Physics

Do sluggers swat on spot or swath?

Millions of baseball fans cheer each time Mark McGwire's or Sammy Sosa's bat kisses another home run good-bye. On Sept. 8, the St. Louis Cardinal star broke the 37-year-old, single-season record of 61 home runs with a sizzling drive over the left-field fence. Chicago Cub Sosa matched him a few days later.

While McGwire and Sosa are reaching the bleachers with uncanny ease this season, a physicist half a world away is offering evidence that the fabled sweet spot of their bats is more complex than previously believed.

According to both baseball lore and earlier scientific studies, the sweet spot is composed of one or maybe two points about 15 centimeters from the end of the bat's barrel. Although batters can hit home runs off other parts of the bat, a hit from the sweet spot delivers an exceptionally powerful wallop to the ball without stinging the batter's hands.

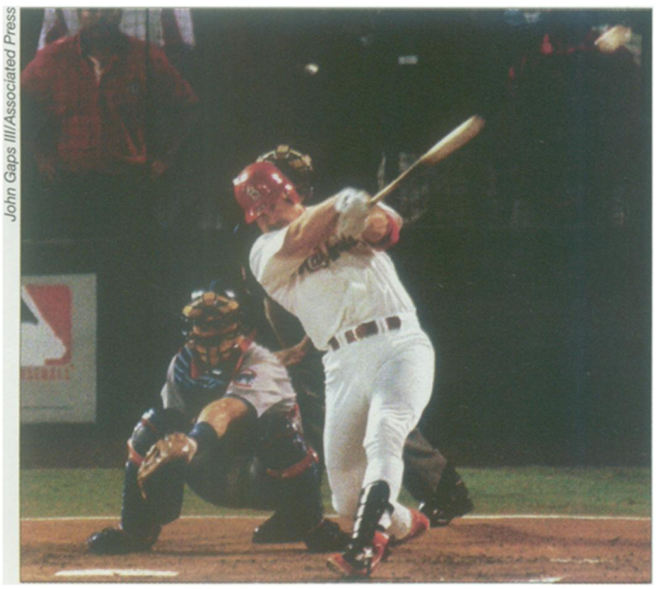
Now, Australian physicist Rod Cross of the University of Sydney reports that the sweet spot is really a 3-cm-wide zone, rather than one or two distinct points. Cross measured forces on batters' hands and noted what batters said they felt during impacts at varying distances along the bat. On a bat 84 cm (33 inches) long, the zone extended down from 15 cm from the top, he found.

Struck anywhere, a bat naturally vibrates with distinctive wave patterns, or modes. Previously, physicists identified one sweet spot as the point where the lowest-frequency wave pattern shrinks to zero and where an impact consequently causes minimal vibration in the handle.

Cross reports in the September AMERICAN JOURNAL OF PHYSICS that a higher-frequency wave pattern, which shrinks to zero at a nearby point, is also a sweet spot. "No one had measured these forces before or had identified that there are two equally important modes," he says. Because impacts along the barrel between those two points cause the weakest vibrations in the handle, Cross argues for a sweet zone.

Moreover, the zone concept is attractive, Cross contends, because recoil in the bat handle is minimized during hits near the two points. Such impacts cause the bat's fulcrum to shift to positions under the batter's hands where the torque drops to zero, minimizing the jarring felt in the hands and arms.

Why the interest in baseball Down Under? Although much less popular than cricket, Australian baseball is televised and growing in popularity, Cross says. —*P.W.*



John Gaps III/Associated Press

Mark McGwire slams historic home run No. 62.

Biology

Methylation: Protector of the genome?

Using enzymes as paintbrushes, the cells of vertebrates chemically coat large portions of their chromosomes with clusters of atoms called methyl groups. The phenomenon, known as methylation, has drawn great scientific interest in recent years as its connections to cancer have emerged. In many tumors, for example, excessive methylation seems to silence certain genes that normally suppress cell division.

In general, however, cancer cells exhibit a puzzling decrease in methylation throughout the genome. Scientists now suggest that this increases the mutation rate within a noncancerous cell and may therefore speed its malignant transformation. The hypothesis implies that methylation does more than just help turn genes off. "It's also crucial to preserve the integrity of the genome," says Rudolf Jaenisch of the Whitehead Institute for Biomedical Research in Cambridge, Mass.

In 1995, Jaenisch and his colleagues showed that mice with half the normal amount of the enzyme used for methylation developed fewer colon tumors than expected, presumably because tumor-suppressor genes could no longer be silenced (SN: 4/22/95, p. 246). Mice completely lacking the enzyme died as embryos, however, implying that specialized adult cells can't survive without at least some methylation.

Jaenisch's group has followed up this earlier work with experiments on a type of embryonic cell that tolerates the absence of methylation. In particular, the researchers have monitored mutations of two genes. In the Sept. 3 NATURE, they report that in the unmethylated embryonic cells, the genes' mutation rates were 6 to 10 times those observed in normally methylated cells. Most of the mutations were DNA deletions caused by recombination, a shuffling of genetic material among pairs of chromosomes that occurs when cells divide. This shuffling is rare in vertebrate cells other than sperm or eggs, which are typically low in methylation. Methylation reins in recombination, protecting cells from cancer-causing mutations, concludes Jaenisch. Removing this restraint "is an advantage for cancer cells because it increases the mutation rate by decreasing the stability of the genome," he says.

While researchers still need to find a way to extend the findings of Jaenisch's team to normal adult cells, the current study "backs the growing suggestion that if you lose methylation . . . from key sites, you're in some way interfering with genome stability," says Stephen B. Baylin of Johns Hopkins Oncology Center in Baltimore. —*J.T.*

Looking to moths for immune insights

The human immune response may be more sophisticated than that of an insect, but the two do have a common heritage that scientists find revealing. "By examining what happens in an insect, you can infer what happens in people," notes Charles A. Janeway Jr. of Yale University School of Medicine.

While the human immune system, unlike that of the insect, eventually generates antibodies and immune cells specifically targeted to particular microbes, both systems have an ability to respond quickly to infectious agents by recognizing common features such as bacterial cell wall components. Scientists in Sweden have now identified a new protein that helps insects, and presumably people, accomplish this feat.

The Swedish team infected moths with bacteria and identified the genes subsequently turned on. The researchers found that the insects increase production of a protein that can bind to the bacterial surface molecule called peptidoglycan. Genes for a related protein have been identified in mice and people and are active in tissues associated with the human immune system, Håkan Steiner of Stockholm University and his colleagues report in the Aug. 18 PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES. —*J.T.*