FINAL REPORT
U.S. Dept. of Energy

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Viral Assembly

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GRANTEE INSTITUTION: Federation of American Societies for Experimental Biology
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Office of Intellectual Property Law

DOE Chicago Operations Office

Oct 23, 2001
Date

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Final Report
FASEB Summer Research Conference, Saxtons River, VT
June 10-15, 2000. Virus Assembly

The 2000 FASEB Meeting on Virus Assembly was organized by Marie Chow, Michael Feiss, Jack Johnson, and Margaret Kielian and attended by 153 participants drawn from the structural biology, cell biology, and virology communities. Although the number of individuals attending was a little lower than previous years, approximately 20% of the independent investigators were attending this conference for the first time. The increased diversity of participating laboratories and backgrounds is due in part to a deliberate broadening of the scientific program to include emerging areas of virus cell biology and new model virus systems. Thus a major emphasis of the program this year was on the general thematic principles and common mechanistic models which are emerging across a number of viral systems. As in previous years, a major strength unique to this meeting was the active participation and dialog between structural biologists, molecular virologists and more recently cell biologists. In addition, approximately 25% of the attendees were graduate students and post-doctoral fellows. The trainees made significant contributions to the intellectual vitality and ambiance of the meeting as well as being exposed to the highly interdisciplinary nature of the field.

The nine sessions were: 1. Structure of Viruses and Viral Proteins, 2. Dynamics of Virus Structures, 3. Virus Entry: Receptor and Post-Receptor Events, 4. Virus Entry: Fusion, 5. Virus Usurpation of Host Functions, 6. Genome Packaging, 7. Capsid Assembly, 8. Virus Exit / Virus Movement, 9. Applications to Biotechnology. There were usually 5 talks of approximately 25-30 minutes in length, with an additional 15 minutes provided to the Chair at the beginning of the session for an overview. In addition, there was a late-breaking talk which presented for the first time a long awaited X-ray structure which was solved two weeks before the meeting. Because of the diverse backgrounds of the participants, a special effort was made by almost all speakers to provide sufficient background for the new information being presented and the Chair's overview was very useful to place the talks in perspective. All talks provided some new unpublished data as well as an opportunity to examine in greater detail unpublished data which supported previously published findings. Overall many of the polled participants indicated that the discussion periods were reasonably well utilized and informative. A total of 85 posters were also presented in 2 sessions of approximately 2 days each. Although the majority of the participants indicated that time allocated for the poster session was sufficient, my own opinion was that there were too many posters for the time available. The significant increase in posters was also seen at the previous meeting (N=81). This suggests that this may be a consistent feature of this meeting and may reflect in part the increased participation by graduate students and post docs. If this trend continues, a possible solution is to devote one of the 9 talk sessions for oral presentations selected from the submitted poster abstracts to reduce the number of posters displayed. Alternatively, if it is possible for the meeting site to increase the number of posters which can be displayed at any given time, then a larger number might be displayed for the entire meeting.

Of the 52 speakers or chairs, 13 were women (33 of the 100 conference participants were women). Two of the speakers were afro-american, three were hispanic and two were chinese. In addition, 16 of the participants were Asian and 7 were hispanic. In addition to the 10 invited

speakers from overseas, 12 of the participants were from Europe, 1 from the UK, 3 from Latin or South America and 3 from Canada.

Fund raising for the Conference was adequate. Contributions from the private sector was very disappointing (\$3000 from Eli Lilly and New England Biolabs) and we need to reevaluate our efforts in this direction. However, significant funds were received from two new sources, the Dept of Energy (\$6800) and Office of Naval Research (\$7500). In addition, NSF contributed \$3000, NIH (NCI+NIAID) contributed a total of \$10,250, and Office of AIDS Res. contributed \$10,000. In addition, one of the speakers received a MARC award from FASEB. Including the \$7500 from FASEB, the amount raised (\$48,050) enabled us to reimburse approximately 80% of the registration and airfare of the 56 speakers/chairs/meeting organizers. This includes our 10 foreign invitees (6 from Europe, 1 from Israel, 1 from Singapore, 2 from UK). The reimbursement could have been higher, but a decision was made by the organizers to use some of the funds as travel scholarships for young investigators. A total of 7 awards were made.

At the business meeting there was very high enthusiasm for holding the Conference again in 2 years. It was felt that having an organizing committee of 2 Co-Organizers and 2 Vice Co-Organizers was preferred due to the diverse fields and technical expertises spanned by this conference. Thus Jack Johnson and Margaret Kielian were confirmed as Co-Organizers. Lindsay Black and Peter Tattersall were voted in as Vice Co-Organizers. Although there had been some suggestions for moving the Conference site to one of the western sites, it was the collective decision of the attendees to remain at the Vermont site to minimize the expenditures and travel time of our European colleagues as well as for many of our participants from the east coast.

Marie Chow for

M. Chow

The Conference Organizers

Marie Chow

Michael Feiss

FASEB Summer Research Conferences

VIRTUAL ASSEMBLY US VAS FAMILY

Chairs: MARIE CHOW

MIKE FEISS

Vice-Chairs: JACK JOHNSON

MARGARET KIELIAN

10-15 June 2000

SAXTONS RIVER, VERMONT

2000 FASEB Conference on Virus Assembly
June 10-15, 2000 VERMONT ACADEMY
Saxtons River, Vermont

Chairs:	Marie Chow	University of Arkansas for Medical Sciences
	Michael Feiss	University Iowa
Vice Chairs:	Jack Johnson	The Scripps Research Institute
	Margaret Kielian	Albert Einstein College of Medicine

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- ❖ Office of AIDS Research, NIH
- ❖ FASEB
- ❖ Office of Naval Research
- ❖ Department of Energy
- ❖ National Institute of Allergy and Infectious Disease
- ❖ National Cancer Institute
- ❖ National Science Foundation
- ❖ Eli Lilly and Company
- ❖ New England Biolabs

Acknowledgements

This conference was possible due to the collective efforts of many individuals. We express our appreciation for the administrative skills of Adele Hewitt (FASEB) - who went with the flow with every unexpected crisis as well as shamed NSF into considering our proposal for funding, the detailed eye and communication skills of Sally "LeLe" Waits for the preparation of the Conference book, the cover art by Roger Hendrix (U. Pittsburgh), Sara Butcher (U. Helsinki), Mavis Agbandje-McKenna (U. Florida), Anette Schneemann (Scripps) and the Medical Graphics Unit at the University of Iowa, and to our many colleagues who provided pathway diagrams and graphics.

Front cover art

Top: A HK97 "whiffle", i.e., a prohead I from a HK97 mutant that, in vitro, assembles proheads lacking pentamers. The picture shows the whole prohead with the difference map (i.e., the pentamers) colored blue. See Poster by Li et al, p. 73.

Middle (left to right): A surface view of a three-dimensional image reconstruction of the phi6 procapsid (polymerase complex) from cryo-electron micrographs. The procapsid is approximately 45 nm in diameter, and is shown viewed down a two-fold axis of symmetry (See Posters by de Haas, et al, p.70; Poranen et al, p. 76); cryo-EM reconstruction of Aleutian mink disease parvovirus (See Poster by Agbandje-McKenna et al, p. 84); a surface view of a three-dimensional image reconstruction at 14 Å resolution of a packaging mutant of PRD1 from cryo-electron micrographs. The virus is approximately 70 nm in diameter, and is shown viewed down a five-fold axis of symmetry. (See Poster by San Martin et al, p.68).

Bottom: Schematic diagram illustrating current model of Flock House Virus assembly. Three coat protein monomers initially form a homotrimer. Two such homotrimers then interact with the viral genome to form a ribonucleoprotein complex. Formation of the ribonucleoprotein complex involves the N- and C termini of the coat protein and specific encapsidation signals on viral RNAs. The complex has the same configuration as the contact observed perpendicular to the twofold axes of crystallized virions. The ribonucleoprotein is propagated into a spherical particle by accretion of coat protein trimers which are guided into the growing shell by binding to helical structures on the RNA. See Abstract by Schneemann et. al. p. 43.

Young Investigator Travel Awards

Anabela Isidro	Instituto de Tecnologia Química e Biológica
Andrea Bertolotti-Ciarlet	Baylor College Of Medicine
Angela Christensen	University of Connecticut Health Sciences Center
Michael Mitchel	The Catholic University of America
April Burch	University of Arizona
Akash Patnaik	Pennsylvania State College of Medicine
Scott Bowers	Medical University of South Carolina

CONFERENCE PROGRAM

Saturday, June 10, 2000

2:00 PM	Registration
6:00 PM	Reception/Mixer
7:30 PM	Dinner: Welcome

Sunday, June 11, 2000

Session I

Structure of Viruses and Viral Proteins (sponsored in part by Eli Lilly and Co)

Session Chair:

Mavis Agbandje-McKenna

U. Florida

8:45 AM Overview: Mavis Agbandje-McKenna

abstract
page

9:00 AM The RNA-Dependent RNA Polymerase Of Hepatitis
C Virus: Crystal Structure And Functional
Implications

14

Felix Rey, CNRS

9:30 AM Visualizing α Helices In Large Viruses: CryoEM
Structures Of Cypovirus And Human
Cytomegalovirus

15

Z Hong Zhou, UT Houston

10:00 AM The Reovirus Core: The 3.6Å Structure Of A
Complex Molecular Machine

16

Karin Reinisch, Harvard

10:30 AM $\Rightarrow$ Coffee Break

11:00 AM Structure And Maturation Of Bacteriophage HK97

17

William Wikoff, Scripps

11:30 AM Structural Characterization Of Adenovirus/ Receptor
Complexes By Cryo-Electron Microscopy

18

Phoebe Stewart, UCLA

12:00 PM $\Rightarrow$ Lunch

6:00 PM $\Rightarrow$ Dinner

Dynamics of Virus Structures**Session Chair:****Carol Teschke****U. Connecticut**

7:30 PM	Overview: Carol Teschke	
		abstract
7:45 PM	Tails And Tail Fibers: Assembly And Structure Of The Helical Parts Of Phage Lambda Roger Hendrix, U. Pittsburgh	page 19
8:15 PM	Conformational Transition In The MVM Virion Allow Extrusion Of The VP1 Specific Region And The Viral Genome Peter Tattersall, Yale	20
8:45 PM	Examination Of Human Rhinovirus Capsid Dynamics Thomas Smith, Purdue	21
9:15 PM	⇒ Coffee Break	
9:30 PM	Large Conformational Changes in the Maturation of a Simple RNA Virus, Nudaurelia Capensis ω Virus (N ω V) Mark Yeager, Scripps	22
10:00 PM	Assembly And Expansion Of The Phage HK97 Capsid James Conway, LMES	23

Monday, June 12, 2000

Session III

Virus Entry: Receptor and Post-Receptor Events

Session Chair:

Lynn Enquist

Princeton

8:45 AM Overview: Lynn Enquist

9:00 AM Interactions Between Primate Lentiviruses And
Cellular Receptors

abstract
page
24

Benhur Lee, U. Pennsylvania

9:30 AM Avian Leukosis Viruses Enter Cells By A pH-
Dependent Mechanism

25

John Young, U. Wisconsin

10:00 AM Universal Mechanisms In Virus Entry Pathways

26

Dennis Bamford, U. Helsinki

10:30 AM ⇒ Coffee Break

11:00 AM Nuclear Binding And Import Of Hepatitis B Virus
Capsid And Genome

27

Michael Kann, Justus-Liebig University Giessen

11:30 AM Modulation Of HIV And SIV Infection By The
Accessory Protein VIF

28

Michael Malim, U. Pennsylvania

12:00 PM ⇒ Lunch

4:00 PM POSTER SESSION I

6:00 PM ⇒ Dinner

Monday, June 12, 2000

Session IV

Virus Entry: Fusion

Session Chair:

Judy White

U. Virginia

7:30 PM	Overview: Judy White	
		abstract
		page
7:45 PM	A Point Mutation In The Binding Subunit Of A Murine Retrovirus Arrests Virus Entry At Hemifusion	29
	Lorraine Albritton, UT Memphis	
8:15 PM	Structural Studies Of The Paramyxovirus Fusion Protein Core	30
	Theodore Jardetzky, Northwestern	
8:45 PM	Visualizing Fusion Complexes In GPI-HA And HA Mediated Fusion	31
	Joshua Zimmerberg, NIH	
9:15 PM	⇒ Coffee Break	
9:30 PM	Cellular Receptors And Viral Proteins In Membrane Fusion For Entry of Herpes Simplex Virus	32
	Oveta Fuller, U. Michigan	
10:00 PM	D-Peptide Inhibitors Of HIV-1 Entry	33
	Debra Eckert, MIT	

Tuesday, June 13, 2000

Session V

Virus Usurpation of Host Functions

Session Chair:

Volker Vogt

Cornell

8:45 AM Overview: Volker Vogt

9:00 AM Inhibition Of Host RNA Synthesis By The Matrix
Protein Of Vesicular Stomatitis Virus

Douglas Lyles, Wake Forest

9:30 AM The Functional Interactions Of The Influenza Virus
NS1 Protein With Host Cell Proteins

Robert Krug, UT Austin

10:00 AM Cis-Acting Signals In Retroviral RNA That Affect
Trafficking And Packaging

David Rekosh, U. Virginia

10:30 AM ⇒ Coffee Break

11:00 AM The Biology of Bacteriophage-Encoded
Cochaperonins

Costa Georgopoulos, U. Geneva

11:30 AM Viral And Host Functions In Bromovirus RNA
Replication, Translation And Encapsidation

Paul Ahlquist, U. Wisconsin

12:00 PM ⇒ Lunch

6:00 PM ⇒ Dinner

abstract
page
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Genome Packaging**Session Chair:****Lindsay Black****U. Maryland**

7:30 PM	Overview: Lindsay Black	
7:45 PM	Biophysical And Structural Characterization Of gpNul, A Viral DNA Packaging Protein Carlos Catalano, U. Colorado	abstract page 39
8:15 PM	Genome Maturation And Encapsidation In HSV-1 Sandra Weller, U. Connecticut	40
8:45 PM	General Architecture Of The DNA Packaging System In Phage ø29 Proheads José Carrascosa, Universidad Autonoma, Madrid	41
9:15 PM	⇒ Coffee Break	
9:30 PM	Participation Of Host Factors In SV40 Assembly Ariella Oppenheim, Hebrew University	42
10:00 PM	Nodaviral RNA Packaging Anette Schneemann, Scripps	43

Wednesday, June 14, 2000

Session VII

Capsid Assembly

Session Chair:

Sherwood Casjens

U. Utah

8:45 AM Overview: Sherwood Casjens

abstract
page
44

9:00 AM In Vitro Assembly Of Bacteriophage P4 Capsids

Terja Dokland, U. Singapore

9:30 AM Norwalk Virus Capsid Structure and Mechanisms of
Assembly and Disassembly

45

Mary Estes, Baylor

10:00 AM A Comparison Of Polyoma And Papillomavirus
Robert Garcea, U. Colorado

46

10:30 AM ⇒ Coffee Break

11:00 AM Molecular Events In The Assembly And Budding Of
Retroviral Capsids

47

Eric Hunter, U. Alabama

11:30 AM Structure And Assembly Of The HIV-1 Capsid
Wesley Sundquist, U. Utah

48

12:00 PM ⇒ Lunch

1:30 PM POSTER SESSION II

Wednesday, June 14, 2000

Session VIII

Virus Exit / Virus Movement

Session Chair:

Tom Wileman

Pirbright

3:45 PM	Overview: Tom Wileman	
4:00 PM	The Mechanism And Regulation Of Phage Lysis In Complex And Simple Phages Ry Young, Texas A&M	abstract page 49
4:30 PM	Role Of pI And pXI In Filamentous Phage Assembly Robert Webster, Duke	50
5:00 PM	The Entry And Exit Of Vaccinia Virus Geoffrey Smith, Oxford	51
5:30 PM	Nuclear Shuttling In Plant Virus Movement Sondra Lazarowitz, Cornell	52
6:00 PM	Genetics Of Directional Alpha Herpesvirus (PRV) Transneuronal Infection Lynn Enquist, Princeton	53

7:00 PM ⇒ Dinner

8:30 PM ⇒ Party Time

Thursday, June 15, 2000

Session IX

Applications to Biotechnology (sponsored in part by New England Biolabs)

Session Chair:

Ben Fane

U. Arizona

9:00 AM Overview: Ben Fane

9:15 AM Structurally-Biased Combinatorial Design of
Antivirals

James Hogle, Harvard

abstract
page
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9:45 AM Recombinant Vesicular Stomatitis Viruses As Cell-
Specific Targeting Vectors

55

Michael Whitt, U T Memphis

10:15 AM Implications Of Latent And Endogenous Viruses For
Xenotransplantation

56

Clive Patience, BioTransplant Incorporated

10:45 AM Viral Protein Cages As Novel Templates For
Material Synthesis And Entrapment

57

Mark Young, Montana State

11:15 AM Conference Close

11:30 AM Bus Departs to Boston Airport

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