

Save the Date! Join the Institute for the Founders Award Dinner and Celebration!

Plan to join the George Marshall Institute on June 13th for the presentation of the *Founders Award* and annual dinner & celebration at the Willard Hotel in Washington, D.C. The Marshall Institute's Founders Award recognizes outstanding individuals for their contributions to science, public policy, and public service. The award was created in honor of the Institute's founders, Dr. Frederick Seitz and Dr. Robert Jastrow, who were its first recipients in 2004. Dr. James R. Schlesinger received the award in 2005.

The Honorable Haley Barbour, Governor of Mississippi, will deliver the keynote address at this year's dinner.

Last year, nearly 200 guests joined the directors and staff of the George Marshall Institute at the Willard Hotel to honor Dr. Schlesinger. Senator Chuck Hagel of Nebraska provided the keynote remarks.

For more information on attending the dinner or sponsorship opportunities, please contact Lynn Miller at 202.296.9655 or miller@marshall.org. ❖

Happer Named Institute Chairman

In January 2006, the George C. Marshall Institute announced the election of Dr. William Happer of Princeton University as Chairman of its Board of Directors. Dr. Happer succeeds Institute founder, Dr. Robert Jastrow. Dr. Jastrow was elevated to the position of Chairman Emeritus, joining Dr. Frederick Seitz in that role.

William Happer is a professor in the Department of Physics at Princeton University. He is a specialist in modern optics, optical and radiofrequency spectroscopy of atoms and molecules, and spin-polarized atoms and nuclei. From 1991 to 1993, he served as Director of Energy Research in the Department of Energy and, upon his return to Princeton, he was named the Eugene Higgins

Professor of Physics and Chair of the University Research Board.

Dr. Happer has maintained an interest in applied as well as basic science and he has served as a consultant to numerous firms, charitable foundations and government agencies. From 1987 to 1990 he served as Chairman of the Steering Committee of JASON, a group of scientists and engineers who advised the Federal Government on matters of defense and other technical issues. Dr. Happer is a Fellow of the American Physical Society, the American Association for the Advancement of Science, and a member of the American Academy of Arts and Sciences, the National Academy of Sciences and the American Philosophical Society. ❖

Observations on the International Negotiations Over Climate Change Policy

By William O’Keefe, Chief Executive Officer

The Kyoto Protocol and the annual Conferences of the Parties (COP) associated with it are based on two fundamental and flawed premises. The first states that the science of climate change is settled, that humans are the primary cause of warming in recent decades, and greenhouse gas (GHG) emissions from human activities will be responsible for most of the warming in the future. Second, absolute reductions in GHG emissions can be made without significant adverse economic impacts. Although there is a demonstrated, direct, and positive relationship between energy use and economic growth, advocates of mandatory targets and timetables assert that growth can occur without increasing energy use and hence increased GHG emissions. However, they never explain how this can occur. Others hold the view that developed countries owe a debt to developing countries for “causing global warming” and that only a transfer of wealth and forsaking future growth can pay that debt.

In addition, the recent COP in Montreal, held in late November 2005, reflected a now widely held view that the United States would have ratified the Kyoto Protocol if George W. Bush were not President and that U.S. policy will accommodate Kyoto-like actions once this Administration leaves office in 2009. This belief demonstrates that if something is repeated often enough and not subjected to verification, it becomes reality.

None of these premises or assumptions reflects reality. Instead, they reflect images—contrived realities—that are used to support an environmentalist agenda championed by the European Union (EU). Rather than

acknowledge that Kyoto cannot work because there is currently no way to achieve economic growth while making absolute reductions in fossil fuel use, as experience is bearing out, advocates find it is easier to blame President Bush for the failure of Kyoto. The reality that twelve out of the fifteen original EU nations are well above their Kyoto targets is simply ignored.

Most European Union countries will miss their Kyoto targets, are experiencing high energy prices, and have no idea how to meet the even more stringent targets post-2012. Although this situation should be the basis for reflection, the official EU and member nation view is to stay the course and begin planning post-2012 targets. Kyoto supporters are committed to compliance. However, given where the EU is today, meeting its obligation to reduce emissions 8% below 1990 levels will require a long recession, buying so-called “hot-air” credits from Russia or Eastern European countries, or acquiring credits from Clean Development Mechanism (CDM) projects.

The bottom line is that they will find a way to claim to meet the 2012 obligations, even if it is based on purchasing credits, to mask the failure of almost all individual members to achieve their individual targets through tangible emissions reductions.

There is another inherent conflict at this and all COPs. There is an underlying theme which holds that the technology which drives economic advancement is also the cause of the current “climate problem.” At the same time, delegates and others talk about the importance of technology in solving the climate problem and the need to accel-

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erate its development and deployment. They cannot reconcile the inconsistency in the belief that the fruits of past technology have been bad while those from future technologies will be good. They get the long-term right, but just cannot articulate how to get from here to there or why they so easily discount potential future externalities. There also was no serious discussion about the cost of developing low- and no-carbon technologies, the rate of deployment, or the economic consequences of pushing technology too far and too fast. Most of the recent attention to technology is a way to avoid the failures of the Kyoto Protocol.

The fissures in the Kyoto phalanx are now apparent. What we may be witnessing is Kyoto signatories going through the motions until they can find a politically viable way of jumping ship and finding some other mechanism to promote a mandatory global approach to combating the climate risk. Although some advocates believe that a climate catastrophe is likely, most seem to be using the climate risk as a vehicle to pursue another agenda. Climate activities at COPs are more about political power than knowledge. Hence, advocates will not give up their global agenda of control over national decision making.

With the exception of the U.S. delegation and a few others referred to as “flat earthers,” no one wanted to discuss the irony that while EU countries are falling short with mandatory measures, the U.S. is achieving greater gains in energy efficiency improvements with a suite of voluntary measures.

Although neither the EU nor any other Kyoto proponents are willing to give the U.S. credit for the Asia-Pacific Partnership, their views on technology and the involvement of China, India, Japan and Korea are an implicit endorsement for this model of action. They simply can not bring themselves to say anything favorable about any

program that was created by the U.S. and not imposed top down. The success of this initiative and its replication in other regions will be critical in slowing the Kyoto drive for additional targets and timetables post 2012.

The political objective of future COPs is to keep a process going that provides employment for thousands of people and opportunities for global travel while waiting for the U.S. to elect a new President. People like Senator Bingaman and former President Clinton perpetuated the myth that the President single handedly dealt a deathblow to ratification and is preventing U.S. participation in the Kyoto process.

Whether the Kyoto club actually believes this because they have convinced themselves that it is true or just finds it a convenient way to plan for the future is unclear and immaterial. They act as if once there is a new President and, implicitly, changes in the Congressional makeup, the U.S. will enact mandatory measures or rejoin the Kyoto process. There can be no doubt that their strategy is to make even greater efforts to bring about political change over the next three years.

The way to stall or reverse their efforts to shift U.S. policy is a counterforce built around trade and economic development and a willingness to engage in a long-term campaign that matches the environmentalists. To be successful, such a campaign must involve education, advocacy, increased research and analysis, especially on economic implications, and commitment to principle. The public may find the climate debate confusing, but it is not confused by the economics and it draws the line at paying more for energy and taking economically risky actions while countries like China and India are exempt from any obligations. Facts do matter and can be powerful in shaping public opinion and policy if communicated effectively. ❖

New Edition of the *Climate Issues and Questions* Released

For well over a decade, the world has debated climate policy. Those debates have been frequently shaped by perceptions of the state of science and the economic impacts of various policy options. There remain many questions over what science does and does not tell us about human influence on climate and potential global warming impacts. Consequently, sound public policy must be based upon sound factual foundation, rather than commonplace misperception.

The George C. Marshall Institute is releasing a report offering a perspective on some fundamental questions related to climate change. The report provides clear and succinct summaries of what we know and do not know about our climate system and human influence thereon. The one fact that remains very clear is that science still has not reached the state where human attribution can be distinguished from natural variability; that remains a critical unknown.

As the U.S. continues its consideration of responses to climate change, this report will be a valuable reference and will help us to better match action with the state of knowledge.

The revised and updated edition of *Climate Issues and Questions* addresses fundamental questions about climate change by summarizing the best available scientific information. The information provided is not intended to rebut claims about human impacts on climate or the potential for adverse impacts later this century. Rather, it is intended to separate fact from speculation and to demonstrate that while concerns are legitimate, there is not a robust scientific basis for drawing definitive and objective conclusions

about the extent of human influence on future climate. The presentation moves from what is well established, to what is uncertain, to what is unknown, and what may be unknowable in the future.

Climate Issues and Questions considers 24 important questions, including:

- ❖ Is the Arctic warming faster than the rest of the Earth? It is, but not as fast as recently claimed, and the rate of warming is neither unusual nor attributable solely to human activities.
- ❖ Are satellite and surface temperature trends different? They still are, even though the differences are smaller than they used to be.
- ❖ Is evidence of increased ocean heat storage a “smoking gun” indicating climate change? No, the publication reporting these results is based on an unverified model and does not make use of satellite measurements for the property (the Earth’s energy balance) it is simulating.
- ❖ Will climate change cause an increase in the number or intensity of hurricanes? The evidence supporting these claims is insufficient.
- ❖ Will there be an increase in other extreme weather events? If the Earth warms there will be an increase in what is now considered hot weather and a decrease in cold weather, but there is insufficient evidence to claim that other extremes (e.g., tornadoes) will increase.

Information on obtaining copies can be found at <http://www.marshall.org> or by calling 202.296.9655. ❖

Shattered Consensus Explores the State of Climate Science

The Marshall Institute's new book on climate change, *Shattered Consensus*, was released at a press conference in Washington, D.C. on December 14th.

The essays in *Shattered Consensus* evaluate the proclamations and conclusions of the 3rd Assessment of the Intergovernmental Panel on Climate Change (IPCC). They expose the lack of certainty in the bold statements of fact by the IPCC and document the numerous misstatements, omissions, and mistaken conclusions. As we are now in the middle of the IPCC's latest effort to update its conclusions about climate science—the 4th Assessment expected late next year—this book provides a valuable reference and a warning,

which is to look deeper into the statements that emerge from the 4th Assessment because the IPCC has been wrong.

Edited by Dr. Pat Michaels, the volume contains essays from leading scientists looking at ten different topics, ranging from the “hockey stick” to solar variability, and from El Niño to assertions about severe weather and human health effects. The essays evaluate the science behind the IPCC reports and show the degree to which their conclusions are supported by the facts.

Information on obtaining copies can be found at <http://www.marshall.org> or by calling 202.296.9655. Discounts are available to members and contributors to the Institute. ❖

Source Book Provides Historical Context for Assessing U.S. Space Policy

In the spring of 2006, the Marshall Institute will release *Presidential Decisions: NSC Documents* under the auspices of our National Security Space Project. The volume represents the first compilation of all relevant NSC statements and directives on national security space topics from President Eisenhower to the present.

Taken together, they trace the expanding role of space systems in American national security, from secret intelligence collectors to military force multipliers to essential components for

advancing science, technology, and industry. They provide a ready reference showing what official national policy has been—and how it has changed—regarding the use of space for military and intelligence purposes and about areas of cooperation with other countries.

These hard-to-find documents are presented in their original unaltered form. To obtain a copy, please contact the Institute at 202.296.9655 or via email at info@marshall.org. ❖

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Washington Roundtable on Science and Public Policy

The Washington Roundtable on Science and Public Policy focused on national security topics in late 2005 and into January of 2006. The Institute hosted events profiling two important missile defense programs, sponsored a briefing on new defense space programs, and provided a forum to discuss new research on the dynamics of missile defense deployment on international stability.

On November 8th, Terry Pudas, then Acting Director of the Defense Department's Office of Force Transformation, discussed the importance of space-based assets in achieving network-centric warfare and responsive space operations as well as their contributions to the overall goal of force transformation. Mr. Pudas reviewed the factors affecting how the DOD leadership is approaching the security environment facing the United States and then offered examples of how that thinking is affecting program decisions and direction. One such program is the TAC SAT which had a goal of a \$15 million budget and one year from go to launch. The program did not meet those goals, Mr. Pudas said, but they have learned a considerable amount about leveraging technologies from other sources, controlling costs, and developing a new generation of small satellites able to launch on much faster timelines than satellites today.

On December 19th, Rear Admiral A. Brad Hicks, the Commander and Director of the Aegis Ballistic Missile Defense program, offered a review of the current status and future direction of that important program. A month before the briefing, the Aegis program scored a major accomplishment during a flight test when it successfully destroyed a separating target. This is a

significant achievement and it marked the sixth successful intercept test.

After reviewing the November 2005 intercept test, Adm. Hicks stated: "The main point is that this is a capability that is available to the nation today. This summer, in August 2006, we should deliver a tactically certified capability, not a contingency capability, but a standard configuration to the fleet with deployment rounds available for load-out, available whenever and however the nation needs to use it."

In describing the program's capabilities in real tactical terms, Adm. Hicks described the area that could be defended by an Aegis vessel. "If you have an Aegis ship stationed off North Korea to detect a launch, that ship can cue the ground-based missile defense sitting in Alaska or in California. But even more importantly for theater and our allies and our forces, think of what it does for Japan. With cueing from an Aegis ship and three ships with the Block IA capability, we can in fact defend our ally Japan and the US forces there. Additionally, if we station a ship off the Hawaiian Islands with a ship forward, we can in fact defend Hawaii. Likewise, we can defend Guam by moving the detection ship forward. We have run many of these scenarios, but I want to give you this as an example of what we can do: the power of the ship forward for detection, mirrored with the correct placement of ships with engagement capability gives you this kind of capability today."

A number of other nations have expressed interest in this system. Adm. Hicks spent some time discussing those emerging relationships and focused specifically on Japan's investment of \$1 billion in the Aegis program.

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Baker Spring, the F.M. Kirby Research Fellow in National Security Policy at the Heritage Foundation, spoke about his new study of the effects of deployed missile defenses on international stability on January 20, 2006. The study, *Nuclear Games*, also explores whether it is wise to rely on nuclear deterrence “working” in the same fashion as it did during the Cold War.

“So we developed a hypothesis that said that in a proliferated environment, the introduction of defense *would not* contribute to instability, unlike what was presumed from the game and game theoretic studies of the Cold War era in a two-player setting, and in fact it may contribute to stability,” Mr. Spring explained.

The study presumed a seven-player environment in which all seven players were nuclear-armed and that those capabilities were able to hold at risk targets in the territories of every other player. This was effectively a nuclear and defense exercise and was not about conventional forces or other weapons of mass destruction. The study is based on an abstract application: the seven players were just labeled A through G, but were modeled on East Asian nations with the US-equivalent player as a global power operating within that theater environment.

After reviewing the details of the game, Mr. Spring concluded that the introduction of missile defenses improved stability and reduced crises for a political and a technical reason. The political reason was that “Defenses provide another avenue of reassurance and a way to cement the friendship and alliance relationship with that US-equivalent power.” The technical reason had to do with an “exchange ratio dynamic,” whereby missile defenses altered the calculations of the strength of player’s nuclear arsenals.

The Institute hosted a panel discussion on the Airborne Laser (ABL) program on January 26th featuring retired Gen. Lester Lyles, formerly head of the Ballistic Missile Defense Organization, and Col. John Daniels, the present director of the ABL program. Col. Daniels discussed the recent accomplishments and plans for the future while Gen. Lyles reviewed the program’s evolution and elaborated on the missions planned for this revolutionary system.

In commenting on the past challenges faced by the program, Gen Lyles reflected that: “In my opinion, with all the programs I have been involved in in my Air Force career ... it has faced all the normal—and I emphasize normal—development problems that you would expect for a very highly complex, very important and very transformational technology like directed energy and putting a large megawatt class laser on a large platform. There have been technical problems, there have been programmatic problems, funding problems, and indeed efficacy problems in terms of getting people to stand behind the program. Nevertheless it has achieved, in my opinion, considerable success.”

The Institute considered how to organize technology development efforts on November 3rd, when Richard Van Atta, a senior analyst at the Institute for Defense Analyses, discussed whether the Defense Advanced Research Projects Agency (DARPA) could provide a model for supporting innovative research and development (R&D) in non-defense areas. Dr. Van Atta’s talk was particularly timely as the recommendation to replicate the DARPA model received great notoriety a few weeks earlier when a prominent National Academy of Science (NAS) panel recommended the creation of an energy ARPA. Dr. Van Atta reviewed the history of DARPA to

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set the stage for consideration of the factors that have made it successful.

“Most importantly, I typify the DARPA that has been successful as idea-driven and outcome-oriented,” Van Atta said. “They go and find people who have ideas, who want to change things, who are frustrated and who are looking for a venue to get their ideas out, to challenge the existing approaches and the things out there that are moving too slowly.”

DARPA does not maintain its own research labs or other facilities, Van Atta noted. The absence of such infrastructure and overhead to support is frequently cited as a contributing factor to DARPA’s apparent nimbleness.

Van Atta also reminded the attendees that “Basically DARPA is a catalytic organization that interrelates with and creates opportunities that must be implemented by others. DARPA is not supposed to implement anything.” The credit for DARPA’s successes therefore must be shared and those looking to replicate the conditions for success elsewhere must be mindful of the importance of channels to move the research and technology onward.

When commenting on the applicability of the DARPA model in the energy area, Van Atta concluded that: “All I can say is that when you talk about what an ARPA was and did, it did it because it wasn’t ingrained in the current organizations, the current structure. It didn’t have a massive bureaucracy that it had to keep feeding. It had a mandate to search for and identify new and change-state concepts and ideas and foster them and bring them through, looking for the people who were themselves frustrated about not finding a way of achieving those solutions. But its success in doing that was based on the fact that it had organizational top cover and support from the highest levels of its organization, essentially the office of

the Secretary of Defense and at one time the President. It also did this with protection from those other vested interests.”

A December 15th panel discussion brought together three speakers to talk about the issue of risk and how it is used and misused in policymaking. The central question, then, is how do American perceptions of risk affect policymaking and regulatory decision-making? Evidence suggests that our assumptions about risk in our daily lives are often mistaken and that this disconnect leads to poor public policy choices in regulatory decisions. The panelists were Dr. Sally Satel, a resident scholar at the American Enterprise Institute, Mr. Fred Reiff, an engineer and a former official of the Pan American Health Organization/World Health Organization, and Dr. Richard Belzer, President of Regulatory Checkbook.

Dr. Satel raised the issue of “harm reduction” and related strategies for “reducing risks for people who don’t want to or can’t change risky behaviors.” Using smoking as her case example, Dr. Satel argued that “the idea in harm reduction for smoking is basically to replace what it is that a smoker always craves, which physiologically and psychologically is nicotine” with something that is less harmful in the event that individual can’t successfully break their habit. She went on to describe how replacing smoked tobacco with smokeless tobacco can reduce the negative health effects associated with the smoke from cigarettes. She concluded by reviewing the “misinformation” provided by health advocacy groups and government at all levels about the risks associated with smokeless tobacco. “Smokeless tobacco really is an important public health product and it could prevent millions of premature deaths, in which the benefits way

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overwhelm the risks,” Dr. Satel noted. “Once you get the facts out, I think it is a pretty compelling story.”

Mr. Reiff summarized the core of the matter in his opening comments: “Unfortunately, these days there seems to be an emphasis on the risks of public health interventions rather than benefits. The governmental-educational complex has spawned an enormous industry devoted predominantly to the identification and study of the risks associated with public health interventions regardless of the magnitude of the risks relative to the benefits obtained from them. Well-meaning, but oft ill-informed environmentalists overstate and exaggerate the degree of risk and the mass media, which seems to thrive on disasters and catastrophes, are all too quick to propagate this as fact, often in a manner that further distorts and already warped viewpoint, fostering a perception of risk among the general public that far exceeds the actual risk. This can result in far more harm than good; it can be costly and sometimes deadly.”

He illustrated those points using two real examples of the consequences of such misuse of risk. The first was resistance to the use of chlorination to combat a cholera outbreak in Peru in the early 1990s. Health officials in Peru resisted the chlorination of water supplies based on “widely disseminated press releases by environmental agen-

cies and organizations” which left the health officials “erroneously [believing] there was a high risk that chlorinated water would cause cancer” and that they might be subjected to legal action. Unfortunately, the risks posed by chlorination paled in comparison to those actually faced by the cholera outbreak. This pandemic resulted in more than 1,200,000 cases and more than 10,000 deaths against the hypothetical risk of overexposure to trihalomethanes in levels in excess of those recommended by EPA and WHO, which was one extra death per 100,000 persons exposed over a lifetime of seventy years.

Mr. Reiff’s other example was the effort to eliminate exposure to radon. According to Mr. Reiff, “the continued inappropriate use of the linear-no-threshold for low-level radon exposure is at the expense of households that are paying a considerable price for their “protection” from low-level radon. It might even be possible that when this protection is used for low-level radon, it is actually increasing the risk of lung cancer.”

Dr. Richard Belzer provided the perspective of a former regulator. Having worked in the Office of Management and Budget, Dr. Belzer reviewed the analytical methods used in risk assessment and their limitations. He concluded that those methods invariably lead to ascribing greater risk of harm to the items under examination than are actually present. ❖

Book Review: “The E-Bomb – How America’s New Directed Energy Weapons Will Change the Way Future Wars will be Fought” by Doug Beason

Review by Howard Kleinberg, Research Analyst

Doug Beason’s book, “The E-Bomb” (Da Capo Press: Cambridge, MA, 2005) provides the reader with wonderful insights into the accomplishments of directed energy weapons research and development in the U.S. The book presents the issue in both its historical and scientific contexts, offering explanations of the basic physics of directed energy, as well as an extensive history of directed-energy research in the U.S., doing full justice to both. Far from being a dry science or politics text, the book is very readable without being ‘dumbed down,’ and is at points quite humorous. It also reflects honestly and accurately the risks involved in ground-breaking scientific research, and the character of many of the major participants in its progress to date. The book also reflects the author’s frustration with the government bureaucracy and its sometime ineffective workings, particularly vis-à-vis laser weapon development.

Doug Beason is eminently qualified to write on this topic, with twenty-six years of experience in research and representation at the highest levels in the U.S., the world-leader in directed energy R&D. He holds a PhD in physics, which shows in the clarity with which he writes about the physics and mechanics of directed energy. He has authored and co-authored some eighteen technical papers on the topic of directed energy and military-technical policy, as well as a number of novels.

The book bursts numerous myths deriding the efficacy of directed energy. For instance, it presents a detailed history of the Airborne Laser Laboratory, which was shooting down air-to-air

missiles and target drones simulating cruise-missiles back in 1983, a fact that flies in the face of claims that laser weapons are impossible, and that even if they were possible, could never be accurate if fired from aircraft. Another example is the myth that polishing the outer metal surface of a missile will grant it protection from lasers. This is untrue, due to the physical requirement that the ‘mirror’ be polished to an accuracy of less than one-tenth the wavelength of the laser. Further, the revelation that a satellite-based laser-relay mirror was successfully used to reflect the beam from a ground-based laser onto a ground-based target back in the 1990s, is proof not only of the author’s superior knowledge in this area, but also a hint of how cynically the entire topic has been treated by journalists and academics alike.

The book’s main shortcoming is that the author doesn’t quite convince the reader that a revolution is here. Certainly, he demonstrates that the science is within reach, that prototypes of varying kinds have been or are being tested, and the possibilities are most exciting indeed, but he doesn’t quite make the case for a Directed Energy-based Revolution in Military Affairs (RMA). The book could have used some more ambitious, sweeping expositional cases, such as highlighting the operations of a directed-energy-weapons-armed U.S. expeditionary force that is all but immune to enemy weaponry of all types. The title calls for a revolution and the book would be improved by more demonstrations of that potential,

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in addition to the “how we got to this point.” This point is not quite at the operational weapon stage, so the potential is not immediately obvious; more explanation of the revolution could have been provided.

Another shortcoming in the book is that recent developments in directed-energy research and development could have strengthened the author’s case even further. For instance, the book makes no mention of Active Electronically-Scanned Arrays, or AESA, a radar-antenna technology that has recently been revealed to be a significant breakthrough in EM weapons technology. The book is also a bit dated regarding HELLADS, the newly-revealed liquid-cooled Solid-State Laser design, and Northrop-Grumman’s 350-sec 27kW Solid-State Laser test in November of 2005. Finally, the author’s reservations about the ability of terahertz-frequency radio signals to penetrate the Earth’s atmosphere may prove to be overly pessimistic, with greater potential for both radar and directed energy

weapons applications than cited by Beason. However, in fairness to the author, these are late-breaking accomplishments, presumably achieved too late to be included in the book.

Overall, this book is an excellent introductory treatise on the subject of directed energy. There are, unfortunately, precious few books written on this groundbreaking subject. Indeed, the book flies in the face of most ‘scholarly’ works on missile defense and related topics, which generally eschew all things RMA or military-technical. It gives an accurate and complete history of the development process and future potential of directed energy. It may actually understate the potential, given the title and promise of directed energy. The field needs more such texts, especially since these technologies are reaching maturation after decades of R&D. Present and future analysts would do well to start with this book before making policy analyses and recommendations on missile defense and directed energy weapons in particular. ❖

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