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NOBODY HITS IT

Scientist and artist join with baseball experts to analyze, for the first time, Hoyt Wilhelm's mysterious pitch

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One of the pitching sensations of the 1959 major league season is a 35-year-old cotton farmer from North Carolina who throws a baseball for the Baltimore Orioles in such a way as to make strong batters weep with frustration and to cause his own star catcher to fall on his reddened face in frequently futile efforts to perform his primary duty, i.e., catching the ball.

The name of the pitcher is Hoyt Wilhelm and his excruciating pitch is called a "knuckle ball," although knuckles actually have nothing to do with its diabolic success. Wilhelm uses it with such effect that he won his first nine games, allowing befuddled opponents less than one earned run a game, making him the most efficient pitcher in baseball. Included in the nine victories were three over the Yankees, three shutouts and a one-hitter.

Rocky Bridges, the tobacco-chewing shortstop of the Tigers, has been attacking the rest of the league's pitchers at a .300 clip—but hasn't been able to do a thing with Wilhelm. "It's like swinging at a goofy ball," he says with a mixture of admiration and resignation. "I just close my eyes and hope."

"I'm glad," says Yogi Berra, "that there's only one of him in the league. If everybody threw a knuckler, there wouldn't be a .200 hitter in baseball."

What then is a knuckle ball and why doesn't every pitcher throw one if it is so devilishly devastating?

In the first place, it isn't a knuckle ball at all. "It's a finger-tip ball, not a knuckler," says Wilhelm, displaying carefully filed-down nails on his index and middle fingers. Wilhelm grips the ball with his thumb and the very tip of these two fingers (see detailed illustration on opposite page) and lets fly with a relatively easy side-arm motion. From that point on neither he, nor the batter, nor his own catcher knows what course it is going to take. For most of 60 feet 6 inches of its journey to the plate the ball does nothing much but float easily and almost enticingly toward the expectant batter. This, as it turns out, is only a sly come-on, for suddenly it begins to bob and weave like Floyd Patterson moving in to throw a left hook. It wobbles, it flutters. It dances and dips. And then, finally, it darts dizzily off in one direction or another—sometimes down, sometimes sideways, occasionally even up—while the batter bludgeons the air and the catcher makes his frantic lunge.

The knuckle ball, or variations of it, has been used for years, but only a few pitchers have been able to control the thing with any reasonable degree of success. Included in the list are such storied masters of the pitch as Dutch Leonard, Ted Lyons, Fat Freddie Fitzsimmons, Eddie Rommel, Roger Wolff—and now Hoyt Wilhelm. Today there are pitchers in Wilhelm's own league, like Early Wynn and Frank Lary and Tom Sturdivant, who use the knuckler as an occasional spot pitch, a change of pace from their usual assortment of curves and fast balls. But Wilhelm throws it all the time. Bud Daley of the Kansas City Athletics might be tempted to do likewise, for he has an excellent knuckler too, except Daley hasn't yet solved the problem of getting it consistently over the plate.

Wilhelm has been a knuckle-ball pitcher since he was 18, and this, finally, is the secret of his success. He has thrown enough of them and worked at it long and hard enough to be able to control the pitch. And this year, for the first time, he has been a regular starter, with the opportunity of smoothing out the imperfections which always seem to arise when a pitcher doesn't get to work often or long enough.

YOU CAN'T EVEN CATCH IT

"That's the story," says Paul Richards, who manages Wilhelm and the Orioles when not answering questions about why Hoyt is suddenly such a success. "Nobody can hit a good knuckle ball. Heck, hardly anybody can even catch one. So if you get it over the plate, you get them out. That's what Hoyt has been doing."

With the season not quite half completed, Wilhelm has learned to control the erratic behavior of his pitch to such an extent that it has been a factor in the pennant race, keeping the punchless Orioles in contention most of the way.

After winning nine straight he lost his next two, once when the Detroit Tigers caught him on a night when the wind was blowing in toward home plate—always disastrous to a breaking-ball pitcher—and again when the Kansas City Athletics decided the only way to hit the puzzling pitch was simply to stick out their bats and just meet the ball. But Wilhelm is still 9-2, and his earned run average is so low that Hoyt's line in the statistical records on the Sunday sports page looks like the last line in the batting column.

Hoyt Wilhelm did not suddenly materialize out of Paul Richards' desk drawer, of course. He came up to the majors with the Giants in 1952, and that season, as a rookie relief pitcher, led the National League both in percentage (won 15, lost 3) and earned run average (2.43). He also had a big year in '54, when the Giants won the pennant. But in 1956 his control, which had been erratic at best, suddenly became worse. National League hitters, instead of swinging at the crazy thing, began to let the knuckle ball alone, waiting instead for the fast ball and curve which they knew Hoyt would throw when he got in a hole. And since neither would win Wilhelm a starting job with P.S. 33, the Giants let him go.

He went from the Giants to the Cardinals to the Cleveland Indians (where Bobby Bragan finally gave him his first big league starting assignment after 360 games in relief) and, on August 23 of last year, to the Orioles for the waiver price of $20,000. A month later he pitched a no-hitter against the Yankees.

This spring Richards and the Baltimore pitching coach, Harry Brecheen, helped Wilhelm correct a

few minor flaws in technique—he was flashing his grip before he threw, and he had a tendency to groove the first pitch in order to get ahead of the hitters right from the start—and since then Wilhelm has been flirting with perfection.

"He always had a terrific knuckler," says Ray Katt, who used to catch Wilhelm on the Giants and, as a consequence, is in the record books as the only man ever charged with four passed balls in one inning. "His trouble was control. I don't mean walking people, he couldn't control the pitch. One time it would break too much and the next not at all.

"I think that now he must have found the groove. He must have learned to throw it at just the right speed. Sometimes, with the Giants, he would throw too hard and sometimes not hard enough. Either way, the ball wouldn't do what it was supposed to do."

Perhaps confidence has as much to do with Wilhelm's success this year as control. Now, instead of using the fast ball or curve when he has to get a pitch over the plate, he sticks to his knuckle ball, throwing it even in 3-and-0 situations. And he gets the batters out.

Rick Ferrell, the Detroit Tiger general manager, once caught a Washington pitching staff which included four knuckle-ball pitchers, and this explains why Ferrell doesn't have much hair. It could have been worse. Neither Leonard nor Wolff nor Johnny Niggeling nor Mickey Haefner ever threw the pitch more than 60 to 70% of the time, Ferrell says. According to Gus Triandos, the Baltimore catcher, Wilhelm frequently uses the knuckler 90% of the time and there may be days when he will throw nothing else.

A LUNGE AND A PRAYER

"I don't know," says Triandos, when asked how he handles the knuckler. "The best thing I've found is just to wait until the last minute and then grab for it. If you get your glove up there too early, thinking it's going to break in one direction, you blank out the ball and then you're in trouble. It usually ends up going somewhere else."

Wilhelm looks as if he might be able to pitch all day, every day. He stands out there, getting the sign with his head cocked strangely over toward his left shoulder (the Orioles call him "Tilt"), and then goes into a smooth, easy delivery. Unlike most knuckle-ballers, who throw the pitch with a stiff wrist, Wilhelm keeps his limp. "If I use a stiff wrist," he says, "it makes the ball break too much." To keep the ball from rotating, he flicks it forward slightly with his fingers at the moment of release.

Wilhelm has a soft little knuckler which he is using now as a first-strike pitch, Richards explains. "He knows he can get this one over consistently, with at least enough break so they won't cream it." After that, there is not too much difference between any of his pitches. Most of them float up toward the plate with little or no rotation, and then they begin to do their tricks. Hoyt can throw one with just a little spin on it, too, "sort of a knuckle curve," as he calls it, that always breaks down. But his regular knuckler is as likely to go in one direction as another.

"The one that breaks up," says Triandos, "is almost always a high pitch, around the letters. It comes up to a certain place, starts dancing and then just takes off. If the pitch is thrown low, it usually breaks in a downward direction. To one side or another, maybe, but downward."

Can Wilhelm exert any control over the way the ball will break? "Heck no," says Hoyt. "I wish I could." Can he predict, even after he releases it, what will happen? "Nope, not even then." Well, what makes it do what it does? "Air pressure," says Wilhelm.

Since air pressure also keeps Hoyt Wilhelm from blowing up like a balloon and the walls of Memorial Stadium from crumbling to the ground, a trip was made to Johns Hopkins University to find out why the knuckle ball does what it does. There, on the second floor of Maryland Hall, sits the chairman of the famed university's mechanical-engineering department, a tall, pipe-smoking professor named Dr. Stanley Corrsin, who saw Wilhelm pitch his no-hitter last year and has spent a certain amount of spare time since attempting to teach his son how to throw a knuckler. Dr. Corrsin, a graduate of Cal Tech, is an aerodynamicist and a specialist in the field of turbulence. He is also a baseball fan. For two years he has been trying, without much success, to get one of his graduate students interested in conducting some research on the knuckle ball.

"I wish," he said, greeting the visitors to his book-strewn office, "that I had the time to do it myself. A fascinating subject."

"You understand," he explained, arming himself with chalk and striding to the blackboard, "that it is impossible to state positively what happens to a knuckle ball in flight without laboratory proof. But I can tell you what I think. Call it an educated conjecture."

Dr. Corrsin's explanation of what happens when Wilhelm throws his knuckler is reproduced on the next page. Omitted, however, are any references to the Magnus force, Venturi effect, Bernoulli's equation, angular velocity and drag coefficient. These might help clarify the situation for Dr. Corrsin, but it is highly unlikely they will have the same effect on anyone else.

"Last year," Dr. Corrsin went on to say, "we performed a few simple experiments."

SCIENTIFIC EXPOSÉ OF THE KNUCKLER

The flow of air around a moving baseball is always fairly irregular. This is because a baseball is a blunt object, as opposed to a streamlined object such as an airplane wing, and the air through which it passes must do quite a bit of hurrying to get out of the way.

Generally, however, the flow is relatively smooth on the top and sides of the ball. But once the air stream reaches the rear of the sphere it becomes confused. It no longer adheres smoothly to the surface of the ball but breaks away, some of it whirling on back into space, some of it sucked in close behind the ball to form a turbulent wake. This is much like the wake behind a boat, a whirling vortex of eddies and currents and agitated air.

The point at which the smooth air stream breaks away from the ball is known as the separation point, and the line formed all around the back part of the ball by these countless separation points is known as the separation line. It is never a smooth line but a zigzag, erratic one, for the air breaks away sooner at some points on the sphere than at others. This is caused by a number of factors, including the seams, the imperfection of any sphere, gusts of wind, etc.

In the case of a curve ball, which is thrown with tremendous spin, or a fast ball, which is thrown very

hard and also with a relatively high rate of spin, the very fact that the ball is spinning tends to have a stabilizing effect on its flight. It smoothes out the streamlined air flow even more, causes the separation points to occur further back on the sphere and reduces drag. The spin, since it is a somewhat overpowering force, also enables the curve or fast ball to proceed along a relatively smooth path.

Because the curve has both sideways and forward rotation, the streamlines which flow along the top side are vastly accelerated compared to those which flow along the bottom. This increased velocity on top sets up a pressure difference and forces the ball in a downward arc.

The fast ball reacts in an opposite manner. Here the ball spins with a bottom-to-top or backward rotation, those streamlines are faster which pass beneath the ball and the pressure difference established in this case tends to force the ball upwards. In a normal fast ball, this only offsets the always-present force of gravity, and the ball proceeds in a straight path. In the case of an exceptionally hard-thrown fast ball, such as those thrown by Herb Score or Don Drysdale, the ball will actually rise toward the end of its flight. This is the "hop" on a good fast ball.

The knuckle ball, however, spins little or not at all; any slight rotation it might produce is so small as to have little effect upon the ball's course. The dominant factor, therefore, is the interaction between the separation line and the turbulent wake. And these confused, swirling eddies not only slow the ball down, they cause unbalanced sideways pressure forces. These forces will eventually cause the ball to go off course. This is why the knuckle ball darts and jumps.

If the separation line was perfectly straight, the ball would go straight, for the pressure forces would be even. But since the separation line is highly irregular, so is the course of the ball. And since the separation line is constantly shifting and changing in its irregularity, the course of a knuckle ball may shift or change. The knuckle ball can change direction several times in flight. It is also well to remember that regardless of other forces acting upon the ball, gravity is always exerting its influence, too. Gravity does not make the ball break, but it does accentuate any downward motion. And that is why Wilhelm's down-breaking knuckler is much more abrupt than the one which rises.

Although the batter may be hard to convince, no knuckle ball—or any other baseball—breaks as sharply as it seems to. No blunt object obeying established physical laws can execute a sharp angle during flight.

"That is why," Dr. Corrsin says, "flying saucers can't make sharp turns."

One of his classes rigged up a 10-foot tube and sent a controlled stream of air up from the bottom, forming a homemade vertical wind tunnel. "We wouldn't have needed the air stream if we could have had a much taller tube," he explained, "but in the laboratory you have to use what you can to simulate actual conditions."

Into the tube they dropped ping-pong balls, rotationless ping-pong balls.

"They behaved," said Dr. Corrsin triumphantly, "just like Wilhelm's knuckler."

The balls would descend in a straight line for a short distance and then dip and dart and shoot off to

one side or another in a most alarming manner, displaying symptoms that would make Gus Triandos shudder in his sleep. By varying the force of the air stream, the class found that the balls would react more violently with a strong breeze blowing, less violently or not at all when the air flow was decreased.

"This is what happens," said Dr. Corrsin, "when Wilhelm pitches into a wind. The forces which act upon the ball are cumulatively greater. So it reacts more violently. As you know, he lost his first game the other night when the wind was blowing from his back. I understand the Detroit Tigers were overjoyed, for they had been anticipating just such a moment.

"If you would like to observe this phenomenon yourself," Dr. Corrsin said, "we can drop a few of these down the stair well." And he scooped up a box of ping-pong balls from his desk and, with the researchers in tow, hurried to the stairway of Maryland Hall.

There was a three-story drop to the basement and, as Dr. Corrsin predicted, the ping-pong balls put on quite a show. For approximately two flights of stairs, they fell in a straight line. Then they would wobble and shoot off to one side or the other, striking the concrete floor with a loud "pong" and bouncing around in the shadowy recesses of the basement. A large boxer dog materialized out of the semidarkness and began to sniff at the balls.

"Leave them alone, Max," yelled Dr. Corrsin. Max looked up with only slight curiosity, seemed to shrug a bit and went away. "He belongs to one of the professors," said Dr. Corrsin. "He's been around here for a long time." This seemed to explain everything, although maybe Max just decided he couldn't catch a knuckle ball, either.

"There are other factors which may govern the behavior of a knuckle ball, of course," Dr. Corrsin said, busily retrieving ping-pong balls. "No sphere, for example, is perfectly round, no matter what the Spalding company might say. There are imperfections, and these influence the way the separation line forms. Also, gusts of wind and humidity and air density could make the ball react more violently one day than the next. These variations, however, would probably be microscopic.

"Actually, the knuckle ball may never break as much as some of the hitters seem to think. But, make no mistake, it breaks. The problem here is also one of optics; the human eye is used to certain things and it can easily be fooled. I don't mean that the knuckle ball is an optical illusion. Not at all. But I understand that hitters like Stan Musial and Ted Williams can actually tell whether a pitch is a curve or fast ball by the way it spins almost as soon as it leaves the pitcher's hand. They can pick up this telltale sign and adjust their swing accordingly. With the knuckle ball, however, since it does not spin, there is no way to plot its course accurately.

"In addition, the baseball has a peculiar seam pattern, and this undoubtedly influences not only the air flow and the line of separation, but also makes the knuckle ball appear to wobble strangely or to turn over while actually not turning at all. Something of a barber-pole effect."

"This is all very enlightening," the doctor was told, "and fascinating, too. I wonder if Wilhelm would be interested."

"It is perhaps," Dr. Corrsin said, "just as well if he doesn't know. Then he would begin to think about

all this, and you never can tell what might happen. Did you ever see a golfer who was hitting the ball well, not thinking about anything but just hitting the ball, and then he began to worry about his backswing and his pivot and his stance and suddenly found that he couldn't get off the tee?"

"You sound like a golfer," it was suggested.

"Of sorts," said Dr. Corrsin. "But I'm considering quitting the game to take up the knuckle ball."

[IMAGES]

TWO ILLUSTRATIONS:
DANCING KNUCKLE BALL has made Hoyt Wilhelm big winner in American League, influenced pennant race. Pitch is actually not knuckler at all but finger-tip ball, thrown with the grip shown above.
ANTHONY RAVIELLI

ILLUSTRATION:
SHARP DOWNWARD BREAK, complete with in-or-out variations, is trademark of most knuckle balls, usually occurs immediately after the batter is hopelessly committed to his swing. Knuckler which breaks too far in front of plate is seldom a strike, while one which breaks too late presents hitters with nice, fat batting-practice pitch.
ANTHONY RAVIELLI

ILLUSTRATION:
UNUSUAL VARIATION is knuckle ball which rises or jumps up. Oriole Catcher Triandos says with Wilhelm this usually happens only with a letter-high pitch, does not occur too often. Manager Paul Richards says Dutch Leonard is only other knuckle-ball pitcher he can remember who also had a ball that seemed to rise at the last moment.
ANTHONY RAVIELLI

ILLUSTRATION:
BATTER'S VIEW shows that knuckler not only drops and hops but does sideways tricks, too. Simplest of these is one above, which resembles ordinary curve. Knuckler usually dances and darts first, however, then breaks with astonishing sharpness.
ANTHONY RAVIELLI

ILLUSTRATION:
ONE OF TOUGHEST for right-hand batter to handle is knuckle ball which appears to be heading for outside corner of plate, then swerves toward hitter. This pitch resembles screwball but absence of telltale spin makes it much harder to solve.
ANTHONY RAVIELLI

ILLUSTRATION:
TWIN SWITCH in course frequently occurs with knuckle ball, makes it a devilish object not only for batter to hit but also for catcher to catch. Triandos says best system is for catcher to wait until last split second, then make desperate lunge.
ANTHONY RAVIELLI

ILLUSTRATION:
SLIGHT DEVIATION can be almost as confusing as big one if it occurs at last moment, is abetted by fact that batter often gets so tense waiting for something to happen that he is completely off balance. Knuckler is psychological weapon, too.
ANTHONY RAVIELLI

PHOTO:
AERODYNAMICIST Dr. Stanley Corrsin of Johns Hopkins is fascinated fan of Hoyt Wilhelm's jitterbugging phenomenon.

ILLUSTRATION:
CURVE BALL spins forward; unequal pressures force it into downward path.
ANTHONY RAVIELLI

ILLUSTRATION:
FAST BALL spins backward, will "hop" if the pitcher can throw it hard enough.
ANTHONY RAVIELLI

TWO ILLUSTRATIONS:
KNUCKLE BALL does not spin, so dominant force is set up by erratic turbulence created when smooth air stream breaks away at back of ball. This is called separation line. In rear view of ball (right), separation line is irregular, constantly shifting.
ANTHONY RAVIELLI

ILLUSTRATION:
LAB EXPERIMENT showed nonrotating ping-pong balls behave like knuckler.
ANTHONY RAVIELLI