The Longest Inning

One of my early pitching experiences was in April at 7,000 feet elevation. It was a cold day--in fact one of my friends Randy Jacobsen quipped, "Spring has sprung, Fall has fell—it's baseball time and cold as hell." He was right.

At that time, there was no precise weather forecasting, so we didn't know or care what the weather would be for game time. We simply had gear with us that always included a coat and a light jacket.

When we arrived at the ball field that day, the wind was really cold, and I suppose it was whipping at a clip of about 30 mph. I had a good curveball, but in order to get it to curve effectively in the 60 to 70 miles per hour range, I had to put a high rate of spin on it. I did this by having a quick wrist, and I hooked my index finger so that the fingertip rested on the threads. So it was a slow pitch at a 75 degree arm slot that produced a lot of movement. But, in the 30 mph wind, what was this going to do to my control?

My coach, who had waited until we arrived to tell me I was starting that day, told me to line up parallel to the mound and plate for warmups, so that I could adjust my control to the effect of the wind. Of course we always did that, so it was not a surprise, but it was a good plan on that particular day.

The wind blew directly into my face and would be pushing directly against every pitch, so I was happy about that. First, I knew that my curveball would be breaking a lot if I could get control of it. Second, even though I was not an extremely hard thrower, I knew my four-seamer would be lifting better in the wind. I knew it was a lifting pitch, even if it could not rise, because the threads would not only be held in a perpendicular direction to my grip, but those seams would be spinning backward, lifting the ball as much as possible under the circumstances.

At that time we didn't have computers or smart phones to allow us to look up how others threw pitches, so my brother, who was a fast-pitch softball pitcher, taught me the concepts. He could make a rise-ball lift by 12-14 inches at about 75-80 mph. I knew that the backward spin would cause the baseball to lift because I had been catching his rise-ball for several years. It would lift, even if it didn't rise like a softball; but would I be able to use my fastball to get outs at my rate of speed?

We hit first and got a lead. So, in my first inning I was pretty relaxed, but that wind was pretty hard right into my face. During warmups a grain of sand hit hard on my cold cheek. It made my right eye tear up a little. I remember the tear rolling off my face and into my ear, but it was time to pitch. I struck out the first hitter on 4-seamers. Sure enough, he was swinging under the ball, just like I had hoped. The second hitter held the bat high above his shoulders—I pretty well knew I could get him out, because I felt that in the process of bringing the bat down, he would probably drop too low on my upward lifting 4-seamer. My catcher called for a curveball. Ball one; then a fastball--strike one. He called for another

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curveball, but I had not settled into a groove on that pitch. I shook him off. He assumed I just wanted a unique pitch, but I wanted another 4-seamer. He called for the 2-seamer. I shook him off again, because I was concerned there would not be enough lift, and it could easily put his bat right on. The umpire had called for the pitch and was getting frustrated (probably due to the cold wind)—and the next thing I knew he called a ball due to delay--two and one.

That had never happened to me before and my coach was furious. Then my catcher called for a curveball and since I could see my coach getting frustrated, I threw it—three balls and one strike. The catcher was beginning to realize I was struggling to hit the strike zone with my normally good curveball, so he called a 4-seamer. The hitter swung and missed (under it!!)—three and two. Now I had him.

The catcher called for a 2-seamer. Now at this level of baseball, I suppose I should have just thrown the 4-seamer—the catcher wouldn't have had a problem catching it and I would have been happy with the result, but I didn't think of that. I shook him off. I shook him off again. The umpire enforced a ball and sent him to first...my coach came out of the dugout screaming at the umpire, but walking straight at me. In no uncertain terms, he was bleeping ticked, let me know it and told me to never, ever shake **his** catcher off again.

The inning didn't get any shorter. Now, I'm facing the third and best hitter in the line-up and I haven't even gotten a feel for their talent yet. I can't shake the catcher off anymore and my curveball, which he's so stuck on making me get control of, is diving out of the zone. I've got a runner on, so I've got to hold him on first from the stretch, which will cause me to make another little adjustment. But, oh well, I'm a pitcher! It feels like I've been on the mound for 30 minutes and I've only thrown 7 pitches.

The wind wasn't letting up any. If anything it was getting stronger and colder. I walked another hitter, but now I'm getting settled in with each of my pitches. Two runners on, only one out– they haven't even touched the ball yet!! But, I knew that I could harness the wind, because it was obvious if I could hit the zone, I had these hitters where I wanted them. My catcher began calling 4-seamers with fear and trembling. He came from the school that if the wind is blowing out toward the outfield, then the ball would fly out of the park easier. However, I came from the school that they first had to square up on my pitch with good movement from the wind's effect.

My catcher quit calling the 2-seamer and even the curveball. The wind made it obvious that I had more friction from the air on my 4-seamer, but what **no one** on the field knew was that the ***cold*** was also making the air heavier even if it hadn't been moving at 30 mph. I struck out the next two hitters on the 4-seamer alone and got out of that inning with a sigh of relief. My catcher and I got on the same page from the dugout and we made short work of the remaining innings. To be continued….

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The Little Championship

Before that "Longest Inning" game I didn't realize that those hitters had been playing and practicing for several days in 70-degree weather both inside their practice area and outside on the field. Later I would put those things together for a rounded understanding of the competition between the pitcher and his opposition. I discovered that a little more **density** in the invisible calm air does the same thing as the wind does, in favor of the pitcher and to the horror of hitters who are surprised by the movement.

I pitched some baseball throughout my high school years, but shortstop was my love, so I went as far as I could into college with that being my most loved position. But unknown to me, those who watched me play felt I was a better hitter than a defensive player. In fact, my college coaches tried to move me around to get my bat in the line-up without telling me what they were trying to accomplish, and I was too shy and not smart enough to ask.

Near the end of my college years I had already given up on baseball and was pitching fast-pitch softball for a local team. Of course, having been a catcher for my substantially older brother in my youth, I had learned everything he had taught me: so I could pitch, but was no match for him in speed. I wasn't really slow for that type of ball, but neither was I in the upper speed ranges of those top pitchers.

Fortunately, I had a good team built around me, and we made it all the way to the **championship finals** of that league. At that point in my life I still didn't know much about the air resistance differences across the country and across the spectrum of weather conditions.

Championship game day came, and to no one's surprise it was a cold day in the spring. Our opponents that day had a faster pitcher. A big guy and former college football player, but he just threw hard with downward spinning thread rotation. (The good thing about this type of pitching in fast-pitch is it is too fast for some hitters, has the downward action for late movement, and is very accurate. The bad thing for this type of pitcher is that former baseball players account for most of the competition, and they are used to a pitch that is pointed downward from the pitcher on the mound to the strike zone.) This pitcher did not throw the rise-ball, but had a good changeup and, although we struggled, we were able to put some runs across the plate.

My game was a mixture of a small rising pitch of about 8 inches of lift, along with a downward spinning drop ball (as we called it), and a knuckleball that worked about half of the time. I also threw a curveball which is more of a slider in baseball terms.

I kept that team of players off balance the entire game. No wind; higher altitude (at 5,000 feet elevation), but it was a calm, very cold day. That team shook their heads in disbelief that they could not hit this "slower than top tier" pitcher. We won that championship game more easily than I would have imagined, but the density from the cold air helped me lift the pitch over those bats with about 12 inches

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of lift instead of my normal eight. In fact the opposing team was a more experienced and better quality team than my team, but these days I realize it was not me, but the air that moved the ball more than what they were used to seeing. My portion was found in being accurate enough to put the ball in the right place. To be continued……

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Day and Night

A few weeks after my championship game, I was invited to pitch in a regional fast-pitch game with a Colorado State top level fast-pitch team. I was feeling strong coming off my championship run. I was confident. I was throwing better than I've ever thrown before or since.

In those days if a pitcher could throw a rise-ball he would use it regularly and on occasion throw a changeup or drop ball to keep the hitter honest and struggling to hit off him. That is the way I started this game. I lasted about a half inning, but then I learned something by sitting on the bench and watching some extremely talented teams.

The team I was on was a top tier fast-pitch team that regularly won the regionals and moved into contention for a state title at the top level of men's fast-pitch. On this particular regional weekend our team (without my help) got to championship day without a loss. Since all the other teams had been beaten out of the tournament, our opponent had one loss and therefore had to beat our team twice to win the championship.

It was an extremely hot day in the middle of the summer, and as I've mentioned before, the altitude was over 4,000 feet elevation. The schedule called for us to play the first game at about 2:00 in the afternoon, which was scorching hot. One of the better pitchers in the state couldn't get his rise-ball past this team. He tried all of his tricks--drop ball, knuckleball, curveball, change of speed (with each type of pitch), and of course his normally effective rise-ball. This team of young, quality players bounced the ball off the fence regularly and won the game handily. That set up the final game between the same two teams for that evening at 7:00 p.m.

The same team that had pounded the ball in the afternoon swung under the rise-ball the entire game and could not touch the ball from the same pitcher they had just faced a few hours earlier. Some of us shook our heads in wonderment; the others just said "that's fast-pitch."

Now in Colorado at 4,000 feet or above, the evening cools down quickly. So by game time the temperature had dropped by 30 degrees from about 98 degrees to 65 degrees Fahrenheit. Little known to baseball people at that time was that a drop in temperature of that magnitude would change the air density enough to allow a ball larger and lighter than a baseball to rise an additional 4 to 6 inches. Scientists know this is true, but baseball and fast-pitch people are performers, not very scientists. Our pitcher was taken advantage of in the hot temperatures, and then he turned the tide on them in the much cooler air and won the tournament championship.

Scientists use a scale that measures from sea level to the very edge of the atmosphere. You may have heard that this scale in pounds per square inch measures 14.7. That creates a scale that is jammed together with few measureable points between. Yet the surface of the earth varies from sea level to

29,000 feet—and many sports and activities take place within this vast geographical spectrum. So scientists can put “0.0067 pounds per cubic foot” for example into their formulas and make sense out of it for weather and for rocket launch and trajectory purposes.

Baseball players, on the other hand, would need to know what the effect might be in their ability to perform between say “0.0067 and 0.0068,” and yet those numbers are meaningless to them and the gap appears harmless. To be continued…….

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Demoralization in Telluride

On the 4th of July every year in Telluride, Colorado, there was an exhibition game of baseball during this period of my fast-pitch and baseball playing days. Shortly after my baseball team competed in a state playoff tournament, we were asked to face in this exhibition the same team we had surprised to get to state during the regular season. We had beaten this quality team in a double header 1-0 and 2-1 to win our conference that year. On a hot 4th of July day a few months later we beat the same team of mostly the same players by a score of somewhere around 21 to 12 with very few errors being committed by either team.

As I recall, there was an exhibition game in Mexico City some years ago between MLB teams that had a similar result. Our game was at 9,000 feet on a hot day in Telluride. Their game was at 7,000 feet on a similar day in Mexico City. The all-time highest score in MLB's Minor Leagues was a game played on a hot day in Amarillo, TX, at over 3,000 feet elevation. What do they all have in common?: Air Density and the teams' ability to hit the straighter pitches. The maximum movement generated by any pitcher is that which the environment allows on that day.

Remember that fast-pitch team that got beat in the hot temperatures at mid-day only to win later that evening with the same pitcher throwing the same rise-ball to the same team? That same talented pitcher was asked to play an exhibition game at the same 4th of July celebration mentioned earlier in 9,000 foot Telluride. After that game he had decided he should retire. He related this story to me, although I was not present for the game:

> Still being one of the top tier fast-pitch pitchers in the State he experienced another game where he could not get the ball by a team he had played previously at 4,000 feet with success. Demoralized, he said he didn't know what was wrong with him as a pitcher. During the game he had thrown his very effective rise-ball, but that pitch must be thrown toward the waist of the hitter and toward the center of the zone and then end at the outside top of the strike zone to be effective. That is because if the rise-ball angles downward from the release point at the pitchers' knee level, it will never recover from gravitational forces to rise above its lowest point and therefore becomes ineffective as a pitch.
>
> In this case he said he couldn't reach the top of the strike zone with his rise-ball and the hitters could get both their eyes and their bats squarely on the ball. He began to throw the ball about 6 inches higher to reach the top of the zone, but the hitters would not swing because they recognized it would be too high. Further complicating the issue was the umpire. He could also see that the

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ball was coming toward the top of the strike zone and was not calling the strike. The pitcher was fooling no one.

On the way home he decided to retire. He was washed up, too old, and no longer effective as a pitcher. Depressed that the younger players had now caught on to his rise-ball, he realized he still had to somehow get through the remainder of his schedule during July and August for his team. He was the only pitcher.

He went home, pitched in his own environment, and realized he was nowhere-near washed up. He pitched another ten years before finally giving it up.

Some of the demoralization that is apparent in Major League Baseball comes from pitching at either Coors Field at 5,000 feet elevation or from pitching against a team in warmer temperatures than the pitcher is used to. When the two aspects of air resistance gang up on a pitcher **everyone** thinks that pitcher should retire. To be continued…..

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Cold Weather BP

Getting through a cold spring of baseball can be a challenge. Day after day, game after game a baseball player never knows what is coming his way in terms of cold, wind, rain or snow. (And in the old days, there were no advance warnings of weather systems hitting locally.) Furthermore, there are only so many days of preparation each week for the game day schedule, so every day to work out is important. Players and coaches just have to work through the cold weather whatever comes.

However, these weather systems can make or break a hitter and/or a pitcher. One of our better pitchers was called upon to pitch live game day for practice, in preparation for an important contest for the conference championship. That day probably prepared us in a way none of us--coach, hitter or pitcher--could possibly have imagined. That pitcher, Robert Durant, had a good fastball and generally threw a two-seamer as often as a four-seamer. The two-seamer gets about 40% of the lift that a four-seamer gets, but close to twice the tail-off of a four-seamer. He was tough to hit, even on a good day of hitting. But the pitch I remember the most got my attention for running far into my hands in cold weather hitting practice.

I didn't know it at the time, but since then I've done studies on air density, and the cold air that day may have prepared us for two of the best pitchers we ever faced. During preparation, Robert was tough. After a couple 4-seamers and a curve or two, and a couple fouled off pitches, he threw me a devastating two-seamer toward the inside corner. I just about took a hack at it. That pitch moved inside in a heartbeat. I had to bail out in a hurry, and I've never seen another two-seam pitch break like that since. For those of you who understand precisely what I'm speaking of, this was not a pitch turned in the hand to create a one-seamer cutting inside; this was a true two-seamer. I didn't have time to pull out my tape measure, but I would guess that pitch broke by as much as 14 inches. Had I swung at that pitch, I may have missed the rest of the season with broken fingers.

All the pitches he threw that day had a lot of movement. It was cold but not blustery. Since they all had good movement, we got some of the best practice during that week of any I can remember. But none of us understood what was happening.

Game day, Saturday comes and it blossoms into a hot May afternoon for a double-header at our home stadium at 6,000 feet elevation. Now, keep in mind, we were fully conformed to the normal pitches at that altitude, but had not seen two pitchers of the caliber this team sported. They were both left handed and were eventually drafted. Our pitcher went on to pitch for two colleges, so he was good, as well. Our opponent that day was from a baseball city about 160 miles away at 4,000 feet elevation, and they had nice weather all week for the upcoming contest. They couldn't believe what transpired that Saturday.

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They had traveled upward by 2,000 feet to our stadium, making the air that much lighter. They had been in warm to hot conditions all week, whereas we had been practicing in cold weather out of doors, making our preparation for movement on a pitch better than we would normally have seen. We were wide-eyed and competing against a formidable foe. They were confident and talented. We won both of those hard fought games, but that hot day flattened those pitchers' fastballs like Coors Field flattens the best pitches available in the MLB. We went on to the state playoffs and they went home.

To this day, those two pitchers, if asked, would probably shake their head and say—***I have no idea how that happened*.**

Speed is the friend of the pitcher and the enemy of the hitter. Hot air and high altitude are enemies of a pitcher. Cold air and low altitude are also enemies, but of the hitter. So what about humidity? To be continued…..

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Altitude, Temperature and Humidity—Constantly in Flux

So what about humidity? Well, as I have explained in detail on my website, humidity does not create heavy air for a ball to push through. Heavy air is caused by pressure on the air molecules being pulled down by gravity. As air molecules repel each other they keep the distance between them that is standard for the altitude and temperature conditions. Air molecules stack up on the earth just like anything else; however they also push upward and sideways against each other to maintain the distance allowable within that pressure. Wind is caused by the air molecules resisting each other and pulling each other back together to equalize the distance between them.

At sea level there is 5,000 feet more air stacked up than is stacked on Denver, Colorado, at 5,000 feet elevation. Additionally, when air gets cold and the molecules become sluggish, they can be pushed closer together. These two (sea level and cold air) are the main cause of greater air density. Engineers, scientists, physicists, pilots, meteorologists and many other disciplines understand the air density. Baseball people are just beginning to study this topic.

Humidity creates lighter air, not heavier air. It feels heavy against our skin and makes our bodies feel sticky, but there is more hydrogen in it than in dry air. There is more nitrogen in dry air, and nitrogen is heavier than hydrogen. So a baseball flying through the air is knocking molecules off it while the air molecules are pushing back against the ball.

Humidity is not a very significant amount of the density issue for baseball. Humidity accounts for only about 3% to 5% of the lift on a 4-seam fastball and is opposite what we feel on our bodies—dry air pushes the ball more and humid air pushes it less. There are still some studies that need to be done on humidity as it relates to baseball; but the facts I mentioned are basic.

After the championship fast-pitch game I revealed a few articles ago, I pitched at about 300 feet elevation. Although the air was humid and warm, I could hardly keep the fast-pitch rise-ball within the strike zone as I threw it toward the thigh to belt level of the hitter. At 5,000 feet in elevation, I could only make a pitch rise about 8 inches. At 300 feet elevation, at the same speed, I could make the pitch rise almost double the amount. In my case it didn't matter; the hitters there were used to that amount of movement and my speed was not overwhelming.

In baseball a pitcher's only significantly upward lifting pitch is the 4-seamer. It will lift about 3 inches more at sea level than at Denver, and it will tail off sideways about 5 inches more. No wonder coaches think they've really faced a quality pitcher when their team of hitters from a higher altitude plays at a lower elevation. The hitters from higher altitudes are simply not used to it.

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Since this subject gets rather technical and baseball players have little time for such talk, I created a gauge of air density for use by athletes. I acquired the help of Colorado State University Professor Emeritus, Dr. Douglas Hittle, who provided me with an air density formula for my scale which accounts for all three factors constantly in flux, now called the "Neeley Scale." The Neeley Scale gauges only the segment of the air density between the mountaintops and sea level on a 100 scale, rather than extending it all the way to the outer atmosphere.

For the purpose of comparing teams' performances within various air densities, I created another index which uses a scale based on how familiar a team is with the air density they will play in their next game. This is called the **Visual Memory Index** **(VMI)**.

By utilizing the VMI, we can compare player's and teams' performances within each of the ranges of air density ***with which they are more or less familiar***. We show the sortable stats on the website. The advantage this provides for MLB and for fantasy players is to know in advance **when, and against which pitches,** players and teams will be most effective.

Most players and coaches assume the difference in ball movement due to air resistance is rather small. The reason they assume it is negligible; is they give all the credit for **movement** to the pitcher without understanding the air resistance from a scientific basis.

To give you an example of air pressure that sounds negligible, but is not-- consider that at sea level scientists measure the air at 14.7 psi and at Denver at 12.29 psi. The difference is 2.41 psi, but is not negligible at all. PSI—(pounds per square inch) identifies pressure on a very small area, smaller than the leading surface of the baseball. If one considers PSF (pounds per square **foot**), then 12" X 12" = 144 square inches X 2.41 psi equals 347 pounds per square foot. When calculated for a surface the size of a door in an airplane, the same differential of 2.41 psi = 7,287 pounds.

So, when a 6 oz. baseball with a leading surface of approximately 3 square inches pushes through about 54 feet of air at 90-95 mph through sea level pressure vs Denver pressure; it will be pushed by the air by approximately 2 inches upward and 3 inches tail-off. Then, when the air is colder at sea level vs warm air at the higher altitude location, another 1.7 psi in differential is created. This causes an additional almost 2 inches upward and 3 inches more tail-off.

This is where the VMI is helpful to know when and how much a player is adjusting. There are sortable stats on the www.baseballvmi.com website so that you may check to see how a player performed against each type of pitch and within each adjustment category. In my next article, I will show some of the stats for the entire league along with how to utilize this to make predictions.

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Changing a Team's wRC+ Statistic

Even casual observers understand that the Colorado Rockies are the single most unique team ever to compete in Major League Baseball. They have the highest home batting average of any team ever over the course of their history and maintain the highest home winning percent over their history. But, coupling those gaudy home numbers with the lowest road batting averages and win percent, as well as recent revelations of their Weighted Runs Created, Plus (wRC+) statistic, the Rockies remain an anomaly, almost indescribable.

A recent article in the Denver Post by writer Patrick Saunders pointed out the wRC+ road statistic as being the worst in the league in spite of the overall high scoring production. Mr. Saunders also outlined the management's planned attempt to bring the road stat into more normal ranges. To be fair, the management has their hands tied. Each year the Rockies add another statistical anomaly without being able to fix any, and the team has done nothing in terms of facilities to prepare for the future, so a new idea must be born every year in order to promise the fans a reason to buy tickets. Just as all the other teams in the league have done for years, they promise a new player, a new coach or manager, and/or a new focus on bringing the most recently exposed anomaly into conformity with the balance of the league. The Rockies think they are making progress with the team and the fans, but it always turns out to be a disappointment to everyone. A subsequent article by Mr. Saunders revealed what almost everyone in baseball agrees with: The Colorado Rockies are loaded with talent.

In 2016 the plan is to use a drill while in Spring Training in Scottsdale, AZ. which will be fun (that is, if putting money in a hat and gambling it against winning an inning is fun) and will cause professional players to focus better than they were capable of during the previous years. So, let me get this straight in my head...the problem over the course of their history was focus? The problem was not trying hard enough to play the necessary small ball? Let's see, was the problem then Vinny Castilla's? Walt Weiss's? Todd Helton's? Larry Walker, Craig Counsel, Andres Galaraga, Dante Bichette, Troy Tulowitzki, Carlos Gonzales, Blackmon, Dickerson, LeMahieu, Fowler, Arenado, Cuddyer, Morneau, Jeff Baker, Matt Holliday, Eric Young, Clint Barmes, Juan Uribe, Jeff Cirillo, Chris Ianetta, Nick Hundley (.355 Home and .237 Road)? Just who, over the past 22 years, hasn't been able to focus on doing things the right way, playing good small ball, and creating runs, like a quality professional baseball player? Maybe it was the fault of managers (Don Baylor, Jim Leland, Buddy Bell, Clint Hurdle, Jim Tracy) and now Walt Weiss!

Actually, the answer is ***all of them were handicapped by playing professional baseball with their home field at Denver, Colorado***. This drill that is planned at 1,200 feet Scottsdale in warm weather will do nothing for the team in terms of wins and the wRC+ statistic. However, if (during any season) they could fly to a sea level location, run the drills, take BP and bunt good moving pitches for about 3 days prior to leaving on every road trip, then this planned drill would have a chance to take effect. Obviously

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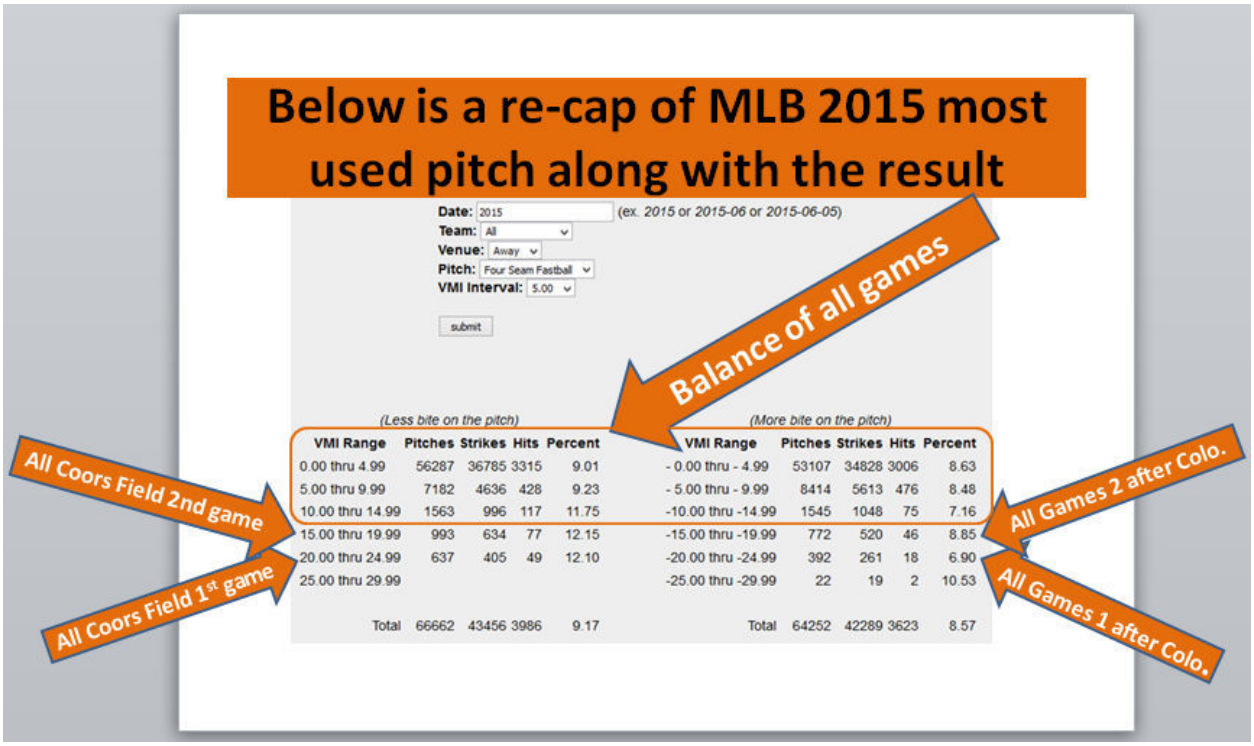
they can't do that, because the schedule will not allow them to do so. Therefore, their work in spring training at Scottsdale will have little positive effect on the team statistics.

If you have been doing some reading on the Rockies and on the effects of altitude and temperature on a baseball pitch, then you know that I am referring to the data on MLB hitters and pitchers moving in and out of good ball movement conditions. Baseball is a much easier game to play when you know effectively where the ball is going. When players spend a home stand at Coors Field, then leave for a road trip to say, San Diego, the ball is diving and darting and they aren't used to it. How are they going to consistently compete in a professional league against ***the Home Team*** under those conditions? They have two different games to play -- one type at home and the other on the road -- and it is well known that professional athletes, in order to keep up with the competition, must be exposed to the full gamut of MLB ball movement **every day** as opposed to on and off every two weeks or so. The extra movement players experience upon leaving Coors Field makes it impossible for them to bunt effectively, hit and run effectively, get timely hits, move runners around the bases, throw accurately from catcher to 2nd base, pitch with precise control, and play the game with great confidence.

Typical baseball answers will never work for Coors Field players, so all the advice the team takes from traditional baseball coaches, managers, owners and players will not work except for in typical baseball aspects. Colorado high school and college coaches and players cannot help the Rockies as they misunderstand the difficulty of the ball movement transitions for players in MLB. These are far more complex for Denver than for the balance of the league. Players, coaches and managers from outside the Rockies organization have never needed to deal with this issue, so few understand enough to help the team. There are teams within MLB that carry tendencies that the Rockies carry, due to either hot temperatures or above sea level locations, but they lose only a maximum of 8 to 10 road games per season as a result. The Coors Field effect causes the Rockies to **lose 18 road games per season** due to this transitional effect, and some additional games each year, due to the lack of confidence that losing creates.

Below is a summary of all teams' road numbers ***including*** when they first travel to Denver for a series, ***plus*** the first few games away from Coors Field for all teams.

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The numbers displayed above are statistical proof that all players in MLB are affected similarly by additional ball movement on the **four-seamer**. Further, it is statistical proof that they all adjust to familiarity within 3 to 6 games. For the Colorado Rockies, it is obvious that they need a place where they can consistently see more bite on the fastball, so they can increase their hit percentage on the road. They have tried to change the ball and the pitching machine, but these attempts cannot possibly cover all the 80-some pitch-movement scenarios that the air density can identify and duplicate within a controlled environment. They can change players, but they cannot change their statistics. Other teams fight the same battle, just not as often, so they too could benefit by advance preparation to play anywhere, anytime. Two websites explain it all to the bonafide baseball person: www.baseballvmi.com and www.airchamberfacilities.com . How soon stubbornness and tradition will be replaced by winning and financial gain is all up to the owners and managers of MLB teams. It is the only way, given the schedule of MLB, that the more affected teams can change their wRC+ statistic.

The average number of hits in MLB is just above **8 hits per game** for both home and road games. The average number of runs per game is just over **4 runs per game**, both home and road. The average ***hits per run scored*** in Major League Baseball is **2**. Below is a chart showing the hit percent on the four-seamer and runs generated within the ball movement and VMI categories from 2015 MLB data.

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MLB Average Road Runs Created Against Four-Seam Fastball 2015							
Road Games W/Less bite on pitch for hitter to adjust to:	Percentage of hits to strikes when less bite on pitch	Average MLB runs generated per hit	Runs Created per 100 strikes (series)	**Road Games W/More bite on pitch for hitter to adjust to:**	Percentage of hits to strikes w/more bite on pitch	Average MLB runs generated per hit	Runs Created per 100 strikes (series)
Normal baseball between +0.00 to +10.00	9.04%	0.045	4.52	**Normal baseball between -0.00 to -10.00**	8.61%	0.043	4.31
		Per game=	1.49			Per game=	1.42
Easier Hitting between +10.00 to +15.00	11.75%	0.059	5.88	**Tougher Hitting between -10.00 to -15.00**	7.16%	0.036	3.58
		Per game=	1. 94			Per game=	1.18
Visitors to Coors Field between +15.00 to +25.00	12.13%	0.061	6.06	**Teams Leaving Coors Field -15.00 to -25.00**	8.19%	0.041	4.10
		Per game=	2.00			Per game=	1.35

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Identifying runs created from 4-seamer alone

When teams travel to Coors Field, they hit the four-seam fastball on the first day at a clip of 12.13% of strikes thrown when their VMI is identified as a high plus rating; by the third game it is down to the 9% range. This rating is due to the larger movement on the four-seam fastball the team has recently experienced prior to arriving at Coors Field.

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Mechanically, this means that when hitters first identify the pitch as a fastball, they set their arms and balance their body to square up on a pitch that should move similarly to what they've recently experienced. But we know that in heavier air than at Coors Field the ball lifts more. Therefore, their bodily setup is higher on the pitch than it should be for accurate Coors Field hitting. However, it is better to be above the pitch on the setup than below it, because it is a lifting pitch. So the bat, being a

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weight on the hitter's arms can be more easily dropped than lifted. These facts cause their higher hit percent in Coors Field than on the road, as the pitch is therefore straighter. These facts also cause the high percentage (see below) against the sinker away from Coors Field for the Rockies on the road. This is because the Rockies' bodily setup has become about 3 inches lower on the fastball because of Coors Field repetition, making the sinker and two-seamer less of an adjustment for them.

Rockies Road Data - 2015				
Games	Teams	Strikes Seen	Pitch-Type	Average Strikes per Game
162	1	5676	Four-seam	35
162	1	1995	Slider	12
162	1	1817	Two-seam	11
162	1	1326	Curveball	8
162	1	786	Cutter	5
162	1	157	Splitter	1
162	1	1275	Sinker	8

Rockies Runs Lost on Road-2015										
Pitch Type	Average Strikes Per Game	Plus VMI COLO Hit Percent	Minus VMI COLO Hit Percent	+VMI MLB Runs per Hit	-VMI MLB Runs per Hit	+VMI COLO Runs per 100 Strikes	-VMI COLO Runs per 100 Strikes	+VMI Runs per Game	-VMI Runs per Game	-VMI Runs Lost per Rockies Game
Four-seam	35	11.54%	6.00%	0.058	0.030	5.77	3.00	2.02	1.05	0.971
Slider	12	15.25%	5.60%	0.076	0.028	7.63	2.80	0.94	0.34	0.594
Two-seam	11	13.87%	9.30%	0.069	0.047	6.94	4.65	0.78	0.52	0.256
Curve ball	8	11.66%	7.58%	0.058	0.038	5.83	3.79	0.48	0.31	0.167
Cutter	5	10.94%	5.00%	0.055	0.025	5.47	2.50	0.27	0.12	0.144
Splitter	1	11.11%	7.69%	0.056	0.038	5.56	3.85	0.05	0.04	0.017
Sinker	8	11.23%	15.18%	0.056	0.076	5.62	7.59	0.44	0.60	-0.155
							Total Runs Lost on Road			**1.99**

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The numbers above and the explanation show that it is preferable to prepare for Coors Field games in good movement conditions (even if in a pressurized cage). The opposite preparation yields less than ***3 runs per game***, which is playing (preparing) in easier or straighter pitching, then transitioning to good movement***.*** We have a real world model for this. All teams that visit Coors Field go immediately from experiencing good movement to (relatively) poor movement and they average over 5 runs per game. This is when the visiting team's VMI is a high plus. Not only does the VMI gauge it and the averages prove it, but it also makes logical sense from everything we know about the game of baseball. Furthermore, as the teams play the series, the VMI decreases in severity for games two and three. The VMI tracks the players becoming more familiar with lesser movement. They begin to lower their setup toward that amount of (lesser) movement to which they have become familiar. This is why all teams' production falls to the 9% range as the series extends—the visiting players are conforming to Coors Field norms just as they also conform to the other stadiums' norms as they play through those series.

This is the Rockies' road winning problem in a nutshell. They have conformed their hitting eye to Coors Field before going on a road trip. This puts their hitting eye 3 inches below the center of the fastball. By preparing daily (4 pitches/day) in good movement before leaving on a road trip, in a hyperbaric batting cage, the team ***will create an additional run per game*** at home, and ***will yield a total of 5 runs per game*** on the road. In other words, the advanced preparation for the 4-seamer will add 1 run per game to the road score and another run per game for the balance of the cumulative pitch-types seen on the road. The 2015 Rockies lost 13 road games by 1 run; they also lost 6 games by two runs and/or where the winning team did not score the average runs in MLB. Those 13 one run losses--and at least 3 of the other 6 games--could have been won by the Rockies, had they utilized the hyperbaric cage.

The preparation in the pressurized batting cage will change the adjustment to "Easier Hitting" at **+10.00 VMI** from the "Tougher Hitting" arena identified above at **-10.00 VMI,** which will then increase the Weighted Runs Created, Plus statistic to a "***normal***" for an MLB team. Good movement is what pitchers desire; hitting good movement is the challenge for hitters, especially as it relates to winning in the home team's stadium.

The Colorado Rockies' ownership, coaching and management mean well and are on the right track in terms of gathering enough talent to win, that is if they had no disadvantage. But they as a team are the abnormality that has brought this disadvantage to light. Yet they have not taken the lead in the fight to win, though fully understanding the problem the statistical data shows. The road disadvantage their team has revealed through statistics is a solvable problem if they realize that it is not going away as long as they do not address it directly. They can no longer sit on their hands and try to find a manager, coach, general manager or player from outside the organization who can show them the direction. They must lead Major League Baseball into the future for the expansion and popularity of the game. The easy way to fix this is for the ownership to move the team to a low altitude and colder summer climate, but that would be very costly in terms of cash. In this case, leadership will be more costly in terms of

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pride alone, but far less expensive in cold cash while taking the lead for the future of baseball by bringing a hyperbaric batting cage into Coors Field in Colorado. Several other teams will quickly follow suit.

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