialist use of a 26 inch diameter motor was as the third stage motor for the Black Arrow launch cehicle. This motor, called Waxwing, has been extensively described elsewhere and is only included here for completeness. Further cut backs in research funds coupled to a continuing "buy American" policy lead to the demise of large diameter motors in the U.K and despite limited use of 36 inch motors in the Chevaline flight test programme, it was only the 17 inch Skylark motors that were destined to remain in production. This situation persited until 1990 when Wescott finally ceased productions of a l solid propellant motors. The last 17 inch diameter motir, a Raven mkVIC, was fired at K Site, Westcott on 6th May 1999 and the last Skylark vehicles employing this motor will fly in 2001. This paper details a history, much from personal experience, of the UK's past solid propellant rocket motors of diameter

443 TEOFILO M. TABANERA (1909-1981) - THE DIVULGER

Brital-Fernandez, Oscar - Sanchez Peňa, M. -

2000 - IAA 2.1.04 - vol 20 - AAS vol not issued -

It belongs to the argentinian engineer Teofilo M. Tabanera the merit of being the first and the principal diseminator of space activities in Argentina and South-America. He was the only latin american signatory of the foundation Act of the International astronautical Federation and one of its Vice presidents for sevenconsecutive periods, President of Secevral Committees; also founder of the Academy (IAA) cretaed within the same. He helds important positions in several organizatuon in Argentina in areas of electricty and petroleum. In 1930, he publiched a pioneer article about the future of space travel. In 1945 he was the first argentine member of the British Interplanetary Society and also of the American Astronautical Society; founding member and president of the Intermaerican Committee on Space Investigations; founder member of the Argentine Institute of Aeronautical and Space History.

444 BAÏKONOUR TRAGEDY

Andreyev, L. - Konyukhov S.N.

2000 - IAA 2.2.08 - vol 20 - AAS vol not issued -

In Guinness Records Book the section "Catastrophe: in air, on land and on sea" deals with the following: "The greatest space catastrophe on earth took place when during fueling on Baykonour in Kazakhstan on the 24th of October 1960, P-16 rocket burst, having killed 91 persons". Thirty years have passed since the moment when this sad event in history of rocketry had taken place. But despite of this fact there is still no full and thorough analysis of all the factors and causes which leg to the catastrophe in open literature. More than that, until the present moment the press time after time deals with various subjective versions with the most improbable hypothese. Even in the information from Guinness Record Book there is a certain discrepancy. The authors for the time performed comprehensive full scale investigation, on the basic of the original materials, that became publically known, departmental publications and evidences (more than twenty) of the participants of the events taken place on October 24, 1960.

445 THE MILITARY SPACE ORGANIZATION IN SOVIET UNION (1946-1991)
Lardier Christian
2000 - IAA 2.2.07 - vol 20 - AAS vol not issued -
The paper detail the organization of the Soviet military space from the second war to 1991. It gives the names of the military people in charge of responsability and sometimes completed by brief biography.

446 EARLY HISTORY OF KAGOSHIMA SPACE CENTER
Matogawa Yasunori
2000 - IAA 2.2.04 - vol 20 - AAS vol not issued -
The Kagoshima Space Center is Japan's second rocket launch site where the first Japanese satellite OHSUMI blastef off in February 1970. Since then, most scientific satellites of Japan have been launched from this center, and it has become a strong bridgehead of various fields of space science. It was established in 1962 after extensive inspections all over japan, a pioneer à Japanese rocketry. It is located at mostly hilly region facing the Pacific Ocean, and offers a broad view-esatward. From the Kagoshima Space Center, more than 400 rockets have been launched, including sounding rockets and satellite launch vehicles as a March 2000. This paper describesd the background that caused construction of this center, and the

447 THE TRUE BEGINNINGS OF FRENCH ASTRONAUTICS - 1938-1959 - PART II
Jung Philippe
2000 - IAA 2.2.03 - vol 20 - AAS vol not issued -
The widely-held opinion about the origins of French space activities is that it all started quite modestly during the fifties, with the emblematic Veronique, followed up in 1962 by the precious Stones rockets and the creation of CNES. Nothing could me more remote from reality. A first attempt at analysing rocket activities in France in the aftermath of World War II just reveals a bewildering array of programs. All three French armed forces lost no time after the Victory to develop missiles, as a con,sequence of German achievements in that field. There were two main lines of thrust: the medium range ground-to-ground missile, an alternative to the tactical bomber, and the very much sought after anti-missile, at a time when the horror of the Coventry and Dresden terror bombings still was resonating. However, everybody followed its own route. The Army initially tried to remake the V-2. In a totally opposite way, the Air Ministry decided to start from search and to launch a wide-ranging prototype policy, covering all missions for all users, including the Army and the Navy. The latter, on its side, adopted an intermediate position, first building German missiles, before switching to its own products. All told, an incredible 76 programs probably reached fight status from 1939 to 1959§ It truly wa La Furia Francese, an unique and so far secret period, unearthed for the first time in this paper. Thus, when De Gaulle came to power, and before CNES

creation, the French armed forces already had mastered the full spectrum of rocketry, with the single exception of inertial guidance. Last year's paper, IAA-99-IAA-2.2.05, detailed the first 45 programs which flew up to 1953, as part 1 of the study. This year's paper covers the remaining ones, as part II of the same study.

448 ROCKET WEAPONS IN ANCIENT CHINA

Chien Lai-Chen - Lo Mei-Vhen - Lee Yu-Ling

2000 - IAA 2.3.07 - vol 20 - AAS vol not issued -

The history of rocket begins with the period following the invention of gunpowder. Chinese are credited with the origination of gunpowder and the first use of rockets as early as 13 century. After hundred years improvement, rockets are powerful weapons in the Chinese war history. The ancient rockets can be classified into two categories. The carryable weapons can be delivered and move freely. Most of the small model rockets can be taken by soldiers easily. Whilst tyhe heavier ones are equipped in vehicles to transport. The others were wing rockets. Taking the advantage of the aerodynamic forces, ancient Chinese technicians developed rockets with wings so that they can hover over sky and can fly more distance to attack enemy. In this investigation, we shall survey the origin and development of the rockets in the ancient China. The configuratio and performance of these weapons are going to have description in the paper.

449 RUGGED EFFICIENCY - A HISTORY OF FRENCH LIQUID ROCKET ENGINE DEVELOPMENT FROM VERONIQUE TO MS 100 (1950-2000)

Rothmund Christophe - Girault Jean-Philippe

2000 - IAA 2.3.04 - vol 20 - AAS vol not issued -

Fifty years ago, the LRBA (Laboratoire de recherches Balistiques et Aérodynamiques) started the development of a new family of liquid propellant rocket engines aimed at giving France a new breed of sounding rockets, missiles and launch vehicles. All these engines, with thrust ranging from 2 tons up to 40 tons, followed the same basic design principles: single wall thrust chamber with toroidal injector, film cooling, massive nozzle throat. Thata ensured ruggedness as well as efficiency. The currently used Ariane 4 launch vehicle family is using on its first two stages the Viking engine that still is based on these design principles. Today a new engine family is currently under consideration in order to match the market needs of the next century, based on the MS-100 demonstrator. Although not following the four principles outlined earlier, it is also of a rugged design in order to maximize efficiency at affordable costs. This, MS-100 is truly a continuator of our division tradition of "rugged efficiency".

450 CONSTANTIN PAUL LENT

Miller Ron

2000 - IAA 2.1.02 - vol 20 - AAS vol not issued -

Like most sciences, astronautics has its share, and more, of what Patrick Moore calls "independent thinkers"…those whose enthusiasm for the subject is not constrained by logic or the laws of physics. What makes astronautics unique is that its independent thinkers have been an important part of its theory…They kept the torch alive for decades, even centuries, before engineers and scientists were able to make spaceflight a reality. There is a considerable grey area where it is sometimes difficult to tell where the serious scientist ends and the independent thinkers begins. The career of Constantin Paul Lent (1905-1977) is a sterling example of this. Born in Greec as Constantine Tselentis and trained as a mechanical engineer, Lent was an early member of the American Rocket Society, using his talents as a draftman to illustrate the rocket motors and other devices being developed by the members. He eventually served as the Society's President during 1944. During this time, and for the remainder of his life, he self-published a vast number of books as well as his own magazine, Rocket-Jet Flying, which had an international amiling list. As spaceflight became a reality and he saw himself and what he perceived as his achievements not even being accorded so much as a distinctive footnote in the history of astronautics, he began using his publications as a soapbox for voicing his disappointment and anger. Lent's is the story of atalented man whose passion for spaceflight caused him to croos the line from enthusiasm to obsession.

451 UKRAINE DNIEPROPETROVSK ROCKET SPACE CENTRE. ALEXANDR MAKSIMOVYCH MAKAROV

Pappo-Korystin V.N.

2000 - IAA 2.1.08 - vol 20 - AAS vol not issued -

On the 12th of October, 1999 one-and-a-half million city of Dniepropetrovsk attended a funeral of domestic rocket production patriarch, A.M. Makarovn Ukrainian President, Leonid Kuchma, U.S.S.R. ex-Ministers of rocket and space industry, Sergey Aphanasiev and Oleg Baklanov, cosmonaut 2, german Titov, came to bid farewell to Makarov. A. Makarov was the only Director of the largest rocket and space plant in U.S.S.R.; he was twice awarded a title of a hero of Socialist Labour and he was in chief of the plant until the day of his 80th anniversary. Being born in a family of workers on the 12th of September 1906, he belonged to the first generation of Soviet engineers, who graduated from higher educational institutions. Compraing to "old" pre-revolutionary specialists, these engineers were fully entrusted and rendered support in prompt proficiency level gaining. Until 1951, Makarov was the chied of several motor-car industry factories with the three-years "break" in the years of Stalin repressions. Since 1951 the former auto-maker has been simultaneously mastring and leading the process of serial production of three denomination of rockets designed by Korylov, the Chief Designer. Since 1954 all the technical projects on strategic missiles turn to material production under his guidance together with the projects on launch vehicles and spacecraft designed by Chief Designers Yangel and Utkin. The name of makarov may be put together with the corypheai of rocketry industry of the twentiteh century second half.

452 HERMAN POTOČNIK NOORDUNG, SLOVENIAN SPACE VIONARAY

Krmelj Milos

2000 - IAA 2.1.07 - vol 20 - AAS vol not issued

Slovenia, now an independent state, is very proud that one of the "father" or early thinkers on possibilities of eventual realisation of space exploration, manned spaceflight and even space station-Herman Potonick Noordung, was one of its important citizens. He in his theoretical and visionary thinkings contributed a lot, even to present and rapidly developing field of astronautics and space exploration. Born in 1892 in now Croatian (Istrian) town of Pula and educated in maribor, he continued his education in Vienna and Berlin. In 1929 he published his only known and most important book entitled "The problem of Space travel - The Rocket Motor" (Das Problem der Befahrung del Weltraums - Der Raketen-Motor). The book was published after his early death in 1928. It is a pity that in the area of space research ptotonick is not known enough, even as it is clear, that his visionary thinking contributed a lot to the development of the modern field of astronautics. For quite a long time his work has not been very much known even in Slovenia. The reason to this was in his pseudonym Noordung as well as the very different former political, scientifical and cultural climate in Slovenia.

453 ONE OF THE PIONEERS OF APPLIED COSMONAUTICS IN UKRAINE

Paschenko, V.A.

2000 - IAA 2.1.05 - vol 20 - AAS vol not issued -

Yri Alekseyevich Smetanin (1925-1999), First Deputy General Designer on Research an System Studies, worked at Dniepropetrovsk Yuzhnoye SDO since its foundation. Being a follower of Yzhnoye Design Bureau founder, Academician Michael Yangel, Smetanin was at the outset of Space subjects development in Dniepropetrovsk. He was a Designer and Deputy Engineering manager on the Cosmos-1 satellite launch, he was ate the head of the Cyclone and Zenit launch vehicles development. He had a great contribution to establishment and strenghening the Ukrainian International conatcts in cosmonautic field. He had o a ll among colleagues in own counrty and foreign ones on space exploration and utilization. The American Biographical Institute gave Smetanin the honoray title of man of year in 1997.

454 THE YOUTH AND SPACE ACTIVITIES IN EARLY 60'S - A HISTORICAL APPROACH OF THE FRENCH CASE

Moulin Hervé

2000 - IAA 2.1.03 - vol 20 - AAS vol not issued -

Space activities have always interested youth. In the 30's, students and young scientists constitued the basis of the rocket groups. The most famous of them was probably Wernher Von Braun who joined the Hermann Oberth Group, at eighteen years old. The interest grew rapidly with the first artificial satellites launches marking the beginning of the Space Era. Wishing hardly to be involved in this new adventure, a few young peoples from several countries spontaneously resumed idea of their predecessors and creatd some small groups to approach more concrete space activities, either theoritically or with experimental projects. At the beginning of the 60's, in France, the rapid development of experimental activities has lead the Cnes (new space French agency) to manage aned control them. French authorities choose an original way quite different from other european countries. The purpose of this paper is to present information of the first year of such activities, with an highlight on the French

455 THE DEVELOPMENT OF THE BRAZILIAN LAUNCH VEHICLE - VLS-1

Domeles Barcelos E.

2000 - IAA 2.1.01 – vol 20 - AAS vol not issued -

The first Brazilian satellite launcher, VLS-1 (Veiculo Lançador de Satelites - 1) initiated its development in the early seventies. The basis for its technology was the sounding rocket program named Sonda (Sonda I, Sonda II, Sonda III and Sonda IV). The VLS-1 is a four stage small launcher, using solid propellant, with capability to insert up to 350 kg into 200 km circular equatorial orbit. Due to budgetary problems and export restrictions, the project suffered many delays until its maiden flight, which occured on December 1997. This paper concetrates upon the main events related to the development of the VLS-1 and in relation to the other Brazilian space programs, mainly the development of satellites and space infrastructure.

456 INDIAN SPACE ENDEAVOUR - A HISTORIAL PERSPECTIVE

Murthi Sridhara K.R - Kasturirangan K. - Rao Munkund,

2000 - IAA 2.3.02 – vol 20 - AAS vol not issued -

Indian Space efforts had their modest beginnings in 1962 under the aegis of Indian National Committee for Space research and subsequently the Indian Space Research Organization, which was formed as an autonomous body, pursued them. The history of indian Space Research Organization over the past three decades represents a saga of intense developments in the areas of space systems design and engineering, their integration, mission management and ground segment development. One of the hallmarks of this program is its strong orientation towards societal applications. The drive for developing state-of-the-art space systems emerged from a judicious blend of international cooperation and the vision of leaders for application of advanced technologies to solve the real problem of society….

457 BIOLOGICAL STUDIES IN ANIMALS USING SOUNDING ROCKETS

Sanchez Peňa M. - Niotti H.F.L. -

2000 - IAA 2.3.01 - vol 20 - AAS vol not issued

In the sixties, Argentina developed a family of sounding rokets with different capabilities, to carry payloads of different weight to several peak altitudes. Also they tested an Orion II sounding rocket in Wallops Island (USA) where a payload descending on parachute was recovered in the air. In 1966 in Argentina a group of scientist and technicians were considering the ioeads of developing different components to integrate a payload with living animals on board, also the sensors and to create the convenient habitat for their survival during the flight and the recovery maneouvers. They established, for that purpose, an gareement between the INMAE (Institute for Aerospace Medicine) and the Institute for Aerospace Research (I.I.A.E), both under the Argentina Air Force. They used white rats to perform this experience called BIO-I. The Wistar type rat was selected due to its size, the easy feeding regime and lodging characteristics; beside the knowledge of their physiological normal parameters and the available budget…

458 CZECHS IN SPACE

Bares,Petr - Grun M.

2000 - IAA 2.1.06 - vol 20 - AAS vol not issued

History of space exploration is inseparable from progress of science in the Czech lands. Charles University, founded in Prague in 1348 by the Emperor Charles IV, has for centuries been a major centre of learning. Prague became the world capital of outer space investigation during the reign of the Holy Roman Emperor Rudolf II, thanks to Tadeas Hajek zHajku (Hagecius) who was instrumental in bringing to Prague celebrities such as Tycho Brahe and J. Kepler. The latter formulated here two of his three laws, and wrote several important works. Later celebrities inspired in, and by, Prague include Jan Marek marci, C. Doppler and A. Einstein. In the young Czechoslovak Republic, created in 1918, science continued to flourish. In the 20's Czechs registered a rocket engine patent, launched two stage rockets, and wrote the first astronautics and the first space law book in the world. F.J. Malina of Czech origin was the co-founder of JPL, California. The Ondrejov Observatory, founded in 1897, became the heart of the Astronomical Institute of the Academy of Sciences established in 1953. In the 50's, new space desiciplines were created e.g. Dr Svestka (predictions of solar proton eruptions) and Dr. Ceplecha (first calculation of the interplanetary orbit of the Luhy-Pribram méteorite. One of the first detections (optical and radio) of both Sputnik 1 and its launcher outside the Soviet territory was achieved in Czechoslovakia. This lead to development of applications such as the satellite geodesy (e.g E. Buchar). Development of sounding rockets peaked in the Military Academy of brno in late 60's. The objective was to build a two stage launcher kit capable of reaching 40 km, for use in geophysics and meteorology. The main source of opportunity during the communist era was the Interkosmos cooperation programme (1965-1989). Czech scientists were involved in all disiciplines (e.g their instruments flew on 23 of the 25 satellites Interkosmos, Prognoz and the Mir station). Five Czech satellites Magion were launched under this programme. The political changes in the 90's allowed unrestricted cooperation with the democratic world and active membership of international organisations such as Eutelsat, Intelsat, Inmarsat and Intersputnik. New projects in the pipeline or advanced stage of development include Czech satellites CESAR and MIMOSA, and instruments to fly on satellites of other countries. ESA membership is on the horizon. Apart from the traditional research institutes, opportunities arise for building small private companies, such as BBT (materials), GISAT (remote sensing applications), Space Devices (mini-satellite construction), CSRC (space qualified hardware), and Science Systems (CR) (satellite contrôle software). The latter accumulated 40 man years experience in subcontracts to ESA, EUMETSAT and other space projects. Its Czech staff even worked with space agencies as far as Argentina (CONAE) and Brazil (INPE). Some of the Czech companies are highly mobile and are ready to contribute their experience at very competitive conditions to new

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(May 2003)

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ROCKETRY & ASTRONAUTICS
IAC SYMPOSIA, 1967-2000

Since the memorial times the Man dreams to reach the stars and travel beyond. The launch of the first artificial satellite, by the Soviet Union, on the 4th October, 1957, following by the first steps of the Man on the Moon surface, on the 21st July 1969, and others successes and failures paving the way through the 20th century, have given a reality to Astronautics and Space Activities.

From 1950, the Men who have given birth, and then participate to its development, meet every year at the International Astronautical Congress organized by the International Astronautical Federation with the International Academy of astronautics and the International Institute for Space Law.

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This book constitute a full resource on historical works realized in the word. It survey the different symposia, contains an abstract of the papers presented at the different International Astronautical Congresses, held between 1967 et 2000, complete by several index allowing easiest searches.