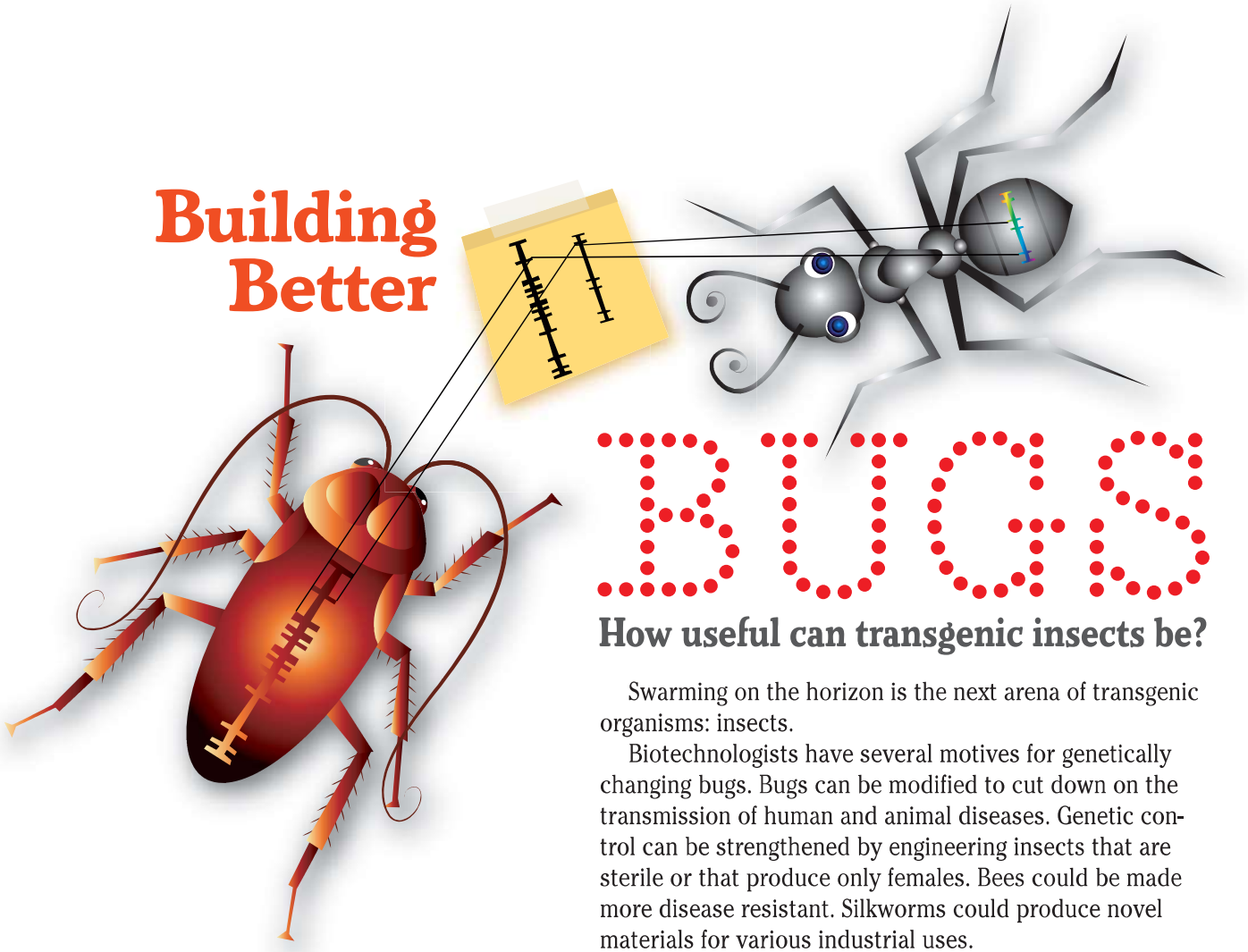
Building Better BUGS



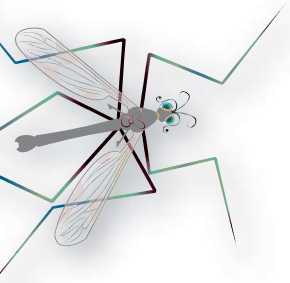
How useful can transgenic insects be?

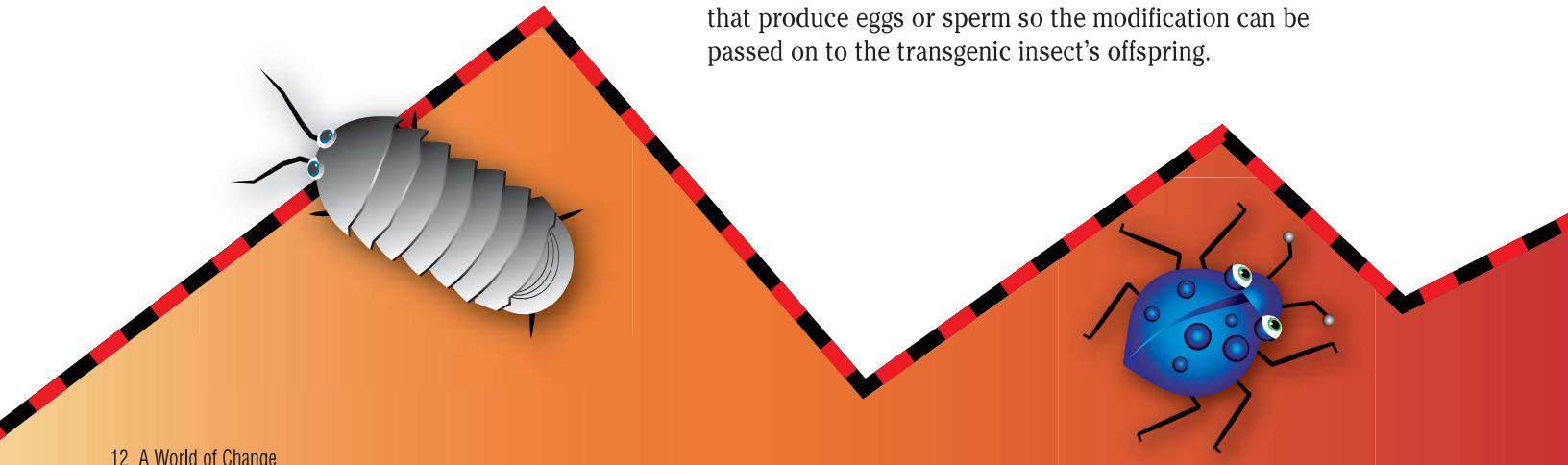
Swarming on the horizon is the next arena of transgenic organisms: insects.

Biotechnologists have several motives for genetically changing bugs. Bugs can be modified to cut down on the transmission of human and animal diseases. Genetic control can be strengthened by engineering insects that are sterile or that produce only females. Bees could be made more disease resistant. Silkworms could produce novel materials for various industrial uses.

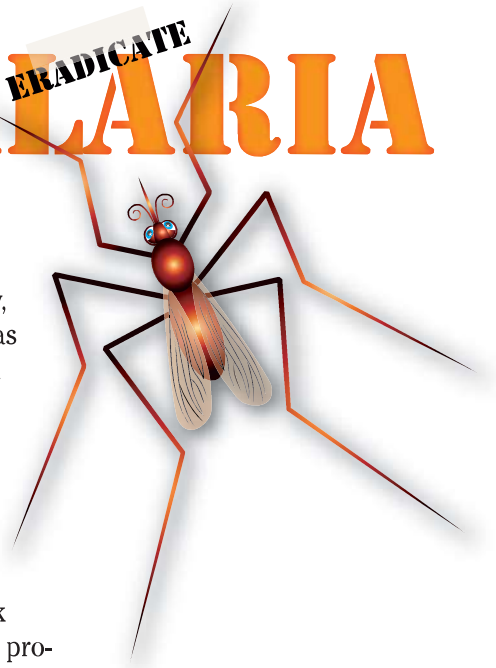
Transgenic insects are like other transgenic products discussed in this magazine—genes are physically inserted into the DNA in their chromosomes. Another kind of insect is also being created, called *paratransgenic.* These are made by placing a section of altered DNA into the microbes that live in the insects' alimentary canal. In this way, the microbe cells are made to express proteins that change the host insect.

To transfer the genetic instructions into the insect, scientists can place that DNA into a "jumping gene." A jumping gene (transposon or mobile genetic element) is a segment of DNA that can be integrated at many different sites along a chromosome. The gene is placed into cells that produce eggs or sperm so the modification can be passed on to the transgenic insect's offspring.





ERADICATE MALARIA



Great to Be Green?

One insect of particular interest is the mosquito that transmits malaria. Malaria infects 300 million to 500 million people and kills over 1 million annually, according to the World Health Organization. It has proven increasingly difficult to control. The creation of mosquitoes with green fluorescent gonads is a breakthrough in fighting the disease. Based on the glowing gonads, a laser machine can sort 180,000 larvae by sex in 10 hours. Once separated from the females, the males can be sterilized and released to mate with wild females. Female mosquitoes mate only once in their two-week life, so if they mate with a sterilized male they will produce no offspring. If a large enough population of sterilized males is released into the wild, the mosquito population should be controlled quickly.

Looking before Leaping

Because insects have been modified with a jumping gene and can't be isolated like plants or animals, researchers worry that a modified gene could show up in other bacteria or insects and cause problems in the ecosystem.

Labwork shows that the transgenic insects produced so far, such as the glowing mosquitoes, are not hardy enough to hold their own against the wild type mosquito for long. They stay alive long enough to cut down on pests, but die out after a few weeks. This can happen when all the insects come from the same insect that has been modified then cloned. Such a monogenetic strain—whether made by nature or a person—can be weak (see biodiversity article, p. 10). Researchers are seeing what happens when they cross lab insects with wild type ones.

Governments want to make sure that existing regulations can deal with transgenic insects. The insects will be difficult, perhaps impossible, to monitor when they're released into the natural environment. For that reason, scientific trials are going slowly.

Between the scientific and regulatory barriers that scientists have to deal with, it may be 10 years or so before these insects get to be out on their own. But the potential of insects in our biotech toolkit is something to buzz about.

—Lois M. Baron

Making mosquito larva gonads glow might light the way to less malaria.

A Certain GLOW

A fluorescent green pig? A glow-in-the-dark fish for your aquarium? There's a serious side to what seems silly. By taking a gene from a jellyfish that glows green and placing it into another organism, anyone can tell at a glance whether a gene can be expressed by that organism's body. In this way, the green fluorescent protein acts as a reporter gene.