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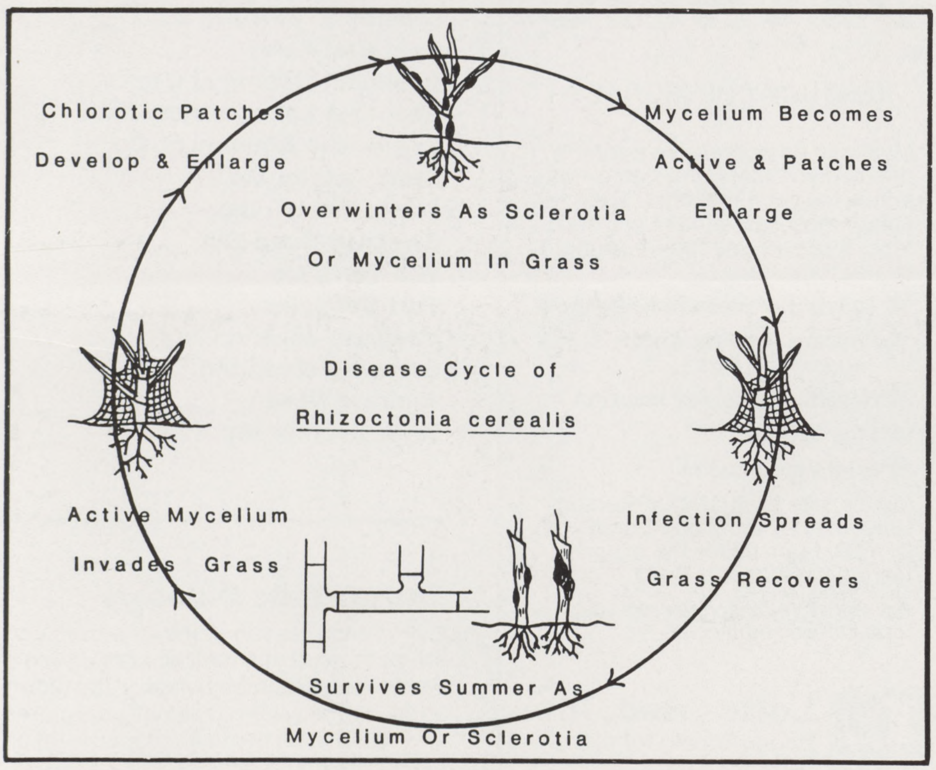
Yellow Patch: A Disease of Turfgrass Induced by *Rhizoctonia cerealis*

B. B. Clarke and P. M. Halisky

Yellow patch (formerly referred to as "Cool Season Brown Patch") is a cool, wet-weather disease that is active from early autumn to mid-spring in many temperate regions of the United States. It was first observed by researchers in the north central and northeastern portions of the country on Kentucky bluegrass and bentgrass during the early 1970's (4, 6, 10). In most cases, isolates believed then to be *Rhizoctonia solani* were obtained from blighted foliage. This created quite a bit of confusion in the turfgrass industry, since turf damage induced by *R. solani* had previously been associated with hot, humid conditions (3). Although the "cool weather isolates" were similar in many respects to *R. solani*, they differed significantly in the number of nuclei present per hyphal cell. While *R. Solani* strains were typically known to contain multinucleate cells, investigators soon found that cool weather isolates were binucleate (9, 10). As a result of this discovery, it soon became apparent that the causal agent of yellow patch was not *R. solani* but rather a structurally-similar species.

It was not until 1980 that *R. cerealis* was finally implicated as the cause of yellow patch on turfgrass (2). Authors of earlier reports (2, 4, 11) have identified this fungus as *Ceratobasidium*, however, such classifications are sheer speculation since the sexual stage of *R. cerealis* has not been produced in culture nor has it been seen in nature.



Hosts

The host range of *R. cerealis* is not completely known at this time, but on turfgrasses the present list includes creeping bentgrass, bermudagrass, Kentucky bluegrass, tall fescue, perennial ryegrass, and zoysia. Prior to its appearance on turf, *R. cerealis* had been associated for years with root decay and sharp eyespot on oats, rye, and wheat (1, 4, 5, 6, 10, 15). It is from this association that the species name *cerealis* was derived.

Distribution

Yellow patch is found on turfgrasses in Arkansas, Bermuda, California, Illinois, Indiana, Maryland, Michigan, New Jersey, New York, Ohio, Pennsylvania, Virginia, and Washington State (2, 4, 5, 6, 7, 8, 10). Fungal isolates from small grains have been recovered in Australia, England, the Netherlands, Scotland, and the United States (2, 12, 15).

Symptoms

Symptom expression may vary slightly depending on the turfgrass cultivar, soil condition, weather, and fungal strain present. In general, however, symptoms usually appear as circular, light-brown-to-yellow patches ranging from 1 inch to 3 feet in diameter (2, 12, 14). Grass in the center of these patches may remain chlorotic (Figure 1), or may eventually recover leading to the formation of a doughnut-shaped spot with a 1-2 inch chlorotic outer ring (Figure 2). Such patches are often referred to as "frog-eyes" and closely resemble damage induced by Fusarium Blight, a hot weather disease (2, 4, 7).

continued page 5

Comments and Opinions

The "Average" Class A GCSAA Member

A recent news release of the Golf Course Superintendents Association of America reported a study by Simmons Market Research Bureau Inc. which indicates the average Class A GCSAA member is 40.87 years of age. He is the superintendent of an 18-hole private course where he has full grounds maintenance responsibility. He has been in his present position for 8.35 years. It is the third such position he has held.

On the average, he is college-educated, plays 21.14 rounds of golf in the course of a year, maintains a 10-stroke USGA handicap, and generally is satisfied with the progress of his career. He and his wife, who works, have 1.15 children. Above all, he is proud of his profession and his Association.

This is most commendable, but I do not like the ring of "average." This is not an average person and better yet, I doubt if there is anything average about his golf course.

REE

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Henry David Thoreau

The Bluegrass Billbug

Differential Response of Kentucky Bluegrass Varieties and Selections to Injury by the Bluegrass Billbug in Turfgrass Trials at Adelphia, New Jersey

C. Reed Funk[1] and Sami Ahmad[2]

Genetic resistance to important turf disease and insect problems is of increasing interest as people attempt to save money, improve the environment, and reduce the use of pesticides. The bluegrass billbug (*Spenophorus pervulus Gyllenhal*) often causes extensive damage to Kentucky bluegrass (*Poa pratensis* L.). In this report we present data on the relative susceptibility of bluegrass varieties and selections to billbugs.

Adult billbugs are black weevils having a distinct snout with chewing mouth parts at the tip. New adults are often found walking over sidewalks and driveways during September and October. They overwinter as adults in thatch or in sheltered areas near lawns. In the spring, they can be seen moving about on sidewalks or other areas adjacent to turf. During May and June, adults lay eggs in feeding holes near the base of grass tillers. These eggs hatch in about two weeks. The larvae begin feeding within the stem and later move down to feed on the crown, roots, rhizomes, and at the base of adjacent tillers. Damage is most apparent during July and August as small patches of turf wilt and die. Under conditions of severe infestation these patches will join to form larger areas of dead turf. Turfgrass plants damaged by billbug larvae are easily pulled from the soil. Bases of the dead or dying tillers will be shredded by the feeding insects. Sawdust-like material also will be left by the larval feeding. Careful examination of the soil will reveal the billbug larvae. They are short, white, without legs, and have a reddish-brown head. After completing development, larvae pupate in late August and emerge as adults in September.

During the summer of 1978, a turfgrass trial located at the New Jersey Agricultural Experiment Station, Soils and Crops Research Center at Adelphia, New Jersey was severely damaged from a natural infestation of bluegrass billbug. This provided an opportunity to assess the relative resistance of various Kentucky bluegrass varieties and selections and to determine whether turfgrass damage was correlated with larval numbers

Experimental Procedure

Over 300 varieties and experimental selections of Kentucky bluegrass were seeded in a replicated turfgrass trial, on a loamy sand soil during September 1974. Plots were 4 x 6 feet with a 6-inch unplanted border between each plot. After fall establishment, the test area was mowed as needed at 3/4-inch. Clippings were not removed. Weeds were controlled as necessary with DCPA, dicamba, and 2,4-D. Ground limestone was applied to maintain a soil pH of abut 6.0. The field was irrigated as needed for rapid establishment and later to prevent severe drought stress. Two nitrogen fertility levels, moderate (e.g., 1.7 lb. per 1000 sq. ft.) and high (e.g., 4.5 lb. per 1000 sq. ft.), were established on

continued page 4

Reaction of Kentucky bluegrass varieties and selections to injury by the bluegrass billbug, during 1978, in turf trials seeded September 1973 at Adelphia, New Jersey.

Variety or selection	Turfgrass damage %	Number of billbug larvae per sq. ft.
BA63-188	13.3 a*	
Midnight	14.0 a	
F-1757	24.7 a-b	12.3 b*
F-353	26.7 a-b	13.0 b
EVB 3275	27.3 a-b	
Kenblue	27.4 a-b	1.3 a
Eclipse	30.3 a-c	
America	31.7 a-c	
Majestic	37.7 b-d	
Princeton P-104	39.1 b-d	14.8 b
Admiral	43.3 b-e	
Adelphi	49.0 c-f	
Somerset	53.3 d-g	
Rugby	54.2 d-g	
Fylking	57.2 d-h	
Bristol	62.7 e-i	
Touchdown	63.3 e-i	
Enmundi	63.3 e-i	
Plush	64.3 e-i	
Baron	67.8 f-j	51.0 c
Bonnieblue	69.3 f-j	
Birka	71.0 g-j	
Merion	76.0 h-j	57.8 c
A-34	78.2 i-j	
Victa	79.5 i-j	
Nugget	82.4 i-j	60.3 c
Cheri	83.5 i-j	45.3 c
K3-182	87.0 j	18.5 b
Ram I	89.3 j	

*Means values: N = 3 for turfgrass damage and N = 6 for billbug counts.

Means not followed by the same letter are significantly different at 5% level by Duncan's multiple range test.

Billbug continued from page 3

each plot. Fertility levels appeared to have little, if any, affect on the degree of billbug damage.

During early July 1978, there was evidence of substantial differential damage to the various varieties. Observations showed that the injury was primarily due to feeding by billbug larvae. Larval counts were made by careful removal and examination of all sod and soil in the samples to a depth of four inches; each sample about one square foot in area. Insect counts were made in four samples of each of nine selected entries during the third week of July. Plots were also visually rated for extent of billbug injury on July 14, August 25, and October 2.

Results and Discussion

The data on degree of damage and the number of billbug larvae responsible for this damage (Ahmad and Funk 1982) are presented in Table 1. Billbug larval counts ranged from a low of 1.3 per square foot for 'Kenblue' to a high of 60.3 per square foot for 'Nugget'. Lower damage estimates of 13.3 to 31.7 percent injury for 'Ba63-188', 'Midnight', 'F1757', 'F-353', 'EVB 3275', 'Kenblue', 'Eclipse', and 'America' contrasted with higher damage estimates of from 67.8 to 89.3 percent injury to 'Baron', 'Bonnieblue', 'Birka' and 'Merion'. 'A-34', 'Victa', 'Nugget', 'Cheri', 'K3-182', and 'Ram I'. A significant correlation of r = 0.767 was found to exist between larval counts and injury ratings. This confirms Nebraska studies reported by Kindler and Kinbacher (1975), and Lindgren, Shearman, Bruneau, and Schaaf (1981) which showed differential bluegrass injury and also, a positive correlation between larval numbers and degree of injury to the various bluegrasses studied.

The mechanisms of bluegrass varietal resistance to the billbug need further study. The common type bluegrass varieties including 'Arboretum', 'Nu Dwarf', 'Geary', 'Delta', 'S-21', 'Park', 'Nebraska Common', and 'South Dakota Certified' were among the most resistant in New Jersey. These common type varieties have a more erect growth, narrow leaves, and fine stems. They are also highly susceptible to leafspot and crown rot disease caused by *Drechslera poae* (Bandys) Shoem. This disease often causes a severe spotting, browning, and blighting of the bluegrass foliage at the time billbugs are laying eggs in bluegrass tillers. It is possible that this disease and/or the finer tillers of the common type bluegrasses makes them less attractive to the adult billbugs as hosts for egg deposition. Kindler and Kinbacher suggest that a natural selection of resistant types had occurred in the evolution of the common type bluegrasses. They report studies indicating that the bluegrass billbug had a long history of infesting Kentucky bluegrass pastures in the North Central United States. Both the New Jersey and the Nebraska studies indicate that most of the leafspot resistant turf-type Kentucky bluegrasses are rather susceptible to the billbug. However, a few turf-type varieties and selections, including Ba63-188, Midnight, F-1757, have improved billbug resistance. A better knowledge of the mechanisms of resistance and the development of more efficient screening techniques would be most useful.

F-353, EVB 3275, Eclipse and America showed promising resistance to the bluegrass billbug in our New Jersey studies. Some of these billbug resistant turf-type bluegrasses have broader leaves, thicker stems, and excellent resistance to the leafspot and crown rot disease. This would indicate that turfgrass breeders should be able to continue to develop attractive, leafspot-resistant bluegrasses which have improved billbug resistance.

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Keep 2,4-D on the Weed Target

When it is necessary to make a general spraying for dandelions, with sensitive plants nearby, use a low volatility form of 2,4-D.

The Great Society will not tolerate anything but an easy life for everyone.

Anonymous

Yellow Patch

continued from page 1

Symptoms can develop suddenly and spread rapidly during cool, moist weather. In many instances, patches merge to form a mosaic pattern. In contrast to brown patch caused by *R. solani*, turfgrass infected with cool temperature isolates of *Rhizoctonia* characteristically lack a marginal "smoke ring." Another difference between brown patch and yellow patch is that turf infected with the latter may remain chlorotic for several weeks without dying. However, foliar necrosis may develop if rainfall and 50 to 70°F temperatures persist for extended periods of time.

Upon close examination, white mycelium can often be detected around the crowns of infected plants along with grayish-tan, mottled lesions on the grass blades. The tips of diseased leaves may turn brown or slightly reddish. During severe infection the lower crown and roots often appear brown or black (7, 12).

The Fungus

Rhizoctonia cerealis is a member of a group of fungi known as the Mycelia Sterilia. It has been placed in this category because asexual spores or conidia have not been observed. Since no sexual stage has been identified, diagnosticians must rely on a variety of hyphal characteristics to confirm that *R. cerealis* is present in the field. Among the most useful of these features are the presence of predominantly binucleate cells, right angle branching, constriction of the branch and formation of a cross wall (dolipore septum) near the point of attachment, hyphal diameters between 2.8 and 8.7 microns and white-to-buff colored colonies on potato-dextrose agar (PDA) (10, 12, 13).

Although *R. cerealis* does not produce spores, it does form modified sclerotia. These structures are composed of compacted masses of hardened hyphae that are produced in response to adverse environmental conditions. They are typically, white-to-dark-brown in color and range from 1/64 to 1/6 inch in diameter (3, 13).

Disease Cycle

Yellow patch fungus is capable of growing over a wide range of temperatures. Mycelial growth can occur from approximately 35°F to about 86°F, with optimum growth and infectivity at 50-75°F (2, 10, 11). The extremes of summer heat and winter cold decrease or check fungal growth and disease development, but they fail to kill this parasite which survives in the form of sclerotia or mycelium in plant debris (13).

During cool damp weather in the fall, fungal mycelium emerges from dormant sclerotia or infected plant tissue and quickly penetrates succulent turfgrass leaves and sheaths. Infected plants eventually become stunted and chlorotic. Prolonged periods of leaf wetness are needed for wilting and plant death to occur. Therefore, any factor that lengthens the duration of leaf wetness (dew) such as humid weather, poorly drained turf, and cloudy conditions will intensify disease severity (13).

Infected patches of turf usually continue to increase in diameter until the white mycelium is killed by sub-freezing winter temperatures. However, fungal mycelium may remain active throughout the winter months as long as the weather is mild. With the advent of moderating temperatures in early spring, symptoms reappear on infected turf. These patches may continue to expand until daytime temperatures stabilize at 75°F to 80°F, at which time infected plants recover and the symptoms disappear (12).

Nutrition

Although it is well known that high fertility enhances the development of warm-weather brown patch, research conducted by Shurtleff (12) indicates that yellow patch is not directly affected by turfgrass nutrition. Other researchers have shown, however, that a balanced fertilization program encourages rapid recovery of diseased turf once fungal activity ceases and weather conditions improve.

Control

Because yellow patch on turfgrasses is a relatively new disease, information on its control is quite limited. Like most diseases caused by *Rhizoctonia* sp., good surface and subsurface drainage reduces disease severity by lowering humidity within the turf canopy. The manual removal of dew in the early morning hours also limits infection by reducing leaf surface wetness. This can be accomplished by dragging a hose laterally over the grass or through the application of certain wetting agents which lower the surface tension of adhering water droplets (13). Similarly, the removal of excessive thatch (3/4 inch) helps reduce disease incidence.

continued page 6

Yellow Patch continued

Chemical control procedures are uncertain at this time since field applications of several registered and experimental fungicides have yielded variable results (7). In fact, certain chemical treatments actually intensified yellow patch, apparently because competition between *R. cerealis* and other soil microorganisms was inhibited (14). In laboratory tests, Sanders *et al.* (10, 11) reported that chlorothalonil (Daconil 2787), chloroneb (Tersan *SP*.) and iprodione (Chipco 26019) showed the greatest overall activity in reducing fungal growth. For the present, however, it is suggested that these fungicides be tried in the field only on an experimental basis until further information becomes available.

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PETER S. LOFT—A FOUNDER AND PRESIDENT OF NJTA

The New Jersey Turfgrass Association lost a great friend with the recent passing of Peter S. Loft. Pete was on the Founding Committee of NJTA and our fifth president. He received the NJTA Hall of Fame Award in 1981.

As president of Lofts Seed Corporation, he had always given valuable support to our organization. Equally, he gave strong support to turfgrass research at Rutgers University.

Pete and his brother Jon added greatly to the successful seed firm their father Selmar Loft founded. The organization has grown to national and international status with its work in developing turfgrasses, seed production, and seed marketing.

Those of us at Rutgers and the NJTA miss Pete greatly. Pete had most impressive goals and accomplishments in mind for New Jersey turf. We have the deepest sympathy for his family and the people at Lofts Seed. Most of all, we wish the best for his wife, his two daughters and two sons who are impressive young ladies and men.

Peter Loft was loved because he pursued his life with thoughtfulness, consideration, and a lot of class.

We enjoyed and benefitted from the too few years this Dear Friend was with us.

Clipping Removal From Bentgrass Fairways[1]/

R. E. Engel[2]/

Many golf turf specialists have believed clipping removal from bentgrass fairways improves turf. Nearly thirty years ago, Sherwood Moore removed clippings from one-half of a bentgrass tee that developed much better turf than the remainder. Shortly after this Tony and Tom Mascaro built an experimental fairway mower that collected clippings. While this machine was far ahead of the market, the idea was considered agronomically sound. Projects of this type increased our awareness that greater failure of bentgrass fairways as compared with greens might be blamed on clippings. More recently the smaller triplex mowers came into use with the hope of less abrasion and more precise mowing. Clipping removal was an accepted benefit. As the use of triplex mowers with clipping removal increased, the benefits became more apparent.

The improvement in bentgrass where clippings were removed has been very consistent and real. There are several interesting explanations. Removal of annual bluegrass seedheads with the clippings is one of the first to come to mind. Surely this will give reduction of annual bluegrass. Most important, in my opinion, may be a reduction in diseases. Clippings hold moisture, may give off considerable heat as they decay, and encourage development of disease pathogens. Also, there is a possibility that toxic residues may occur briefly during decay.

The reduced amount of nitrogen available to the bentgrass plant with clipping removal will be helpful on occasion. However, when bentgrass clippings remain in warm weather, they decay quickly. Thus, it is likely the amount of nitrogen released from clippings in any brief period is small compared with the amounts that are applied in warm weather fertilizer applications or are released from other natural sources in the soil. If an abundance of nitrogen from bentgrass clippings becomes damaging, it is most likely to occur when hot weather develops abruptly following a cool period that has given good growth and a large residue of clippings.

The mowers commonly used in clipping removal have additional blades per reel and give more thorough mowing. Also, the firmer turf that occurs on many sites with clipping removal suggests mowing may be closer which gives more intense rooting in the top 2-3 inches of soil. There is considerable belief and evidence that creeping bentgrasses become more competitive to annual bluegrass with closer fairway heights of 1/2 to 5/8 inch.

Better performance of bentgrass with clipping removal creates some interesting considerations for fairway programs. How many courses will accept the extra expense for the potential turf improvement? Is it necessary to remove the clippings throughout the season? Possibly, starting clipping removal shortly before the hot, wet weather season and continuing until cooler weather in late August or September is adequate. Removal when annual bluegrass seedheads are abundant might be another important period.

Some of the clipping removal programs suggest the increased success with bentgrass greatly reduces the need for overseeding. This demonstrates the dominance of this species when growing conditions are more ideal.

Ultimately, bentgrass develops serious thatch problems. Do not expect clipping removal to prevent this problem. Some of the worst thatch problems with bentgrass have developed with close mowing and surface rooting. Maintaining a thatch control program will remain a necessary part of bentgrass fairway culture with clipping removal. Some changes in the thatch problem may occur, but almost any change will be welcome as all of us are tired of thatch as we have known it.

With clipping removal from fairways, there will be a greater desire to reduce the size of fairways. Is it possible this will lead to smaller fairways, with increased use of a prime- or first-rough with a more meadow-like second-rough at greater distance from the major area of play?

Setting conjecture aside, clipping removal programs for bentgrass fairways are here to stay for some courses.

[1]/New Jersey Agricultural Experiment Station Publication No. E-15461-(1)-83

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How Fast is Fast?

by Sherwood A. Moore
Superintendent of Courses
Winged Foot Golf Club

In the English language the word fast has many meanings: you can run fast, hold fast, go on a fast, and have fast greens.

The topic of conversation around the locker and grill rooms of golf clubs these days is "how fast are the greens today?" In some areas of the country it is referred to as "the roll of the green." It all boils down to the speed of the ball on the green. Lost is the art of stroking the ball; today a tap is all that is required. I think some of the golfers want the ball to roll into the cup just by looking at it. At some clubs they post the speed of the green on the bulletin board for the day.

Are we becoming victims of the stipmeter, fast greens, and tournament play? When big tournaments are on T-V all we hear about is how fast the greens putt, that they double cut the greens daily, even triple cut, and yes, on some greens quadruple cut to increase the speed.

Whenever a group of golfers or superintendents congregate, golf and turf are naturally discussed. Proper greens speed is a favorite topic. Suggestions of speeds range from seven to ten or more feet.

Has the superintendent contributed to the dilemma? Yes, in a way. He probably has perfected his course to the point where only incredibly fast greens will save par. Also, the competition to have faster greens than ones neighbor is not helping the situation in any way.

In any event, an increasing amount of pressure is put on the superintendent to increase the speed of the greens. Every superintendent has heard the following remarks: "Are the greens going to be mowed today?" "When are you going to lower the height of cut? "The greens at 'such and such a club' are faster than ours."

Seriously, I am concerned about this trend of "fast greens." Can we afford to maintain greens of this caliber—that require frequent topdressing; frequent verti-cutting; daily cutting or double cutting of greens; close, close mowing—even to the point of grinding the underside of already thin bedknives.

And in all my conversation, reading, and listening, I have never heard anyone mention a thing about the little grass plant. How is it standing up under all this abuse? I was tutored under the late professor Lawrence Dickenson of Massachusetts and one of his often quoted phrases was "Give the grass plant half a chance. It wants to live." Under these conditions of shaving the grass plant to 1/8" or less are we giving it "half a chance?" I do not think so. We are giving it very little chance. Sooner or later we are headed for trouble.

We all know that the root growth of the grass plant is in proportion to the top growth. The grass plant needs leaf surface for survival—for transpiration, respiration, the manufacturing of carbohydrates to maintain life and growth. It also needs nitrogen and other nutrients that we are withholding so as to increase speed by limiting plant growth.

I predict that in the not too distant future we will get back to the basics of a good putting-green surface, that the demands of the grass plant will be given equal or more consideration than the demands of the golfers. A *firm, true healthy green* with reasonable speed is much more pleasurable than putting on dead grass and plain soil. We will return to stroking the ball, not tapping it.

the Horse-Chestnut.

All nature seems at work. Slugs leave their lair—
The bees are stirring—birds are on the wing—
And Winter slumbering in the open air,
Wears on his smiling face a dream of Spring!
. . . .
Samuel Taylor Coleridge