FIFTH YEAR OF PUBLICATION

EYE CARE-THE INVISIBLE ADVERSARIES

Optics in physics involves the properties of light usually discribing the behavior of visible, ultraviolet and infrared light. Optical science is studied in many related disciplines that include astronomy, engineering, photography and medicine; ophthalmology and optometry.

An Arab by the name of Alhzen (lbn al-Haytham) is said to be the father of optics when he wrote his *Book of Optic* in the early 11th century. Alhzen contribution included optics, astronomy, mathematics, meteorology, visual perception and scientific methods. The study has contineud through the centuries to advance the understanding of optics bringing with it new technology in optical systems. Optics is a part of everyday life. Visual systems in biology play a central role in the science of what we know as our five senses and optical communication in the use of internet, cameras and modern telephone.

Invisible Adversaries

As new technologies were introduced and improved so did the need to adapt to changes brought about by developments in industry as well as the advent of aviation. During WWll long duration flights of up to 12 hours caused pilots and crew to experience vision problems. This un-explaneable medical problem was solved when the connection was made to the extended exposure to radioluminecent paint invented in 1908. This new technology was used to paint aircraft instruments on flight decks to improve night vision while concealing the aircraft from detection.

High-Gs Deny Vital Oxygen to Eyes and Brain

Pilots reported mild experiences with accleration forces as early as WW l. Pilots complained of blurred vision when pulling out of a dive or executing severe combat maneuvers. These G forces were not understood at the time.

Sustained acceleration, or high-Gs is a measurement of gravitational forces on the human body. High-G forces basically affects the cardiovascular system by increasing the distance blood flow travels from the heart to the eyes and brain due to stretching and elasticity of the veins and arteries of the pilots neck during high-G flight operations. The brain has only three to five seconds worth of stored oxygen;when depleted, anoxia occures causing subtl change during an actual shuting down of body function. By WW ll greater measures had to be taken to protect the pilot and crew during momentary pull out of a dive or high-G turns. An anti-G suit was designed to prevent blood flow from leaving the bodies core providing a counter-pressure on the blood in the legs and abdomen. During high acceleration tests at Edwards and Holloman Air Force Base, test pilots would experience High-G tests proving that the human body could endure no more than 18 times the force of gravity.

Gravity Receptors

Acceleration will stimulate the otolith membranes located in the inner ear and send neural signals via the vestibulocochlear nerve to the brain. The eyes provide visual information about the position of the body while the otolith organs, along with nerves and muscles that control coordination and movement, maintain the body's balance. The otolith membranes are gravity receptors sensitive to gravitational changes during horizontal and vertical acceleration. When the body or head is tilted, that movement sends neural impulses to the brain to convey the new change of speed or direction of gravitational pull. When these membranes move subject to accelerated forces the movement can momentarily lead to disorientation. The forward acceleration of a take off at low-Gs can confuse the otolithic membranes that communicate information about the body's position in space. During takeoff a pilot can preceive a nose-high attitude when the airplane is actually near level or at moderate angle of attack. The brain is given a horizontal neural signal from the otolith of a change in linear movement toward the back of the head and will provide appropriate information for that position. Even though the airplane is at a slight angle of attack, the otolith membrane position will signal to the brain and identify it as an attack angle of 45° so the pilot must develop instrument disipline with frequent monitoring and trust of the information received from them.

Microgravity Research

Fifteen space stations have been in use for research starting in 1971. The International Space Station with over 36 long duration crews has been the most successful. Astronauts must exercise regularly to compensate for the 0-Gs weightless environment to keep muscle and bone density within normal ranges. Astronauts have already suffered vision problems after long tours in space. Early tests have not solved the problem of eye care and protection for long term exposure in microgravity environments.

Minneapolis, Minnesota Ophthalmologist, Dr. Richard Lindstrom, has been named to a NASA team of eye doctors to solve the questions about future space exploration and to solve why astronauts suffer severe vision problems. Dr. Lindstrom stated that "If we can not solve the vision problems associated with long term space travel in a microgravity environment, the Mission to Mars will not happen." The Mars mission is being planned for 2030, *STAR TRIBUNE • SCIENCE-HEALTH • FEBRUARY 1, 2015*