New reference book by UCSD biologists dedicated to heroes of genetic studies: the fruit flies

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NEW REFERENCE BY UCSD BIOLOGISTS DEDICATED TO HEROES OF GENETIC STUDIES: FRUIT FLIES

To Dan Lindsley, professor emeritus of biology at the University of California, San Diego, the encyclopedic tome sitting on his desk is simply "the red book."

Though its nickname is modest, the seven-pound work recently completed by Lindsley and UCSD biologist Georgianna Zimm represents the most complete reference to anything that anyone ever wanted to know about one of the major experimental subjects in the study of genetics, the fruit fly, Drosophila melanogaster.

Historically, fruit flies have shared the genetics research spotlight with several other species, including mice, several species of plants, bacteria, a viruses called bacteriophage, and a tiny roundworm called Caenorhabditis elegans. Recently the zebra fish, whose early developmental stages are virtually transparent, has become a popular research animal.

But Lindsley believes the fruit fly has played, and continues to play, the largest role. "When you look at the sophistication of what the young researchers are doing today with fruit flies, it's just incredible," he says.

It all began earlier this century when a white-eyed fruit fly was lured by the aroma of an overripe banana into the laboratory of T.H. Morgan, a zoology professor at Columbia University. Morgan then began a series of breeding experiments with this fly and its descendants that confirmed the presence of a gene for eye color. The red book today lists several pages of fruit flies with mutated eye pigment.

About 4,000 mutant varieties are featured in the book, with complete descriptions--including detailed drawings in many cases- -of their physical, genetic and biochemical attributes.

Representing more than 10 years of painstaking digging in libraries and journals, the book published by the Academic Press condenses the research of thousands of scientists during the past century, who have used fruit flies as basic models for genetics studies.

Lindsley notes that this latest version of the red book, entitled the "Genome of Drosophila melanogaster," is actually a sequel to the original red book "Genetic Variations of Drosophila melanogaster" he co-authored in 1968 with E.H. Grell currently at the University of California, San Francisco.

"I think the first red book played a big part in making Drosophila such a successful model organism for molecular genetics," he said. "For people who didn't know a whole lot about Drosophila, this book was an authoritative guide; it described all the genes and chromosome aberrations that were known at the time. The new red book summarizes the information explosion that has taken place during the past 25 years, and it will be required in every Drosophila laboratory."

Lindsley, who has conducted research on chromosome behavior and male fertility in fruit flies, notes that these insects have been ideal models for genetic studies. Sequester a male and female fruit fly in a confined space and 10 days later they'll be proud parents of about 100 progeny. Fruit flies not only produce large families in short time periods, their genes also are easily mutated and reintroduced into other flies. They also require very little upkeep--a glass vial containing a nutrient medium of corn meal, yeast and agar will do.

"Any function that a fly can perform can be interrupted by mutation of the genes controlling that function," said Lindsley. For example, in one recent study, a team of UCSD biologists led by Charles Zuker used a mutant strain of fruit fly to identify a crucial protein that protects the light-detecting cells in the retina. The results could offer medical researchers new leads into understanding and perhaps reversing cellular degeneration that results in some forms of blindness.

Behavioral genetics is a current avenue of active research; mutations are known to interfere with the fly's ability to see, smell, taste, learn, remember, jump, walk, groom, court, mate or even fly. For example, a mutation named "dunce" is defective in short-term memory; flies can be trained to avoid certain odors or electroshock, but dunce flies rapidly forget their lessons. The protein product specified by the unmutated dunce gene has been identified and is known to perform a basic cellular function that is likely to be important to human memory.

The book documents hundreds of lethal mutations that interrupt some function that is vital to the survival of the organism, and in most cases these same functions are performed by nearly identical genes in humans. Lethal mutations have proven to be especially powerful in unraveling the role of genes in controlling the development from a fertilized egg into a complex animal with different organs and complex physiology. Three laboratories at UCSD are actively pursuing developmental genetics in Drosophila.

Lindsley noted that this version of the red book will be his last. The book's information already has been licensed to two research groups who will incorporate it into separate electronic data bases. It will be their responsibility to keep the material up to date.

"This book was more work than fun," Lindsley conceded. "It's like when you go on a camping trip in the rain; you look back on it sort of fondly, but while you were sitting there in the mud, it wasn't so great."

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