Dr. John Bandy's Cycling Magazine Articles

BALANCING HEALTH AND FITNESS
or SURVIVING TRAINING

A number of years ago a young woman patient brought her national class marathoner boyfriend to see me because he had passed out twice in recent weeks (once in the middle of a major race). He had already been examined by a local sports medicine clinic and pronounced the fittest person they had ever tested. My examination made me suspect his episodes to be blood sugar related.

When I asked him about his diet, he responded by pinching his 2% fat skin and saying, "See, I eat great." His girl friend volunteered that his idea of great was candy bar in the daytime and beer at night. The point is that although information is getting more available, many athletes and even doctors still confuse fitness with health.

The enemy of health is stress (structural, chemical or psychological.) The primary body response to repeated stress is adaptation. Fitness, on the other hand, is itself an adaptation created by repeated stress (training). It is fair to say with only minor qualification that fitness and health are inversely proportional. For the math impaired that means that the more fit you become the less healthy you tend to be.

There is no sport that requires more fitness than cycling especially for those who compete in the major tours. So it is no wonder so many starters in the Tour de France have to abandon due to fevers, intestinal bugs, fatigue, allergy flair ups, etc. Often as many as half the field are forced out by one illness or another. Even serious weekend racers like us are often victims of the combined stresses of job, family and training, which can lead to illness.

In future articles I hope to discuss some of the specific things that happen to our bodies as we train (and or answer reader questions), but for now just remember that stress is cumulative. Since we have decided to add the stress of training and racing we need to limit as many other stresses as is practical.

Get plenty of rest. Eat nutritious foods in adequate amounts al regular intervals. Stay hydrated. Make sure your bike fits. Monitor your resting pulse. If it starts to rise back off your training until it recovers or better yet, ride with your significant other. Get a hobby. You may think bikes are your hobby but for many of us bikes are an avocation or even a compulsion. HINT: If you can't ride fifty miles with Dusty and Old Rider in a 42x19 without going crazy or attacking, it may be a compulsion.

Follow a routine. Bodies love routine. Don't ignore small injuries or illnesses. When you can't control your other stresses -(heavy work schedules, big problems at home, divorce) back off your training a notch. Give yourself permission to rest more. Keep the rubber side down and of course read the V.C, Newsletter for great stress reduction.

Ride healthy,
Dr. T. P. Turner

HEALTH NOTES FOR THE OFF SEASON
by Dr. T. P. Turner

Couch time!! The racing season is over and rest and healing season has begun. Most of us end the season tired and at least a little banged up. Unless you are feeling one hundred percent healthy, I recommend that you give yourself three weeks totally off the bike. Stop that! I hate whining! Find an activity that will help maintain your aerobic base and that uses your muscles in a very different way than cycling. Once you feel rested and the knee pains, back pains, etc. are gone you can get back on the bike and start doing your winter "fat burning" rides.

It seems that most people misunderstand this term. The primary purpose of these rides is not weight loss, although there may be some. The purpose of fat burning rides is to teach your body to burn fats more efficiently. This is building your aerobic base. It is what Lydiard had in mind when he coined the term LSD (long slow distance.)

The aerobic system can burn fat in the presence of oxygen. The more efficiently it does this, the more our glycogen stores are spared and the more effective our interval training and racing will be later in the season.

Another important factor in burning fats efficiently is diet. Not all bodies are the same and you may have to modify some of these concepts to maximize your results, but here are some basic ideas to start:

1) Drink plenty of water. Five or six glasses per day is about right for the average person. However, riding will raise your need significantly. You might try weighing before and after rides to be sure you re-hydrate. Water weighs eight pounds per gallon and you can figure your extra need from there.

Also try to keep your urine clear and light colored. Dehydration will make it darker and more cloudy. Do not substitute soft drinks, tea, coffee or alcohol for water. These are all diuretics and may result in a net loss of water. When drinking fruit juices dilute them two or three to one to ensure that they do not trigger an insulin response.

2) Avoid sugar, sucrose, dextrose, maltose, glucose and corn syrup. These concentrated, simple carbohydrates cause the release of large amounts of insulin into the system. Insulin pushes the sugar into the cells and eventually leads to low blood sugar causing fatigue and cravings (usually for more sweets.) Insulin also converts almost half of your carbohydrates into stored fat.

Insulin also inhibits the production of glucagon and growth hormone. Glucagon promotes the burning of both fats and carbohydrates for energy and growth hormone is necessary for muscle growth and development.

3) Avoid trans fats including: hydrogenated and partially hydrogenated oils, fried foods and rancid oils. These fats interfere with normal fat metabolism. They cause prostaglandin imbalances which can increase inflammatory responses. They also lack essential fat-soluble nutrients.

Hydrogenation is a chemical process which artificially saturates oils prolonging shelf life and making them solid at room temperature. It is used in the manufacture of margarine, peanut butter, chips, crackers and cookies to name only a few. Read labels and use butter, olive oil or canola oil when possible.

4) Use whole, grains instead of refined, "enriched" grains as much as is practical. Whole grains contain many more nutrients and significantly more fiber than refined grains. This does not mean you can never eat regular pasta again, but it does mean that white pasta is an empty calorie and leads to the depletion of micronutrients.

5) Eat a balance of carbohydrates, proteins and fats. 40%, 30%, 30% by calorie count is a good balance for most people. Remember that carbohydrates and proteins yield 4 calories per gram and that fats yield 9 calories per gram. When counting grams in foods this works out to: for each gram of carbohydrate, you need 3/4 gram of protein and 1/3 gram of fat. I know the idea that we need fat is new to some and I will 'discuss fats in detail in a future article.

6) Eat at least three servings of cooked vegetables per day. Variety is important to provide a balance of nutrients.

7) Eat regularly. Bodies like routine. Whether you do best with three meals per day or five smaller meals, eat them around the same time of day. Your body will be ready to digest and absorb out of habit.

8) Keep junk food to a minimum. If you need a snack between meals try fresh fruit, an egg or raw almonds or cashews (roasting makes the oils rancid.) If you are fond of desserts, save them for special occasions. If you are fond of soft drinks, save them for late in long, hard rides. They have no nutrients and way too much sugar for regular use, but under the special conditions of extended hard efforts the caffeine and sugar will give you a boost.

These recommendations are for the off season but Our nutritional needs change only a little during the training and racing season. We need extra carbohydrates when regularly stressing our anaerobic system to replace depleted glycogen stores. We can best get these by taking in high carbohydrate bars, drinks or foods during and immediately after hard efforts.

These general concepts should help you maintain the energy and focus needed to achieve your training and racing goals.

EAT NAILS

By Dr. T. P. Turner

Well, I hope all of you two wheeled riders of the velvet couch read last months opening installment about maintaining health while trying to achieve fitness. It is time to start discussing specific factors that can adversely effect and interfere with training. This month I get to write about one of my favorite topics: iron. A significant number of athletes, especially women, are deficient enough in iron to affect performance, general well being, concentration, and to induce general fatigue. The discussion of iron is, after all, a discussion about energy.

Most of the body’s energy is produced aerobically. This process is an oxidative reaction much like fire. To keep a fire burning requires fuel and oxygen. In the aerobic process the fuel is hydrogen ions gathered from carbohydrates, proteins, and especially fats. The oxygen is supplied by hemoglobin carried in red blood cells. Iron is essential for hemoglobin function.

There is some disagreement in literature as to whether athletes are more prone to iron deficiency than the general population. One camp suggests that training increases plasma volume (the fluid component of blood) and that this is responsible for any differences seen on blood tests of athletes.

However, there is another camp, which recognizes that there are three stages of iron deficiency. Stage 1: depletion of iron stores in the liver, spleen, and bone marrow measured as low ferritin. Stage 2: low serum iron. Stage 3: low hemoglobin. They also recognize that there are two easily measured factors that are significantly different in athletes as compared to non-athletes; ferritin, which is stored iron (see stage 1 above) and mean cell volume (MCV), which is the size of each red blood cell.

In a recent study, for example, the average ferritin level of female aerobics instructors was 16.7 as compared to 36.4 for non-exercising controls. The average MCV for the same groups was 94 and 87 respectively.

Lower ferritin and increased cell volume cause a loss of efficiency in the aerobic system, which is associated with symptoms such as fatigue and loss of concentration. This loss of efficiency is a problem for the general population but it is especially problematic for cyclists due to the intense demands we put on our aerobic systems. 80-95% of our muscle fibers are aerobic fibers and cycling tends to demand more of them than any other sport.

I find in actual practice that athletes with low ferritin levels and elevated MCV tend to suffer loss of motivation, fatigue, poor recovery and they even appear to have a greater tendency to injury.

The ranges considered "normal" for ferritin and MCV are quite large and tend to be related to pathology. Experience and recent research have led me to set narrower physiological or "ideal" limits.

My target range for ferritin is 60-100 g/L. This is based on the observation that subjects with levels below 12-15 most often have all the symptoms listed above plus poor workouts and poor performances. A significant number of them tend to have stage 2 or stage 3 deficiencies as well. Subjects with levels below 30 tend to have one or more of the symptoms but rarely have the more advanced stages.

Subjects with levels above 30 tend to be symptom free but the stress of a long season of training and racing puts a strain on this system and lowers levels in many athletes. I like to see levels above 60 at the start of the season.

Very high levels of ferritin can be associated with increased risk of heart disease. It is wise to actually have your blood tested before considering supplementation.

To give some perspective on all of this, lets look at our aerobics instructors again. In this study 1/3 of the subjects had ferritin levels below 12 while none of the controls were that low. In the women's athletic department at our local mega university 20% of 332 athletes tested had levels below 15, 36% had levels between 15 - 30 while another 36% had levels between 30-60. Only 9% had levels above 60 without supplementation and 56% had levels below 30 without supplementation.

The numbers for women are probably worse than for men due to menses and the high incidence of eating disorders among female athletes. However, remember in our aerobics instructor study the average ferritin was 16.7 as compared to 36.4 in controls who were also women. The difference was clearly

training. Although I do not have the same access to numbers for men, we are not immune to this problem.

Pathological standards for MCV dictate that levels above 97-100 cu _ indicate a type of anemia called macrocytosis (cells too big.) Functional or "ideal" levels are probably somewhat lower. I prefer to see levels below 90. The cause of the increased cell size in athletes is a subject of some debate. My experience is that supplementation with vitamin B12 and folic acid generally has a lowering effect.

This off-season, along with a lot of rest and reflection, take a good look at your body. If you have had some of the symptoms mentioned here, consider a trip to your favorite sports or family doctor. Have a good exam including a CBC and a ferritin check. (You will probably have to ask for a ferritin check to get one.) If your ferritin is low and your MCV is high consider making a few changes.

In spite of all the talk about complex carbohydrates save room for meat at least three times per week. A good rare or medium rare steak seared in a cast iron skillet is not only tasty but a great source of the nutrients you need. If levels are very low, supplementation is probably the most efficient thing to do.

When choosing an iron supplement avoid ferrous sulfate. It binds up the gut and is poorly absorbed. Your doctor may not agree but then I once had a doctor tell one of my patients that eating a nail would work as well as any supplement. Instead of eating nails, try ferrous gluconate or ferrous fumerate in doses of 30-60 mg/day. Take it before meals and away from calcium and vitamin E supplements for best absorption.

When choosing B12 look for a resin bound form (read the label) if possible and always suck or chew them. Folic acid is easily absorbed and most products are o.k. Take both of these in 1-5 mg/day doses. A very high MCV may need B12 in shot form. Talk to your doctor about that.

DAMAGE
By Dr. T.P. Turner

Guyton's *Textbook of Medical Physiology* has this to say about exercise. "...there are no normal stresses to which the body is exposed that even nearly approach the extreme stresses of heavy exercise. In fact, if some of the extremes of exercise were continued for even slightly prolonged periods of time, they might easily be lethal.... In a person who has extremely high fever, approaching the level of lethality, the body metabolism increases to about 100 percent above normal. By comparison the metabolism of the body during a marathon race increases to 2000 percent above normal."

In future articles we will look at the specific stresses we put our bodies through and discuss ways to protect ourselves from them. We will also discuss how we can neutralize stresses to speed recovery between workouts and perhaps even enhance performance.

Training and racing stress almost every body system. We have to manage tremendous amounts of beat, buffer large quantities of add metabolic byproducts, regulate our fluid balances in spite of great losses and produce incredible amounts of energy which our muscles convert to power.

We constantly are in the process of healing damaged tissues, even if we keep the rubber side down. Our respiratory, cardiovascular, urinary and lymphatic systems are continually stress to the max.

I have stacks of notes on these metabolic subjects, but recent events have made me shift gears. There have been an alarming number of club members who have already made strong entries in this year's "best beef contest. So, the health message for this month is don't crash. Right. Actually, it is about protection.

Now, I know you guys don't want me to preach about helmets, talk about bead injury statistics or describe post concussive syndromes. Instead, I'm going to let Tailwind tell you a story.

Dudes, did I ever tell you about the last time I rode the Hotter 'n Hell? We started just as it got gray light. There was a huge field. Must have covered fifty acres of highway and the crashes started while we were still behind the frickin pace car.

The car pulled off and we started fly in. You know how flat it is and this was a handicap race and the Cat 4's didn't want to get caught. Guys just kept getting crazy and going down. It was like dominos. I got bumped and banged for miles. I actually bunny hopped over some poor guy. I even cleared most of him.

After about fifty miles at 33 mph, the field bad shrunk considerably and things seemed to have calmed down a bit. I slid to the back to eat a bit. I knew I would need the gas up the road. This was B.C. (before camelbacks), so I had an extra bottle in my pockets. I reached back with both hands to put it back just as a kid about sixteen got bored and derided to see if his brakes worked.

I never got back to the bars. I hit the asphalt face first at 30 plus and you know what took all the damage? My Giro, dudes. That sucker explodes into six pieces. Just the "hair net " held it together and I slid to a stop with all my weight on it. A little road rash on the hip and shoulder were the only body damage. No bead damage at all. I mean, I didn't even scratch my glasses. I swear, without that helmet I'd be droolin on myself.

I heard Giro would send you a new helmet if you sent the cradled one in, but I thought I'd keep it around to remind me, just in case I ever got stupid and figured I'd go for a little cruise with the wind in my hair. I figure that even if I only have one crash like that in life time, wearing a bucket everyday is worth it.

Well, guess what. Yeah, I just broke another Giro. Last weekend Leggo, Los and I lined up near Smithville to do V.C. proud in a killer fat tire race. The sprint to the single track was a rolling climb over a mile long.

We hammered maxed out at the front and entered the single track 2nd, 3rd and 4th. I knew I had good legs that day because we were haul'n ass, Leggo was making that noise he makes early in races when it's really hard (you know the one, sounds like Bill the cat expelling a hair ball.), and I wasn't suffering.

We were just settling in pretty well when Leggo missed a turn. I followed but Los figured it out. We dismounted and turned around while five guys passed us. Turns out that everyone else was dropped on the hill.

I pulled us through the track for the next forty or so minutes and we picked off one rider and passed another with a

mechanical. It was 85 with 90% humidity and by the time we mashed through the finishing circuit for the start of the second lap two guys had just plain quit.

Only Los and two others were up front. We were really motivated and worked hard up the hill. Leggo passed two guys from another age group as we entered the single track. It took me a while to get by. As I set out to catch back on I dropped into one of about a million deep gullies on the course.

The track in the compression was soft and my front wheel washed a bit with the shock really loaded. The wheel just tacoed. I hit the dirt with my hand still on the bars. The impact was so hard that the bike bounced into a tree five feet off the ground. Another helmet first landing. No roll, I hit like cow pie.

As I sat there contemplating the deep mysteries of bike racing. Like, how you could be having a great day one minute and be smelling flowers the next. I couldn't help but appreciate that I was still able to contemplate.

I know, you 're tired of being told to wear your helmet. Hey, I'm not telling. I'm asking. Several of you are even a little hurt that when people see you with your face and bead all scabbed up, they ask you if had your helmet on before asking how you feel. Get over it.

I've heard lots of excuses." Hey, I landed on my face, not my head." Well, I've crashed face first twice and didn't even scratch my glasses. Make sure your helmet sticks out in front far enough to protect your face.

Also, make sure the straps hold the bucket in position. I see riders with their helmets in all kinds of odd positions. The Airblast I had on in Smithville has a new strap design with a piece that comes down on the back of your head. It stays put really well and is very comfortable.

The newer designs also have hard shells and internal skeletons that hold them together much better.

Look, I know that you have a God given right to ride bare headed. I just think that being stupid because you have a right to is still stupid. Hey, I even like some of you guys. So please, wear your damn helmet.

No droolin', Tailwind

BIG LAC ATTACK
By Dr. T. P. Turner

Where was I? Oh well, I guess that's a better question than "Where am I?". What were we talking about before I landed on my head and went off on that Giro tangent? Oh yeah, we were talking about the stresses of cycling...with the rubber side on the bottom.

I want to start with the best known stressor of them all, lactic acid. We all know that lactic acid is produced during hard efforts. We know what it feels like to have or legs bum and our chest feel like it's on fire.

We also have the idea that lactic acid makes us sore after hard efforts and is the reason we feel tired. Right? Well, no. Actually, lactic acid has gotten a bad rap all around. We need to examine the whole process to understand lactic acid's role in energy production.

The energy for muscle contraction comes from the breakdown of ATP (adenosine triphosphate).

[Adenosine-P04~P03~P03]

The bonds represented by the "little squiggles" on the last two phosphate radicals are "high energy bonds". When these bonds are broken, there is a release of about 11,000 calories of energy/mole for each bond or 22,000 calories in all.

Breaking the first bond, converts ATP into ADP (diphosphate). Breaking the second bond converts ADP into AMP (monophosphate). There is only enough ATP hanging around in the muscles to fuel maximum muscle power for about 5 or 6 seconds. New ATP has to be formed continuously. There are three systems for producing new ATP.

1) Muscle stores of phosphocreatine:

[Creatine ~P03]

Notice the high-energy phosphate bond. This bond stores even more energy than the bonds of ATP. When this bond is broken, the energy released is used to reconstitute AMP to ADP and ADP to ATP. This takes only a small fraction of a second.

The muscle stores of ATP and phosphocreatine combined are called the phosphagen energy system. This system can provide maximum muscle power for about 10-15 seconds. This system requires no oxygen, but the time is only accurate when the stores are completely full. Running the 100 yard dash is a good example. It is hard to equate directly to cycling because we rarely get to sprint when fully recovered.

2) The aerobic system involves the combining of glucose, fatty acids and amino acids with oxygen in the mitochondria of our cells to release energy to convert AMP and ADP to ATP. The aerobic system can theoretically provide energy as long as the nutrients last. It is relatively slow however, compared to the phosphagen system. The aerobic system can reconstitute ATP at a maximum rate of about I mole/minute (all day long) while the phosphagen system can reconstitute at a rate of 4 moles/minute (but only for about 10 seconds).

3) The glycogen-lactic acid system can reconstitute ATP at a rate of about 2.5 moles/minute. It can sustain maximum muscle power for about 30 - 40 seconds. This system along with the phosphagen system can provide the well trained athlete with 50 - 60 seconds of maximum anaerobic power. This equates to running the 400 meters or to cycling the kilo. It can provide submaximum power for an hour or more depending on the rate and relative fitness of the athlete, of course.

Muscles and the liver store glucose as glycogen. To produce energy glycogen is first broken down into glucose. Glucose is split into 2 pyruvic acid molecules by a process called glycolysis. This split releases energy to reconstitute ATP. Pyruvic acid ordinarily enters the mitochondria and combines with available oxygen to form still more ATP (the aerobic system). When there is not enough oxygen to go around, the amount of pyruvic acid in the cell begins to rise.

The law of mass action says that as the end products of a chemical reaction build up in the reacting medium, the rate of reaction approaches zero. That means that if the pyruvic acid was allowed to build up in the cell, we would stop producing energy in a very few seconds. So, most of this excess pyruvic acid is converted into lactic acid.

The lactic acid diffuses out of the muscle cells into the fluids between the cells and into the blood. This allows the breakdown of glucose for energy to continue. The big limiting factor in the use of this system is the amount of lactic acid we can stand. You all know how it feels. When the lactic acid levels get high enough, the burning and fatigue just shut you down. Can you say bonk?

So, although lactic acid levels do limit the amount of anaerobic energy we can produce, it does allow us to produce more than we could without it. It also saves the end products of glycolysis for reuse.

When oxygen becomes readily available again, the pyruvic acid being produces is oxidized and the conversion to lactic acid reverses itself and the lactic acid again becomes pyruvic acid. Some of this pyruvic acid is used for energy to reconstitute ATP and the rest is converted back into glucose and into glycogen. Most of this reconversion happens in the liver.

Once oxygen is readily available, lactic acid has a half-life in the system of about 30 minutes. This means that within an hour or two it has all been eliminated from the body. So, although lactic acid causes us considerable suffering during hard efforts it is not around the next day to cause the residual muscle soreness it gets blamed for. Well, if it's not lactic acid in the muscles that makes us sore, what is it? To tell the truth, I don't know for sure. It's not a done deal. There are only theories. The most popular one is that the soreness following exercise is from micro tearing of muscle fibers and connective tissue. This idea makes sense when talking about weight lifting but I'm not sure I buy it for most cycling workouts. Let's look at some of the facts.

1) I can get sore after easy rides if they are long enough. There is not much stress to cause tearing, but there is a whole lot of aerobic energy production. 2) An easy recovery ride the next day significantly reduces the soreness. Tearing would just take time to heal. 3) Massage helps reduce soreness a lot. (See no. 2) 4) The soreness is a burning type pain. This is fairly subjective but most people seem to agree. The neurological mechano-receptors that send the signals to our brains that are interpreted as burning are called nociceptors and are stimulated by noxious chemicals and not by micro tears. 5) I have checked the urine of lots of sore athletes and they all have very acid urine.

My pet theory about soreness is based on the fact that when we produce energy by any system there are a great many hydrogen ions produced. Hydrogen ions seriously acidify the tissues. There are a lot more produced in anaerobic metabolism and when the lactic acid is reconverted into pyruvic acid much of this acid byproduct is left behind.

The sodium bicarbonate buffering system is our first line of defense in neutralizing this acid. Our kidneys are responsible for ridding the body of the excess ions we can't neutralize. The kidneys can only dump hydrogen ions at a rate that will lower the pH of the urine to 4.5. This makes the process a slow one. It often takes the urine two or three days to return to normal pH (6.5 - 7).
In his book *Road Racing Technique and Training*, Bernard Hinault suggests that after long hard races " detoxification" is the first priority. The first thing he recommends is sodium bicarbonate. I have found that 1/2 to I teaspoon of baking soda in water after hard efforts generally eliminates soreness. So, my theory is that it is the hydrogen ions and not lactic acid that produces the soreness. Hey, it's just a theory. Put those rocks down.

RADICAL!!
by Dr. T. P. Turner

"Indeed, we now know that a number of environmental factors and seemingly beneficial health habits- including exercise to excess- can harm our health by triggering the release in the body of unstable oxygen molecules known as free radicals." This a quote from *Antioxidant Revolution* by Kenneth H. Cooper, M.D. Yes, that Dr. Cooper. The guru of exercise. The author of *Aerobics*. The guy who started America running has had to revise his thinking.

Dr. Cooper remains convinced that aerobic exercise is an essential component in a healthy lifestyle, but growing evidence has made him question the wisdom of "distress" exercise. Hard training has been linked to an increased incidence of heart attack, stroke, asthma and, as we all know, colds and flu's. Distress exercise seems especially linked to various types of cancers,

The cause of all this tissue carnage appears to be a class of renegade oxygen molecules called "reactive oxygen species". These molecules are volatile and aggressive. There are radical and non-radical reactive oxygen species that differ in structure. The radical type has one or more unpaired electrons. The single electrons make them very unstable and they look for other molecules to lock onto. They create molecular havoc when they combine. The most important "radicals" are the hydroxyl radical and the superoxide radical.

The non- radical type has paired electrons and is not as unstable as the radicals. However, they are still less stable than most other molecules. The most important "non-radicals" are the oxygen singlet and hydrogen peroxide. Although not exactly accurate, all of these reactive oxygen species are generally known as "free radicals".

Our bodies are never without free radicals and in normal amounts they are actually helpful. They help fight inflammation, kill bacteria and control the tone of smooth muscle. Problems start when excess free radicals are formed. Factors which cause excess free radicals include smoking (arguably the worst), partially hydrogenated oils, rancid fats, air pollution, ultraviolet light, pesticides, contaminants in food and exercise.

Free radicals are very difficult to measure because they exist for only a fraction of a second, but they do leave "foot prints". Pentane can be measured in expired air. Studies done as early as 1928 found that cycling 20 minutes at 50% of maximum effort caused no increase in expired pentane, but cycling 20 minutes at 75% of maximum effort doubled pentane output. This supposes that free radicals were also doubled by the effort.

Another "foot print" is thiobarbituric acid reactive substances or “TBARS". TBARS can be measured in the blood and at Coopers clinic he found that untrained men had an average TBAR level of 1.71 while highly trained men had and average level of 2.32,

There are at least two ways free radicals are produced during exercise: 1. Electron leak: During exhaustive exercise oxygen consumption, by the body, is increased 20 times or more. Individual muscle fibers may consume 200 times their resting amount of oxygen. The system just isn't as efficient at that level of activity. Leaks happen.

2. Ischemic Reperfusion: So much blood is shunted to your muscles during exhaustive exercise that organs get left out and often become hypoxic. After exercise, blood rushes back in (reperfusion) and an excessive amount of free radicals are produced. This can also happen inside a muscle that is worked to exhaustion. Reperfusion happens when the effort is over and the muscle is re-oxygenated. Highly trained muscles are resistant to free radical damage but the organs are not so lucky.

The indication is that free radical formation is primarily increased by anaerobic activity and is probably responsible for many of the symptoms associated with "over training".

In general, the damaging effects of free radicals are thought to be the oxidation of polyunsaturated fatty acids that are essential components of the membrane structures of the cells. They also oxidize some of the cellular enzymes, seriously hand cuffing the cellular metabolic systems. Specifically, they are thought to cause heart disease by damaging LDL cholesterol. White blood cells known as macrophages consume the damaged LDLs and become swollen, white and frothy. They are then called foam cells. They become lodged in the walls of the arteries and cause narrowing and inflammation.

Well campers, that's the bad news. The good news is that, unlike with our miserable childhoods, we are not total victims in this scenario. We actually have three lines of defense against free radical pathology.

First is a class of chemicals our bodies produce all the time to protect us called "endogenous antioxidants". The most important of these are superoxide dismutase, catalase and glutathione peroxidase. As long as the level of free radical production is not too high, these chemicals protect us.

Next, are substances called "exogenous antioxidants". These are substances we must take in through our diets that protect us from oxidative damage. They include vitamin C, vitamin E, beta-carotene and selenium.

The general recommendation for obtaining antioxidants is to eat at least five servings of fruits and vegetables per day. The lack of degenerative diseases in our ancestors indicates that this was adequate protection from free radicals at one time. So, what happened? Well, bike racing happened. Also, cigarettes happened, ozone happened, air pollution happened, water pollution happened, pesticides happened, hydrogenated oils happened, fast foods happened, alcohol, sugar, coffee and drugs happened. We have made wholesale changes in our environment and habits and the mechanisms that have protected us for the past two million years are just no longer adequate.

Enter antioxidant supplementation. There is a growing body of evidence that suggest that we all should be taking antioxidants daily. It also appears that competitive cyclist need significantly higher levels than the average person. Antioxidants have been shown to significantly reduce the risk of cancer, heart disease, cataracts and even viruses.

Dr. Cooper's recommendations, for those of us who do a significant amount of exercise above 80% of max. heart rate, are: natural vitamin E 1,200 I.U.s per day, vitamin C 3,000 mg per day for men and 2,000 for women, beta carotene 50,000 I.U.s per day and selenium 100 mcg per day. Remember from past articles that natural vitamin E is d alpha tocopherol. If the label says dl or tocopheryl don't buy it.

My only difference with Dr. Cooper is that I take more vitamin C than he does. I take 10,000 mg per day. Large doses of C will cause diarrhea in some people. So, you might consider raising the dose slowly to check your bowel tolerance.

The third line of defense is avoiding the factors that produce free radicals. As I said in the very first article in this "zine", cycling is a big stress. Avoid other stresses as much as possible. So, avoid these free radical factors: smoking- gees just don't, ultraviolet- ride early or late and use sunscreen, car exhaust avoid heavy traffic areas and rush hour, ozone- on advisory days, ride early or don't ride, allergies and viruses- when your not feeling well, keep it under 80%, emotional stress- chill.

Oh, and Leggo, wear your freeking helmet!!

FAT-AL ATTRACTION
By Dr. T. P. Turner

Seasons greeting VC'ers. I hope you are enjoying life in the slow lane. While you are recovering from today's weight workout, let's begin discussing macronutrients (carbohydrates, proteins and fats.) I have always been a fan of the underdog. So, I want to start with fats.

There is a ton of information and misinformation about fats and their role in heart disease and cancer. This, along with our obsession with weight, has given many people the idea that fats are just plain evil. In order to redeem and demystify fats, we need to look closely at the biochemistry involved. I have tried to pare the information down to a minimum so as not to intimidate the "equation impaired' or to bore you to death. Let's dig in.

Fats are essential for life. Our bodies use them for insulation from both heat and cold. We also use them for shock absorption. Check out the pad on the bottom of your heel. Imagine how 'it would feel to walk on the bone instead. They also protect our organs from shock. Imagine crashing in a downhill comer with no shock absorption for your spleen. Okay, that's pretty hard to Imagine, but trust me, your spleen needs the protection.

We burn fat for energy. Fats are a clean burning fuel, essentially giving off CO; and water as waste which, unlike the lactic acid given off during sugar burning, does not make us suffer. They are also very effective, giving off 9 calories /gram as opposed to the 4 calories/gram given off by carbohydrates and proteins.

The membrane of every cell is made from fats. All of our steroid hormones are made from fats as are our inflammatory and anti- inflammatory prostaglandins. Our skin is protected from the elements by fats.

So, if fats are so necessary, why all the bad press? Fats are essential, but there are three basic considerations that are critical when making healthy food choices. Making the right choices is what determines whether fats are friend or foe.

Consideration 1) Quantity: As with everything in our bodies there can be too much or too little fat. Metabolic individualities definitely exist and most people do best with a diet 'in the neighborhood of 40% carbohydrate, 30% protein and 30% fat by calorie count. This equates to 48% carbohydrate, 36% protein and 16% fat by weight. For example, a 250 gram meal would ideally consist of 120 grams of carbohydrate, 90 grams of protein and 40 grams of fat.

Although, in my general practice, I spend more time removing fat from diets, I find endurance athletes often are not getting enough. Recognizing too little can be difficult due to considerations 2 and 3 but if your cholesterol is below 150 and your hair is dull and lifeless and your nails are thin and brittle, you may be fat deficient.

Consideration 2) Balance: There are different kinds of fats and we need the proper balance of these for optimal health. All fats are made of fatty acids. A fatty acid is a molecule counting a non-polar fatty and water insoluble carbon chain of variable length, made of carbon and hydrogen atoms, ending on one end in a methyl group (-CH3) and on the other in a weak organic acid called a carboxyl group (-COOH).

There can be any number of carbon atoms in the fatty acid mole- clue, but the most common lengths are from 4-24. Acetic acid (vinegar) is essentially the same molecule with 2 carbon atoms and formic acid (bee sting and ant bite) is this molecule with 1 carbon atom. These substances are water-soluble. So, they are more weak acids than fat.

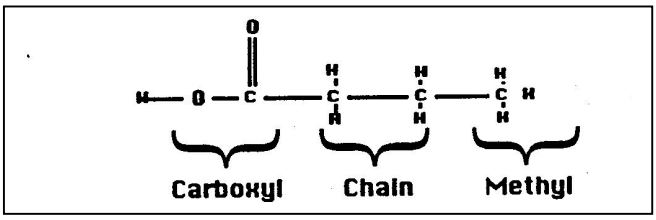


Figure 1

There are two primary categories of fatty acids. Figure 1 shows the structure of the fatty acid butyric acid (named for butter where it is most commonly found.) Butyric acid is an example of a satu- rated fatty acid. Saturated fats have 2 hydrogen atoms for each carbon atom in the fatty chain.

Saturated fats can be burned as fuel. The shorter chains (4- 16 carbons) burn best. They have the advantage of being stable. which means that they don't react with chemicals or oxygen readily and they are also relatively heat stable. This gives them long shelf life and makes them good for cooking. They are solid at body temperature which gives our cell membranes a waxy structural integrity.

The disadvantages of saturated fatty acids is that, due to their straight configuration and their lack of electrical charge, they tend to clump together easily. This makes it easier for them to form plaque, in arteries for example.

The other major category of fatty acids are the unsaturated fatty acids. Unsaturated fatty acids have at least 2 carbon atoms with only 1 hydrogen atom a piece and a double bond. (Figure 2)

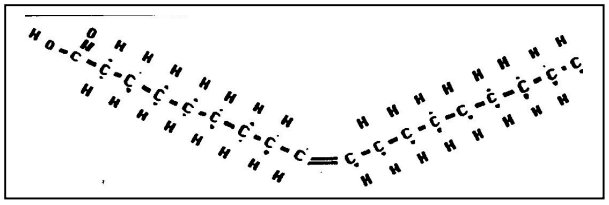


Figure 2

This 18 carbon chain molecule with the double bond between carbon 9 and 10 is oleic acid (olive oil). Oleic acid has just one double bond and is called a monounsaturate. There can be as many as 6 double bonds. Fatty acids with more than 1 double bond are called polyunsaturates. Unsaturated fats can be used for energy. They are liquid at body temperature and they give our cell membranes elasticity and allow messenger proteins to move freely through.

Notice that oleic acid is "bent". This is due to the pressure exerted by the two negatively charged hydrogen atoms next to each other with none to balance them on the opposite side of the molecule. The combination of this bend and the charge make unsaturated fatty acids tend to spread out and not dump together. So, they are less likely to be involved in plaque formation.

The negative side of unsaturated fatty acids is that they are unstable. They react with chemicals, heat, light and oxygen and break down to form free radicals. The fewer the double bonds, the less unstable. This makes monounsaturates like olive, canal and sesame oils best for general use. They have relatively good shelf life and withstand cooking pretty well. While polyunsaturates like safflower, corn and sunflower oils should be bought in small quantities and kept refrigerated. They should only be used for salads and other uses which don't require heating.

There are a number of critical bodily functions which require specific unsaturated fatty acids. Many of these may be low or even absent from the diet. Fortunately, most of these can be formed from other unsaturates by moving double bonds around. There are two fatty adds that can only be gotten from the diet and these are called essential fatty acids. The essential fatty acids are linoleic acid and linolenic acid. They are found in raw nuts and seeds, whole grains, and fish.

Symptoms of linoleic acid deficiency include eczema, hair toss, menstrual cramps, liver degeneration, susceptibility to infection, failure of wound healing, arthritis and heart and circulatory sump- toms. Symptoms of linolenic acid deficiency include retarded growth, weakness, impaired vision, impaired learning abilities and motor coordination, tingling in the extremities and behavioral changes.

Flax or linseed oil is the best single source of essential fatty acids and if you think that you may not be getting enough in your diet, 1 tablespoon of linseed oil/day is good insurance. It is not very tasty but it can be bought in pearls, which have the added advantage of protecting the oil from light and oxygen. When adding oils to your diet, it is recommended that you also add 200-400 IU. of vitamin E as an antioxidant.

Consideration 3) Quality: Fatty acids can be altered, either accidentally or purposefully, by light, heat, oxygen or chemical reactions. The more double bonds the fatty acid has, the more reactive or the less stable. Choose oils that have been extracted by mechanical pressing as opposed to chemical extraction. Look for bottles which keep out light if possible and keep all oils, except monounsaturates, in the refrigerator. When buying olive oil, buy only extra virgin. This will assure quality.

Oxygen induced reactions of fats (rancidity) produce peroxides, ozonides, hydroperoxides, polymers, hydroperoxyaldehydes and phytonic acid, which are all very toxic, and free radicals. Free radicals all have tissue destructive qualities and are responsible for many of the problems which have been associated with fats including

cardiovascular disease, aging and many forms of cancer. Free radical formation in fats 'is increased 1000 times by light and even more by excessive heat.

To keep free radical formation to a minimum, cook only with saturated fats, such as butter, or monounsaturates, such as olive oil. Avoid deep-frying all together. This, of course, means French fries, chips and donuts. Life's a bitch.

The biggest health hazard from fats is from hydrogenation. This is a process where unsaturated fats are exposed to extreme heat and pressure in the presence of hydrogen and a metal catalyst (usually nickel) for as long as 6- 8 hours. This breaks the double bonds and adds the missing hydrogens making saturated fats. Hydrogenation causes several problems.

First, the saturated fats formed are mostly triglycerides which is a glycerol molecule with three fatty acids attached at the carboxyl end. This, by itself, is not a problem since 95% of our dietary fats are triglycerides. However, naturally occurring triglycerides have preference for saturated fatty acids at the outer two positions an an essential fatty acid in the center position, while hydrogenation formed triglycerides have saturated fats at all three positions.

A much bigger problem exists with hydrogenation, however. During the process of creating saturated fats there are a huge number of free radicals formed along with a new type of fatty acid molecule called a trans-fatty acid. Trans-fatty acids are found ii especially high percentages in partially hydrogenated oils, like margarine, shortening or peanut butter that doesn't separate. Earlier we discussed the configuration of a natural unsaturated fatty acid (figure 2.) Remember the double bond with the single hydrogen on either side causing the molecule to bend. This natural configuration is called a cis-configuration. Oleic acid is a cis-fatty acid. The excessive heat and pressure used in hydrogenation causes a percentage of the hydrogens at the double bonds to flip to the other side of the molecule. (figure 3) This causes the molecule to straighten.

Since trans-fats are no longer bent and have no negative charge, they can clump together and form plaque. An even bigger problem is that the molecule is enough like the corresponding cis- fatty acid to be accepted into the complex chemical reactions essential for life, but it is unable to complete these reactions. They just take up space and don't allow the cis-fats to do their jobs.

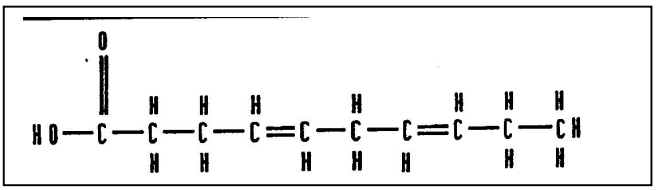


Figure 3

Hydrogenation is used to make fats stable and prolong shelf life. Partial hydrogenation is used to make oils a desired consistency for use in such products as stick margarine which contains an average of 31% trans-fats, tub margarine with an average of 17%, and shortenings with an average of 37%. They are advertised as cholesterol free. It is not a fair trade.

A recent study compared French and American heart attack figures. The percentage of smokers was similar as was the percentage of fat in the diet, the French getting their fat primarily from dairy and the Americans primarily from trans-fat sources. The French had significantly fewer heart attacks. The researchers looking at the data came to the only logical conclusion. It must be the wine!!? Yeah, right dudes!

Now, so much for the biochemistry, what do we eat?
1) Quantity: Don't avoid fats, but eat them in moderation.
2) Balance: Eat fish, whole grains and raw nuts and seeds.
Cook with butter, olive oil, canola or sesame oil.
If you have symptoms, take linseed oil and vit. E.
Use poultry, eggs and dairy for protein and use lean red meat in moderation.
3) Quality: Buy mechanically pressed salad oils in small containers and keep them refrigerated.
Buy extra virgin olive oil and use it liberally.
Avoid deep fried foods and hydrogenated oils.
Read labels. Eat butter and not margarine.
Don't overcook meats or eggs.
Buy natural peanut butter and keep it refrigerated.

SUGAR IN YOUR TANK
by Dr. T. P. Turner

Well class, this month we continue our discussion of the macronutrients by exploring the fascinating world of carbohydrates. After a lot of feedback about our discussion of fats, I have decided not to use any formulas. (Dudes, you guys can really whine.) I digress.

When discussing carbohydrates, what we are really talking about is glucose. Glucose is a monosaccharide and it is the preferred fuel for most types of cells in our bodies. Our brains, for example, just don't want anything else. To get glucose into our blood we ingest, digest and absorb carbohydrates. These may be monosaccharides, disaccharides or polysaccharides.

Mono and disaccharides are called simple carbohydrates or sugars and polysaccharides are called complex carbohydrates or starches. All of these are digested and broken down into absorbable monosaccharides (glucose 80%, galactose 10%, fructose 10%).

Glucose and galactose are absorbed very quickly while fructose is absorbed 60% more slowly. Absorption of these sugars triggers the release of insulin, which drives the sugars into cells where they can be burned as energy, stored as glycogen in the liver and muscles or stored as triglycerides in adipose tissue (fat).

You hear a lot about eating complex carbohydrates rather than sugars. There are three major reasons for this:
1) Foods high in complex carbohydrates contain vitamins and minerals while simple sugars are empty calories.
2) They also contain fiber, which is essential for bowel function and is a cancer preventative.
3) Simple sugars require little or no digestion and can be absorbed very rapidly into the blood. This rapid rise in blood sugar tends to cause the pancreas to over produce insulin, which eventually leads to low blood sugar. This is a major stress. Fructose is an exception due its slow absorption rate.

The general rules for meals are:

1) Eat complex carbohydrates (grains, potatoes, and fruit)

2) Eat grains in their unrefined state. "Whole grains" such as whole wheat bread or pasta and brown rice contain many more nutrients than their refined counterparts.

3) Avoid simple sugars. Just toss cokes and candies from your diet. Save your "cheats" for desserts you really like and eat them in the evening or right after a ride. No donuts or sticky buns for breakfast.

Now, what we are really interested in is carbohydrates in relation to cycling. We're not nearly as interested in our brains as in our muscles. For all practical purposes, the only cells that can store glucose are those in the liver and in our muscles. It is stored in the form of glycogen (an insoluble glucose polymer). The liver cells can store up to about 5% of their weight in glycogen, which equates to about 400 kilocalories worth. The muscle cells can store between 1-2% of their weight or about 1400 kilocalories.

Muscles can produce aerobic energy from either glucose or fatty acids but they can only produce anaerobic energy from glucose. On the average we store enough glycogen for about two good hours of intense cycling. After that we depend more and more on fats and glucose we can absorb as we go. Good training and dietary habits may allow us to burn more fats earlier, sparing muscle glycogen. This, along with proper refueling on the bike, may extend our stores to as much as four to six hours or more.

For training or racing longer than two hours carbohydrate replacement is very important. This can be done with liquids or solids. Carbohydrate drinks should be about 6% solutions. Higher concentrations may delay stomach emptying which can be uncomfortable and inefficient. Powerbars, Cliff bars and Fig Newtons are not as quickly absorbed as sports drinks, but they can be more satisfying when you are hungry.

There is a unique feature to muscle cells. They are virtually non-permeable to glucose under normal conditions. Insulin does increase their permeability, but for a reason not clearly understood, hard exercise allows glucose to pass easily through the muscle cell wall. This allows us to use simple sugars as energy sources during rides without fear of raising our blood sugar so much that we get the paradoxical hypoglycemia mentioned earlier.

This effect lasts 15-30 minutes after an intense effort which gives us a perfect opportunity to replenish our glycogen stores. Dr. John Ivy, from that school down the street from the shop, has shown that by consuming one gram of carbohydrate for each kilogram of body weight (2.2 lb.) during that first 15-30 minutes, cyclist can increase our glycogen stores 40% more than if we wait two hours to eat. A 150 pound rider would need about 68 grams of carbohydrate post ride for maximum reloading.

It is generally best to use liquids for this because they supply needed water for hydration. They absorb more quickly and they don't kill your appetite. You will still have room for that good "40-30-30" meal come suppertime.

WHERE'S THE BEEF?
by Dr. T. P. Turner

Greetings V.C.ers and eavesdroppers. Can you believe its already racing season? Well, it is. It's also time to finish our three part series on macronutrients. So, on to protein.

Next to water, proteins are the most abundant substances in most cells. About 3/4 of our bodies solids are proteins. There are two types, structural and globular. Structural proteins are the type that make up the contractile mechanism of muscles, the fibers of connective tissue, blood vessels, tendons and ligaments.

Globular proteins are mostly individual protein molecules or small "globs" of molecules suspended in the fluid of cells. They are mostly enzymes, which come into direct contact with other substances in the cell and catalyze chemical reactions. Some perform special functions. For example, hemoglobin and myoglobin carry oxygen in the red blood cells and muscle cells respectively. Antibodies are proteins that help protect us from diseases, allergies and toxins.

There is a constant breakdown of proteins in our bodies during regular activity. This amounts to about 20 - 30 grams of protein loss per day under normal sedentary conditions. During exercise 5-10% of our energy comes from the breakdown of proteins by a process called gluconeogenesis. There is also significant loss of protein from muscle during exercise related to micro trauma and pH buffering.

Scientist have not determined the exact amount of protein breakdown and loss in athletes, but best guesses range from .8- 1.7 grams/ kilogram of body weight/ day depending upon the volume of exercise. That translates to losses of about 65-135 grams/ day for a 175 pounder. This protein has to replaced daily. Proteins are made up of amino acids. There are twenty that are regularly found in our tissues. Ten of these either can't be manufactured by the body or at least not in large enough quantities. They are called essential amino acids because they are essential in the diet.

Cells form either whole proteins or none at all. So, it is also essential that these ten amino acids are in the proper ratio in the diet. Dietary proteins with the proper ratio of essential amino acids are called complete proteins. Those with one or more in short supply are called incomplete.

Meats, eggs and cheeses are great protein sources because animals have about the same amino acid ratios as humans. Vegetarian sources, on the other hand, are incomplete and need to be combined with complimentary sources to supply complete proteins. The old standby for this information is *Diet For A Small Planet*.

Four ounces of beef supply about 20 - 30 grams of complete protein. Four ounces of beans and rice supply 8 - 10 grams. With the exception of folks with eating disorders and those on restricted or fad diets, most of us get adequate protein to supply our basic needs. In fact, a good many sedentary Americans get too much. The extra is converted to fat.

In the last few years, there has been some interesting work done on amino acids and exercise. For example, our friend Dr. John Ivy who did the study on carbohydrate drinks and recovery has shown that adding 20-30% protein to our recovery drinks stimulates extra insulin secretion. This causes greater intake of both carbohydrate and protein into muscle cells speeding recovery.

This discovery has led to the production of a new line of products called "metabolic optimizers". Products like Endura Optimizer, Metaol II, Muscle Pep and Pro Optibol are now available at the shop and in health food stores. Remember, it is still important to use these products within 15-30 minutes after your ride.

Another interesting study has shown that large amounts of glutamine and alanine are released from the breakdown of

intramuscular proteins during and immediately after intense exercise. Also, the body prefers glutamine for gluconeogenesis and breaks down muscle tissue to get it. Taking extra glutamine should be muscle tissue sparing, but when glutamine is put directly into the stomach it breaks down into ammonia, (not good)

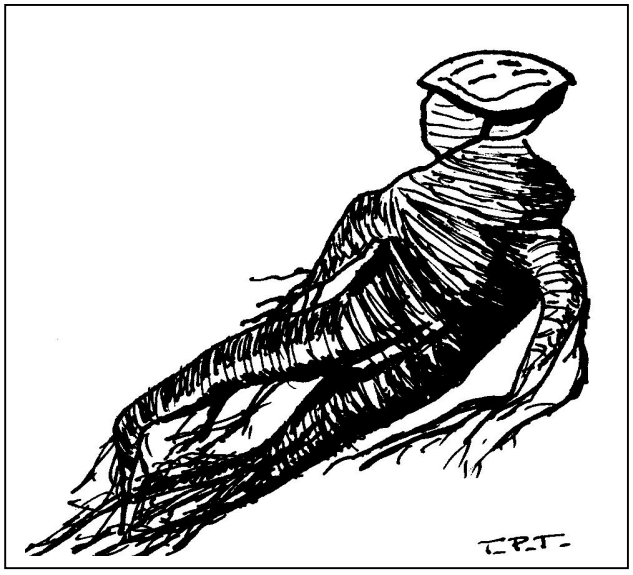
Adding alpha-ketoglutarate to optimizers has been found to be a good alternative. It is glutamine sparing and also is an ammonia scavenger.

Recently, there have been a bunch of studies looking at the immunosuppressive effects of intense exercise. Dr. Richard Kreider and Dr. Brian Leutholtz reviewed the results of 62 studies and concluded that supplementation with branch-chain amino acids including leucine, isoleucine, valine, alanine and glutamine "may reduce net protein degradation, hasten muscle recovery and glycogen restoration...and improve immune status during training".

Now, to recap our dietary plan. The base is a 40- 30-30 (carbohydrate -protein -fat) by calorie count diet, using mostly complex instead of simple carbohydrates, quality natural unsaturated fats instead of hydrogenated or partially hydrogenated fats and complete proteins. Eat regularly.

Add to that carbohydrate drinks and/or energy bars or equivalent substitutes on rides lasting two hours or longer. Most importantly, high carbohydrate and moderate protein optimizer replacement formula immediately following high intensity efforts or any long efforts.

Include enough water to maintain our weight and keep our urine nice and clear and we should have our macronutrients handled.



GO FASTER & FEEL BETTER

by Dr. P. T. Turner

Greetings VC'ers. This month we are going to begin exploring the subject of legal performance enhancing agents. Performance enhancers fall into a number of different categories. There are stimulants, muscle volume increasers, fuel concentrators and a group of herbs, which effect changes in the glandular system, called adaptogens.

I want to start this series with adaptogens. In general terms, adaptogens are agents, which increase resistance to stress. The antioxidants I wrote about in the last article are adaptogens by this definition.

The agents more commonly referred to by this term share other traits. They arc all at least mild stimulants, most of them have been shown to effect change in the endocrine system and they are herbs.

The most well known of the adaptogenic herbs is Ginseng. Ginseng is a group name for a series of similar herbs including Panax quinquefolium (American Ginseng), Panax schinseng (Korean or Asiatic Ginseng), Panax pseudoginseng (Tienchi Ginseng) and Eleutherococcus senticosus (Siberian Ginseng).

The active part of the plant is the root, which is roughly shaped like a man (head, arms and legs). "Ginseng" is roughly Chinese for "man plant". "Panax" is derived from the Greek word "panacea".

Herbs have active ingredients of two main types. They have nutrients (amino acids, fatty acids, vitamins, minerals and enzymes) and chemicals (inorganic salts, organic adds, volatile oils, phenolic compounds, saponins, tannins, bitters, alkaloids, etc.), which have pharmacological effects. The majority of allopathic drugs, although chemically produced, were originally discovered in herbs.

In western literature, herbs are typically classified by the action of these pharmacological agents. For example, herbs, which contain a large number of bitter principles, are known to stimulate digestion and have antibiotic and anti-fungal properties. Herbs may be classified as anti-inflammatory, anti-spasmodic, analgesic, astringent, diuretic... you get the picture. Many herbs contain hormones, or their precursors, which are virtually the same as our own.

Adaptogenic herbs generally contain a combination of agents, which give them a broad range of actions. Through the interaction of its many agents (panaxosides, ginsengosides, essential oils, organic acids, peptides, antioxidants, saponins and sterols). Ginseng is said to often normalize physiological imbalances. For example, in one person, Ginseng may increase the conversion of sugars to fats, lowering elevated blood sugar. While in another person, it may increase cortisol production enabling the liver to convert more fat to sugar raising low blood sugar.

Ginseng is known to stimulate RNA synthesis. It increases liver cell polysome content. This allows for more efficient conversion of lactic acid to glucose. (For cyclist, this is a good thing.) It increases the number of endoplasmic reticulum and gives cells more capacity for energy production and protein synthesis. Used by itself, Ginseng is not very effective as a quick fix for fatigue, but used daily it gradually increases the bodies resistance to fatigue. The saponins in Ginseng act on the adrenal cortex and influence cellular enzyme activity. One result is an increased ability to tolerate anaerobic conditions. Its overall tonic effect and anti-stress properties are probably responsible for Ginseng's reputation as an aphrodisiac.

One problem I will have in discussing herbs in future articles is the lack of good scientific research. (So many herbs, so little time and money.) This is not the case with Ginseng. Research has been done in Russia since W.W.II. In the early 1960's a

number of monographs made their way to the west. Universities from Siberia to Moscow were confirming the properties we discussed above. They concluded that Ginseng may indeed prolong life and that all people over the age of 40 should use it for at least 6 weeks twice per year. Looking at any herb form a purely pharmacological point of view is awfully limiting. Ginseng, in particular, has a long rich history that, even if the claims for its healing powers have been exaggerated, is worth a look. The Chinese have valued this root for at least as long as recorded history. An 1800 year old Chinese text reported that Ginseng increases wisdom and enlightenment and with continued use "increases longevity".

They are still willing to pay dearly for it. The oldest, largest roots are the most sought after. Jack Ritchason, in his "The Little Herb Encyclopedia", reports that in 1976, a four hundred year old root from Manchuria was sold for an incredible $10,000.00 per ounce. It weighed 14 1/2 lbs! (Six to ten year old roots are a bit more reasonable and Siberian Ginseng is actually pretty cheap.)

The history of American Ginseng is probably as long, if not as well documented. No one knows how long the Native Americans have used the root. It grows in shaded woods in the mountains from Quebec to Georgia. In the late 1600's natives shared it with Jesuits in the Blue Ridge Mountains. They, in turn, began exporting the root to England and from there the East India Company sent it around the Cape of Good Hope to the orient. Interestingly enough, while Americans consume mostly Korean Ginseng, the common folk in China prefer the American variety.

There may also be a lot to learn about the action of an herb from the historical perspective. Traditional wisdom is based on experience. Not a perfect teacher, but neither is science. Traditionally, there are differences in the uses of the various varieties of Ginseng. Korean G. is said to normalize the flow from the adrenal glands. It is categorized as an adaptogen, a diuretic, an expectorant, a nervine, a nutritive, a rejuvenative and an immuno-stimulant and a cardio-tonic. American G. is said to share these properties, except that it is thought to be a nervous system tranquilizer while stimulating the other organs. Both varieties are recommended for long-term use to help fight fatigue and depression in men. Whether this is "sexist thing" or is based on actual experience is hard to determine.

Siberian G. is not a Panax and is a little different. For one thing, no sexual preference. It is thought to be safe for both sexes to take long term to increase cerebral circulation with related increased alertness. It is said to increase athletic performance and to protect from viral infections. Tienchi G. is known as an especially strong tonic. It is favored for the under 40 set and/or those involved in sports requiring increased stamina. There is less chance of over stimulation with Tienchi than with other varieties. It is also traditionally used for trauma to muscles, tendons and connective tissue.

Ginseng is available in several different forms. There are teas, capsules, tinctures and decoctions and some people prefer to just chew the root. If you have ridden the Jack rides, besides gravel roads you have probably seen Tac Hammer pull out his small plastic bag, remove the rubber band and pass around pieces of dry root. On the other hand, if you have been on the Swedish Hill rides, you may have noticed Leggo pulling the stopper from a small vial with his teeth and draining his Ginseng decoction.

The evidence we have suggests that Ginseng is safe and that it is effective for increasing stamina, speeding recovery and protecting the body from stress. Although experimentation will probably be required to find the best variety of Ginseng for your needs, here are some guidelines that may help. The younger guys might consider trying Panax pseudoginseng. The women should probably stay with Siberian G. and the older guys will probably best benefit form Korean or American G. If you decide that you would like to experiment, you can choose the variety and form that most appeals to you. Just remember that when they ask, tell them you didn't inhale. Next month I'll tell you about some other adaptogens that might be beneficial by themselves or in combinations.

GO FASTER & FEEL BETTER TWO

By Dr. T. P. Turner

Greetings VC'ers. This month we are going to continue exploring legal performance enhancers. For those few readers who were on another planet last month, we started this discussion with Ginseng, the master adaptogen. Adaptogens are mild herbal stimulants that effect change in the endocrine system increasing our resistance to stress.

No single herb (even Ginseng) has all the characteristics desirable for increasing the performance and health of cyclists. There are other adaptogens that are useful in combination with Ginseng to increase its effectiveness.

The individual properties of these herbs compliment the properties of Ginseng and the synergistic properties of the combination may further enhance its effectiveness. The concept that a properly conceived combination is greater than the sum of its parts is a common theme in herbology.

So, lets talk about some other herbs and about how to build an effective adaptogenic tonic.

One of my favorite herbs is Gotu Kola (Hydrocotyle Asiatica,) also called Indian Pennywort. It is considered to be one of the very best nerve tonics. As we have already discussed with adaptogens, Gotu Kola has the unique ability to both calm and energize the brain cells. This leads to better concentration and is probably why Gotu Kola has a reputation for enhancing learning and recall. It is also why it is considered specific in several cultures for the prevention and treatment of nervous breakdown. This herb is also said to balance hormones, increase longevity, and relieve anxiety. The reason it is in my tonic formula is that it gradually increases energy over time.

Contrary to many peoples belief, Gotu Kola is not related to Kola nut and does not contain caffeine. It does not cause nervousness or other unwanted side effects. Like most herbs, there is not much research information available on Gotu Kola. So, the mechanism of its action is poorly understood.

Research is not a problem for Licorice root. There have been hundreds of research articles published about this remedy, which rivals Ginseng for the title of most studied herb.

Licorice root has very strong adrenal steroid properties and has been found to increase the effectiveness of glucocorticoids circulating in the liver. It also mimics the action of these hormones. Both of these actions help alleviate low blood sugar brought on by adrenal stress, (like on a long bike ride!!?)

This herb has been found to help maintain proper electrolyte balance in the tissues. It does this by keeping mineral corticoids and glucocorticoids active longer.

A Russian study has found it to inhibit the growth of certain tumors. Other studies have found that Licorice stimulates the production of interferon, which may explain the Russian results as well as its antiviral activity.

Licorice has clearly been shown to have estrogenic activity. This is due to the presence of estriol as well as beta-sitosterol and stigmasterol, which keep estrogens active longer.

It has been found to protect and heal distressed mucous membranes in the intestinal tract. In fact, Licorice is one of the only substances that has ever been proven to heal ulcers.

The first recorded reference to this use for Licorice was by Hippocrates himself in 400 BC. Western medicine began using Licorice for ulcer in the 1940's. Then in 1962, an English scientist found that a chemical extracted from Licorice called glycyrrhizinic acid (GLA), also known as carbenoxolone sodium (CS), was very effective in the treatment of ulcers.

In spite of the fact that CS had some unwanted side effects, the extract enjoyed wide spread use for about ten years. Then another group of researchers found that Licorice root with 97% of the GLA removed was also capable of healing ulcers but without side effects. Deglycyrrhizinated Licorice (DGL) is still widely available, but the whole root is even more effective and is also side effect free.

The reason it is in my formula is that it has a profound effect on the adrenal cortical functions that we stress so heavily in cycling. It increases our ability to mobilize glycogen; helps protect us from viruses and from inflammation related to heavy muscle and joint use.

There is a lot of misinformation about side effects associated with Licorice use. While there have been problems associated with the over use of extracts in the form of ulcer medications (CS), laxatives and even candies, there have been no reported problems with the use of whole root products. The side effects from the overuse of extracts are associated with potassium depletion and are reversible by discontinuing the products.

With this information in mind, it is best to use only whole root or DGL products. These are available as powders, sticks, teas and tinctures. Most herbalist believe it is best to use Licorice in combination with other herbs rather than singly.

Another adaptogen for the mix comes from South America. Suma (Pfaffia paniculata), also known as Brazilian Ginseng, is fairly new to the US scene, but it is an ancient herb called "para todo" or "for everything" by the natives.

Suma is more like Siberian Ginseng than the Panax varieties. It is a good energy producer for both men and women. As with the other adrenal adaptogens, Suma helps regulate blood sugar and strengthen the immune system. There are authors who claim that it is beneficial for Epstein-Bair and chronic fatigue syndrome. There are two hormones known to be in Suma. Sitosteral and stigmasterol have been found to help the heart and lower blood cholesterol levels. Like the other Ginsengs, Suma is high in germanium and is an antioxidant.

It is thought to help restore sexual function in both men and women and like most adaptogens is thought to increase longevity. Japanese researchers have discovered a chemical in Suma that has anti-viral and anti-tumor properties.

So, to build your own adaptogenic tonic, check out last months article to help you choose the right Ginseng. Then, add equal parts of Gotu Kola, Licorice and Suma.

Try teas, capsules (which are best made into teas), decoctions, tinctures or sticks and take the tonic each morning. Remember, this tonic will increase energy and vitality gradually over time.

In the first article I wrote in the VC News, I talked about the difference between health and fitness. An adaptogenic tonic is one of the only things that I know of which can increase both.

MORE HERBAL GOODIES
by T. P. Turner

Greetings VC'ers. Well, here we are, just three parts into our series on legal performance enhancement and I'm already getting distracted. All this talk about herbs has me thinking about other herb, cycling relationships.

So, this month's article makes the totally logical leap to prostate problems. The prostate is definitely related to performance; not necessarily "on the bike" performance, but hey, lets not get picky.

The prostate gland is vital to male health and has a big effect on urinary and sexual performance. It is the size and shape of a walnut and is located in front of the rectum and encircles the urethra (the tube that passes urine from the bladder). The prostate produces enzyme rich seminal fluid. This fluid supplies substances, which nourish and protect the sperm.

Most men, in our society, fall prey to some form of prostate disease by the time they reach fifty. However, problems can start as early as twenty-five. There are three basic problems common to the prostate gland.

1) Prostatitis - acute and chronic inflammation. Inflammation is heat, redness, swelling and pain. Swelling puts pressure on the urethra and can create urine retention. The bladder becomes distended, weak and prone to infection.

Acute prostatitis is usually bacterial and often serious, but fortunately not very common. Symptoms include pain between the scrotum and rectum, chills and fever, frequent urination, often there is lower back pain and blood in the urine and semen is common. These symptoms warrant a quick trip to your family doctor or a urologist.

Chronic prostatitis is much more common. This condition has multiple causal factors including too many "bad fats" in the diet (see Fat-al Attraction), coffee, tea, alcohol, smoking, chlorinated and/or fluoridated water, drugs, malnutrition and mechanical stress (can you say Sella Italia).

Symptoms include frequent urination, often a small urine stream and dribbling of urine, occasionally lower back pain and blood in the urine and semen.

2) Benign prostatic hypertrophy (BPH) - is generally hormonally induced. Prolactin is a pituitary hormone, which increases in men with age and is known to cause (BPH) although the mechanism is not clear. Another hormonal

reaction, that is better understood, is the breakdown of testosterone to dihydrotestosterone (DHT) by an enzyme called 5-alpha reductase. (DHT) acts as a catalyst.

When it attaches to the receptors in the prostate cells, it unlocks their genetic materials allowing them to divide and the prostate to enlarge. The breakdown of testosterone tends to accelerate with age.

The symptoms of (BPH) include frequent urination, especially at night, decreased urine stream, dribbling at the end of urination, throbbing, backache and loss of libido and sexual potency.

In both prostatitis and (BPH) the prostate is enlarged and encroaches on the urethra. In prostatitis the enlargement comes from swelling and in (BPH) it comes from an increase in the number of cells.

3) Prostate cancer - one out of eleven men will develop prostate cancer at some point in their lives. Those with a family history of the disease are the most at risk. High "bad fat" diets and exposure to chemicals such as insecticides may also increase the risk. Symptoms begin the same as in (BPH).

Digital rectal exam is the most important test for screening. There is also a blood test for prostate specific antigens (PSA's). It is important to note that (PSA's) can be elevated by (BPH) and prostatitis and also by bike riding. So, be sure to tell your doctor that you are a cyclist.

Those of us in the 40+ category should probably have the "finger wave" at some regular interval. Some experts say it should be as often as once per year. 130,000 men were diagnosed with prostate cancer in the U.S. last year. 35,000 men died from it, including Frank Zappa.

Of these three basic problems, the most cycling related arc chronic prostatitis and (BPH). Advancing age and lots of time in the saddle are the risk factors. Studies suggest that most cyclist deal with some form of prostate inflammation and/ or enlargement. Obviously one problem for male cyclist is that we sit on our prostates. Not totally, of course, but with the saddle between our legs, there is a significant amount of pressure directly on the gland. This repeated stress certainly accounts for a percentage of the prostate problems.

Another possible causal factor is the increased breakdown of testosterone related to the intense metabolic activity of training and racing. Of course, what these articles are about is staying healthy while still enjoying the sport we love. So, what's the good news?

Proper saddle position is a big help for the first problem. A number of doctors have written articles endorsing the use of alternative (noseless) saddles to reduce prostate pressure. The problem with these saddles is that they just don't perform as well as the classic design.

I asked our esteemed secretary about the one he used when he had that unfortunate bout with the flesh eating strep. bugs and he said it allowed him to ride but he hated it. The lack of a nose made a big difference when cornering and it was hard to stay on the saddle when riding on rough terrain.

It took me about eight years to figure out what I have since learned is common knowledge among grizzled vets. There is a proper way to set up saddle position to limit prostate pressure. I'm sure not many of you are as slow as I was, but just in case a few of you are still in the dark about this, you will know you are there when your ischiums (sit bones) are on top of the wide portion of the saddle. I had to lower my saddle considerably when I figured this out.

The other good news is that there arc a number of safe, effective natural remedies that have been proven to relieve the pressure of prostatitis and (BPH) in most suffers. This is true for cyclist and normal humans alike.

Zinc has long been known to reduce prostate size and symptoms. Along with vitamin B6 it works by reducing prolactin levels. 50 mg of zinc picolinate and 200 mg of B6 per day is a common effective dosage.

The berries of the Saw palmetto plant (serenoa repens or serrulata) contain fats and sterols which block the function of 5-alpha reductase. This slows the breakdown of testosterone to dihydrotestosterone. These fats and sterols also inhibit (DHT) from binding to prostate cell receptors. The result of these actions is an increase in testosterone and a decrease in prostate size.

Saw palmetto berries have also been shown to reduce the inflammation of chronic prostatitis, although the mechanism of this is not yet understood. Ginseng has been shown to increase testosterone levels and decrease prostate weight. It has also been reported to increase zinc absorption.

Another herb Pygeum africanum contains chemicals known as pentacyclic triterpenoids. Their effect is a diuretic action that relieves some of the pain of prostatitis and (BPH).

It also contains hormone like chemicals called phytosterols that reduce the levels of inflammatory prostaglandins in the prostate. Note: It is also important to eat a diet high in essential fatty acids and low in hydrogenated and partially hydrogenated oils to balance prostaglandin activity, (see Fat-al Attraction)

Finally, Pygeum contains linear alcohols and ferulic esters that reduce cholesterol deposits in the prostate. It is not known whether cholesterol is a cause or an effect of an enlarged prostate, but removal reduces its size and weight. I have one article that claims that 80% of all prescriptions for the treatment of (BPH) in France arc for Pygeum.

If you have prostate symptoms, go see your doctor and get "the wave" to rule out serious problems. Then, provided the news is good, you have a number of safe, effective, natural therapeutic options. Oh, and wear your helmet!

GOOD BUZZ
By Dr. T. P.Turner

Greetings V.C.er's. I hope all of you had a great holiday and are well on the way to a happy, healthy and fast new year. Well, it's time to continue our look at legal performance enhancers. If you have been keeping up, then you are aware that I have been preoccupied with herbs. Guess what. I still am.

We are going to talk about another set of similar alkaloids, found in a group of herbs. These herbs are so common that they are considered everyday foods and the alkaloids have long been synthesized as drugs.

These drugs are chemically related to amphetamines (speed) and are used as stimulants, headache preparations and even asthma medications. The alkaloids are collectively known as methyl xanthines and include caffeine, theophylline and theobromine. The herbs containing these alkaloids are coffee, tea and chocolate respectively.

I know, you already use coffee to help your performance, but hey, I feel obligated to include it in the series and just maybe there are a few things about it that you don't know.

Lets answer a few questions about methyl xanthines. First, do they actually improve performance? Although there are conflicting reports, the majority of studies indicate that they do. Besides, we all know that they do because we've tried them.

Monique Ryan reported, in Velo News, on the work of Spriet and Grahm. They studied the effect of high doses of caffeine on runners and cyclist. The participants were given 9 mg of caffeine/kilo of body weight one hour before exercising at 85% of their V02 max. The caffeine increased the runner's time to exhaustion from 49 minutes to 71 minutes and the cyclist's from 39 to 59 minutes.

There were a couple of things about this study that surprised me. The athlete's regular caffeine consumption had little effect on the outcome. Also, the athletes who were the better trained had the most performance enhancement. Another study found a 7% decrease in marathoners' times with the introduction of caffeine. Next question, how does caffeine help? We know that it mobilizes fatty acids and spares muscle glycogen, but we don't know the mechanism. It stimulates the cerebral cortex, improving both reaction time and motor activity.

Caffeine has interesting effects of blood vessels. It dilates the coronary arteries and arteries in skeletal muscles. That's gotta help, both early in the ride, before we are completely warmed up and late in the ride when we are beginning to bonk.

At the same time caffeine constricts the small arteries in the brain. This is why it is in headache preparations like Anacin and Excedrin. It also relaxes the smooth muscles of the bronchi, which improves breathing volume. Related compounds (more specific and more efficient) are used in asthma medications.

Next question, how much is enough? This is a tough one. I mentioned a dose of 9 mg/kilo earlier (about 6 cups of coffee for a 150 pound rider), but this dose is right on the margin and might put you over the legal urine level of 12 mcg/milliliter set by the I.O.C. and the U.S.C.F. It's not wise to anger the gods and you are likely to have some unpleasant side effects with a dose that high.

Fortunately, other studies have indicated that doses around 3 mg/kilo are sufficient to get the performance benefits we seek and conventional wisdom is that doses around 150-300 mg for a 150 pound rider is about right. This translates to about 1 1/23 cups of coffee, which averages about 100 mg/cup. (This varies considerably with different beans, roasts and brewing methods and times.)

Tea averages between 1/3 and 1/2 the caffeine of coffee. Soft drinks contain similar amounts to tea. Mountain Dew and Jolt top the list. No-Doz contains 100 mg/tablet, Excedrin contains 65 mg/tablet and Anacin contains 35 mg/ tablet. It is important to remember that dosage is related to the weight of the rider. A 100 pound rider would get the same effects (both good and bad) from 2/3 the dose of our 150 pounder.

Last question, what problems are associated with caffeine use? Well, first, coffee beans are high in polyunsaturated oils, which can get rancid if left exposed to oxygen. (See Fat-al Attraction.) This can be handled by buying freshly roasted beans, keeping them in the freezer, and grinding them just before you brew them. Also, the darker the roast, the more heat they have been exposed to. So, pick lighter roasts. Caffeine stimulates the intestines. Leave enough time before the race for that extra bathroom stop.

The positive effects of caffeine tend to last about 1 1/2 -2 hours and can be followed by a drop in blood sugar. Have another dose available for longer events. Many riders find it most effective for the last hour of long hard events.

Finally, there have been countless studies and articles on the long-term health effects of regular caffeine consumption. Some of the problems that have been reported with long term, high doses are elevated liver enzymes, changes in plasma lipoproteins, increased stomach acid secretion associated with stomach upset and aggravation of ulcers, and increased risk of osteoporotic fractures in middle aged women.

Lets talk about some guidelines for caffeine consumption that should give us the performance we want without risking our health. The evidence suggests that the caffeine in 1-3 cups of coffee is safe and effective as a performance enhancer and that it will keep us well within U.S.C.F. guidelines.

Also, the evidence suggests that long-term doses of 3 cups or less/day probably don't pose risk of major disease. Having said that, my experience with functional disorders suggests that we are better off keeping daily doses to I cup or less/day. Save the larger doses for races or long hard training days. There is enough evidence to suggest that if you are using more caffeine then the equivalent of 3 cups of coffee/day, cut down.

There are a few other precautions I'd like to mention. Caffeine is not a substitute for effective training, good dietary preparation or a good warm up. All of these can produce similar and even more important effects.

There is a small body of evidence that suggests that it is best for those of us who use Ginseng regularly to avoid regular caffeine use. Also, check all supplements and herbal preparations for caffeine sources. The herb Guarana is very high in caffeine.

Ephedra is another stimulant which often goes by the name Ma Huang. Of course, none of us would use it because it's illegal in racing. For those of you who like to use soft drinks. Avoid cans. Imperfections in the lacquering of drink cans may allow the acids to leach the aluminum, which has been associated with a number of disorders including Alzheimer's and fibromyalgia.

Last, but not least, happy birthday to the short person and to the Legg man and thanks for wearing your helmet.

SOME LIKE IT HOT
by Dr. T.P. Turner

Greetings Campers! Welcome to summer in Austin. Can you say heat index? In this installment of our series on the stresses of cycling, I want to talk about heat.

Basically, we produce heat when we work. We have to dissipate this heat or it builds up until we can't work or even until we die. Of course, we aren't just interested in the basics ...now are we?

Last month we talked at length about the production of all that energy we use to turn the pedals. Briefly, we said that the energy in food is converted to ATP, which is broken down for energy to fuel muscle contraction.

What we did not say was that this is not a very efficient process. About 35% of the energy in food is lost as heat during ATP formation. Another 30-35% is lost as heat during the transfer of energy to muscles.

So, at least 73% of our energy is lost as heat before the contraction, leaving no more than 27% for actual pedal turning. Much of this contractile energy becomes heat eventually due to friction in muscles, friction from the flow of blood within the vessels and the degradation of proteins.

All in all, we produce a lot of heat. In order to continue activity, we have to get rid of it. The rate at which heat can be lost is determined by two things: 1) how rapidly heat can be conducted from core to skin and 2) how rapidly heat can be transferred from skin to air.

1) Heat is conducted from core to skin primarily by blood. As much as 30% of the total cardiac output can be devoted to this under intense conditions. This is why yours heart rate is higher when you climb your favorite hill on a hot day, even though you are going slower.

2) Heat is lost from the skin by three primary mechanisms:

a) Radiation: Infrared heat rays (a type of electromagnetic wave) move from the skin to the air. The efficiency of this system depends on the differential between body temperature and air temperature. In cold weather, radiation accounts for as much as 60% of heat loss. This is why the reflective surface of a thin "space blanket" can provide so much warmth.

b) Conduction: Vibratory rates of molecules in the skin transfer to the air next to the skin. This mechanism requires wind (convection), so that the warmed air does not act as an insulator.

The greater the velocity of air movement, the more effective this mechanism is. Heat loss is proportional to the square root of wind velocity. In other words, conduction is two times more efficient in a 4 mph wind than in a I mph wind.

c) Evaporation: .58 Calories (kilocalories) of heat are lost for each gram of water evaporated. When the air temperature is hotter than the body temperature, the body gains heat through conduction and radiation. Then, evaporation is the only means of losing heat.

Acclimatization is an important factor in the efficiency of evaporation. We adapt to repetitive heat exposure in several ways. Over a 1-3 week period, sweat volume increases from about 700ml/hr to as much as 2 liters/hr. At this rate, under optimal conditions, evaporation can remove heat from the body at a rate of 10 times the normal basal rate of heat production.

During those first warm weather rides of the year, we lose sodium chloride (salt) and potassium at a very high rate. As we acclimatize, our bodies "learn" to conserve these minerals, but the loss is still significant.

We now know where the heat comes from and the mechanisms we use to lose it. We know that these mechanisms work really well under optimal conditions. Notice how cool you stay on windy winter rides. Ideal conditions are cool air, good convection and low humidity.

During endurance athletics, core temperature usually rises from 98.6 to 102-103 degrees. We produce the same amount of heat at all times of the year. The problem is that in the summer the conditions for heat loss are not optimal.

As cyclist, we don't generally have to worry about convection. We create much of our own wind, but I bet that you have noticed that it is cooler riding into the wind than with it. This is because conduction and evaporation are more efficient with more wind.

The obvious difference in the summer is the higher air temperature. Radiation and conduction both depend on the air being cooler than our bodies. As the air approaches 103 degrees, we lose all benefit from these two mechanisms. In fact, if the air temperature gets hotter that 103, we gain heat from them.

However, evaporation is so effective that if the air is very dry and the convection is good, an acclimatized body, at rest, can tolerate temperatures up to 130 degrees for several hours.

The major inhibitor of evaporation is humidity. The term relative humidity indicates the amount of water in the air in relation to the amount it can hold. As the relative humidity approaches 100% the air just can't hold any more water and sweat just sits on our skin and we get hotter.
At 100% humidity body temperature rises at rest when the air temperature is 94 degrees or higher. With heavy exercise, 85-90 may be too high.

If body heat is not lost and the core temperature continues to rise to 106-108 degrees, heat stroke is likely. Symptoms can include weakness, exhaustion (heat bonk), headache, dizziness, abdominal distress, staggering gait, delirium and eventually loss of consciousness.

These symptoms happen more easily with circulatory shock brought on by excessive loss of water, salt and potassium. If any of these symptoms start on a ride, get out of the heat and reduce the core temperature by spraying or sponging the skin with cool water.

It is probably not realistic to ask you to avoid hot, humid conditions when training in a Texas summer. There are going to be races held in less than ideal conditions. So, you need to prepare.

Acclimatize. Ease into riding in the heat. Go for morning rides that gradually extend into the hotter part of the day over a 3-4 week period. Hydrate or die. Drink constantly on rides. One regular bottle for each 30 minutes to and hour. Drink water all through the day. As much as two gallons per day during periods of heavy training and racing. Weigh regularly to insure that you are hydrating adequately.

Replace minerals. Salt your food. Eat lots of fruits. They are high in potassium and water too. Most carbohydrate replacement drinks contain potassium. If yours does not, change brands.

No matter how well you are prepared, there are times when it is probably smarter to stay home. When the heat index (a value figured from the combined heat and humidity) is above 95 to 100 degrees think twice. If you don't know the heat index, when the relative humidity is above 80% and the temperature is above 90 degrees, it may be too risky.

One small item on another subject. Those of you who enjoy the mystical Tuesday night experience, please stay right of the yellow and be cool. Scooping riders off the pavement is getting old and it is only a matter of time until it will be off the hood of a Pinto.