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EDWARD F. KNIPLING
How his life's work saved the livestock industry

E. F. Knipling

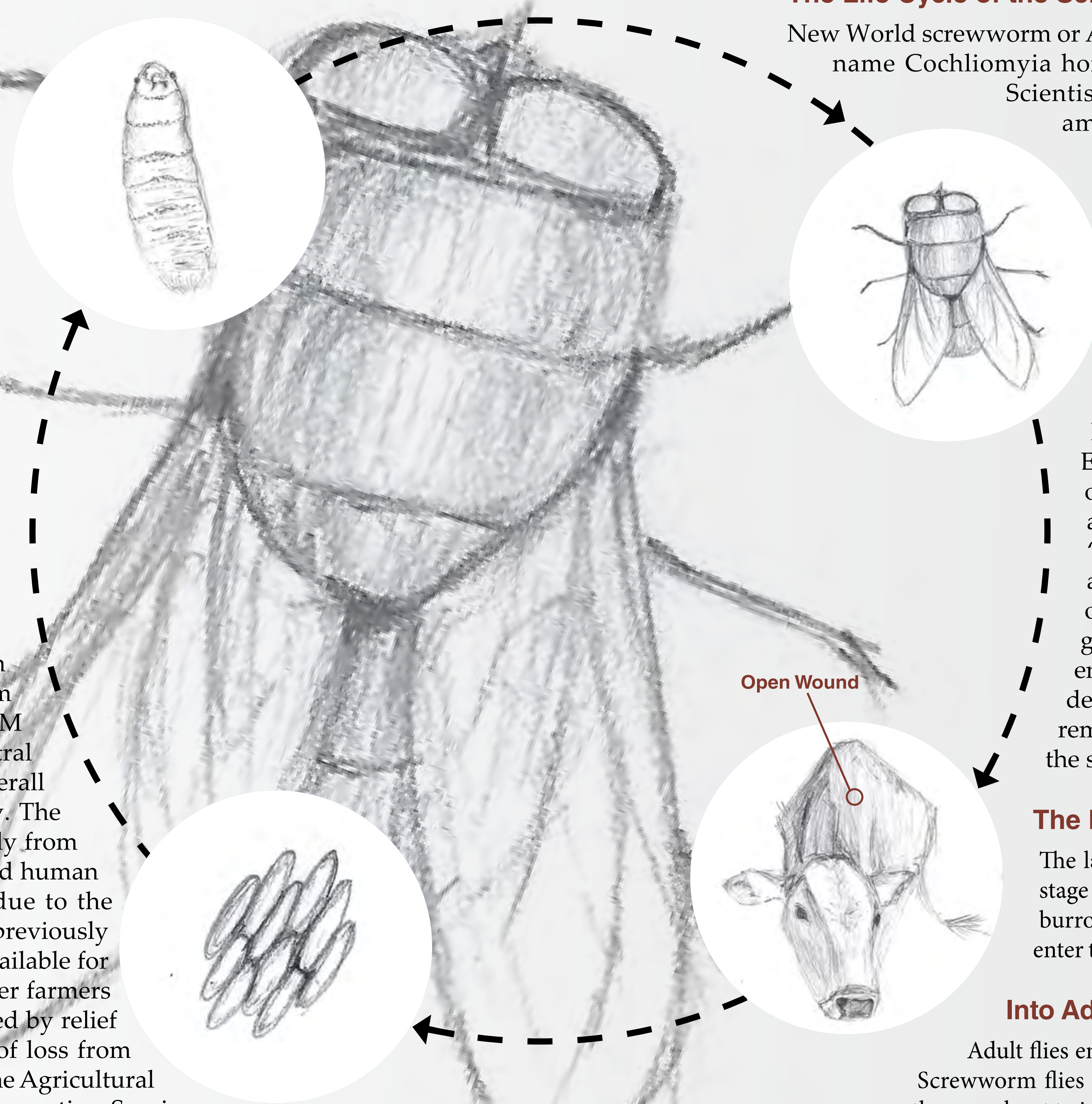
A Life's Work

Born (March 20, 1909 – March 17, 2000), Edward Fred Knipling was an American entomologist, who along with his longtime colleague Raymond C. Bushland, received the 1992 World Food Prize for their collaborative achievements in developing the sterile insect technique for eradicating or suppressing the threat posed by pests to the livestock and crops that contribute to the world's food supply. Knipling's contributions included the parasitoid augmentation technique, insect control methods involving the medication of the hosts, and various models of total insect population management. Knipling was best known as the inventor of the sterile insect technique (SIT), an autocidal theory of total insect population management. The New York Times Magazine proclaimed on January 11, 1970, that "Knipling...has been credited by some scientists as having come up with 'the single most original thought in the 20th century."

Disrupt-ing the Cycle

Raymond C. Bushland (standing) and Edward F. Knipling (seated at microscope). Photo courtesy of World Food Prize Foundation.

USDA estimates that the U.S. livestock industry benefits by more than $900 million a year as a result of the eradication of the screwworm. Mexican producers and consumers saved about $2 billion from the beginning of eradication to 1991. A 1995 Texas A&M University study evaluated the direct benefit to the Central America livestock producers at $73 million a year and overall economic benefits to the region at $257 million annually. The benefits to Mexico were estimated at $275 million annually from 1991 to 1994. In addition there are the benefits of enhanced human and animal health and increased standards of living due to the removal of this deadly insect. Additional grazing areas previously subject to high rates of screwworm infestation are now available for use by livestock and wildlife. The quality of life for smaller farmers and ranchers, especially in Central America, was improved by relief from lost man-hours needed to treat livestock and risk of loss from screwworm infestation. USDA scientists, primarily from the Agricultural Research Service (ARS) and Animal and Plant Health Inspection Service (APHIS), achieved the scientific and tech advances that made eradication possible.



The Life Cycle of the Screwworm

New World screwworm or American primary screwworm, known now by the scientific name Cochliomyia hominivorax (Coquerel) is endemic only to the Americas. Scientists. Some categorized the New World screwworm as C. americana or Callitroga hominivorax before the scientific community agreed on Cochliomyia hominivorax. The life cycle of the insect lasts about 21 days in warm weather and slightly longer in cooler climates. The adult female mates only once and lays her white, elongated eggs along the edges of wounds on warm-blooded animals.

The Larval Stage

Infestations are possible in smaller animals such as cats, dogs, and birds but the greatest economic impact is on larger animals such as pigs, goats, sheep, deer, and cattle. Even humans are susceptible to infestation, often in the nose or sinus cavities. Left untreated in humans, livestock, or wild animals, the egg masses hatch into swarms of larvae"the "worm" stage"which embed themselves in the host's flesh and consume the living tissue and fluids. The appearance of the larvae and the way they burrow into the host's flesh give the screwworm its common name. Feeding screwworms enlarge the wound and attract additional female flies, which deposit more and more eggs in the wound. If the infestation remains untreated, the host animal has little chance of surviving the secondary infections that often follow.

The Pupal Stage

The larvae gorge for several days to provide nourishment for the next stage in their development. Once mature, they drop to the ground and burrow shallowly into the soil. There they develop a dry outer shell and enter the pupal stage. The pupae undergo metamorphosis into adult flies.

Into Adulthood: Flies

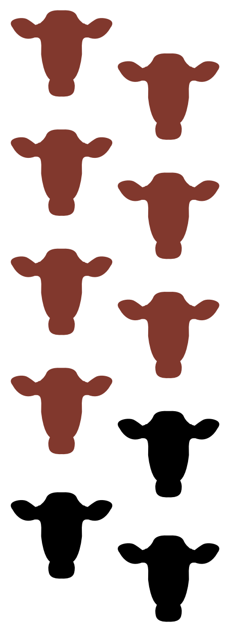
Adult flies emerge from the pupae and soon begin mating, to repeat the cycle. Screwworm flies are blue-green, have three dark stripes on their backs, and have orange eyes; they are about twice the size of a housefly. Sexually mature adults breed 3–4 days after emerging from the pupa. Females feed on the fluids from live wounds.

Sterilization by Radiation

World War II intervened and entomologists of USDA's Bureau of Entomology and Plant Quarantine, including Knipling and Bushland, were assigned to the Orlando, Florida, station to take part in research for controlling insects that threatened U.S. servicemen and women. The rapid development of atomic research provided the fifth crucial element needed to eradicate the screwworm: a way to sterilize large numbers of screwworms, which as adult flies could compete for mates in the wild. After the war, Bushland was assigned to the Livestock Insect Laboratory in Kerrville, Texas, part of the Agricultural Research Administration, which later became ARS. Knipling directed research on insects affecting livestock and humans from headquarters in Washington, D.C. In 1950, Alfred W. Lindquist, a colleague, drew Knipling's attention to an article by the Nobel Prize winner Dr. Hermann J. Muller on the sterilization of flies by radiation. Knipling saw this as a potential solution to the problem of mass sterilization. Bushland arranged to use hospital x-ray equipment to test whether radiation could effectively and efficiently sterilize large numbers of C. hominivorax. The experiment was a success, and cobalt-60 gamma ray equipment from Oak Ridge National Laboratory made it possible to sterilize masses of screwworm flies.

Full Impact

In 1972, there were over 90,000 estimated cases of screwworm in Texas. **7 out of every 10** *livestock were affected.*



Field Testing

Florida was selected to field test Knipling's sterile fly release technique. In the Southeast and the Southwest, the northern areas of screwworm infestation were insect free during the coldest winter months but were reinfested every spring by the movement of livestock and insects from the warmer areas, where the screwworm could overwinter. In the Southeast, these areas were central and south Florida. If these areas could be rid of screwworms, then the Southeast would benefit from eradication. A small, isolated area, Sanibel Island, a few miles off the southern Gulf coast" was chosen to prove the efficacy of the technique. Small planes released hundreds of sterile flies over the island. On the ground, scientists checked fly traps for the number of sterile to fertile flies and the overall number of flies trapped. The number of flies diminished quickly and dramatically, yet there was a small but steady reinfestation from the mainland.

Eradication Efforts

By 1958, under the urging of Florida livestock producers, including the Florida Cattlemen's Association, the Florida legislature appropriated funds for a full-scale screwworm eradication program. The federal government provided matching funds, and a larger insect production plant was built in Sebring, Florida. Under full production this plant produced 50 million sterile flies per week.

A severe winter in 1957-1958 drove the screwworms into a smaller overwintering area than usual. A rapid release of sterile males created a barrier zone across central Florida beginning early in 1958. For the rest of that year and the next, heavy and then lighter concentrations of flies were air dropped into 3 Florida zones. Although sterile fly releases continued through the end of 1959, screwworms disappeared from Florida and the Southeast earlier in the year. The Southeast was kept screwworm free by livestock inspection and quarantine, as well as occasional concentrated fly releases in areas accidentally reinfested by livestock from other areas.

Because screwworm populations that infested the Southwest overwintered in Mexico and Central America, Mexico's cooperation was essential to success. Screwworm outbreaks in central and southern Mexico and Central America were difficult to control. ARS and APHIS researchers developed new strains of screwworm flies that were more effective in competing with native males, as well as new feeding techniques for the larvae.

A severe screwworm outbreak in the United States in 1972 demonstrated the continuing vulnerability of U.S. livestock to the spread of screwworm from the flies' own flight range and from the movement of infested animals. The Screwworm Eradication Program Agreement between the United States and Mexico was signed the same year. Other pests throughout the world have been eradicated, reduced, or controlled by the use of the SIT and related developments.The techniques and technologies developed to control the screwworm, especially the Sterile Insect Technique (SIT), have been applied to other pests in North America, such as the Mediterranean fruit fly. The originators of SIT, Raymond C. Bushland and Edward F. Knipling, received the World Food Prize in 1992 for contributions to the well-being of the world population. In 1993, Mexico recorded its last screwworm outbreak.

Today the World Wide Web is a valuable tool in the dissemination of information related to screwworm eradication. Sites produced by USDA agencies and affiliated organizations expand the knowledge of ranchers and scientists. Information on the Screwworm Eradication Collection are located on the Special Collections page of the NAL website.

In 1992 Bushland and Knipling, the originators of STI (Sterile Insect Technique), received the World Food Prize for contributions to the well-being of the world population. Knipling also received the Japan Prize in 1995 for his contributions to Japanese agriculture industy.

By Becky Lake

Forgotten Piece of Me

This Personal esssay was first published in the Albemarle High Shcool literary magazine, 2016-2017

Fingers clenched around the flashlight handle, the texture and color of Candy Buttons. The dull orange beam, searching for some lost item, scans the desolate scene of empty water bottles and discarded tissues; the mesh fabric from the underside of my bed dangles above it all like tattered banners at the end of a party. The already faint light flickers once, a tiny orb of vivid orange glows, and then retreats back into the finger-tip sized bulb; the fuzzy darkness below my bed engulfs the scene. In frustration and acceptance of unchangeable situations, my fingers release the flashlight which falls upon the carpet with a muffled thud; the search ceases with the end of the battery's life. That misplaced object would remain a captive to the folds of blackness.

In the realm of household appliances, this illuminative feature dominates. While certain designs may temporarily confuse the user, a majority of flashlights resonate with ease of use; a button or a rotating knob that controls the strength of the emitted light. For ideal situations where something needs the clarity of light, then a flashlight meets the intended use. But technology should exeed its purpose.

My inclination towards literary work, my youthful disobedience; these factors influenced me as a child to remain awake (often past my bedtime) to consume another plot point, another character, another novel. As an eight year old my bedtime consisted of a strict "no lights after 9:00" rule; and I obliged for the most part. Once 9:00 PM faded away with the ticking of the clock and my eyes adjusted to the lack of light, I would instinctively reach behind my pillow for the craftily placed flashlight. And I would read with that yellow circle as my substitute lamp. Time dissolved; only the words, the story, and the glow of the flashlight mattered those late hours.

Apathy consumed my parents; the chains of a rigid bedtime no longer restrained me. Technologies occupied the place of personally selected books, my main room light replaced the flashlight; midnight transformed into a realm of homework and other pursuits. The nights of reading collapsed under the pressures of responsibilities. For me the flashlight once represented rebellion and satisfaction; it meant something. From a position as an extension of me, an essential element of the moment to an instrument with the sole purpose of identifying lost objects underneath the furniture in my room.

With maturity enclosing around my childhood, I found a few occasions to revive my flashlight; these certain events were camping trips. Besides the traditional use as a guide through the dark trails, this flashlight had another purpose. Once the embers of the fire eliminated the necessity of man made light, I would aim my flashlight up into the starry sky; the white line of light would shoot up into the blackness, into the mysteries of space.

The flashlight and its beacon for the glittering night sky merged with the experience and memory of those camping adventures; the proper use of the flashlight was insignificant in comparison. Even now I can still picture how the light stretched upward for an undetermined length; how it reached upward, approaching the reaches of a vast unknown.

Now Smartphones have overthrown the flashlight's domain; these convient devices come equipped with their own flashlight apps. Soon flashlights will become obsolete. Experiences like mine will fade away, obscured by the se these ephemeral creations.