[*The following Backgrounder and Talking Points Release was circulated by NSS HQ by email to NSS chapters prior to the March 19 re-broadcast of NBC-TV's made-for-TV movie 'Asteroid.' The information should be equally useful in commenting on the forthcoming other asteroid/comet movies*.]

By Karen Rugg
NSS Director of Communications

Hot on the heels of recent media coverage for Asteroid 1997 XF11, "Asteroid" is coming to NBC-TV once again on Sunday, March 29 from 7:00 -11:00 p.m.

While the National Space Society (NSS) has never given a specific policy position on the issue of asteroid detection and deflection, we anticipate that members, chapter activists, board directors, etc., might be contacted for comment. The following information will provide you with the basic facts on asteroids, as well as NSS's position on their relevance to our vision.

Our thanks to Board member **Pete Worden** (and former Director, National Space Council) for his assistance in drafting this document, and to Board member **Jeffrey Liss** for additional background and guidance. Please forward this document as you deem appropriate:

BACKGROUNDER & TALKING POINTS

NOTE: A number of media events has generated interest in the asteroid/comet issue beginning with NBC-TV's re-broadcast of "Asteroid" on March 29. Two feature films on the same subject, "Deep Impact" and "Armageddon" hit the box office this summer. NSS provides this backgrounder and talking points to help your local media, community leaders and friends via your role as an NSS member and/or space advocate.

** Are asteroids a real threat?

Yes. Scientists believe the dinosaurs became extinct as the result of an asteroid ten miles in diameter impacting the Earth near what's now the Yucatan 65 million years ago, causing massive earth upheaval, a huge crater and a mile-high tidal wave that swept what is now the eastern United States.

The threat of a cataclysmic impact continues today. In 1908 a comet exploded over Siberia with a force of at least ten megatons leveling a forest 50 miles across. On Nov. 22, 1996 a small asteroid hit Honduras and made a crater 165 feet wide. In recent years, scientists have come to recognize just how much of Earth's surface evolution has been rapidly driven by catastrophic events such as asteroid strikes.

** What are the odds?

Experts estimate that an asteroid capable of cataclysmic impact on life on Earth hits once every 300,000 to one million years, meaning a one in 6,000 or one in 20,000 chance of one hitting in the next 50 years. According to planetary scientists Chapman and Morrison (1991), an individual's chance of dying from large scale devastation caused by a "doomsday" asteroid is 1 in 30,000, slightly higher than the lifetime chance of dying in an airplane crash (1 in 20,000).

** What is an 'asteroid;' how does it differ from a 'comet'?

Both asteroids and comets are the "stuff" left over from the formation of the solar system some four and a half billion years ago. Asteroids are made of rock or metal. The majority often reside in the orbit between Mars and Jupiter. Some, called "Near Earth Asteroids" or NEAs, come close to the Earth and can even collide with the planet. Comets, also remnants of the early solar system, are partly comprised of ice and reside in the outer reaches of our solar system and beyond.

Occasionally a comet wanders into the inner solar system. As the sun melts the ice, it streams away and creates the impressive "tail" we see. In March and April of 1997, a very large comet, designated "Hale-Bopp" after its discoverers, lit up the night sky (and caused some unwanted media coverage when the so-called "Heaven's Gate" cult believed a "UFO" was trailing behind it --adding a new twist to old superstitions and unenlightenment that were prevalent in the Middle Ages) .

** How big are asteroids and comets?

The asteroids between Mars and Jupiter can be several hundred miles across. Of the 2,000 NEAs tracked to date, most are between one and 10 miles in diameter.

Comets are typically a few miles in diameter. In 1994, a string of comet fragments called "Shoemaker-Levy 9"

struck Jupiter with spectacular results, releasing millions of megatons of energy into Jupiter's atmosphere --and should have served as a "wake up call" for the inhabitants of planet Earth.

*** What should we do about asteroids?***

Currently, there are three steps to addressing the threat of asteroids: survey, study and mitigate (deflection or destruction). The U.S. government has considered a project that would use existing scientific and military space surveillance systems to survey the sky to catalog and watch for objects on a collision course with Earth. There is currently a handful of scientific investigators, most within the U.S. and funded by or associated with military surveillance missions, surveying the sky for NEOs (Near Earth Objects). These efforts are a good start, but NSS members should insist that the U.S government supplement them with many more telescopes and a much more systematic approach. The key is to be able to speed up the process of identifying potentially threatening objects to within 10 or 20 years, as compared to 200 years at our current rate.

NSS supports additional scientific and exploration missions to these objects to study their composition and vulnerabilities. A NASA satellite, NEAR (Near Earth Asteroid Rendezvous), launched in early 1996, is on its way to rendezvous with the asteroid Eros in early 1999. Information provided through such study is vital to determining the best option for mitigation, which currently include destruction or deflection through detonation of a missile or nuclear device, or vaporization.

*** How are NEOs relevant to NSS's vision for a spacefaring civilization?***

Besides the threat they represent, these objects also present great opportunity. The same objects that come near the Earth provide the raw materials for large scale space industry. The metal ones are almost pure iron and nickel, but also contain high abundance of such rare metals as platinum and gold. As humans move out into space, asteroids can actually be a resource.

Comets contain lots of water. Many contain complex hydrocarbons from which rocket fuel and even space habitats may be constructed. Both robotic and human missions to these objects could be the next step in solar system expansion.

On May 8, the Paramount/Dreamworks movie “Deep Impact,” will debut in theaters. This drama about a comet’s encounter with Earth, and its creation, is described in great detail in the March-April *Ad Astra*.

On July 1, the movie “Armageddon” will be released. That movie, starring Bruce Willis, describes what might happen when a Texas-sized asteroid heads for Earth.

WHY THIS PACKET

When these movies hit, your friends, *and your media contacts*, knowing of your interest in space, will ask you: Can this happen? If so, how bad will it be? Will we have warning? (Answer: maybe not enough) And, especially, is there anything we can do to prevent it? The answer to the last question is YES. But only if we have mechanisms in place for detection and intervention. That means more active sky searches, spacecraft *in existence* capable of reaching asteroids and comets, and possible weapons (e.g., laser, nuclear, chemical, on asteroid propulsion). The policy issues which should be discussed in your communities and in the media are how much we should be doing to protect our planet, and how soon.

This Packet will arm you for that inquiry.

For an exciting story of what a ***pre-existing*** fleet of spaceplanes could do to divert falling rocks, read *Moonfall*, by **Jack McDevitt** (1998, $24, Harper / Prism).

[*Reprinted from **Inside NSS**, February 1997*]

A fascinating new book, *Impact! The Threat of Comets and Asteroids* by **Gerrit Verschuur** (Oxford University Press 1996) reminds us enthrallingly that civilization- and species-threatening dangers from the sky are quite real and, more important not as a rare as the media may have led us to believe. Smaller major impacts 20,000, 7,000 and 5,000 years ago were not insignificant, either.

The book describes in fascinating detail the second-by-second consequences of various kinds of collisions -- would you believe Atlantic tidal waves that reach to the Rockies, the particulars of the dinosaur-destroying impact (and step by step how it was proved), and the orbital mechanics that tend to drive an unexpectedly large variety of celestial visitors toward our planet. The book also catalogues a sample of recent very near misses:

June 1975 -- According to seismographs left by Apollo missions, the Moon was struck by many one ton

boulders over a five day period, which left the Moon "ringing." These came from the Beta Taurids meteor stream (remnants of a broken comet), which is part of a Taurid complex of four meteor streams that produce regular meteor showers (annually) and as many as 8 other streams (and which some authorities have labeled as the greatest danger to life on Earth).

March 1989 -- An object (1989 FC) about 300 meters across missed Earth by about 650,000 kilometers (about 6 hours); it would have produced a blast of between 1,000 and 20,000 megatons (a size capable of causing global catastrophe).

January 1991 -- An approximately 10-meter object passed within 170,000 kilometers of Earth (less than half the distance to the Moon); its impact would have been four to eight times that of the Hiroshima bomb.

June 1993 -- A 10-meter object was discovered a few hours *after* it passed within 150,000 kilometers of Earth; impact would have dug a nice crater or caused a large wave.

March 1994 -- An asteroid (1994 ES1) 10-20 meters across missed Earth by 180,000 kilometers; it would have exploded in the atmosphere with the force of 20 times the Hiroshima bomb.

December 1994 -- An asteroid the size of a school bus was discovered 14 hours before it passed within 105,000 kilometers of Earth; its explosion would have been Hiroshima size in the atmosphere.

The Leonid meteors, associated with the comet Swift-Tuttle, the parent of the Perseid meteor stream, show a 33-year period of meteor storms.

[NASA's Release 96-249 also reminded us that the asteroid Toutatis passed within 14 lunar distances last month and in 2004 will pass within only four lunar distances. That dumbell-shaped asteroid has dimensions of 2.9 by 1.5 by 1.2 miles.]

The very clear point is, we should be scared, and the public should be scared. And the public might indeed realize it should be scared if space activists explain the facts often enough and loudly enough. If scared enough, development might be accelerated of spacefaring technologies capable of dealing with such celestial missiles — and at the same time capable of supporting the human exploration of space.

The further implication is that it may be too soon for space activists to give up on collision-protection as a driver for an accelerated space program. We should take a closer look.

Jeffrey Liss, NSS Director

[*Modified from **Inside NSS**, Feb. 1997*]

All space advocates will have an opportunity to parlay the increasingly popularized asteroid threat into arguments for your favorite space project when [the "Asteroid" disaster movies] air.

Right around air time or immediately thereafter, mail/fax letters to the editors of local newspapers and explain why we should have: ____ (fill in blank with your favorite space project: space telescope surveillance of near-Earth objects to detect incoming threats, space defense system to deter incoming objects, cheap access to space to get populations off Earth, space station to advance human settlement off of Earth, colonization of Mars and elsewhere to assure survival of human species in the event of celestial impacts on Earth, or whatever is your favorite program).

Explain that all the public needs to do to save its collective ass (well, don't use THOSE terms) is to: __ (fill in the blank with your favorite public response: call their congressional representative and tell them to stop decreasing NASA's budget, invest their life savings in a private rocket company that is developing public access to space, demand the U.S. government release the alien space propulsion technology that it has held since 1947, build asteroid shelters in their back yards, or whatever is your favorite public response).

Start writing your letters now and have them ready.

Cynthia Griffin
Space Station Future Fighters

(1) Major asteroid impacts are a threat to our planet and the human race. They are infrequent, but potentially very destructive. They are a threat primarily because we still do not know how many are in a position to cross Earth's orbit. Completing a systematic process of identification and cataloguing as quickly as possible, within the next 10 to 20 years, is the real challenge.

(2) There is more than one way to look at an asteroid. Asteroids are a threat, but they are also a valuable source of scientific knowledge and mineral resources. Asteroids are scientifically fascinating --being made of the stuff

from which our solar system was formed --as well as commercially promising.

(3) The National Space Society, which advocates a spacefaring civilization, supports and calls for the funds to implement the international cataloguing project proposed by past NEO working groups. The information we desperately need to know about asteroid and comet structure will provide answers leading to further development of a realistic deflection strategy and also to identification of new resources that could spur space commercialization and greater human access to space.

(4) NSS advocates the development of alternative launch vehicles which provide cheaper access to space and platforms for space-based defense against asteroids or for mining.

OTHER CONTACTS:

National Space Society
Website: *http://www.nss.org/*

OASIS -The Los Angeles Chapter of the National Space Society
Website: *http://www.geocities.com/CapeCanaveral/Lab/4005/*

Orange County Space Society
(c/o Orange County Register's "Lift Off" section)
Website: *http://www.ocregister.com*

California Space Development Council
Website: *http://home.earthlink.net/~cew/csdc/index.html*

California Space & Technology Alliance
Website: *http://www.csta.net*

Western Commercial Space Center (Vandenberg AFB)
Website: *http://www.calspace.com/wcscpg.htm*

[*Reprinted from **Inside NSS**, March 1997*]

[Source: *Impact! The Threat of Comets and Asteroids,* by **Gerrit Verschuur** (Oxford University Press 1996)]

IN GENERAL

About 10,000 TONS of space debris fall to Earth every year, mostly in meteoric form. [p.33] Most burn up in the atmosphere.

Craters, in general are expected to be about 20 times wider than the object that slams into the ground. [p.41]

The 1.2 kilometer-wide Barringer Crater in Arizona ("Meteor Crater") was created, according to one estimate, by an iron meteorite only about 40 meters wide. [p.41]

A 60-meter wide stony object will destroy cities. A 200-meter wide stony object would do severe regional destruction and, according to most guesses, may do planetwide damages.

Plumes produced by asteroids larger than 120 meters across cannot be contained by the atmosphere, so a bubble of hot gas would form above the atmosphere and quickly girdle much of the planet, and as a result no sunlight would penetrate to the ground. [p.153]

The object that extinguished the dinosaurs has been estimated to have been 10 kilometers across. [p.17] It was an ocean impact, generating a subsurface crater 20 kilometers deep and 180 kilometers across and earthquakes approximately 12 to 13 on the Richter scale. [p.122]

The Shoemaker-Levy 9 comet fragments which struck Jupiter in 1994 were estimated to be about half a kilometer in size.

OCEAN IMPACT

An ocean impact is more likely than a land impact, since there is so much more ocean than continent. An ocean is much more threatening to human life than a land impact. [p.153]

The splash causes enormous waves, which result in tsunamis ("tidal waves") thousands of kilometers away.

First are so-called "deep-water waves;" then come the tsunamis which on the average are 40 TIMES higher than the deep water waves. [p.153]

Calculations: A small 200-meter wide asteroid -- composition unspecified -- splashing in the mid-Atlantic Ocean would, according to one calculation, produce deep water waves that would be 5 meters high, but when they break they would be 200 meters high! "The wave pulse would last several minutes and would sweep over all low-lying land, including, for example, Holland, Denmark, Long Island and Manhattan. Hundreds of millions of people wold be wiped out in minutes." [p.153]

Waves 1,000 kilometers from impact would be [p.153]:

-- For a 50-meter wide iron asteroid, deep water waves would be 2 meters high, with a tsunami 80 meters (!) high. Even a stony meteor of that size would produce deep and tsunami waves of 0.8 meter and 32 meters (!) high.

-- For a 100-meter wide asteroid, the waves would be 7 meters and 280 meters (!) high for an iron object, 2 meters and 80 meters high.

-- For a 300-meter wide asteroid, the waves would be 40 meters and 1.6 KILOMETERS (!) high for an iron object, 25 meters and 1 KILOMETER high.

-- For a 1-kilometer-wide asteroid, the waves would be 700 meters and 28 KILOMETERS (!) high for an iron object, 200 meters and 8 KILOMETERS high.

The brief brouhaha over XF 11 "should be a very real wake-up call," said Glenn Reynolds of the University of Tennessee. "People in the space and scientific communities have been raising the alarm about this issue for 20 years.

"And there will be other asteroids. One of the things that people have learned in the last couple of decades is that this (close flyby) happens a lot more often than we thought."

[*Discussing current activities:*]

--At the University of Tennessee and elsewhere, scholars have proposed enlisting amateur astronomers to hasten the discovery of other potentially menacing asteroids and comets.

Most comets are discovered by amateur astronomers who use small telescopes to scan the heavens just before sunrise or just after sunset. . . . Every amateur astronomer dreams of discovering a comet that will forever bear her or his name.

But amateur astronomers might appreciate an extra incentive to rise before the roosters --say, a $50,000 award for discovering a threatening celestial object. So argues Reynolds, a professor at the University of Tennessee and noted authority on space law.

"Amateur astronomers will put in the hours that you couldn't pay (other scientists) to do," Reynolds said of the proposal, which a Washington associate and he have informally circulated to Washington officials. "Maybe someone like Bill Gates could fund it --it would be pocket change to him."

[*On the possibility of using nuclear missiles on approaching asteroids:*]

Reynolds compared the legal status of space nukes to ordinary dynamite: "Use it in an artillery shell, and it's a weapon. Use it to get rid of a stump, and it's a tool."

In any case, he said, laughing, "If an asteroid is coming in, I don't think anyone is going to stand on legalities. The president can abrogate a treaty under his own authority, anyway. He could say, 'If people don't like it, then they can sue me in the world court for saving the planet.' "

Now, however, for the first time in human history we almost -- repeat, <u>almost</u> -- have the ability to both <u>predict</u> and <u>prevent</u> such catastrophes. We know how to locate comets and asteroids that cross Earth's orbit and we know how to build rudimentary spacecraft. But our searches are minimal and haphazard, and neither our scientific knowledge nor space hardware is capable of averting doom.