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Randal T. Schapiro, MD, FAAN, is the founder and former medical director of The Schapiro Center for Multiple Sclerosis at the Minneapolis Clinic of Neurology. He is a founding member and first elected president of the Consortium of MS Centers. He served five years on the National Board of the National MS Society, 34 years on the Minnesota board, and five years on the Colorado Board. He also serves on the International MS Society’s Medical Advisory Board. Schapiro has been elected to the National MS Society Hall of Fame and was presented the prestigious Starfish Award by the National MS Society and the Lifetime Achievement Award by the Consortium of MS Centers. He retired from private practice in 2009 to devote more time to teaching and consulting on topics related to MS. He lives in Mesa, Arizona.
MANAGING THE SYMPTOMS
OF MULTIPLE SCLEROSIS
MANAGING THE SYMPTOMS OF MULTIPLE SCLEROSIS

SIXTH EDITION

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Clinical Professor of Neurology (Retired),
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To all those whose lives are altered by the effects of multiple sclerosis along with a special dedication to Diana Schneider, PhD, who founded Demos Publications and edited the previous editions of this book. She passed away after a fight with cancer but remained a major force for MS education to the end. She will be missed!
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It was not that long ago that people with multiple sclerosis (MS) were told there is nothing that can be done for them! The progress made during my career has been absolutely remarkable. When the first edition of this book was published in 1986, disease management was only dreamed about, and the backbone of managing MS was symptom management. Now, there are numerous treatments that allow for control of this seemingly uncontrollable disease for most with MS. As I have always emphasized, there is a person behind the MS who has needs that go beyond disease and symptom management, and these needs must also be addressed in any comprehensive management program.

This book remains a guide to managing the symptoms of MS, but also focuses on disease and personal management strategies. It is based on the management program developed at the oldest comprehensive MS Center in the United States, The Schapiro Center for Multiple Sclerosis (formerly The Fairview MS Center) in Minneapolis, Minnesota. With all that has happened in health care delivery, it is even more important for people with MS to take charge of their destiny as much as possible. This book provides ammunition in that fight by suggesting ways to manage the issues that accompany MS.

This new edition updates the management techniques for multiple sclerosis. A fresh look at all aspects of MS emphasizes the fact that much can be done to improve quality of life for those with the disease. It is our hope that all who use this book will be empowered to do as much as they can with what they have and to live their lives as fully as possible.
I retired from practice six years ago but continue to educate nationally and internationally about MS. Without me, The Schapiro Center for Multiple Sclerosis at the Minneapolis Clinic of Neurology has continued to lead the clinical fight against MS. For almost 40 years it has seen the growth and development of organizations that have enhanced the lives of those with MS, including the National Multiple Sclerosis Society, the Consortium of Multiple Sclerosis Centers, The Multiple Sclerosis Association of America, the Multiple Sclerosis Foundation, and Can Do MS (formerly The Heuga Center).

With this new edition, the author continues to acknowledge those organizations for consistency and growth in the expansion of knowledge in MS, and especially, June Halper, MSN, ANP, FAAN (Executive Director of the Consortium of MS Centers in New Jersey), Nancy Holland, EdD (Retired Vice President National MS Society), Rosalind Kalb, PhD (the National MS Society), and Nicholas LaRocca, PhD (the National MS Society) for all they have done for those with MS.

None of this could happen without a brilliant and caring, most experienced staff of professionals during my tenure in our office: Brenda Brelje, RN, Cindy Phair, RN, MA, Rosemary Nelson, RN, Mary Grendahl, RN, and Roberta Shohn. Jonathan Calkwood, MD, continues the excellent, dedicated MS neurological care at the Schapiro Center.
The author also wishes to acknowledge the assistance of Demos Medical Publishing and its creator, Dr. Diana M. Schneider; she was an inspiration and will be missed by all. The stabilizing influence of my wife, Cathy Schapiro continues to be of utmost importance and is very much appreciated!

—Randall T. Schapiro, MD, FAAN
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Managing the Symptoms of Multiple Sclerosis, Sixth Edition

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Part I

The Disease and Its Management
Chapter 1

What Is Multiple Sclerosis?

Multiple sclerosis (MS) is a disease of the immune system, the body’s surveillance system that recognizes something that is foreign to the body and attempts to control it. In MS the immune system is very active and may see its own nervous system components as foreign and attack them. It is one of a broad category of demyelinating diseases that affect the central nervous system (CNS)—the brain and spinal cord. Myelin is a fatty material that insulates nerves, acting like the covering of an electrical wire and allowing nerves to transmit impulses rapidly. It is the speed and efficiency with which these impulses are conducted that permits us to perform smooth, rapid, and coordinated movements with little conscious effort. In MS the loss of myelin is accompanied by a loss of the ability to perform these movements. The sites where myelin is lost appear as hardened sclerotic (scarred) areas, and because there tend to be many such areas within the CNS, the term multiple sclerosis (literally, many scars) is appropriate.

It is well understood that the nerve fiber itself—called an “axon”—is also affected by MS. Newer studies have shown even more dramatically what has been known for hundreds of years: that the axon can degenerate in MS. This degeneration may lead to more
permanent damage than if the myelin only were involved. It is also recognized that this degeneration of the axons may appear much earlier in the course of the disease than previously thought. These myelinated axons look white to the naked eye. Thus they are called white matter. It is well understood that MS is a disease of the myelin of the white matter. Now we are learning that MS is also a disease involving the other nerves, the so-called gray matter.

The brain functions somewhat as if it were a large computer or an electrical system that sends its messages down nerves in the nervous system. These nerves function like wires—you decide to move your right arm, and it moves. This amazing system is made efficient by the presence of myelin. To understand this process more completely, it is helpful to understand the anatomy of the nervous system.

A Word About Anatomy

The anatomy of the nerves and muscles is referred to frequently throughout this book. This overview will provide a quick reference for the reader. More specific information is included with each topic as needed.

Three fairly distinct components make up the human nervous system: the CNS, which is somewhat analogous to the main processing unit of a computer; the peripheral nervous system (PNS), which links the CNS to the muscles; and the sympathetic nervous system, which links the CNS to the internal organs (see Figure 1.1). The CNS has two major parts, the brain and spinal cord, which in turn have several subdivisions, each of which plays a unique role in regulating the functions of the body.

The portion of the brain referred to as the cerebrum acts as a master control system and is responsible for initiating all thought and movement. Memory, personality, vision, hearing, touch, and muscle tone all are housed within the cerebrum. Behind the cerebrum is the cerebellum, which coordinates movement and “smooths” muscle activity. The proper functioning of this region of
Figure 1.1 The nervous system.
the brain controls balance during walking and the smooth use of your hands and arms.

Beneath the cerebrum and cerebellum is the brain stem, which contains the nerves that control eye movements and the vital centers involved in functions such as breathing and heart rate. Extending downward from the brain stem is the spinal cord, which functions very much like a large electrical cord that carries messages between the brain centers and all other parts of the body. Although numerous biochemical reactions occur in the brain and spinal cord, their major role is to produce electrical activity that stimulates and regulates various bodily activities. These messages are delivered to the target structures very efficiently and effectively because the entire system is well insulated and shielded by the myelin that surrounds the conducting systems and allows the electrical nervous impulses to move through the pathways with little loss of information. The myelin in the brain and spinal cord is produced by a specific type of cell called an oligodendrocyte (oligo). Both oligos and myelin appear to be damaged in MS. When they are damaged, the nerve beneath the myelin sometimes is also affected (axonal damage). Oligos disappear as the affected myelin becomes hardened and scarred, forming what is called a plaque and causing a short-circuiting of electrical transmission.

The PNS is responsible for transmitting electrical messages between the spinal cord and the muscles, including those of the arms and legs. This system also contains myelin, although it is made by a different cell type than the oligo, a cell that does not appear to be affected by MS. Thus, although it is not uncommon to find leg or arm weakness in MS, the problem lies in the central conduction system (the brain and spinal cord), not in the peripheral nerves that lead from the spinal cord.

The autonomic nervous system has two divisions, the sympathetic and the parasympathetic. These systems are responsible for automatic types of function such as the beating of your heart, perspiration, and so on. This system also contains myelin, but, like the PNS, it is not directly affected by MS.
Although MS directly affects only the CNS, the disease has indirect effects on other systems and their functions because all components of the nervous system communicate with one another.

It may be stated that MS is a disease of the immune system, a disease of myelin, and a disease of axons. Most important, MS is a disease of people—people who have feelings that go well beyond myelin and axons. All of this leads to the reality that MS is not simple and explains why the mystery remains as to what causes this process.

**SYMPTOMS OF MULTIPLE SCLEROSIS**

The most common characteristics of MS include:

- Onset most commonly is between the ages of 15 and 50 years. The average age of diagnosis is 30.
- Remissions and exacerbations (improvements and flare-ups) are the rule in the initial stage of the disease.
- Scattered areas in the CNS are affected.

Because different areas of the brain and spinal cord are responsible for different kinds of movements and sensations, the neurologic deficit that results from an area of scarring depends on the exact location of the abnormality (lesion) and its relationship to other areas within the brain. For example, when an area of demyelination develops in the cerebellum, the area of the brain that is responsible for making coordinated movements, such coordination becomes difficult. Because symptoms depend on the location of the area of scarring, no two cases of MS are exactly alike, and symptoms vary considerably from one individual to another. In one person, the extent of MS symptoms might be mild disturbances of gait and vision, whereas another person might suffer a severe or complete sensory and motor loss. Some people with MS may have many, many symptoms, whereas others may have very few! In a similar fashion, some people with MS may have severe disease, whereas others may be only mildly affected.
To better understand individual variations and to develop appropriate management plans, MS often is divided into subtypes. This classification also helps in having uniform groups for research studies. The most current classification includes:

- **Relapsing-remitting.** This form of MS is characterized by clearly defined acute attacks, with either full recovery or some remaining neurologic signs/symptoms and residual deficit upon recovery. The periods between relapses are characterized by a lack of disease progression. It is thought that about 80% of MS begins in this manner. Over time the course may change and then the person moves into a different category. About 50% will develop a progressive course after the relapsing start. We then call it:

- **Secondary progressive.** This form of the disease begins with an initial relapsing-remitting course, followed by progression at a variable rate that also may include occasional relapses and minor remissions. About 10% of MS worsens right from the start and is called:

- **Primary progressive.** The disease shows progression of disability from its onset, without plateaus or remissions or with occasional plateaus and temporary minor improvements. It more commonly is seen in people who develop the disease after 40 years of age. About 5% of MS starts with a progressive course and becomes more fluctuating. It is called:

- **Progressive-relapsing.** This pattern of MS shows progression from the onset but with clear acute relapses that may or may not have some recovery or remissions.
Two points should be emphasized. First, more than two-thirds of all people who have MS are walking 20 years after diagnosis. The idea that MS is a progressive disease that inevitably leads to wheelchair use does not fit the most common scenario. Second, even those who have progressive disease usually stop progressing at some point. Many MS experts fear the potential progression of the disease so much they often overlook the fact that the disease is not always progressive. About 20% of patients with MS appear to remain fairly stable. Just why this occurs is not known, despite lengthy inquiries into diet, lifestyle, and other factors. That means that about 80% of MS patients will need more aggressive management.

It is important to understand that the four classifications listed above describe the common patterns that MS takes. They are not meant to show four different diseases. Unfortunately, many insurance companies and health care plans, have adopted the idea that a person has one of these four when, in fact, people are simply put into the appropriate category by observing their patterns of disease. That may change from time to time and the person then is moved into a different category. There are other classifications used in MS that involve descriptions of the parts of the brain and spinal cord involved such as cerebral MS or spinal MS. There are also classifications based on what the disease actually looks like under the microscope. Thus the clinical classification is just one of many, and it has been overemphasized in today’s world.

The MS Society has estimated that there are about 450,000 cases of MS in the United States. It is extremely difficult to estimate accurately just how many have MS because of the variability of the disease and the fact that many people can hide it or may not even recognize it. All medical professionals recognize that this data is old and should be revised in the near future. But though we truly do not know how many cases of multiple sclerosis there are in the United States or worldwide, we do know that over time we have been able to recognize it better, diagnose it easier and earlier, and understand it more clearly. This has led to earlier and more frequent diagnosis and to more certainty in the diagnosis. That gives the appearance of
there being more multiple sclerosis in the world. That may, in fact, be the case, but other factors also must be taken into account.

**Possible Causes of Multiple Sclerosis**

Although a specific cause of MS has not yet been determined, several theories are plausible. MS generally is considered to be an autoimmune disease in which—for unknown reasons—the body’s own immune system begins to attack normal body tissue. In the case of MS, the cells that make myelin, the myelin itself, and/or the axons are attacked.

**The Immune System**

The nervous system is not the only system in the body that “talks” to other systems and to itself. Many parts of the body communicate with each other. This is especially true for the immune system, which is responsible for destroying foreign substances such as viruses and bacteria. Most people know about the immune system because they are familiar with the acquired immunodeficiency syndrome (AIDS), in which a virus attacks the immune system and makes it inactive. In MS the picture is different in that the immune system appears to be too active. It sends out “messengers” in the form of specific types of white blood cells that attack myelin as if it were a foreign substance.

The immune system is made up of many different cells that function to protect the body. These cells are made and stored in different parts of the body and make a large number of immunomodulating substances. The combinations of cells and substances that may be formed are essentially unlimited, which adds to the complexity of the immune system. Some cells, called *B cells*, are made in the bone marrow. Some cells are made in other parts of the body, such as the thymus gland (over the heart) and the tonsils (in the throat); these *T cells* also communicate with and regulate each other. Cells that suppress reactions are called *T suppressor cells*; those that help reactions along are called *T helper cells*. It was
thought that MS was a disease only of T cells. It has become known now that MS also involves the B cells. This new knowledge has spurred research into different areas of the immune system which appears very promising. Cells in the immune system that target foreign bodies for destruction are called macrophages. Each of these cells has an important individual function; together they create the immune reaction. These reactions usually are beneficial and often lifesaving, but sometimes the system malfunctions and produces an autoimmune problem. This is what appears to happen in MS, which is therefore often referred to as an autoimmune disease. Other autoimmune diseases include systemic lupus erythematosus (SLE) and rheumatoid arthritis. All autoimmune diseases involve a faulty regulation of the immune system that appears to be overaggressive and may need to be suppressed.

Many things influence the immune system, including exposure to foreign substances, stress, and life itself. A virus may turn the system off, whereas another challenge may turn it on.

Susceptibility to autoimmune diseases appears to be at least partly genetic, so that, although MS itself is not a hereditary disease, a hereditary factor may make an individual susceptible to its development. Approximately 10% to 20% of people with MS have MS in their extended families—a higher rate than would be expected by chance. But MS is not a hereditary disease in the sense that most people consider heredity. Clearly, people do not inherit MS, but they may inherit the possibility of developing the disease. The likelihood of developing MS in the absence of its presence in close family members is 1:2000 (0.2%). If a parent has MS, the probability that a daughter will develop the disease is 4:100 (4%), whereas a son’s chances are 2:100 (2%). If an identical twin has MS, the likelihood of the other having it is 30%! Again, if MS were solely a hereditary disease, this figure would be 100%, but it does show that genetics plays some role in the development of the disease. Although these numbers are small, they are larger than would be expected if there were no genetic connection. Thus, it appears that one does not inherit MS, but may have a substantial chance of inheriting an immune
system that may become overactive if it is stimulated in a specific way. MS is termed a \textit{multifactorial disease}, which means that more than one factor is involved and that the factors must interact in a highly specific way to result in the disease process.

A distinct possibility exists that viruses may stimulate the immune system and lead to the development of MS in susceptible individuals. Although no virus has been consistently isolated in people with MS, many investigators believe that a virus originally is responsible for turning on the immune system and making it behave in this abnormal fashion. Because of this, much research is devoted to looking for a viral inducer of MS. Studies of populations who appear to be at high risk for MS fuel the idea of a viral origin. For example, the incidence of MS increased dramatically during World War II in the Faroe Islands off the coast of Scotland. Other islands off the Scottish coast, the Shetlands and Orkneys, had previously had a high prevalence of MS. The difference in prevalence between the two island groups appears to have involved British soldiers who moved to the Faroes during the war. This type of spread of MS follows the pattern of a viral transmission. However, no virus has been found, and the incidence of MS appears to have decreased in both island groups at this time.

The fact that viruses may cause demyelination is demonstrated by the viral origin of the demyelinating disease \textit{tropical spastic paraparesis}. The search for a viral cause of MS continues. Rubeola, rubella, herpes, and human T-cell lymphotropic type I (HTLV-I) viruses all have been considered and eliminated. The herpes 6 virus was thought to be the culprit a few years ago, but no solid evidence for its role has emerged. This virus causes a childhood disease that is very common but temporary. Also closely studied was the common bacterium \textit{Chlamydia}, which is common in humans, but which does not usually cause symptoms. Today the Epstein-Barr (EB) virus appears to be the culprit in many studies. This is the virus that is involved in mononucleosis. It is a very appealing hypothesis because it is more commonly seen in multiple sclerosis than expected. However, history shows a pattern, and so many once-suspected
viruses are now no longer being considered. It is highly likely that if a virus is involved, it has disappeared from the body by the time the immune system has begun its reaction against myelin. The search for a viral cause continues and is further stimulated by the fact that environmental factors appear to be involved in the disease.

People who spend the first 15 years or so of life in areas at a distance from the equator have a much higher risk for developing the disease than do those who spend this part of their lives closer to the equator. After the first years, there is no correlation to where a person lives, but Caucasians appear to be at higher risk than people of other races. It may be that this tendency is emphasized by the fact that more people of the same racial type live at northern latitudes. They most commonly are genetically northern European, especially Scandinavian in origin. Today, we live in a mobile society, and differences between North and South are not as prominent as they once were. MS appears with prominence virtually everywhere. However, these types of observations suggest that vitamin D may have a role in MS. Data show that people living away from the equator with less sun per day are more likely to have decreased vitamin D levels. Other data indicate that having a lower level of vitamin D in the blood may make one more susceptible to MS. This has promoted a significant increase in studies on vitamin D. Thus far, this is theory only and, in fact, most people, no matter where they are living, have low vitamin D levels in the blood based on current standards. As our understanding of the role of vitamin D remains incomplete, this will be an area of fertile research in the next decade.

Our understanding of the impact of pregnancy has evolved over the past couple of decades. It had been observed that mothers with MS often had a more significant attack following the delivery of the baby. It was then assumed that pregnancy was bad for MS. However, we now know that women who have MS and become pregnant will actually have fewer relapses during their pregnancy. It may be that the immune system automatically turns down its intensity to keep from expelling the half-foreign body of the fetus. It may also involve female hormones of pregnancy. After the delivery there is a slight
increase in the likelihood of attack from MS, but this is relatively small. Thus attitudes about pregnancy in MS have significantly changed and now it is most important to think about raising the child as opposed to conceiving her/him.

Research strategies that involve the immune system vary because it is not clear exactly where in the immune process the abnormality occurs. Thus, researchers point to many different areas of the immune system in an attempt to change what happens in the MS process.

Even if a cause of MS is not found, it may be possible to halt this disease by intervening somewhere in the immune cascade and halting its progression. This does not mean that a management strategy aimed at allowing a person with MS to do as much as possible given his or her present level of function cannot be developed. This is the principle that underlies symptom management, which has advanced with time, experience, and research. That is what this book is about—making it possible for people with MS to live creative, meaningful, and enjoyable lives.

People with MS usually are quite healthy and have an almost normal life span.

MS is unique in that few diseases with the potential to cause disability appear to involve only one system in the body. Except for demyelination, oligo loss, and secondary axonal (nerve) death within the brain and spinal cord, MS leaves the individual relatively unscathed. Thus, people with MS usually are quite healthy and have an almost normal life span.

CHOOSING YOUR PHYSICIAN

A good relationship with your doctor is among the more important associations for a person with MS. However, finding a physician with whom you relate well may be not only difficult but also stressful.
Some basic principles should be understood when making a decision about the right doctor for you. Despite the fact that insurance companies and other health care plan administrators act as if one physician is the same as another, this simply is untrue. Family physicians are trained to take care of general problems, but MS is not considered a general medical problem. A person with MS does need a general physician, but clearly he or she also needs someone more specialized. Internists specialize in many complicated medical problems, but most of them probably have seen few cases of MS. Physiatrists are specialists in rehabilitation and are increasingly involved as MS doctors, especially for those who have significant disability. However, neurologists—physicians who specialize in diseases of the nervous system—usually manage MS. Today, appropriately trained clinical nurse practitioners and physician’s assistants are often involved in MS care. On-the-job training has become extremely important. It matters little what we call the specialist involved. What matters more is that they have, in fact, specialized knowledge.

Not all neurologists are the same. Although neurologists are trained to make detailed and difficult diagnoses of neurologic disorders, many of them are not particularly capable of, or interested in, managing a disease after it has been diagnosed. The person with MS needs to work with a physician who will care for him or her on a long-term basis. People with MS deserve specialized care, but choosing a professional caregiver is not always easy.

Several factors should be considered in making your decision. Although all physicians want to be helpful, some personalities simply do not mesh. Some patients want their doctor to tell them what to do, whereas others want more choice in the process. Neither is intrinsically good or bad, but if you are with the wrong type of physician, the personal chemistry might not allow for an optimal experience. Try to be aware of the type of person you are and try to find a physician with whom you are compatible.

Remember that a patient who wants to entirely direct his or her own care is wasting money by paying a physician for advice.
A physician who takes care of himself is said to have a fool both for a patient and for a doctor. Likewise, a patient should not try to direct specialized medical care. A healthy dialogue, with the patient ultimately in control, usually works best.

Another thing to remember is that good physicians are busy. All patients would like their physician to spend a lot of time with them, and that is a fair expectation. However, just how much time is enough may be difficult to determine. Before visiting your physician, write down the specific questions that you want answered. Get right to your questions because they may raise other important questions from the physician. It helps to have a list of all your medications and their dosages, because your physician may not be aware of all the medications that you are taking.

Do not expect your doctor to fix everything that is wrong. It is hoped that he or she will be able to help with problems, but you should have realistic and attainable expectations.

There may be no physician in your area who is understanding, capable, and competent to meet your needs. If not, go outside your area to find a physician. Talk with other people who have MS and try to discover where your needs may be met. Although it is vitally important to have a relationship with a specialist, it may not be necessary to see that specialist more than once or twice a year. It is important to see your MS physician at least once a year to develop a strong and understanding relationship. It also is important to be able to contact his or her office with questions that arise between appointments. Because you know each other, a phone call often can save a visit.

Remember that medications prescribed by your physician may or may not be helpful. Do not categorically condemn all medications as unnatural and useless. Before the advent of modern medicine, the life span of many people with MS was not much beyond 40 years of age, whereas people with MS can now expect to have a reasonably normal life span. Medications should not be taken without a purpose, but they should not be feared if they are used properly.
MS is a highly variable disease, and no single management program fits everyone. It is difficult for people who are distant from problems to grasp the total picture. Insurance review organizations, businesses, and others who would like to manage care have an especially difficult time with MS. They often like to force patients to see physicians whom they know well but whom the patient may not know at all. In the case of a chronic disease such as MS, the physician–patient relationship should not be taken lightly. It may be important to attempt to get your managed care company to recognize your special problems and to make allowances for them. The squeaky wheel gets the oil, so keep squeaking until you get what you need.

A Word About Complementary Medicine

There is a lot of talk about “alternative” or “complementary” medicine as many people seek answers to the unanswerable. MS is a disease in which most people actually do well even if they do not expect to. This means that no matter what treatment one takes, a good result is likely. However, it may not be the result of the treatment, but rather of the natural history of the disease.

All of us have heard of miracle cures attributed to bee stings, lightning, cobra venom, hyperimmune cow’s milk, magnets, hyperbaric oxygen, vitamins, food supplements, special shoes, calcium, and other similar “treatments.” None of these have undergone research studies that support their use. All rely solely on testimonials. Gullibility does not come with MS, but it often comes with being human.

Several questions should be asked about a proposed treatment:

- Has a properly performed research study demonstrated positive results?
- Has that study been repeated in some fashion?
- Is one person or a small company making a large profit from the treatment?
- Is the treatment rational, or is it “pie in the sky”?
Even if a treatment appears ridiculous, some people will swear by it. That is human nature and will persist despite significant advances in modern medical science. There always will be people who are willing to forsake science for quackery.

Having said that, there are many treatments that are not “medical” but that may have some effect on the management of some symptoms of MS. Many of these are mentioned in later chapters and include biofeedback, meditation, relaxation, acupuncture for pain, chiropractic for back pain, and others. The appropriate use of these modalities may be helpful and should not be discouraged. We now live in an era with treatments that can change the course of MS. Using complementary supplements along with good medical approaches makes sense. Using alternative approaches that have no scientific or reasonable studies behind them instead of good medical approaches makes no sense at all. A good basic guide is *Complementary and Alternative Medicine and Multiple Sclerosis, Second Edition* by Dr. Allen C. Bowling (see Appendix D).