ISS - Benefits for Humanity and Hermann Oberth

International Space Station Benefits for Humanity (Second Edition)

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Finally, as a complete book, the results of over ten years of research on the International Space Station (ISS) are summarized.
It intrigued me to go back to the roots – in this case to Hermann Oberth's book "The Rocket into Planetary Space", published in 1923 –to see how visionary Oberth's look into the future was.
In §17 "Outlook" of his book he listed a series of experiments which could be performed with "*an apparatus that can attain cosmic velocity and that it is probably possible for humans to ride in these vehicles and carry them to on high*". [1]

Oberth's experiments suggestions are numbered from a) to g) and 1. to 3., and are copied from his book verbatim to be matched with the appropriate list of experiments from the "ISS Benefits for Humanity" book.
The result is: Oberth has foreseen it all …and more! (Oberth's text in *Italic*)

*With the apparatus just described, the following experiments and observations could be carried out first. These experiments can be facilitated by having the observer(s) leave the apparatus in a diving suit and, because there is no Andruck, [*weightlessness*] they can reach any desired point. They merely need to be connected to the apparatus by a line that they could use to pull themselves back.*

In his introduction to the experiment suggestions Oberth described two important features of manned spaceflight: *weightless conditions* inside the apparatus and the capability to *perform activities outside the apparatus* (EVA) in particular, to maintain the experiments outside the pressurized module and to perform repair and maintenance activities.
In the following listing only the highlights of the summary "ISS Benefits for Humanity" are mentioned, the interested reader is encouraged to download the entire book and a recent update study the fascinating results of over 3000 experiments carried out onboard the ISS so far. [1] [2]

To start with Hermann Oberth's ideas from a 100 years ago:
a) Experiments that are only possible in a large, airless space.
b) During free flight, the apparatus is not exposed to "Andruck". Therefore, many physical and physiological experiments can be performed that are impossible on Earth because of gravity

The bulk of the experiments onboard the ISS is carried out inside the modules and for keeping an overview the highlighted experiments for *a)* and *b)* are categorized according to the following research goals as per reference [1]

> Human Health:
> - Robotic arms lend a healing touch. The world's first robotic technology capable of performing surgery inside magnetic resonance machines makes difficult surgeries easier or impossible

surgeries possible.
- Improved eye surgery with space hardware. An eye-tracking device allows the tracking of eye position without interfering with a surgeon's work during corrective laser eye surgery.
- Bringing space station ultrasound to the ends of the Earth. Small ultrasound units, tele-medicine and remote guidance techniques make medical care more accessible in remote regions
- Improved eye surgery with space hardware. An eye-tracking device allows the tracking of eye position without interfering with a surgeon's work during corrective laser eye surgery
- High-quality protein crystal growth experiment aboard Kibo Protein crystal growth experiments contribute to the development of medical treatments. JAXA is making positive advance

Innovative Technology:
- Advanced ISS technology supports water purification efforts worldwide. At-risk areas can gain access to advanced water filtration and purification systems affording them clean drinking water.
- Tomatosphere™: Sowing the seeds of discovery through student science. This award-winning educational project with an estimated 3 million students participating is helping researchers answer questions about growing food in space while teaching students about science, agriculture and nutrition.

Global Education:
- Inspiring the next generation of students with the International Space Station by Inquiry-based Learning and inspiration
- - Calling cosmonauts from home. Currently aboard the Russian segment of the station are four space investigations that have educational components to inspire future generations of scientists, technologists, engineers and mathematicians.

Economic Development of Space:
- Commercialization of low-Earth orbit (LEO) Forward-thinking, agile companies like NanoRacks and UrtheCast believe routine utilization of the unique environment of outer space has come of age, and that at long last ISS is open for business.
- Space mice teach us about muscle and bone loss Biotech and pharmaceutical companies like Amgen use spaceflight to study their drugs and do preclinical work important for FDA approval

c) In ether space, telescopes of any size can be used, because the stars do not twinkle.

The ROSCOSMOS-ASI investigation operating the Multiwavelength Imaging New Instrument (MINI) for the Extreme Universe Space Observatory (Mini-EUSO – UVAtmosphere) is a representative example for putting telescopes in space. [3]

d) Because the sky is completely dark, masking the solar disk suffices for observing the regions in proximity of the Sun at will.

The SOLAR experiment has been monitoring our Sun's output since it was installed on ESA's Columbus laboratory module in February 2008. The package will celebrate its fifth anniversary next year. [4]

e) Certain investigations of radiant energy are not possible on Earth because the atmosphere absorbs shortwave light rays and
f) We could determine how much radiant energy comes from different regions of the sky.

The Matroshka experiments (MTR-1 and MTR-2) were performed early on the ISS using a mannequin that has been used to study cosmic radiation dose types and rates that relate to the health of space travelers on long duration missions. [5]
Additionally eight experiments to investigate the long term influence of radiation on astronauts and three more experiments studying the nature of cosmic rays were carried out [6]

g) Finally, with an initial velocity of = 11 km/sec, such a rocket could travel around the Moon and investigate its unknown hemisphere.

Traveling to the Moon was achieved by the Apollo Program (1961 – 1975).

If we let such large rockets [as a space station or like Skylab, STS, Salyut, MIR or the ISS] *circle Earth, the purpose of these observation stations would be as follows:*

1. With their precise instruments, they could recognize details on Earth and send light signals to Earth with suitable mirrors. They would enable: telegraphic connections for places that are not reached either by cables or electrical waves.

Earth Observation and Disaster Response:
- Earth remote sensing from the space station ISS contributes to humanity by collecting data on global climate, environmental change, and natural hazards using its unique complement of crew-operated and automated Earth observation payloads (almost 200 different experiments carried out on the ISS).

2. This station would have some practical use, but the following would be even greater: One could spread out a circular, wire net …inclined to the rays of the Sun by 45°. Now by proper positioning of the individual facets, one could concentrate, as needed, all the solar energy reflected by the mirror to single points on Earth.

Here, Oberth was off the mark – however 100 years ago he could not have known about man made climate change and global warming.
However his idea was also considered for solar energy supply to the Earth. It was abandoned because of practical non-feasibility. The proper way to transport solar energy down to Earth is by using photovoltaics.

3. I should like to mention one more thing here: The observation station could at the same time be a fueling station.

ISS requires fuel (and oxygen) in regular intervals to stay in orbit but never served as fueling station. However, the ISS provides deployment capabilities for small satellites.
Even commercial satellite deployment from the ISS, offered by Nanoracks, has proven to be simpler, easier, faster, more secure and lower cost than regular "rideshare" satellite launches. As of the end of 2020, Nanoracks has launched more than 200 satellites from the ISS, with manifests continuing to fill up for future missions [7].

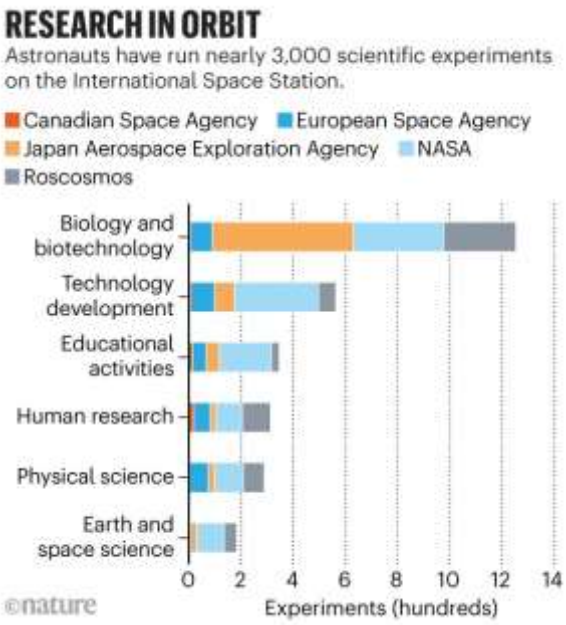
Summary

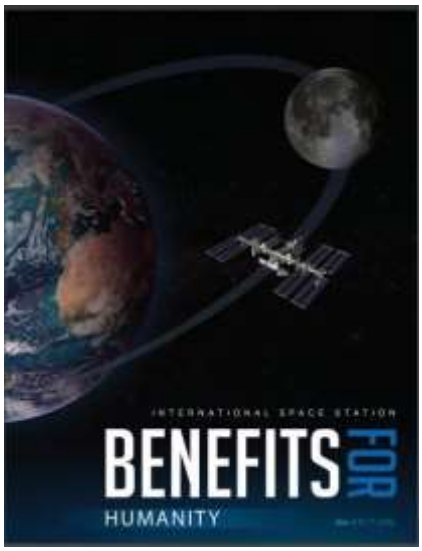
As shown in the graphic below, the status on 03 November 2020 was: Nearly 3,000 science experiments have been carried out by the international astronaut- and cosmonaut crews aboard the ISS.

The idea of international cooperation in space was realized from the very beginning. The ISS partners include Canada (CSA), European ESA members, Japan (JAXA), USA-NASA and Russia (Roscosmos) performing their own experiments by sharing resources and equipment – but most important is the liberal sharing of the results -for the benefit of humankind.

Currently it is planned to continue with this mode of operation until the end of 2030 – so the just published 3rd edition of the "Benefits for Humanity" will not be the last update.

Until then, the number of experiments is growing every day. [8]





Benefits for Humanity (3rd Edition, June 2022 … and no end in sight! [9]

Reference

[1] Herman Oberth: The Rocket into Interplanetary Space

[2] Benefits for Humanity (2nd Edition, December 2014) https://www.academia.edu/21797024/International_Space_Station_Benefits_for_Humanity?email_work_card=view-paper

[3] ROSCOSMOS https://www.nasa.gov/sites/default/files/atoms/files/np-2021-12-016-jsc_annual_highlights_fy21-011922.pdf

[4] ESA Science Human Exploration https://www.esa.int/Science_Exploration/Human_and_Robotic_Exploration/Columbus/International_Space_Station_salutes_the_Sun

[5] Matroshka

[6] Wikipedia Science research on ISS *https://en.wikipedia.org/wiki/Scientific_research_on_the_International_Space_Station*

[7] Nanoracks: https://nanoracks.com/products/iss-launch

[8] Nature: https://www.nature.com/articles/d41586-020-03085-8#:~:text=03%20November%202020-,Astronauts%20have%20conducted%20nearly%203%2C000%20science%20experiments%20aboard%20the%20ISS,Station%20%E2%80%94%20and%20who%20did%20it.

[9] 3rd Edition to be released in summer 2022 https://www.nasa.gov/sites/default/files/atoms/files/benefits-for-humanity_third.pdf