(Continued from page 39)
suspended in green # 1,2,3,4,6,7,8,10,11,12,13,15,16 and 17 and possibly in the rest of the greens as well! If you're a conservative Republican rather than a liberal Democrat, stay with me and I'll show you how you can gently let your very high or excessive soil tests slide down to more reasonable values.

In looking at the soil tests in Table 1 and their interpretations in Table 2, there is something else you need to be aware of. Note that in Table 1 there are a lot of soil test vales of 400 lb P/A, but none higher. There is a good reason for this. Soil test procedures are such that there is a maximum amount that can be detected without modifying the procedure. In the present case that amount for P is 400 lb/A. In actual fact, some of the greens represented in the tables may have 600 lb. P/A or more! If you're encountering increasing problems with weeds and algae in your pond or ponds and soil test P levels on the golf course are frequently excessive, there is a very good chance that the two are directly related.

The next step in mining your soil test reports is where time, patience and a calculator come into play. What we need to know is how much phosphate and potash have been applied during the period of time between soil tests. If your fertilization records show actual rates of fertilizer applied and the grade (information you have to have in any case), the calculation of the rates of P_2O_5 and K_2O applied is easy. You merely multiply the fertilizer rate by the percent P_2O_5 or K_2O in the fertilizer. Most of the time, however, what gets recorded is the rate of N applied. In this case, the calculations are a bit more complex. What you have to do is multiply the rate of N applied by the ratio of percent P_2O_5 or K_2O in the fertilizer to the percent of N. To give you an example, assume we've applied 0.5 lb N/M as an 18-3-12 fertilizer. The amount of P_2O_5 applied was (0.5 lb N) 3 ÷ P_2O_5/18 ÷ N) or 0.08 lb/M. Likewise, the amount of K_2O applied was (0.5 lb N) (12 ÷ K_2O/ 18 ÷ N) = 0.33 lb/M.

Table 3.

Nitrogen, phosphate and potash applied to putting greens in 1980.

Fertilizer grade	N Rate	P_2O_5 Applied	K_2O_5 Applied
18-5-5	0.45	0.12	0.12
20-26-6	0.72	0.94	0.22
18-5-5	0.45	0.12	0.12
6-2-0	1.00	0.33	0
18-5-5	0.45	0.12	0.12
18-5-5	0.45	0.12	0.12
0-0-50	0	0	3.00
22-0-16	0.45	0	0.33
18-5-5	0.45	0.12	0.12
24-5-3	0.50	0.10	0.06

What these calculations lead to is many tables, each one showing how much P_2O_5 or K_2O was applied in a single season to your greens, tees or fairways. An example of such a tabulation is shown in Table 3. If you've been fertilizing different greens, tees and fairways differently, then you'll wind up with that many more tables. Having assembled these year-by-year P_2O_5 and K_2O application tables, you then need to calculate the total amounts applied for the time interval between soil samplings and the average amounts applied per season over this time interval. The P_2O_5 totals and averages for the putting green soil tests being used here as an example are shown in Table 4.

Table 4.

Phosphate applied to putting greens between soil tests.

Green	1973 to 1977 Total P_2O_5	1973 to 1977 Ave/yr	1978 to 1990 Total P_2O_5	1978 to 1990 Ave/yr
1	3.68	0.74	18.70	1.44
2	3.68	0.74	19.38	1.49
3	4.62	0.92	22.06	1.70
4	4.62	0.92	20.51	1.58
5	3.68	0.74	19.51	1.50
6	3.68	0.74	18.70	1.44
7	4.62	0.92	21.93	1.69
8	3.68	0.74	18.90	1.45
9	4.62	0.92	21.93	1.69
10	3.68	0.74	18.70	1.44
11	3.68	0.74	18.82	1.45
12	3.68	0.74	19.38	1.49
13	3.68	0.74	18.92	1.46
14	4.62	0.92	22.06	1.70
15	3.68	0.74	18.92	1.46
16	3.68	0.74	18.70	1.44
17	3.68	0.74	18.70	1.44
18	5.05	1.01	21.71	1.67

Now we need to work with Tables 1 and 4 to tabulate the annual average changes in soil test P that occurred between samplings and the average annual amounts of phosphate applied over the same time intervals. These tabulations are shown in Table 5. Note the many blank spots. These are where at least one of the pairs of soil test values involved a test of 400 lb P/A. We cannot use these values because they are soil test procedure maximums and the actual amounts of P that were present are unknown.

The next step is to place the data in Table 5 in graphical form. As shown in Figure 1, soil test change per year is plotted on the vertical axis and annual average P_2O_5 rate on the horizontal axis. Graphing the data is important for two reasons. One is to give us a visual image of the data that quickly shows whether or not we have some "oddball" data points. As indicated by the two arrows, we do have two strange looking data points. When this happens we have to decide whether to use these points or not. In this particular case, I feel we're justified in not using those two points. These points are from greens #1 and 11. I strongly suspect that the two greens were reconstructed sometime between 1973 and 1977. What this would do is invalidate the 1972 soil test results and give us a new starting point in soil test P that was much lower than the values of 300 to 350 lb P/A found in 1972.

Table 5.

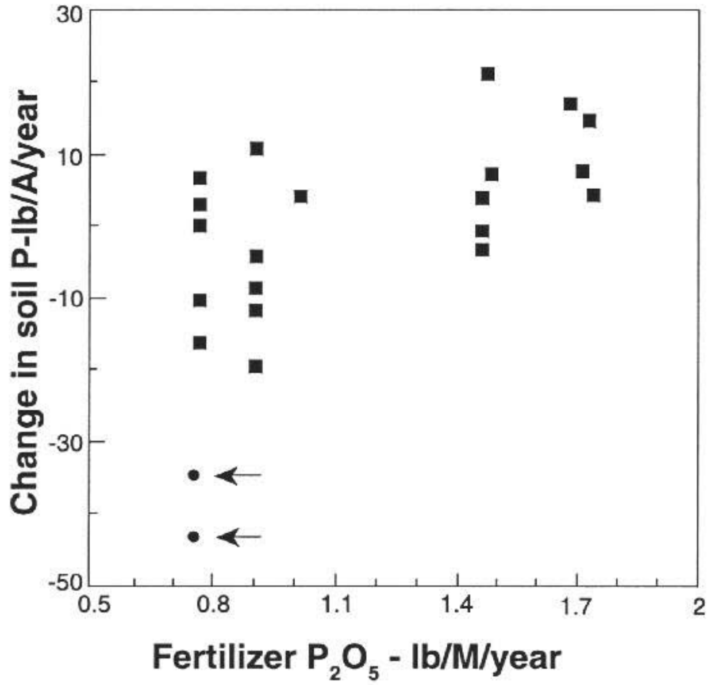
Changes in putting green soil P levels and the average amounts of phosphate per year.

Putting Green	Soil P change/year 1973/77	Soil P change/year 1978/90	P_2O_5 applied/year 1973/77	P_2O_5 applied/year 1978/90
	lb/A		lb/M	
1	-36.0		0.74	
2	0		0.74	
3	9.0	13.5	0.92	1.70
4	-18.0		0.92	
5				
6	-10.0	0.4	0.74	1.44
7	- 5.0		0.92	
8				
9	- 9.0	7.3	0.92	1.69
10	5.0	-1.2	0.74	1.69
11	-46.0	19.6	0.74	1.45
12				
13				
14	-11.0	4.6	0.92	1.70
15	2.0	6.9	0.74	1.46
16	-15.0	4.6	0.74	1.44
17	-10.0		0.74	
18	2.8	14.6	1.01	1.67

Having prepared the graph shown in Figure 1 and having eliminated the two oddball data points, we now want to draw a line through the remaining points. Here's where it really helps to have a friend that knows the procedure and has a computer with which he can use regression analysis to calculate the mathematical equation for the line we need. You can, however, determine this line yourself with the degree of accuracy needed here. The process is as follows. In looking at Figure 1, you'll notice that there are several data points associated with each of several P_2O_5 application rates. For example, there are 5 data points associated with the P_2O_5 rate of 0.74 lb/M/year. Multiple points are also associated with P_2O_5 rates of 0.92, 1.44 to 1.46 and 1.67 to 1.70 lb/M/year. What you want to do is average the data points associated with each of these P_2O_5 rates and graph the resulting averages. Doing so leads to the graph shown in Figure 2. With only four data points, it's a relatively simple matter to use the old eyeball method to draw a straight line through the points. Note that the scale on the vertical line is such that we can see where this axis is intersected when the P_2O_5 application rate is zero. It is essential that we do this.

Even without going any further in our "mining" process, the graph in Figure 2 gives us a valuable piece of information. Note where the line crosses the point on the vertical axis where there is no (zero) change in soil test P. As shown, if we extend a line straight down from this point to the horizontal axis, this intersects at a P_2O_5 rate of about 1.15 lb/M/year. What this value represents is the annual P_2O_5 application rate needed for these greens to maintain soil P at a constant level. In other words, this is the so-called maintenance P_2O_5 rate for this particular set of putting greens. It is a "customized" phosphate recommendation for this golf course that may or may not apply to other courses.

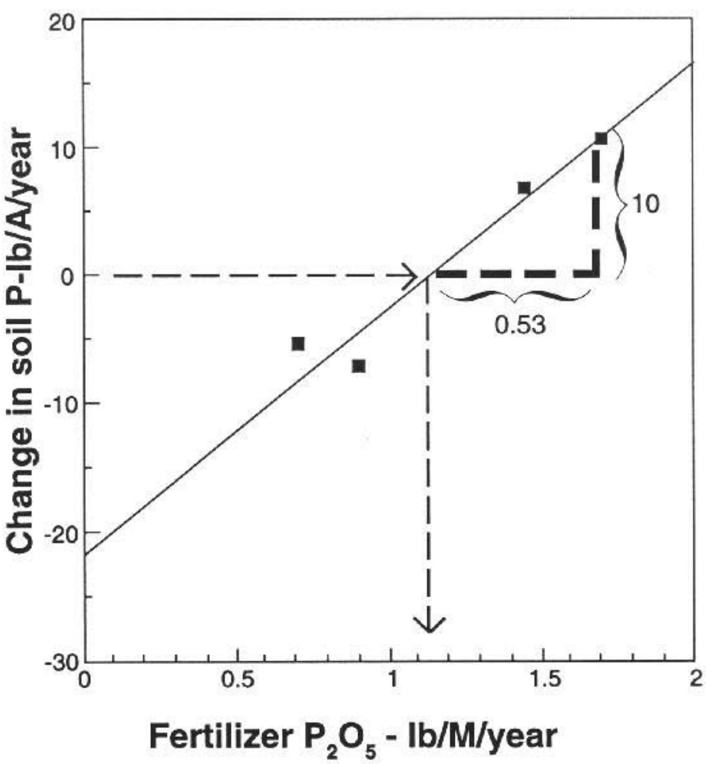
Figure 1.



Annual changes in soil test P vs. P_2O_5 applied.

The line in Figure 2 can also do something else for us. What this line does is define the relationship between the annual change in soil test P and the annual rate of P_2O_5 application. To make this relationship really useful, we need to express it in mathematical terms. We already have part of this mathematical relationship. It is the change in soil test P when no fertilizer is applied. In short, it is where the line in Figure 2 crosses the vertical axis. For Figure 2 that value is -21.5 lb P/M/year. The other number we need for our mathematical relationship is the slope of the line. To get this, we note in Figure 2 the change in soil test P resulting from a certain change in the rate of P_2O_5 applied. We can use any part of the line in Figure 2 to do this. I arbitrarily chose a segment that could be indicated without conflicting with other lines drawn on the graph. Note in Figure 2 that I came up with a 10 lb change in soil test P for a 0.53 difference in our P_2O_5 application rate. The slope of the line in Figure 2 is the ratio of these two numbers, i.e., 10 lb soil P/0.53 lb P_2O_5 Dividing, we get an 18.9 lb change in soil test P/A/year per 1.0 lb application of P_2O_5/M/year. Finally, we can assemble the mathematical relationship between the change in soil test P and rate of fertilization. The equation, in all its glory is: Soil P change in lb/A/year = -21.5 + (18.9)(lb P_2O_5/M/year).

Figure 2.



Average annual changes in soil P vs. P_2O_5 applied.

This equation is a powerful management tool. Let me illustrate its use. Going back to Table 2, we note that all of the soil test P values are "high" or "excessive" and should be reduced. Let's set as our goal soil P levels around 150 lb P/M. Looking at green #3, we see that it currently contains 310 lb P/A. Thus, we want to reduce the P level by 310 minus 150 or 160 lb/A. First we'll take the Republican approach and bring about the change gradually. In other words, we're going to continue to apply some fertilizer phosphate each year. We know already that if we apply 1.15 lb P_2O_5/M/year we will maintain the 310 lb soil test. So, let's reduce the annual application rate to 0.75 lb P_2O_5/M/year. How fast will the soil test decrease? Our magical equation holds the answer. Simply insert 0.75 lb P_2O_5 and solve the equation like so: soil P change = -21.5 + (18.9)(0.75 lb P_2O_5) = -21.5 + 14.2 = -7.3 lb P/A/year. In this case the time required to reduce soil P in this green from 310 to 150 lb/A would be 160 lb/7.3 lb/year = 21.9 years! A good Democrat would go the more liberal route, not apply any fertilizer phosphate for awhile, and bring about the same change in 160/21.5 or about 7.4 years.

We can also use our equation to tell us how much fertilizer is needed to adjust a new putting green to an optimum soil P level of 150 lb/A. Just a note of caution before we do so. This calculation assumes that the rootzone mix going into the new green is the same as in the existing greens. To come up with this fertilizer requirement, we have to know the P status of the rootzone mix. I've analyzed a commercial mix that's being used in the state and found 35 lb P/A, so let's use that number. To bring this up to 150 lb P/A requires an increase in the P test of 115 lb/A. The amount of P_2O_5 required can be estimated by plugging this number into our equation and solving for the P_2O_5 needed. The calculation is as follows:

$$\begin{aligned} 115\text{ lb P/A} &= -21.5 + (18.9)(\text{lb } P_2O_5\text{ /M}) \\ (115 + 21.5) &= (18.9)(\text{lb } P_2O_5\text{ /M}) \\ 136.5 &= (18.9)(\text{lb } P_2O_5\text{ /M}) \\ 136.5/18.9 &= 7.2\text{ lb } P_2O_5\text{ /M} \end{aligned}$$

Maybe you don't want to apply this all at once. Let's split it up into five equal annual applications of 7.2/5 = 1.26 lb P_2O_5/M/year. This is fine, but you have to keep in mind that to maintain the P level each year you also have to apply 1.15 lb/M of maintenance P_2O_5. Thus, what you really need to apply each year for five consecutive years is 1.26 + 1.15, or 2.4 lb P_2O_5/M/year.

What I've illustrated here is the process for mining some unique information from your soil test reports and fertilization records. We looked at just P for putting greens. You'll want to do the same for K in your greens and for P and K in your tees and fairways. Doing so will bring you out of the dark as to where you're headed with your present fertilization program and give you the means to exercise unprecedented control over your soil P and K levels. Is it worth the effort? Only you can answer that question.

PLEASE, Be a good WGCSA citizen—
Pay Your 1992 Dues On Time!

The 1991 Season— At Least It Wasn't Boring

By James M. Latham, Director
USGA Green Section, Great Lakes Region

The 1991 season has been a good news/bad news affair so far, with weather conditions determining the difference much of the time. Good news came to the West in the spring, with timely rains which have brought precipitation records up to par for the first time in 5 or 6 years, but they were preceded by winter desiccation damage to greens, tees AND fairways on many courses. Desiccation? How about 80-mile-an-hour winds with still air temperatures at 20 degrees below zero!

Crown hydration/winterkill of *Poa annua*, which has plagued northern latitudes of Wisconsin to Montana the last two years, moved south to the Wisconsin-Illinois state line area and southward. Rather than general, across-the-board damage to all courses, it was a patchwork of turf loss. One course could be almost undamaged, while a neighbor was hurt severely. This provided an early season supply of grist for the mills of locker room agronomists. At the same time, though, it gave superintendents an opportunity to reintroduce bentgrass into weak spots and justify the formulation of pro-bent maintenance programs.

For other areas, the worst was yet to come. Southern Michigan and Chicagoland went through a most disquieting season. It was an accelerated growing season, according to one Michigan superintendent. July weather came in May, August in June, and a breath of September in late July. Not a very deep breath, though, because another spell of hot, humid weather finished off a lot of *Poa annua* already weakened by disease and the hot, humid, but rainless weather earlier in the summer. Any time winterkill or Summer Patch become destructive is the time to present a plan for regeneration of bentgrass to The Powers so that a means of funding can be found. In this way, adversity might become a positive beginning to more reliable playing surfaces.

All of these woes were not shared democratically, however. Many courses have come through the hard times in fine condition. Those with a predominance of bentgrass and Kentucky bluegrass fared well. Naturally, *Poa annua* seedlings came on strong after winterkill, but the high temperatures in late spring applied some degree of stress.

Hopefully, the new Poa plants got a lot of competition by inter-or overseeding with more dependable species. In hot weather, the percentage of bentgrass or bluegrass seedling survival is low, but poa competition will not be as great as it is in either fall or spring. And what is wrong with aeration, slit-seeding, etc., weak or dead areas during the prime playing season? At least, the golfers see something *positive* being done to their course rather than our usual moaning about that blankety-blank P.a.

Golf Courses in the Midwest

Have you noticed the number of golf championships being played in the Mid-Lands these days? Medinah, Hazeltine, Oakland Hills, Crooked Stick, Cog Hill, Edinburgh USA, SentryWorld, Crystal Downs, Kemper Lakes, Interlachen, Otter Creek, Golden Valley, Indianwood, and others have become better known to competitive golfers of all ages in the last few years because of the USGA and PGA championships conducted in these environs in recent years. Architecture and style are, of course, the primary reasons for the associations to accept invitations to use these venues, but you can bet that course care comes next. The golf course superintendents at these courses, with backing by forward-looking Green Committees, have produced turf quality fit for champions as well as the non-handicapped.

The playing conditions at these courses did, at some time, favorably impress visiting golfers who communicate with The Powers who make decisions on competition sites. Potential hosts may not even be aware of this. That's why *playing quality* of the turf is usually as important as cosmetic greenness. Probably more. Thatchy, overwatered fairways are underwhelming, regardless of the shade of green. P.J. Boatright believed that play to firm, fast, fair greens demands firm, fast fairways.

The Courts

Litigation or legislation? When the U.S. Supreme Court ruled that communities could indeed promulgate rules exceeding those of USEPA, the door was opened for the political intimidation of governing bodies of all sizes. Timid politicians and highly vocal Anti groups can legislate away all pesticide use unless someone *locally* speaks up in their favor. This means that individual golf course superintendents, golfers, pros, club managers, as well as their organizations, will have to speak up.

We must talk to and inform our down-home folks in wards or precincts. Company lobbyists and pro-pesticide organizations cannot be of much help at community levels. If golf course managers *do* know more about pesticides than anyone in the neighborhood, they'd better begin speaking up. And *before* restrictions are proposed, not afterward, because the Anti's already have their ducks in a row. Remember that they know *how* to intimidate the polls, and scientific facts are of little concern. They deal in fear of the unknown and threaten law-givers with fear of being unseated. Golf courses in America are, *or should be*, prime examples of positive pesticide use, without distorting the population balance among 'harmless' bugs or beasts.

The Audubon Cooperative Sanctuary program has attracted a great deal of positive comment from both public and private golf operations in this initial year of operation. It is a first step in removing some of the unintended secrecy about golf course operations. This program does require an accountable performance of some projects, but if it didn't, it would mean nothing to anyone. It provides *living* proof that good golf course operations do not interfere with the natural scheme of things. It also provides a means of communicating with golfers and neighbors and politicians that golf courses exert a positive effect in their environment.

It will also be to the advantage of golf course superintendents to tell anyone, whether they are deeply interested or not, about the special environmental research being funded by the USGA. It is a Straight-Arrow evaluation of what happens to fertilizer and pesticides after they are applied and have done what they were supposed to do. They don't just disappear, so what *does* happen, to them? The nationwide study is being conducted by outstanding researchers at a number of cooperating universities. Talk it up to show people that golf is a responsible member of a community.

Green Section Greens

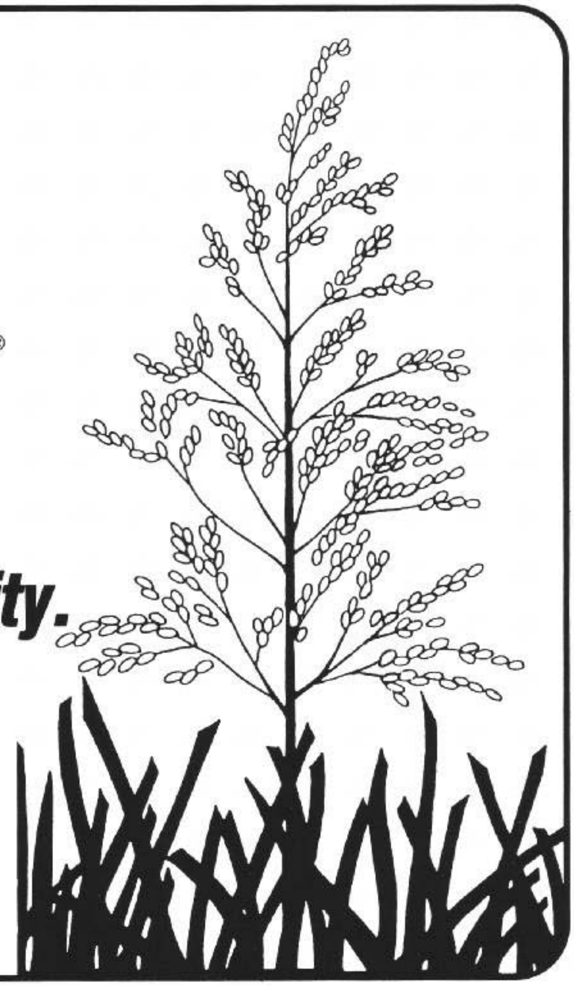
An inordinate amount of ink has been sloshed around this year about some imagined or contrived controversy about well-established procedures which have proven to be successful for over 30 years. CONTROVERSY! is a media cliche used to grab attention by creating doubt or fear, not unlike the words used by Anti groups. The Green Section is making use of Dr. Norm Hummel's expertise in soil laboratory technique to ensure that the physical tests on putting green mixtures are consistent with the procedures established early on and that their results are reproducible.

Anytime a single green building procedure is adopted on a national basis, some local problems arise. That leads to a lot of nickel and dime nit-picking by people who ought to know better, thus confusing the issue and distorting the purpose of this construction technique. Personalities, prejudices and pettiness get in the way of performance. And who suffers? The golf course superintendent trying to do the best for his organization, who has learned that hip pocket soil mixes are hazardous to his employment longevity but is being misled by egotists or corner-cutters riding on short-term performance.

Green Section greens are real and they perform according to the construction procedures used. Maintenance is easy when one learns their characteristics. They are easily over-watered because they accept water so easily. You might be surprised at the low water *requirement* when the perched water table is managed properly. And that, Virginia, is the reason we harp on having a sharp textural change just below the growing medium and feel that an intermediate sand layer is necessary between it and the gravel drainage bed below.

Green Speed

When the putts don't fall and approach shots don't hold, what's the matter? According to some competitors in the Senior Open at Oakland Hills, the greens became "crispy and faster" during the gorgeous weather they enjoyed during the Thursday-Sunday rounds. To answer that complaint, we measured the greens in the afternoon as well as in the morning. At 6:30 a.m., Stimpmeter readings were 10.5 feet and at 5:30 (or so) in the afternoon they were 9.5 feet, except near holes where the distance was 10.0 feet. So when your speed demons ask for more Stimp distance, ask them to play mid-morning, not late afternoon.



A Christmas Letter

EDITOR'S NOTE: I received the following letter late last year, before Christmas and after the November/December issue of THE GRASS ROOTS.

It was written in response to a letter written under the pen name Joe Blow that appeared in that issue. The letter was a typical Christmas letter many of us receive at Christmas time.

Not many of you will ever receive a Christmas letter like this one, however. That is why I had to share it with you.

Surely there is no doubt about who Stash really is. His popularity remains high and his chronic good sense of humor is a big reason why.

Merry Christmas to Stan, Marti and Chris!

November 30, 1990

Mr. Joe Blow and Family
c/o Monroe Miller, Superintendent
Blackhawk Country Club
P.O. Box 5127
Madison, Wisconsin 53705

Dear Joe B. and F,

Thanks for the wonderful Christmas letter! It is so wonderful to hear how you and your family continue to excel in all that you do. The next decade, and in fact the next century, should open up wonderful vistas for you and your deserving family.

We here in the Polok, or is it Pollock (I never can get it straight), family also have had a wonderful and exciting year. First, our son Chris.

As I know you are aware, he has always liked to travel. This fall he became a juggler in the circus. We are very proud of him. He frequently keeps in touch and it is nice to know we will always have a place to stay and good seats when the circus arrives at some of our favorite places like Paducah, Kentucky; Cuyahoga Falls, Ohio and Pocomoke City, Virginia. It sure is hard to find a good hotel room in these towns. His trailer, located next to the elephant holding area, is better than a cedar trunk for that "earthy" odor we all love so much...compliments of Milorganite.

While on the subject of jugglers, you know, my wife has been juggling our checkbook for years. Good news. If all goes well, Marti should be paroled in time for Christmas. Like mother, like son.

As for myself, well, my experiment of trying to lose weight by becoming an alcoholic (when was the last time you saw a fat alcoholic?) isn't working all that great. I may becoming an alcoholic but also my clothes don't fit. The fellas down at the clinic, Bojack's Bar & Grill, have been helping me all they can (especially with hand-me-down clothes since Marti took the checkbook with her).

Our big trip of the year is to the convention in Las Vegas. It works out great! The circus is in Boulder City and it's an easy hitchhike to Vegas from there.

Hope to see you there, I am sure you won't have trouble finding me...get my drift?!

This has been real fun. We should exchange letters more frequently. How about next Christmas?

Yours truly,

Stash Pollock and Family