

ACCOMPLISHMENT REPORT

PROPULSION DIRECTORATE

June 1999

PR-WEST LMCA BEST IN AFMC: The Logistics Material Control Activity (LMCA) at the Propulsion Directorate's Edwards AFB location was recently recognized for its outstanding work. PR-West's LMCA team was presented with the Richard L. Hennes Outstanding LMCA Award given annually to the top LMCA unit in AFMC. The award-winning team consisted of both government employees and a new contractor, Armstrong Data Services (ADS). The function of the LMCA unit is to provide acquisition support to PR's research, development, and test functions for non-standard supply items and one-of-a-kind items. During the evaluation period for the award, LMCA operation was transitioned from the government to ADS under the guidance of Pam Raneri and Veronica Norman of AFRL/PROF. During the period of transition, the LMCA operation maintained an unparalleled level of excellence. Following a recent IG inspection, Veronica Norman was recognized as an "Outstanding Performer." The IG also praised the LMCA team for having the best IMPAC card management program, outstanding property management, and professional, knowledgeable, and courteous employees. In addition to the LMCA award, AFMC recognized Pam Raneri for Outstanding Management as the Quality Assurance Evaluator (QAE) and recognized Veronica Norman for Outstanding Service. The LMCA team is well deserving of these accolades. (A. Kuphal, AFRL/PROI, (661) 275-5343)



Winners of the Richard L Hennes Outstanding LMCA Award

FINAL SELECTION FOR MARS LANDER LITHIUM ION BATTERIES: Yardney Technical Products, under contract to the Battery Branch (AFRL/PRPB), has been selected by Lockheed Martin Astronautics to provide rechargeable lithium-ion batteries for the Mars 2001 Lander. Two other vendors, Alliant Techsystems and Bluestar, were also in competition for this program, but after each vendor's Critical Design Review (CDR), Yardney was the clear winner. The Lander requires two 25 ampere-hour, 8-cell batteries that operate over a temperature range of -20°C and 40°C for 200 cycles. The batteries must retain this capability after the 9-month spaceflight to Mars. The batteries will be used to power the Lander's onboard computer and several experiment modules once on the surface of Mars.

Work leading up to the CDRs for Yardney and Bluestar was funded through the joint NASA/DoD Lithium Ion Consortium. The Lander is scheduled for launch in April 2001. (S. Vukson, AFRL/PRPB, (937) 255-7770)

[More details on the Mars 2001 Mission are available at the following website, <http://mars.jpl.nasa.gov/2001/index.html>]

ADDRESSING UAV FUEL CONCERNS:

The Reconnaissance SPO (ASC/RA) at Wright-Patterson AFB is seeking the expertise of the Fuels Branch (AFRL/PRSF) to address concerns regarding fuel for the Global Hawk unmanned aerial vehicle (UAV). The Global Hawk is a UAV designed for a high-altitude, long duration photo reconnaissance mission. At the Global Hawk's design altitude of 65,000 feet, the temperature of the standard atmosphere is about -70°F . Because of this low temperature operating environment and the long duration mission, there is concern that the JP-8 fuel in the Global Hawk could be subject to freezing. Recent tests performed by the Fuels Branch indicate that standard JP-8 becomes inoperable near its freeze point (-53°F). ASC/RA, aware of the groundbreaking work that PRSF is doing on low temperature fuels for the U-2 reconnaissance aircraft, hopes to exploit this technology for the Global Hawk. Teledyne Ryan Aeronautical, the manufacturer of the Global Hawk, is assembling a test article for testing in PRSF's cold test chamber. ASC/RA plans to fund PRSF to run the tests and analyze the data. (C. Obringer, AFRL/PRSF, (937) 255-6390)



Artist's Concept of the Mars 2001 Lander



The Global Hawk UAV



Cutaway View of the Global Hawk

HyTECH TEAM WINS MANAGEMENT AWARD: The HyTech Program Government Management Team has won the American Institute of Aeronautics and Astronautics (AIAA) Dayton-Cincinnati Section Outstanding Management Contribution Award for 1999. This award is presented to an AIAA Dayton-Cincinnati Section member (or team) for outstanding management contributions during the past year. The members of the award-winning HyTech Management Team are Bob Mercier, Dr. James Weber, Dr. Tom Jackson, and Dr. Terry Ronald of the High Speed Propulsion Development Branch (AFRL/PRSS), Dr. Tim Edwards of the Fuels Branch (AFRL/PRSF), and Dr. Keith Numbers from the Air Vehicles Directorate (AFRL/VA). The team members were recognized for their outstanding work in leading and directing the HyTech Program. Their efforts have resulted in the successful development and demonstration of a number of critical hydrocarbon scramjet propulsion system technologies. The winners were formally honored at the AIAA Dayton-Cincinnati Section Awards Banquet held in Lebanon OH on 26 May 1999. (J. Pearce, AFRL/PRO, (937) 255-5451)



Lithium-Ion Battery Used by Patterson Career Center's in the 1999 Solar BikeRayce USA

BATTERY BRANCH SUPPORTS ELECTRIC BIKE PROJECT:

The Battery Branch (AFRL/PRPB) supported the Patterson Career Center (PCC) with its participation in the 1999 Solar BikeRayce USA. This race event, held 29-30 May 1999 in Topeka KS, is sponsored by Solar BikeRayce USA, an educational development program that promotes the use of electrochemical and solar power. PCC entered a bike powered by a lithium-ion battery that uses solar energy to recharge during the race. Branch involvement began when the Wright-Patterson Education Outreach Council contacted Richard Marsh. He subsequently

coordinated between PCC and Yardney Technical Products to supply nine lithium-ion cells developed by Yardney's lithium-ion program. Gary Loeber and Cam Riepenhoff offered technical support by constructing a battery from the individual cells, discussing mounting of the battery to the bike, and briefing PCC on correct charging techniques, maximum charge/discharge rates and voltages, and safety and handling considerations. This event marks the first time a lithium-ion battery was used in competition. PCC represented themselves well in the race finishing 2nd in the Open Category, 4th in the High School Women's Production Frame Bikes Category, and 12th in the High School Men's Production Frame Bikes Category. (G. Loeber, AFRL/PRPB, (937) 255-6564)

[More information on the 1999 Solar BikeRayce USA is available at the following website, <http://sunrayce.com/sunrayce/BikeRayce/index.html>]

EMISSION REDUCTION PROGRAM INITIATED: On 7 May 99, the Aerophysics Branch (AFRL/PRSA) hosted the kickoff meeting for a new Phase I SBIR Program with Johnson Rockets, Inc titled "Emission Reduction Through Chemical Kinetic Modeling of Real Engine Effects (REE)." The

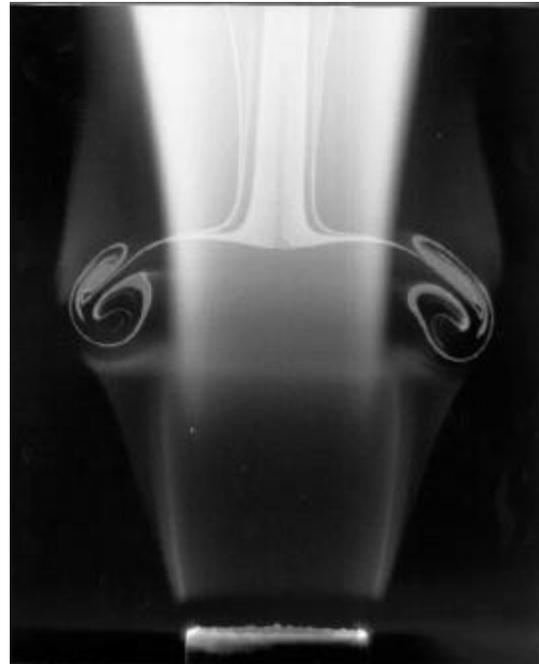
objective of this program, which is being managed by PRSA for the Ballistic Missile Defense Organization (BMDO), is to determine the conditions under which soot is formed for hydrocarbon fueled engines. The relevance of this work lies in the fact that plume signature recognition is used to identify and neutralize hostile missiles, and the concentration of soot in the missile exhaust largely defines the plume signature. Johnson Rockets will gather soot data by firing a small subscale engine with various hydrocarbon fuels and different oxidizer to fuel ratios. The data collected will be used to validate the chemical kinetic models embedded in the Performance Correlation Program (PERCORP)/Viscous Performance (VIPER) Codes which will have the ability to predict the amount of soot formed under various operating conditions. Johnson Rockets will be working cooperatively with the Naval Postgraduate School in Monterey CA on this effort. (J. Levine, AFRL/PRSA, (661) 275-6179)

PR SCIENTIST RECOGNIZED ALONGSIDE PHYSICS GREATS: Albert Einstein, Niels Bohr, Erwin Schrödinger - a few of the great minds of physics from the past century. Standing alongside these great men in the newly published book, *Physics in the 20th Century*, is the Propulsion Directorate's own Dr. W. Melvyn Roquemore. The publication of *Physics in the 20th Century* was sponsored by the American Physical Society (APS) and the American Institute of Physics to coincide with the centennial of the APS. In this book, author Carl Suplee documents the tremendous expansion of scientific knowledge that has occurred over the past century. The focus is on demonstrating how physical theories were demonstrated by ingenious experiments which ultimately led to the development of the devices that have shaped 20th century technology. The work of Dr. Roquemore and his team to examine the mechanics of flames is featured in the chapter titled "Chaos and Order." In this chapter, a full five pages of flame images captured by Dr. Roquemore's team are featured. Dr. Roquemore's team consisted of other government researchers as well as researchers from the University of Iowa and Innovative Science Solutions, Inc (ISSI) of Dayton OH. Dr. Roquemore continues to do groundbreaking work in the field of combustion and flames for PR's Combustion Branch (AFRL/PRSC). (J. Pearce, AFRL/PRO, (937) 255-5451)

STUDY EXAMINES POTENTIAL OF SPACEPLANE CONCEPTS: The Reusable Military Aerospace Vehicle (RMAV) study completed the first design iteration of potential near-term, military spaceplane concepts. The study is being conducted jointly between the Applications and Assessment Branch (AFRL/PRST) and the ASC's Air Vehicle Design Branch (ASC/ENFD). The objective of the study is to evaluate a variety of vehicle concepts designed to accomplish future military requirements. Vehicle design configurations include all-rocket and airbreathing-rocket, two-stage-to-orbit (TSTO) concepts. An in-depth systems analysis of each configuration will identify and define key technology requirements. This study will also provide system-level baselines for measuring the benefits and payoffs associated with ongoing technology programs within PR's Aerospace Propulsion Thrust. (S. Mozes, AFRL/PRST, (937) 255-9991)

PR TAKES HOME AWARDS FROM AIAA SYMPOSIUM: Propulsion Directorate government employees and contractors took home four of the 16 available Best Paper Awards at the American Institute of Aeronautics and Astronautics (AIAA) Dayton-Cincinnati Aerospace Science Symposium held on 9 April 1999. Papers were judged based on the quality of the abstract, innovation, level of effort, technical contribution, and quality of presentation. PR's civil servant award winners were Dr.

James Gord of the Combustion Branch (AFRL/PRSC) in the Vortex Flows category and Robert Gray of the Turbine Branch (AFRL/PRTT) in the Thermal Management/Heat Transfer category. PR's contractor's also did well with Dr. Greg Fiechtner of Innovative Scientific Solutions, Inc (ISSI) winning in the Instrumentation category and D. Cory Kirk of the University of Dayton Research Institute (UDRI) winning in the Combustion category. In addition to the Best Paper Awards, a special Art-in-the-Science Competition was held. Dr. Mel Roquemore of PRSC captured one of the two awards in this special competition for his image titled "Visualizing Vortices in Combustion." The winners were formally honored at the AIAA Dayton-Cincinnati Section Awards Banquet held on 26 May 1999. (J. Pearce, AFRL/PRO, (937) 255-5451)



Dr. Roquemore's Winning Image, "Visualizing Vortices in Combustion"

BEARING TESTS OFFER RISK REDUCTION FOR IHPTET DEMONSTRATOR:

A kickoff meeting was recently held for the PRDA VI Program titled "Full Scale Hot Magnetic Bearing Rig With Advanced Controller." The objective of this program with the Allison Advanced Development Company (AADC) is to reduce the risk of Advanced Turbine Engine Gas Generator (ATEGG) XTC-77/1 Integrated High Performance Turbine Engine Technology (IHPTET) demonstrator tests. Risk reduction will be achieved by evaluating all full-scale more electric engine (MEE) components in a full-scale heated rig test. The full-scale rig test will include the testing of magnetic radial and axial thrust bearings, auxiliary bearings, integral starter generator (ISG) machines, and controllers. Test conditions for the XTC-77/1 demonstrator require that the components be tested at 500°F and at engine rotor speeds up to 18,000 rpm. (J. Geis, AFRL/PRSL, (937) 255-6608)

IHPRPT SOLID PROPELLANT PROGRAM UNDER WAY: The kickoff meeting for the Integrated High Payoff Rocket Propulsion Technology (IHPRPT) Phase III Solid Propellant Ingredients contract was held on 19 May 1999. The objective of this program is to develop new energetic solid ingredients for boost and orbit transfer propellants that meet IHPRPT propellant development objectives. Representatives of Thiokol Propulsion, SRI International, and AFRL were in attendance for the kickoff meeting. At the meeting, 15 compounds were identified and selected with AFRL concurrence based on the criteria of high density and high heat of formation as candidates for small scale (i.e., 10 gram) synthesis. (D. Bach, AFRL/PRSP, (661) 275-5847)

PBS SPECIAL FEATURES LASER-PROPELLED LIGHTCRAFT: A PBS special titled "Voyage to the Milky Way" was aired for the first time on 19 May 1999. The 2-hour special featured extensive footage of AFRL's laser propelled Lightcraft in action. The program also featured interview segments with Dr. Leik Myrabo of Rensselaer Polytechnic Institute (RPI), the Lightcraft's creator. The "Voyage

to the Milky” program examined the world of space exploration from many diverse perspectives including real estate developers, scientists, visionaries, amateur rocketeers, and government bureaucrats. The program focused on the science and economics behind space travel and explored the race between the public and private sectors to carry out space expeditions. The Lightcraft project, funded jointly by AFRL/PR and NASA Marshall Space Flight Center, is developing the technology to create a vehicle that can be propelled into space by a ground-based laser. It is envisioned that this technology will be able to put small payloads into orbit in a matter of years, and eventually be capable of powering manned space flights. (J. Pearce, AFRL/PRO, (937) 255-5451)

[See the “Voyage to the Milky Way” website at <http://www.pbs.org/milkyway/index.html> and follow the “Our Future in Space” link to read Dr. Myrabo’s vision for laser propulsion titled “Ride the Highways of Light.”]



A Lightcraft Model



A Time Lapse Photograph of a
Lightcraft Flight Test

PRSL TO TEST NEW BEARING STEEL: Representatives from Timken Aerospace visited the Lubrication Branch (AFRL/PRSL) on 13 May 1999 to deliver test specimens and discuss testing of a new bearing steel, CSS-42L. This new steel has excellent hot hardness, superior fatigue life, good corrosion resistance, and twice the fracture toughness of the current state-of-the-art fracture tough material (M50 NiL). No other bearing steel has this combination of desired properties, and there is currently a great need for a new bearing steel to meet load carrying and speed requirements for Joint

Strike Fighter (JSF) engines from Pratt & Whitney (P&W) and General Electric (GE). The two leading candidate steels, Cronidur 30 and Pyrowear 675, have both developed severe wear problems. The Pyrowear wear problem was evident in recent GE/Allison Advanced Development Company (AADC) Advanced Turbine Engine Gas Generator (ATEGG) testing. Similar results have occurred with the Cronidur material. To determine if CSS-42L is a viable material, specimens will be tested for fatigue life at temperature, wear properties will be measured, material stability at temperature will be determined, and analytical surface chemistry will be used to examine reactions with oil additives. Testing of Pyrowear 675, Cronidur 30, and M50 in back-to-back tests will also be completed for comparison to CSS-42L. The test specimens were supplied by Timken free of charge and, in return, data from this testing will be made available to Timken. (N. Forster, AFRL/PRSL, (937) 255-4347)

[More information on CSS-42L is available at Timken's website. Follow the link below:
<http://www.timken.com/steel/features/aerospace/cssuprt.asp>]

CARRICK SELECTED FOR PRESTIGIOUS COURSE: Dr. Patrick Carrick, Chief of the Propellants Branch (AFRL/PRSP) at Edwards AFB, was recently selected to attend the Industrial College of the Armed Forces (ICAF) Senior Acquisition Course (SAC). SAC is the preeminent course for members of the Acquisition Corps. It is designed to prepare selected military officers and civilians for senior leadership and staff positions throughout the acquisition community. Dr. Carrick's selection is a noteworthy accomplishment since there are only seven slots available to Air Force civilians for this course. The ten-month course begins in August 1999 in Washington DC. (P. Carrick, AFRL/PRSP, (661) 275-5883)



Dr. Patrick Carrick