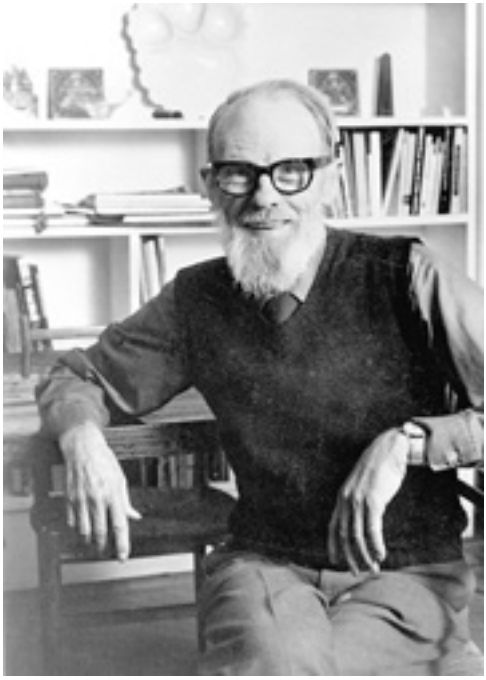
Organic Growing

The Road to Survival

Organic Growing: The Road to Survival
By Haanel Cassidy

Written in 1979



Left to right: Haanel Cassidy, Ananta, Swami Kriyananda, Govinda, Shivani, Suresh, Maria

It's God's green earth!
It's not yours, it's not mine.
It's a legacy given to all.
It's ours to enjoy,
To keep, to improve,
But never ours to destroy.

It's God's green earth!
May we never despair
For the hatred so many express.
The tension they know
Is wisdom's stern way
Of scolding those who transgress.

Men hate, or men love:
How little they see
The fruits they reap are the same.
Hate all: You reap hatred;
Love all: You reap love.
The joy is yours—or the blame!

It's God's green earth!
It's not yours, it's not mine.
It's a legacy given to all.
It's ours to enjoy,
To keep, to improve,
But never ours to destroy.

—Swami Kriyananda

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PREFACE
BY NAYASWAMI MARIA

Haanel Cassidy was a yogi, a dedicated seeker of truth, disciple of Paramhansa Yogananda, and a kriyaban. Swami Kriyananda invited him to move to Ananda Village in 1969 from his home in Escondido, California where he was at the time operating a small truck farm, having retired from his career as a professional photographer for Conde Nast, Home and Garden, and others. (Search for *Eugene Haanel Cassidy*).

He was one of the foremost proponents of Bio Dynamic Agriculture and a personal friend of Dr. Ehrenfried Pfieffer. Haanel exercised his knowledge to convert the formidable and unyielding clays of Nevada County to production. Of our native foothill soil he would often say: "Ananda Farm goes from being a bog to a tennis court overnight!" Regarding our climate, at 2400-foot elevation in the Sierra Foothills, "Spring comes to Ananda 24 times a year!"

I first met Hannel in the summer of 1976. I arrived the day after the historic fire that blazed through Ananda property destroying nearly all the existing housing, modest as it was, and turning to ash nearly all the vegetation. When I arrived, I was asked to help in the gardens and jumped at the chance.

Haanel directed all that went on in the gardens; he and his onsite "head gardener", Shivani, as well as other seasoned staff, were my instructors.

Haanel would drive to the farm daily from his home at the Meditation Retreat. A very punctual man, he expected those of us serving in the garden to be there to greet him promptly at 7:30 am, ready to start our day. He would then lead us on a "duck walk" through all the areas under cultivation. When I met him, Haanel was in his seventies and no longer worked in the fields with us. These morning walks were when he shared his vast experience and understanding. He would answer questions, offer suggestions, and give directions for the day. He asked us each to carry a little notebook for writing down his instructions and important insights.

These morning walks were a highlight of the day, and essential to our success as gardeners. And they were great fun. Haanel's teaching was always interspersed with storytelling, jokes, and wit. He had a wonderful sense of humor and keen attention to detail. Occasionally, he even serenaded us with a delightful song from his repertoire of Winnie the Pooh songs.

Haanel's name will always be associated with the founding of the initial gardens at Ananda Village. Ananda was still in its formative years, and most of his students were just out of college. In addition to teaching us how to cultivate the garden, he also cultivated in each of us the spiritual qualities necessary for success on every level: tenacity, perseverance, self-discipline, focus, hard work, sense of humor, and love. His wisdom was profoundly important to the community at that time. Faced with a well-meaning but rebellious and largely undisciplined

generation, he treated us with unwavering patience and understanding.

In addition to his expertise in gardening, he offered his services as an instructor in meditation, photography, calligraphy, voice, English language, houseplant care and propagation, and the cultivation of flowers, which he referred to as "food for the soul". Haanel was extremely opinionated and demanding, but if you befriended him, he was the most loyal of friends and would do anything for you.

In addition to the various classes he would share gratis with anyone who asked him, he would occasionally invite a group over to view a slide show of his world-class photography. Or he might invite you to dine on his famous Cassidy spaghetti, his own ingenious and delicious recipe. Or he might invite you for a long meditation. He could be a demanding taskmaster and also the dearest friend, with a tender and generous heart. He had an unforgettable impact on everyone who knew him as teacher, friend, and gurubhai.

Haanel was unable to complete this manuscript to his satisfaction due to ill health, but it was extremely important to him. This manuscript is based in large part on the annual, weeklong summer gardening seminars for which he was the main, often the only, speaker. He felt that there was much misunderstanding about fundamental principles of caring for the land and also about sustainable gardening practices. While his book primarily addresses the home gardener, detailing crop culture and necessary implements, the core principles are forever true, and can be applied on a larger scale; these

principles are corroborated today by respected teachers of sound organic farming and gardening practices.

Haanel was exceptional in everything he did. But above all, he was a great disciple and yogi. His favorite chant was "Thou Art My Life". He awoke daily in the very early hours of the morning to meditate for three hours, seated in perfect lotus pose on his bed. When he discovered that he had a fatal illness, he chose to end his days in the room that was both his bedroom and his shrine. In the final weeks of his life, as he lay in bed looking at the photograph of Yogananda facing him, he felt himself bathed in the vibrations of the Masters. His last request was to face Yogananda's photo. He left his body consciously, an act of tremendous yogic self-mastery and devotion.

INTRODUCTION

Life normally consists of a series of judgments or decisions based on inadequate knowledge or information. This precarious situation is inescapable, and in times of real crisis can produce unbearable tensions. (One could also say that life requires learning to bear unbearable tensions.) The sounder the underlying philosophy, scale of values, and principles, the more likely are the resulting guesses to be correct, or at least workable. A false philosophy or a misguided set of values can put all satisfactory solutions out of reach.

This book was triggered by a desire to help cope with the prophesies of doom which pervade the contemporary atmosphere. Are they true? What should be done? In a sense they are neither true nor untrue. They are warnings: If you persist on your present course, catastrophe is inevitable; but if you take heed and change your thoughts and actions, disaster can still be averted. It is extraordinary, quite unbelievable in fact, how energetically such warnings are being ignored by the powers that be.

Surely the Three Mile Island disaster was a great enough warning to produce results, but judging by the results—or the appalling lack thereof—apparently not. "There was nothing to lose by getting those people out of the dangerous area, except

the nuclear industry. We might have lost the nuclear industry."[1] What reasonable and responsible reaction is possible to such a warning but to abandon "the nuclear industry" before it is too late?

If a doctor prescribes for a patient and the patient continues to grow worse, the doctor will try another type of treatment and change the prescription. However, in the case of deadly nuclear accidents, and equally deadly disasters with violent chemicals, the formula seems to be to increase the dose. Some who adopt this strange course of action, obviously believe so sincerely in what they are doing that this appears reasonable to them. With others, one is forced to suspect that greed and the hope of quick and easy personal gains are the underlying motives. Cases abound (in asbestos processing, in logging, in mining, et al.) where employers drive their employees to take suicidal risks to increase profits. It is such false philosophies and distorted values which are the root cause of these destructive actions typical of the times.

The questions now quivering in the air is: Will there be a majority change of heart large enough and soon enough to avoid a total collapse? Current signs suggest not. In which case those who have been individually alerted by the warnings must prepare with all possible care for individual action before it is too late—with the additional discomfort that there appears to be no practical way of telling how late is too late.

This will vary, of course, from case to case. It would be the wildest sentimental dreaming to assume that a city dweller,

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1. Jan Beyea, quoted in *Harper's*, October, 1979, p. 22

who has never even taken care of a house plant, can become self-sufficient in feeding himself, without a considerable period of painful readjustment and much trial and error. The transition should be undertaken in groups, which will cause problems, but the advantages should outweigh all disadvantages. For one thing, it should make possible the salvaging of at least some degree of specialization. Every effort should be made to find a spot with a mild and cooperative climate and responsive soil.

The following text will provide all the help I am able to offer with the practical problems of food supply, but surely it would be a most inadequate type of survival which consisted solely of keeping the belly half full and the body breathing. Surely it should not be necessary to regress all the way back to the pure brutishness of the caveman. Yet that is a danger which can be avoided only by the exertion of extreme control.

Only the most disciplined army can carry out a retreat without allowing it to degenerate into a rout. A retreat from a highly sophisticated technology involving an intricate interdependence of extreme specializations, will be at least as delicate a maneuver. I know of no case in recorded history where such an undertaking has been successfully carried out. Hence the need for careful thought and relentless discipline. Once started down that slope, every care must be taken to arrest the descent at the first possible moment.

Moral problems are by no means a modern invention, nor are the inevitably accompanying moral failures. But the scale

of penalties appears to be something new. The Atlanteans managed to do themselves in without rendering the whole planet uninhabitable. The human record down through the ages has been generously dappled with the darker colours, but "man's inhumanity to man" has always been on a less than worldwide scale. The greater the knowledge, the more sophisticated the techniques, the greater the forces involved; the greater will be the penalties for misjudgment and malpractise.

CHAPTER ONE
TOOLS AND EQUIPMENT

For anyone seriously interested in gardening of any kind, it is always important to assemble a set of carefully selected basic tools of high quality. In times like these this is of special urgency because good quality tools are in short supply and sometimes for considerable periods are quite unavailable. At all times, and particularly now, it is the part of wisdom to accept only the highest quality tools available. They will aid the gardener in performing the necessary tasks with a minimum of effort, and with proper care will last a long time. There is a wide variety of eccentric tools being offered which the experienced gardener will recognize as useless toys, but which can easily entrap the beginner in pointless expense.

The gardener's basic digging tool is the standard spade, with flat, square-ended blade, and D handle. Although an awkward instrument for regular digging, the long-handled shovel is useful for digging holes, loading wheelbarrows, or moving earth or soil about. (If you want to shove dirt around, by all means use a broom or washcloth.)

A digging fork with four flat, pointed tines, and D handle, is useful for digging in certain conditions, and for harvesting such crops as carrots. The tines on even the best-made forks

are none too strong, and care must be taken not to put too much strain on them. If bent out of shape, the tines can easily be bent back, but they are never as strong again.

A pitchfork is necessary for handling hay, straw, and various composting materials. A true hay fork has only three tines, but a compromise pitchfork with four, or perhaps five, tines will meet normal uses very well.

The rake is one of the most important tools and one requiring the greatest skill to use efficiently. Undoubtedly a bow rake is the strongest, but it is so heavy and badly balanced, that it is tiring to use for any length of time. A T rake, preferably with curved teeth, is much more friendly. If of the best quality, made of heavy metal, it will be quite strong enough for a reasonable use, but will not stand of to having the ends used instead of a hoe.

The Warren hoe is generally available but is not by any means as well known as it is deserved to be. For most garden jobs it is far more effective than the regular square hoe. It is very important to choose a well-balanced model. If the curve between handle and blade is well-designed, the hoe will lie in the hands in any position with almost no pressure on the handle. Since the Warren hoe can be used in five different positions, this is a major consideration. A badly balanced hoe will have to be gripped so hard in use that it will be very tiring. The Green Thumb brand Warren hoe is the best balanced I have seen, and in general, Green Thumb offers the best in all these hand tools.

There is a narrow Warren hoe with the blade 2-inch wide at the handle end. It is useful for running shallow drills for

small seeds, and even for running furrows for transplanting small seedlings.

The trowel is an important tool, and it is best to have one with a narrow blade and one with a much wider blade. The strongest trowel will have a blade revoted to a solid shank. These are hard to find. Any blade and shank pressed from sheet metal will be weak in comparison and will have to be handled gently.

The spud was designed for uprooting big weeds, such as dandelions in lawns. It is useful for harvesting such crops as carrots or leeks, where the largest specimens are being taken out singly from among the smaller ones.

All these hand tools will quickly degenerate if not given the proper care. Metal parts should be cleaned after use, although this is more important in some climates and with some soils than with others. It is the wood handles which demand the most attention. If they are left out in the weather over night to be wet with dew, or worse still, left out in the rain, they will soon get rough, then begin to splinter, and finally splint. If they are properly stored whenever they are not in use, the normal movement of hands along them will keep them smooth and sufficiently oiled to keep them in good shape indefinitely. It is a mistake to oil them, as is sometimes recommended: this treatment produces a rough, sticky surface most unpleasant to handle.

The Hoeboy is a patented, imported tool, available from (and apparently only from):

Tradewinds, Inc.
P.O. Box 1191
Tacoma, Wash. 98401
(206) 272-4887
$34.95 prepaid

It is very well made and should last indefinitely. When properly adjusted for the height of the user, and used with reasonable skill, it is a great time saver, but it must be used when the soil is in the right condition, especially true for clay of course. If the soil is too wet it will clog the Hoeboy immediately. If used when a new germination of weeds is just showing, it will dispose of the weeds and leave a fine dust-mulch surface. That is, of course, the right time to get rid of a crop of weeds. They should never be left until it becomes a major chore to pull them—a counsel of perfection which the poor chronically-behind-in-his-work gardener cannot always achieve but a goal well worth aiming for.

A serviceable wheelbarrow is a necessity in any garden. Some of the best-made and most expensive are so heavy they are hard enough to push around even unloaded. It is a mistake to get too small a model, but any of the medium-sized, light weight, all metal types should prove satisfactory. Such a wheelbarrow is the best place in which to stir together soil mixes for cold frames and special beds. Especially in larger gardens, a two-wheeled garden cart can be very useful. It can transport far heavier or bulkier loads than are possible in any wheelbarrow.

Whenever there are fruit trees to be kept in shape—and

a home orchard should never be chopped about as ruthlessly and carelessly as commercial orchards now are—it pays to buy the best tools made. The pruning shears (secateurs) made by Wilkinson Sword and listed in the Burpee retail catalogue should be the main tool. Sawing should be avoided as much as possible since the saw tears and bruises the bark around the cut however carefully it is used, and this delays healing. In fact it is best to trim the bark with a sharp knife, and for this purpose the Wilkinson Sword pocket knife is a good buy. The best saw available is a folding pull-saw. The fine pruning shears should be used only for real pruning. For other jobs, such as harvesting woody herbs, anvil clippers will serve very well, but here again it pays to buy the best and take care of them. Since pepper plants break so easily, it is a good idea to use anvil clippers for harvesting.

In the watering department it is usually best to buy good-quality 3/4-inch plastic hose. There should be a nozzle capable of delivering anything from a jet to a fine mist. Sprinklers should deb chosen which deliver the water in a fine spray. Many of the most popular types pound the life out of the soil with heavy jets. The better watering systems attempt to simulate the ffect of gentle rain. None really succeed, but the nearer they approach, the better, for that is the ideal to aim for.

Watering cans are a necessity and for serious work should be large and durable. Good galvanized cans are the best available, at about $15, but are rather hard to find. The very best plastic cans are a poor second, and those with the rose molded to the body are the worst.

For certain rough jobs, such as breaking in new ground, a crowbar (at least medium size), a pickaxe, and a mattock are a help, almost essential. On a small place a scythe is hardly needed. On a larger place it could be very useful, and of course, if the day comes when power mowers can no longer be used, it would become an absolute necessity. Unfortunately, to be used effectively it demands a rare skill, which in these days is practically obsolete. Even on the smallest place a sickle has its uses. There seem to be none available made of good enough metal to take a good edge. In any case both these tools must be frequently honed with a good sharpening stone, to be taken along when on the job.

Compost can be made without the aid of a thermometre, but it is such a help that it would be foolish to try to get along without one, especially in the learning stages. By far the best type available is made by Weston—as illustrated, with protective guard to be assembled by purchaser from a 2-foot length of 3/8-inch pipe threaded at one end and a 3/8-inch to 1/4-inch reducer. The model required has a 24-inch stem and is calibrated from 0° to 200° F., catalogue number 2281-0015127. These are not carried in stock but must be made up to order. Consequently acquiring a thermometre will be a matter of months.

Weston Instruments Division
Weston Instruments, Inc.
614 Frelinghuysen Avenue
Newark, N.J. 07114

Orders are handled only through local agents.[1] In the San Francisco are the agents are:

Waldron, Duffy, Inc.
1550 Tennessee Street
San Francisco, C.A. 94107

For Bio-Dynamic Compost Starter, Field Spray, Literature, and Soil Tests:

Three Fold Farm
Spring Valley, N.Y. 10977

For diatomaceous earth:

Perma-Guard
Box 21014
Phoenix, A.Z. 85030

Plain diatomaceous earth is not very effective without a duster with a special electrical attachment. This should also be ordered from Perma-Guard.

For Blackleaf 40:

Blackleaf Products
Box 418
Elgin, Ill. 60120

Small quantities are usually available locally.

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1. Recommendations from Nayaswami Maria in 2014 are:
Peaceful Valley Farm supply — www.groworganic.com, 888-784-1722
Sierra Seeds — www.sierraseeds.org, info@sierraseeds.org

CHAPTER TWO
DEFINITIONS AND DISCRIMINATIONS

Up until roughly a century ago, all known methods of agriculture were organic. The experiments and theories of Baron Justus von Liebig, 1803–1873, marked the beginning of the new era of emphasis on Nitrogen, Phosphorus, and Potassium (NPK) and the increasing use of chemical fertilizers, and eventually of chemical pesticides and weed killers. From this it is at least clear that the organicists were the traditionally orthodox, and the chemical boys were the upstarts and heretics, but as soon as a heresy becomes the belief of the majority, it quickly becomes the orthodoxy of the day. The new believers were not slow in labeling the organicists as reactionary heretics, and for a time it seemed they were on their way to total victory. Certainly they were themselves completely convinced of this, and to be fair, one must always remember that, at least in the beginning, they were sincere and earnest in their convictions. More recently the faults and fallacies of the system began to surface. Rather naturally self-interest increasingly took over, and the urge was to apply more and more of the questionable medicine in order to insure continued quick and easy profits.

The difficulties increasingly confronting the official commercial growers provided welcome ammunition for the

organicists, who began to take a remarkably more effective part in the continuing debate. Indeed it at last begins to look as if "organic" is on the way to becoming, if it has not already become, the bandwagon word. At this stage, one is forced to conclude that more organic produce is being sold than is being grown—and this only partly because of the generally vague understanding of what "organic" ought to mean.

In support of sound organic theory there are three meanings of the word "organic" which must be clearly understood: organic method, organic matter, organic compounds.

The organic method can be defined broadly as *working with nature rather than against nature*. Nature is the best of all gardeners, but her purpose is different from what ours must be. To begin with, she has unlimited time. Then her goal is to encourage and support life without any discrimination whatsoever. She is just as willing to give a mosquito or a "weed" its chance as a hummingbird or wholesome vegetable.

In order to survive, we must sweet-talk her into doing what we want, which can be done as long as our wants remain legitimate. We can select from among nature's various methods those which will encourage the specific crops we need. We can in certain cases produce acceleration, very necessary since we have relatively little time at our disposal. As will be seen, in other cases we must seek deceleration.

Because it is often stated in reaction to chemical methods, the organic method is likely to be expressed in negatives: no artificial fertilizers, no chemical sprays, and no weed killers. These negatives are definitely and fundamentally true, and

must be scrupulously adhered to. "No chemical fertilizers" means exactly that, and "No chemical pesticides" must have no qualifications or limitations. If you think you are going to lose a crop without chemical pesticides, then be willing and prepared to lose it. Crop failures are always a possibility even for the best gardeners and farmers. On the other hand, if you give in and resort to chemicals, you have at once lost the battle. Quite apart from the great possibility that even with the use of chemicals you may still lose the crop, you will not only have corrupted your soil, probably more or less permanently, but you will have produced a crop which you know is not fit for human consumption.

Obviously one cannot produce an adequate agricultural method just by not doing certain things. It is obligatory to substitute acceptable and effective alternatives. These must be sought out.

Organic matter is the true source and basis of any sound and successful organic method. Yet an adequate definition of organic matter is quite a rare thing, and very many self-styled organicists are dangerously vague in their understanding of it.

Organic matter is any matter which is, or has recently been, part of living tissue, plant or animal. Iron, say, or in fact any element, taken from living matter or from a rock or test tube will be different. However subtle and difficult to measure this difference may be, it remains a fact of the profoundest importance. It is almost certain to be a waste of time trying to convince a chemist of this. He will take both samples and put them through all his chemical tests, and will be unable to detect any difference whatever. All this should mean is that he

hasn't applied the right test—but try to convince him of that! As a matter of fact, laboratory tests capable of detecting this difference have not been available.

At any rate the gardener adequately sensitive to nature will not be in any doubt. The differences between soils fed on compost or on chemical fertilizers will be obvious. The differences in flavor between produce from compost fed soils and chemically fed soils will be equally obvious to anyone with any surviving taste buds. Although our instincts have atrophied to the point where we are no longer able to select the most nutritious foods as the animals still can, the produce from organically treated soils will prove to be healthfully nutritious, whereas chemically raised and treated produce may actually be poisonous.

As organic growers we must be completely convinced of these things. If the difference between organic and inorganic elements were indeed illusory, the chemical boys would be right, and we might as well forget the whole thing. Fortunately it is only necessary to work with nature with an open mind and a minimum of sensitivity to be convinced beyond any possible doubt of the truth of these differences.

It may seem unnecessarily fussy to bother about the chemists' definition of organic compounds, but organic growers have in fact been confused by it, and continue to be. When chemistry grew so complicated that subdivisions were made for the sake of clarity, all carbon chemistry was labeled "organic", since carbon appears in all living tissue. It just so happens that some of the latest, most virulent, jet-propelled insecticides are carbon compounds. Hence by the chemists'

definition, they are *organic compounds*—but it would be impossible to conceive of anything less organic by any of our definitions.[1]

1. Carsten Pank, quoted in "The Next American Dust Bowl… and How to Avert It", *The Atlantic Monthly*, July, 1979, p. 48: "I get particularly annoyed at these people who insist on doing everything according to this word 'organic'. What these people don't want to admit is that the chemicals used in most herbicides and pesticides are organic chemicals."

CHAPTER THREE
THE ORGANIC CYCLE

All the soil of the earth's mantle derives from broken down rock. A number of forces are constantly at work continuing this process: alternate freezing and thawing, running water, even air and wind. The resulting pulverized rock constitutes the chemical basis of all soils.

At the same time another chain of forces sets up the organic cycle. Primitive plant forms such as the lichens sit on rocks and gradually dissolve away the rock under them, thus feeding themselves and beginning the formation of organic matter. Bacteria, other fungi, earthworms, and many others add constantly and increasingly to the accumulation of organic matter, until the soil becomes an actively living thing.

It is this extremely complex symbiosis which lifts the chemical rock into the cycle of life, and develops and ideally fertile and friable verdant soil. Organic agricultural practices in harmony with the laws of nature are designed to maintain the life and consequent fertility of such soils.[1]

1. Dr Robert Petit, quoted in "The Next America Dust Bowl… and How to Avert It", *The Atlantic Monthly*, July, 1979, p. 48: "All these claims that organically grown food is different or tastes better than chemically grown food are just nonsense. There's absolutely nothing sacred about having organic matter and humus in your soil. You can grow the same plants in water if you to add enough

The surface layers of the soil, the top few inches, are the point at which the positive forces of sun and air, and the negative forces of soil and water interact. In a moderate climate where these are in reasonable balance, the accumulation of organic matter and healthy plant growth proceed smoothly. In a cool, cloudy, wet climate the negative forces are in excess. The soil will tend to be excessively acid. The accumulation of organic matter, and plant growth, will be more or less inhibited, and special measures will have to be taken to counteract these conditions.

In a desert climate the positive forces are nothing short of violent. The production of organic matter is impossible, or nearly so, and the soil will be mineral and alkaline. Nothing can be done to alter these conditions without the addition of water, but when that is made possible the soil can be built up in several ways.

A soil can be raised to a high state of fertility by the use of cover crops alone. The chief problem with this method is likely to be economic. While the process is under way no other crops can be taken from the soil. If the farmer needs a regular income to survive, there will obviously be difficulties. One solution would be to apply the method when enlarging the area under cultivation. In any case, as soon as the soil is sufficiently improved to produce worthwhile crops, paying and soil-building crops can be alternated in various rhythms.

There are many possible cover crops, individual choice

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chemical fertilizers." (Might one perhaps suspect a case of defunct taste buds? It must be a common condition, considering all the junk food being ingested with apparent approval.)

being determined by local contains. One determining factor is the price of seed, which should be as cheap as possible since a good deal will be needed. Barely and rye are widely useful. All the vetches, and particularly purple vetch, are excellent, with a great added advantage as nitrogen-fixing legumes. Unfortunately the seed has become very expensive and will have to be used sparingly. A barley and vetch mixture works well in the appropriate seasons.

From the moment of seeding, the cover crop will have to be kept well watered. In the case of grains, such as barley, it will have to be cut with a rotary mower to keep it from heading. If this is done, it will keep growing indefinitely. If not, it will ripen off and stop growing. The growth cut down by the mower will mulch the soil and add somewhat to the soil build up. However, it is the roots which provide the greatest benefit. Consequently the oftener the cover crop can be turned under and reseeded, the faster will be the soil improvement.

A practical combination of methods can be used if a quantity of cheap organic matter such as sawdust, or even leaves, is available. If an application of such materials is disced into the soil even before the first seeding, the following crops will produce a good deal better from the start.

Improving soil by a succession of cover crops alone is a way of forcing the soil to lift itself by its own bootstraps, so to speak. Whenever organic matter can be added to the soil from other sources, the process can be accelerated in various degrees depending on the quantity and quality of the materials applied. Traditionally, the commonest addition has been manure.

It is effective to some extent, of course, even when most inefficiently used, but the effectiveness of various methods varies widely. All manures will yield the greatest benefits when composted before application. Some manures should never be added to the soil raw. Putting fresh horse manure in the soil is just asking for nematode trouble. Pig manure is even worse. The only manure which will break down easily and with no ill effects is rabbit manure.

Another possibility is to devote part of the soil to raising organic matter for feeding the area in active production. A planting of alfalfa or comfrey are excellent examples. The alfalfa must be harvest and composted. Comfrey is a gross feeder and must be richly fertilized to produce maximum returns. It will respond happily even to fresh chicken manure. It must then be harvested regularly to keep it producing new growth. Perhaps the most remarkable thing about comfrey is that the fresh leaves can be put directly in the soil, when they will break down quickly and completely. Naturally they will also compost easily.

Obviously weeds and crop residue are also sources of organic matter, all of which should be returned to the soil, preferably after composting. Burning organic matter of any kind should be avoided whenever possible. Fire is the great purifier and will return organic matter to its inorganic state. For example, sawdust is organic in both senses, but wood ash is organic only in the first sense.

Wood ashes are, in fact, a very useful soil additive. They must be kept most carefully dry until they are put in the soil.

Otherwise the effective portion, the potash, will be dissolved out and lost. Since potash is so soluble, the ashes should be kept near the surface of the soil, and the potash allowed to work down into the soil with subsequent watering. Potash is strongly alkaline and care must be taken not to burn plants by letting it come in direct contact with them. It is obviously a good source of potassium for plants with a strong potassium appetite, such as potatoes.

I remember reading an article by some chap outlining instructions for growing good potatoes. Most naturally he recommended adding wood ashes, but then he went on to say—but not too many, or the potatoes will get mealy! A mealy potato is the ideal. How can a potato be good without being mealy?

If with the help of water and sundry human aids the desert has been made to bloom, the fundamental conditions remain those of the desert: i.e., the positive forces remain strongly predominant. It will then be necessary to pour in organic matter to bring the soil up to fertility. It will be a never-ending undertaking, and there will never be any time to relax and take it easy. Well, perhaps you could rest overnight.

CHAPTER FOUR
COMPOSTING AND COMPOST APPLICATION

Composting is one of the most important operations in organic soil care, and an outstanding example of selection and acceleration of nature's most effective methods. There is simply no substitute for returning all available organic matter to the soil, and efficient composting is the most effective way to accomplish this. This is evidence on every hand that neglect of this principle is having increasingly disastrous results. No wonder that those who are aware of what is going on are reduced to a state of desperation. To quote but one example from *The Soil and Health*, by Sir Albert Howard: "The net result of a century's mismanagement in the United States was summed up in 1937 as either the complete or partial destruction of the fertility of over 250,000,000 acres, i.e., 61 percent of the total area under crops: three-fifths of the original agricultural capital of this great country has been forfeited in less than a century."

In the latest edition of the best garden encyclopedia to be had, there still appears under the heading, "Organic Gardening", this concluding statement: "Such response to good horticultural practice should not delude the grower into

assuming that plants so grown are immune to pest attack, or have significantly higher food value." It is difficult indeed not to despair!

There will have to be a great change in outlook and in agricultural methods if catastrophe is to be avoided. In the meantime all one can do is put into practise sound organic methods and demonstrate yet again the great benefits they can produce.

No one has contributed more, and probably nothing like as much, to the understanding and practise of composing as Dr. Ehrenfried Pfeiffer—and since he is my own chief authority in all these matters, I must give him a formal introduction. He was a disciple of Dr. Rudolf Steiner, founder of the Anthroposophical Society. Dr. Steiner was credited with being completely clairvoyant, and based his agricultural theories on his observation of the forces actually at work in nature. He appointed Dr. Pfeiffer to organize his theories into a system for practical application.

Dr. Pfeiffer had been himself a successful large-scale farmer, and was a trained laboratory technician. He had therefore the threefold advantage of a spiritual point of view, and understanding of the farmer's problems, and acceptance of the necessity for thorough testing before announcing any results. Under the guidance given him by Rudolf Steiner he developed the Bio-Dynamic system of agriculture. I had the great good fortune to know him personally and he was always most generous in discussing my problems and answering all my questions. He was that way with any ernest seeker, which

was why he died a poor man when he could easily have made a fortune.

Composting is an extremely complex process, and no one can analyse and describe it beyond a certain point. In all its forms it is some type of fermentation, and it is perfectly true that the air is full of bacteria capable of inaugurating fermentation. For this reason many people insist that there is no need for any type of inoculant. However, it is also true that a pile inoculated with Dr. Pfeiffer's Bio-Dynamic inoculant (commonly called BD Compost Starter) undergoes a different and superior type of fermentation. It will tend to peak at a higher temperature (optimum 160°F, anywhere between 150° and 160°F is excellent) and ripen more quickly. The higher temperature has the advantage that it is more certain to kill weed seeds and plant diseases, and there is no need to keep these out of the pile as is often suggested. The increased speed in ripening is also an advantage, but not really of great importance where composting is carried on continuously, as it should be. The great and decisive advantage is that the end product is of superior quality. This would be difficult to prove without extensive laboratory tests, if indeed such tests even exist, but anyone who has used Bio-Dynamic compost in any quantity and over any considerable period of time comes to know its superior effectiveness in actual use.

The BD starter is dispensed in multiples of "ton" units. This "ton" is an arbitrary measure having no consistent relation to the actual weight of the material, but rather to its bulk, one and a half cubic yards per ton. It is simply a convenient way of

measuring how much inoculant should be applied to the pile. It is of no importance how much water is used in spreading it on the pile, just whatever is easy and convenient.

The starter appears as a black powder, but even this powder is not the actual starter, but merely an inert carrier for the active elements. The starter must be activated from the dormant phase in which it is stored, before being applied to the pile. It is important to bear in mind that the starter is a living thing, like yeast, and must be appropriately cared for at all stages of the operation.

The starter is activated by moistening it some hours before use; overnight is the usual period. The water used should have the chill off, and must not be chlorinated. If the available water is chlorinated, it can be purified by leaving it standing in the sun for at least a day. Into any small can put a spoonful or so of water, empty in the starter, and then slowly add water while stirring. The result should be a thick paste, thoroughly stirred until there is no dry powder remaining.

It is the best practise to set aside an area in a convenient location, as the permanent composting area. If at all possible, it should be in shade. The longer it is used, the better will be the quality of the compost produced. The piles should be made on bare soil, so the whole surface of the area should be cleared, preferably lowered about 6 feet below ground level. This is all the preparation and equipment necessary—no pits, bins, or other obtainers are of any advantage, except in the one case where there are local ordinances requiring such things, in

which case one can proceed normally in spite of them, rather than because of them.

The maximum width of a pile should be 12 feet (8 feet to 10 feet is adequate) and the height, 5 feet and 6 inches. With this profile, the pile can be extended to any convenient length. I have seen piles hundreds of yards long in large-scale operations. The normal form is pyramidal, with the pile rising almost to a point, and this form is best under most conditions, but in our desert summers I prefer to make the sides vertical. This doubles the bulk in any length of pile and makes it easier to keep the pile moist.

Finished compost is an extremely complex thing with a great variety of constituents beyond all possibility of enumeration. By the same token, the greater the variety of appropriate material collected for the pile, the better. (Old boots and discarded kitchen utensils are really no advantage.) However, there are two basic elements of diet the fermenting bacteria must have in order to survive and function properly, carbon and nitrogen; and these must be roughly in balance, approximately twenty of carbon to one of nitrogen—again no more than a rule of thumb guide. If there isn't enough nitrogen, fermentation cannot begin. If there is significantly too much, it will go off into the air as ammonia and be lost. Ammonia is intensely pungent, and a slight smell of ammonia around a pile is fairly common and not very serious; but a strong smell will indicate a serious loss. Obviously it is impossible to take off for the laboratory to measure these things accurately in the midst of making a pile, and one must

learn to judge well enough as one goes along. In general, a yellow material will be pure, or nearly pure, cellulose, largely carbon and containing little or no nitrogen. All green plant matter will contain nitrogen, the greener the better. Manure, of course, though rarely green, contains some nitrogen, although surprisingly little in most cases. For example, and to use the most approximate figures, a freshly delivered cow pie contains about five percent nitrogen. The same sample left to weather for 24 hours will contain something like one percent, and, not very much later, none at all. Fresh chicken manure is high in nitrogen and special care must be taken not to lose this volatile element.

In making the pile these various materials are put down in layers in regular sequence, the thinner the layers, the better. If there is some especially coarse material available, such as Jerusalem artichoke tops, it will make a good first layer. There must be a flow of air up through the pile, from bottom to top; it is a necessary skill in making a pile, to get this approximately right. Insufficient air creates the danger of anaerobic fermentation, or at best, a slow-starting pile. Too much will start the pile off too quickly, causing it to use up all available water in short order, and drop dead. If this happens, it is vital to turn and water the pile at once, or it will be necessary to start all over again and re-inoculate.

Begin then by marking out the intended size of the pile with a carbon layer, keeping it straight and square. It is better to under-estimate, for it is easy to add to the length of the pile later, while too large a foundation will result in a pile below

optimum height. Cover the carbon layer with a thin layer of nitrogenous material, and this with a dusting of soil. The poorer the estimated nitrogen supply, the less soil. If there is any danger of too much nitrogen, as with a generous supply of fresh chicken manure and a shortage of carboniferous material, use the soil more generously.

Over a period of time it is a problem to keep a supply of soil at hand for adding to compost piles. At first the soil scraped from the area can be left at one side for this purpose, but eventually soil will have to be brought in. The quality of the soil is of little importance to the pile, and it is in fact an advantage to put low-grade subsoil through the piles to enrich it.

Now comes the problem of watering, which requires considerable skill and constant attention. The pile should be 50 percent saturated. The watering necessary to achieve this will vary greatly with the types of material forming the pile. Some materials are naturally moist and will require little watering. Others may be not only very dry, but actually water resistant, and will require careful soaking. Such materials will have to be exposed to water over an extended period of time in order to take up sufficient moisture. All one can do is wet the surfaces of the material, and adding more water at that moment will not hasten the process of wetting in the slightest, and will waste water. In such a case it will greatly save time to begin soaking the material before it is added to the pile. This will also reduce the danger of flushing the inoculant out of the pile.

For the pile will also have to be inoculated with the aid of water. If the two operations could be combined, it would greatly simplify matters, but in practise, this is very difficult to accomplish. In practise it is best to put on plain water first, followed by inoculant. With the first few layers of the pile, watering of both types should be kept to a minimum, for the water will soon begin running out at the bottom of the pile, a pure waste in every way. As the pile rises more water can be used, and it will drip down through the pile, thus completing the soaking of the lower layers.

After it is completed, a pile shrinks in two ways, first in response to the force of gravity, then as a result of fermentation. The degree of the first shrinkage depends greatly on the material in the pile. If it is predominantly solid and heavy, there will not be much change; but if it is markedly loose and springy, the change will be considerable and the pile should be made higher to begin with, to make up for this. The shrinkage due to fermentation is, of course, quite another matter, and is unavoidable. As it ferments, the pile gives off a steady stream of carbon dioxide, and will finally be about half its original size—sad but inevitable. If the material is solid and heavy, the pile should not be walked on in making, but if it is loose and springy, the more it is tramped down, the better.

If the pile is pyramid shaped, as soon as it is thoroughly soaked it should be covered from top to bottom with about an inch of dry soil. This is the ideal covering. It will help keep in the moisture right out to the edges, and will ensure that there will be no smells and no flies. If the pile has vertical sides, it

can be covered with soil only on top, but at least this much should be done.

As soon as the pile is finished, the thermometre should be inserted. This must always be done gently and with care. The two-foot rod is easily bent, and any bending puts it out of action. If used with reasonable care, the thermometre should last indefinitely.

Because of the chimney action in the pile, it is normally hottest near the top. It is convenient to insert the thermometer at one end, near the top, and leave it there, taking a reading at once, and every morning thereafter. A record of these readings should be kept for every pile. It is a help in keeping track of what is going on, and will be a valuable source of accumulating experience as to what is normal for a pile—though it is astonishing how much variation there can be among piles which come out all right in the end. Naturally there is also a limit to what can be considered normal variations, and anything beyond that must be investigated and corrected immediately. It is also a good idea to take readings, not recorded, from various parts of the pile to find out how evenly it is progressing. For the sake of consistency, all recorded readings should be taken from the original position.

A rise of about 30°F for the first day after making the pile is a good average. Too much more is likely to indicate inadequate wetting, and danger that the pile will dry out and need turning and watering. Anything less is slow, and will suggest a pile too tight or too wet or both. If it is merely too wet, it may gradually gain speed and dry itself out to normal,

but if it remains slow, it will have to be turned for inspection and correction. A slow rise, or no rise, can also indicate a lack of nitrogen and, of course, that will have to be corrected or a dead pile will result. In all cases, whenever some abnormality is suspected, turning the pile is the first thing to do. If the pile is too wet and tight, the turning will alone cure the trouble. If the pile is too dry, this can easily be corrected during the turning. In fact, as soon as a pile has settled into shape, it cannot be adequately watered without turning.

A pile should rise consistently until it peaks. Anything between 150° and 160°F is excellent. Over 160° is not good, but fortunately is also rare. A few excess degrees can probably be ignored. In any case a pile can be cooled by watering, turning, or both. Over-cooling won't do any good. A pile will hold its maximum temperature for varying periods, sometimes not very long. As soon as it has fallen significantly, say below 130°, it should be given its first turning. The temperature should then rise, but usually not as high as the first time. When again it has fallen significantly, the pile should be given its second turning. All piles should ideally be turned twice, which should be enough. If pressure of work (no other excuse is adequate!) prevents turning, the pile will still work, but not as well, usually in the sense that it progresses more irregularly. It is a common experience when using an unturned pile, to find dry spots which have not fermented, and even parts which were so wet and tight that they suffered anaerobic fermentation, producing a black, slimy, evil-smelling mess. In both cases, these portions of the pile will have to be thrown

over into a later pile to complete their ripening. Also, the whole outside of the pile will not have broken down.

When a pile is turned, it can be rolled over into a space right beside it, of approximately the same size as that it has been occupying, except that it is often good to shorten a pile in order to restore its height. In turning a pile, the outside should be placed inside (unfortunately forcing the inside outside), since the outside never ferments as well, and this gives it a chance to catch up—one of the main purposes in turning the pile. The more a pile is broken up and stirred about in turning, the better. In placing successive piles, room for turning should always be left between piles. The progression of piles should move evenly from one side of the area to the other, returning to the first side as those piles are used. All turning should also be done in the same direction. Otherwise traffic problems will soon get out of hand.

As soon as the heat has gone out of a pile, it is ready for use, and normally the sooner it is used, the better. One often hears remarks about compost piles full of earthworms. But earthworms cannot stand heat, and cannot enter a pile until it is fully ripened and cool. It is far better to apply the compost to the soil before this happens, and let the worms do their final digesting in the soil where it will do the most good. In case of need, it is even possible to use compost effectively before the heat has quite left it. Since the compost will be immediately cooled as soon as it is worked into the soil, this operation must not be rushed too much.

Dr. Pfeiffer gives directions for storing compost (drying

it out completely and covering it from the weather) and says it can be kept almost indefinitely. Since it is rare in my experience to have *enough* compost, I have no personal experience of storing it for any length of time.

However, Dr. Pfeiffer also says that the longer he farmed, the more he believed in using a little compost often, rather than using a lot, less often. At one time it was standard farming practise to work to a regular cycle of three, four, five, or six years, emptying all the manure in the barnyard into the first area the first year, and returning to that area only at the beginning of the next cycle. This method worked, but not as well as more frequent applications would have done—and it would have been even better to compost the manure instead of applying it raw. Of course there was also a cycle of crops as well as of manuring, and that had a good deal to do with the success of the system. Some crops would be ruined, or at least seriously damaged, if planted right after an application of raw manure. This would happen much less with well-ripened compost.

Whenever compost is being applied to the soil, it should never be left on the surface and exposed to the weather one moment longer than is unavoidable. Obviously it should never be left on the surface as a mulch, although one frequently finds this recommended by those who should know better. There are indeed situations where the compost must be left on the surface, but it should then always be protected from sun and air by a mulch of such materials as wood chips, sawdust, or straw. As to the amount of compost to apply, the answer is

usually as much as can be spared. Applying too much would be a rare case indeed.

CHAPTER FIVE
PLANTING AND TRANSPLANTING

This is a time when the murder of words and the degradation of language are among the great national enthusiasms. "Hybrid" is one of the important words in process of destruction, which is turn leads to serious misunderstandings in the choice of varieties for the vegetable garden or farm. When even some of the best seedsmen insist on misusing the word, it is little wonder that misunderstanding and confusion are general.

Hybridizing is the production of new types or varieties in plants or animals, through cross-fertilization of different species or varieties. It is a process which has been going on in nature since the emergence of sexual reproduction, and which has been practiced by man for a long time, although until rather recently, with little understanding of the principles involved.

In historical perspective, until quite recently there was only one known method of developing a new hybrid variety. Two promising species were cross-pollinated, the resulting seeds were raised, the more promising progeny reserved and the rest eliminated—an operation called "roguing". Following

generations were subjected to the same treatment until all, or very nearly all, plants came true to type. The plant breeder then had a fixed hybrid which he could propagate and market. This method was hard on a seedsman, for as soon as he marketed his superior new variety, anyone could buy, propagate, and sell the seed. In the vegetable garden there are few plants which are true species and not hybrids of some sort.

The latest achievement in what has become the science of hybridizing is the development of F_1 hybrids. If I remember correctly, this was first tried with field corn, and was at once such an immediate success, that it has been applied more and more widely ever since.

F_1 stands for first generation, and an F_1 hybrid is one which has been bred to produce a crop of outstanding quality and hybrid vigor in the first generation after the final cross-pollination. The hybrid is not fixed, and the seed from that first generation will break down into a confused mixture of types deriving from all the genetic strains temporarily brought together in the F_1 generation. There are a few cases, notably a variety of Petunia, where the F_2 generation separates into several distinct types which go well together.

The development of an F_1 hybrid requires the prior establishment of two fixed hybrids, one to be the male, and the other the female, parent of the final F_1 hybrid. The pollen of the male parent must always go to the stigmas of the female parent, and this usually requires hand-pollination, just one of the reasons why F_1 hybrid seed must be more expensive than fixed hybrid seed. F_1's great advantage to the seedsman is that

it is no use saving seed from an F_1 hybrid, and the grower must return to the seedsman every year for his seed supply, and no other seedsman can help himself to his new improved variety. The seedsman has thoroughly earned and fully deserves this advantage.

Modern plant breeders have developed what appear to be almost miraculous skills in turning out hybrids tailored to fit all sorts of market requirements. Most unfortunately, the said market requirements are often aimed at maximum profits, with no concern whatsoever for flavor or food value. Commercial tomatoes are an obvious example, where the requirements have been for large quantities of fruit, tough enough to stand rough handling in harvesting and shipping, and usually ripening as nearly all at once as possible. In self-defence, the home grower and conscientious organic farmer must avoid all varieties which are commercially popular. This is especially true of tomatoes, which have proved exceptionally vulnerable to deliberate commercial degeneration.

There is another hazard in buying and storing seeds which is worth mentioning. The seed companies are required by law to test all seeds before each growing season. If germination falls below a certain percentage, the seed cannot be sold. This means that for the season for which the seeds are sold, one can be sure they are viable. Surely, even without the legal regulations, the seed companies would be just as careful as they are now not to sell questionable seeds. A very few cases of the sort would put them out of business.

Years ago, when I was raising organically-grown vegetables

for sale (I should hardly need to point out that I have never grown any other kind) I had an elderly customer who used to announce dramatically each spring that he was going to have his own garden, but somehow continued to remain my customer year after year. I patiently answered all his questions, even if it meant talking myself out of a customer, for I looked on my operation as a demonstration more than anything else.

One day he arrived in a furious rage. "It shouldn't be allowed! It should be against the law! These seed companies shouldn't be allowed to sell dead seed," he exploded. "I just bought and planted some lettuce seed and not one came up." I asked quietly, "How deep did you plant them?" "About so deep," he said, indicating about an inch with thumb and finger. "There's your trouble right there," I said. "Lettuce seed is one of the weakest that we plant in the vegetable garden, and should be barely covered. No lettuce seed in the world could get up from that depth. For myself, I always blame myself at least six times before I dare blame the seed company."

Well, to continue: All seed when purchased can safely be assumed to be in good shape for that season; but the purchaser has no way of knowing how long it may already have been in stock. If it is a recent crop, it may still be good for years. On the other hand, that may be its last season before dropping dead. If one can get around to it during the winter, it is a wise and quite simple precaution to run a seed test on all stored seeds, or at least the more questionable ones. Lettuce and parsnip seed have a short life and should be bought fresh

each year if possible. Usually, the larger the seed, the longer its life. Winter squash seed is even said to improve with some years of storage, for plants from the older seed will tend to set more fruit.

If conditions degenerate to a struggle-for-survival level, the grower will have to resume responsibility for growing his own seeds, and this will indeed be a considerable added chore. Some seeds will present few problems: with things like peas, beans, and corn all that is needed is to let part of the crop ripen thoroughly before harvesting. In normal farm or garden conditions it may be almost impossible to prevent undesirable hybridizing in such crops as corn, winter squash, and perhaps some members of the cabbage family. Winter squash is one of the best and easiest sources of winter food, and in normal conditions it is best to grow a variety of types. However, they cross-pollinate readily, and if seed must be kept, either the several varieties will have to be kept as far apart as possible, or it will be unavoidable to accept whatever mixture of mixtures turns up the following year.

Such biennials as carrots, parsnips, and cabbages will present other difficulties. First, and obviously, seed gathering will take two years. Further, where winters are severe, the plants will have to be stored over winter and set out again in spring. Seed should never be kept from carrots which bolt to seed the first year.

Then there is the problem of F_1 hybrids. The only possible course would be to rogue successive generations of open-

pollinated offspring until the best available fixed hybrid is obtained.

In all seed gathering it is unwise to collect all the seed from one plant. If there is only one plant available, then of course nothing else can be done, but it is worth taking considerable care to avoid being caught in this situation.

In most cases seed harvesting is quite simple, although with fine seeds it will not be possible to clean them as perfectly as the seedsman can with his highly sophisticated equipment. Fortunately some chaff with the seed presents no great problem when planting. The cleaning of seed from a pulpy fruit like the tomato is more troublesome. All the pulp must be washed away by working it through a sieve, before the seed is spread thinly on paper to dry thoroughly before storing.

Getting the seed safely up is one of the most critical phases in producing a successful crop. The hazards vary widely in varying conditions. In an equable climate, with rich, friable loam, there will be considerable room for error, but in a desert climate, with heavy clay, the margin of error may be little more than zero.

Especially with the smaller seeds, and very especially in a soil which crusts badly, the depth and method of covering is critical. Early plantings in cold, wet soil should all be as shallow as possible. In the heat of summer, when the soil is warm and dry, planting should be deeper. In a climate where irrigation is necessary, the soil should be well soaked before planting. Small seeds should be tamped into the bottom of a shallow drill, with the back of a rake, handle held vertical, then

a light covering of loose soil drawn into the furrow with the back of the rake. The seed should then be firmly in contact with moist soil, as it must be, and the loose covering will delay drying out. It is ideal if the seedlings appear before subsequent watering seems necessary.

The smaller the seed, the shallower the covering—very fine seeds pressed into the surface with no covering at all. The larger the seed, not only the thicker the covering can be, but must be. With the larger seeds, a sturdy root will soon be trying to bore its way into the soil. If there is insufficient weight on top of the seed to hold it down, the radicle will push it right up out of the ground, where it will lie helplessly on its back with its foot in the air. This fate is normally reserved for the largest seeds only.

The moment a dry seed is pressed into firm contact with wet or damp soil, it begins to absorb moisture and swell. At this moment also the process of germination begins. Once started it must continue unchecked to completion. Any check means almost certain death to the seedling. The seed must, therefore, have a constant supply of moisture, which it can absorb only from the soil actually in contact with it. Obviously, this means in turn that the soil must be kept consistently moist, and how this is achieved depends on local conditions; but the gardener must be constantly on the watch to see that it is accomplished by one means or another, if he is to have any hope of a good germination. It is a great help in hot, dry weather, to lay newspaper or cardboard over the planting, weighted down here and there with soil to keep any breeze

from blowing it away. This will keep the surface moist without further watering for considerably longer periods. The covering must be removed the moment seedlings begin to appear. Otherwise they will be drawn into a puny white growth which will be killed by the sun when it is later allowed to strike them.

As they grow, the seedlings will develop their own root systems, but it will be some time before these reach any sizable extent, and in the meantime the seedlings will continue vulnerable to even a brief drought. As the roots penetrate deeper into the soil, watering will also have to go deeper. Roots will not advance into dry soil, and it is always necessary to water below them to encourage the deep and extensive root system required for healthy and consistent growth.

There are a number of cases where soaking the seeds before planting is advantageous, and some in which it is absolutely necessary. Parsley is slow to germinate, and the process can be appreciably hurried by pre-soaking, in this case for as much as two days, whereas in most cases overnight is enough. The soaked seed is sticky and difficult to handle in planting. Adding about an equal quantity of dry sand and stirring thoroughly will make the seed much easier to handle and spread evenly.

The "seeds" of New Zealand spinach are actually small fruits containing several seeds each. (The "seeds" of beets and Swiss Chard, another beet, are also small fruits of several seeds.) When dried and stored, the shells of these fruits become very hard, and if they are not soaked, the seeds cannot break their way out. When properly soaked, New Zealand

spinach usually germinates easily and well, and causes no problems—except inevitable thinning, since there will be a tight cluster of seedlings for each fruit, and the plants should eventually be at least 18 inches apart, even farther if they put on a really good growth.

It is absolutely essential to plant all soaked seeds in saturated soil and keep it that way. Any soil the least bit on the dry side will draw moisture back out of the soaked seed—disastrous! Almost any seed will respond to soaking and germinate more quickly, a help if planting is judged to be somewhat late, but it should never be attempted unless the soil can be kept soaked. It may be dangerous for early plantings in cold soil, when the seed may rot instead of germinating.

The one instance of wind pollination in the vegetable planting calls for remark. Corn is wind pollinated, and for this reason should never be planted in single rows. There is the theoretical possibility that in a location with a persistent prevailing wind, one might aim the row exactly in that direction, the pollen would be blown down the length of the row, and pollination would be adequate; and this would be a typical example of beginner's luck, but better not count on it. Corn should always be planted in blocks of at least three rows, better four. This would make the minimum planting sixteen hills, four rows each way. Any planting of corn is at its best for only a few days. Therefore, to provide a constant supply throughout the season, corn must be planted in a carefully spaced sequence of successive blocks.

In this whole discussion of planting, it has been assumed

that the seed would be planted in straight rows, and it would be ridiculous to attempt this without a good garden line. Yet it is both inefficient and ugly if rows obviously intended to be straight are allowed to get straggly. By all means, then, a sufficient number of well-designed lines should be kept on hand. Nylon cord is by far the best: even if left out in all weathers it will last for a long time. It will stretch to quite an extraordinary extent, and care must be taken to exert enough tension to overcome this. Stakes for lines should be of hard wood or they can't be expected to last long enough to be worth making. Broken tool handles are excellent for this purpose. They should be cut to definite lengths—3, or 3 and 1/2 feet are convenient lengths—pointed at one end, and marked off from end to end with 6-inch notches, and useful aid in spacing rows. A line is kept rolled on one of the stakes (near but not too near the point) when not in use.

In any diversified vegetable or small fruit planting, a good deal of transplanting will be required for a wide variety of reasons; and transplanting in all its various versions should be a highly skilled operation. First the basic method and motions should be mastered, and then reduced to a streamlined rhythm, to gain speed and save time—for it is one of the most basic facts of life that there is no such thing as a grower who is not getting hopelessly behind in his schedule.

First there is the question as to depth of planting. There are no plants which will do better, or even survive, if set shallower than they have been growing. Most plants will do best set at exactly the same depth, strawberries being a most

demanding example. However, there are some plants which do a great deal better if set significantly deeper than they were before. This is particularly true of tomatoes, but is also true of all the cabbage family, for the simple reason that any stem set below ground level will send out roots, thus enlarging the overall root system, and more generously feeding the plant.

Every root has a growing tip, and if this is curled back in transplanting, the root is helplessly and hopelessly checked, bad enough in any case, but disastrous in the case of the tap root. A simple trick to avoid this is to drop the seedling lower in the hole than it should remain. Pulling it up to the correct level should automatically straighten out the roots. If the roots are too long to make this easily possible, it is far better to trim them to a length which will ensure straight tips in every case, even in the haste of planting a great many seedlings. When setting out a batch of strawberries or celery, for example, it should be standard practise to trim all the roots before starting.

In a climate where there are rains throughout the growing season, a cool, cloudy day—or even better, a rainy day—should always be chosen for transplanting. The soil should always be left in close contact with the roots, and in such conditions, or in any case where the soil is thoroughly wet, this can be achieved with pressure alone. In dry, sunny weather, water should be used as well, to ensure good contact.

With all plants spaced rather widely in the row, e.g., the cabbage family, peppers, eggplant, tomatoes, it is the most efficient to make a number of holes with a trowel, fill them all with water, and if necessary refill them one or more times.

Finally set in the plants, fill the holes about half way with loose soil, and settle it with more water. Then fill the holes with loose soil and leave it that way. At all times try not to leave puddled water on the surface of the soil to cake it and ruin the soil texture.

With all plants spaced closely in the row, which most often means lettuce but would include parsley, the most effective method is to make a furrow and run water down it until the soil is well watered and the bottom of the furrow is liquid mud. The furrow should be just deep enough to keep the water from bursting its banks, because the seedlings are usually quite small, and if the furrow is too deep to begin with, it will be awkward trying to set them at the right depth.

Lettuce should usually be spaced 6 inches apart. Then when it is about half grown, alternate plants can be cut out, leaving the rest to grow to full size. Push your trowel straight down in the bottom of the furrow, guided by a taut line of course, and by pressing it to one side and then to the other, open a deep, clean-sided hole. Drop the lettuce seedling in deep, and pull it up to the correct level to straighten out the roots. Fill in the hole with firm pressure from bottom to top, by pushing down your trowel about an inch from one side of the plant and pressing toward the original hole, and repeating the operation on the other side. This will leave the soil in good contact with the roots from bottom to top. The side holes and the furrow itself can then be lightly filled in, leaving the soil neatly leveled, with a loose dry surface if possible. It takes far more time to describe this operation than it should

take to perform it. With these motions correctly memorized and performed in proper rhythm, it is possible to set out a row of lettuce, or similar seedlings, in perfect condition in a surprisingly short time.

Most seedlings subjected to bare-root transplanting will wilt to some extent, but the less they are allowed to wilt, the shorter will be the transplanting set back. In dry, sunny weather they should be shielded from the sun by humped newspaper or folded cardboard. If there is time, it is best to remove the covering in late afternoon and replace it before the full heat of the morning. A day or two of shading should be enough. If they are shaded too long, they will be burned by the sun when they are finally uncovered. In any case, late afternoon is the best time to remove the covering.

Even with the best care, the plants will probably wilt during the day, but they must sharpen up by morning. Mild wilting during the day is unfortunate but not fatal, but if they are still wilted in the morning, it is a very bad sign indeed. If the plants have been properly watered and firmed when transplanted, the wilting is not caused by lack of water at the roots: the reduced root system is simply incapable of maintaining sufficient root pressure to prevent wilting. Further soaking of the soil may do more harm than good. However, the more and longer the leaf surfaces can be kept wet, the more the plant will be helped. In fact this is the very best way to avoid or reduce wilting: as long as there is water evaporating from the leaves, the strain on the root system is completely removed, and the roots have a chance to re-establish contact

with the soil and restore root pressure to normal. As soon as this has happened, but not before, growth can be resumed.

Transplanting plants from flats is a different operation in at least one way: it is no longer bare-root. The plants should be separated out by driving a trowel right to the bottom of the flat and cutting a clean line as exactly as possible in the middle between each pair of rows, first in one direction, then at right angles. This will leave each plant with the largest possible cube of undisturbed roots. Even when this has been done with the greatest skill and care, the root systems will, inevitably, be severely pruned, but there should be enough left to prevent wilting. With such plants as peppers and eggplant, all that will then be necessary is to set them out in the prepared holes, at original level—or a little lower, to prop them up and prevent flopping about. They should not even need shading, but in especially hot, dry conditions, it might be a wise precaution to give them this much needed additional help. It is always easier to prevent trouble than it is to cure it once it has been allowed to happen.

As has already been mentioned, all members of the cabbage family can advantageously be set a good deal lower than they have been growing. In all cases, all leaves which would go below ground level should be carefully pinched off, leaving a short stump on the stem. If they are left on and buried, they will decay and the decay may attack the plant stem. If they are roughly torn off, the nodes on the plant stem will be so damaged that rooting will be needlessly delayed, and the stem may even suffer spots of decay.

Tomatoes are a case by themselves. Small seedlings can, of course, be set out in the usual way, and will do well enough; but a far more sophisticated method can be applied to larger seedlings, about a foot high being about the best. They should be cut out of the flats as has just been described, and all but the top two or three leaves pinched off. Then they are set down until these top leaves are barely above the soil surface—but not straight down! It is more effective to angle the stems at a gentle slope, so that the whole available stem is below ground and in a position to take root, and yet the original root is not itself very far below the soil surface. This makes it possible for both root and stem to send out a really vast spread of feeder roots just below the soil surface—and mulching will greatly aid these roots to flourish.

If seedlings a foot high are planted in this way, it will mean that the root will be 10 inches to one side of the plant. Obviously all workers in the garden must be kept constantly aware of this fact, because there must be no messing about in that area, or the plant may be severely damaged or even killed. This essential goal can be most easily achieved by establishing a rigid convention: all plant stems always slope downhill, with the root ball always downhill from the plant. Then also, any necessary stakes can be safely driven in just above a plant.

With this method of planting, very particular care must be taken in firming in the plants, most especially in applying any pressure downward on the stem without making sure there is soil pressing upward from below to support it. If the stem is cracked or broken, it is finished for all practical purposes. It

would eventually send up shoots from below the break, but they would be so delayed as to be useless. It is by far the best to fill in the hole about half way loosely, using water to settle the soil firmly around both stem and root ball, and again filling the hole level with loose dry soil.

One last special type of plant required a special method of transplanting: leeks. This vegetable is not as well known as it deserves to be, and is seldom for sale commercially. It has a unique and delightful flavour, and as an off-season crop is particularly welcome when it is available. Dependent on climate, it is harvested in the fall, and sometimes on through winter and into early spring. It is one plant which is actually improved by transplanting, probably because its roots spring from a bulb plate and are quite different from all other vegetable root systems. There is no tap root, the root cluster looks like a dish mop.

The seeds should be planted in a seed bed about midsummer or somewhat earlier, and the seedlings set out when about 6 inches tall. The seedlings vary widely in vigour, as do also all the cabbage family, and as in all cases, it is best to have enough seedlings to permit planting only the most vigourous.

When transplanting, run a furrow as deep as possible with a hoe, run water down it, and set the plants in the bottom, 6 to 8 inches apart and somewhat deeper than they have been growing, and for once stuffing in the roots without paying any attention whatever to straightening them out. Apparently

mistreated this way, leeks will quickly send out a dense new root system.

Leeks require bleaching, hence the deep furrow, which should be filled in gradually as the plants grow, but not too soon or the soil will get into the hearts of the plants and cause trouble when the leeks are being prepared for cooking. The deeper the bleaching, the better, so it is good to keep on hilling after the trench has been filled. Leeks should be encouraged to grow quickly when they are making their main growth. They are edible at any size, but a well-developed specimen should measure 3 or more inches through the thick end.

CHAPTER SIX
CULTIVATION, WEEDING, WATERING, MULCHING

Having got our seedlings safely up, and having done all necessary transplanting for the moment, we can settle down to a relatively restful period of aftercare. Just how restful depends greatly on local conditions: some climates are so much more helpful than others. Nature does it all in the end, of course, but in some conditions she does need considerable interim assistance. Perhaps it would be more accurate to say "persuasion" rather than "assistance", for nature is quite content to support whatever type of growth is most natural for every time and place, whereas, in order to survive, we must always succeed in directing her forces into supporting some type of growth which will in turn sustain *us*.

Cultivation is one of the basic operations in this programme, and it serves so many various purposes in different conditions that it is difficult almost to the point of impossibility to outline them all. However, and most fortunately, if you can develop an adequate understanding of the basic principles involved, it should be fairly easily

possible to work out the practical necessities in individual cases, however various.

In a cool, cloudy, moist climate, where the negative forces tend to be in excess, just opening up the soil with rather deep cultivation will let the positive forces into the soil, thereby increasing their effectiveness, helping to sweeten a soil which would otherwise be too acid and tend to become increasingly so.

In a hot, dry climate, where the positive forces are in excess, the soil must be opened up more cautiously, and whenever it has been deeply loosened, it must be repacked to the right texture by running the cultivator over it until only the top inch or so is left really loose.

All plants require air at their roots as well as water. This is one of the many reasons for cultivating, and also why cultivating techniques must be adjusted to soil and climate. Soil texture cannot be more than very temporarily improved by mechanical means alone. A good, friable loam will stay open and free even when soaked. it will take up what water it can, and let the rest pass through with a minimum of disturbance. A heavy clay, on the other hand, however carefully it has been cultivated and finely worked, will immediately revert to its natural solid state the moment it is watered. The addition of sand will open up such a soil, but on any sizable scale such an undertaking would be ruinously expensive, and in the end the fertility of the soil must actually be reduced. The addition of humus, of organic matter in the right state, is the only way to bring about permanent improvement.

In some conditions, subsoiling, breaking up the subsoil to a depth of several feet without brining any of the subsoil to the surface, can bring about immediate and dramatic improvement. The special tool for accomplishing this is called, obviously enough, a subsoiler. Regular use of the mould-board plough is likely to develop an impervious started called "plough-sole". Where this has occurred, subsoiling is definitely indicated. The same result can be brought about more slowly by establishing such deep-rooted plants as alfalfa, comfrey, and sweet clover.

Because of its tendency to produce plough-sole, the mould-board plough should be outlawed. For large-scale cultivation, the disc harrow is one of the best substitutes. Its effectiveness will depend greatly, of course, on correct adjustment of the angle and depth of the blades. For smaller-scale work, there is nothing equal to the Gravely plough, a unique instrument which stores the soil without inverting it. In any soil with good tilth, it can produce a perfect seed bed without the use of any other tool.

There is a valuable discussion of cultivation, including subsoiling, in Friend Skyes's article, "Farming for Profit on a 750-Acre Farm in Wiltshire with Organic Manures as the Sole Medium of Refertilization" included in Appendix D in Sir Albert Howard's *The Soil and Health*, of which there is a soft-cover edition published by Rodale Books, Inc., Emmaus, Pennsylvania[1]. This book is altogether a rich mine of varied

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1. Also available at http://journeytoforever.org/farm_library/medtest/medtest_sykes.html

information on many types and phases of organic agriculture throughout the world. Anyone who can read it without being convinced that organic agriculture is the only sound method, must have a mind invulnerably fortified against all danger of enlightenment.

While it is important to read such books, and I know of none more nourishing than this one, there is danger of temporary indigestion. It should provide food for thought, worthy of fletcherizing for at least a twelve-month. However, the normally resulting desire to try out all the methods and techniques mentioned must be rigorously controlled. Many will be quite inappropriate for local conditions, and it is possible to realize this without the waste of actual experiment.

One of the purposes of cultivation is to control weeds, and since there are no weeds in nature's book, we are here completely on our own, but control weeds we must if we are going to give our chosen crops an adequate opportunity to provide us with our needs. In some cases weeds will constitute as good a cover crop as anything else, with the one serious fault that they are usually difficult to eliminate when we are through with them, and in no case should they be left long enough to contaminate the soil with a fresh crop of seed. Whenever they have been given a chance to seed, they should be pulled and carried carefully to the composting area, where the heat of a pile will prevent the seeds from doing any further harm.

With all cultivated crops, the ideal time to dispose of weeds is just as they emerge or very soon thereafter. At this stage, and on any sunny day, a light stirring of the soil and

a short time in the sun will kill them with a minimum of effort on the cultivator's part. If this opportunity is missed, a light and easy task can soon become a tiring and time-consuming chore.

All through the growing season the water supply must be watched and kept as nearly ideal as may be. In an equable climate very little watering may be necessary, but there are few places where it is not a great advantage to have water available to help out in dry spells. In places where there is a long rainless season, watering will be one of the most demanding tasks throughout that season. All crops will depend entirely on skillful watering. Watering just enough to keep the plants alive will produce no satisfactory crops. All through the growing season, they must be watered well before there are any signs of water stress. Allowing them to dry out too far may easily start a premature ripening off process. With some crops, such as winter squash and onions, all watering should be stopped toward the end of the season to force them to ripen thoroughly before harvesting. This must be done in good time to get the crops in before fall rains tempt them into fresh growth.

There are two general methods of applying water: by furrows or by sprinklers. Both are, of course, types of irrigation, and each has advantages in specific cases. For example, tomatoes do not like having their leaves wet, and must be watered by furrows. Most plants enjoy having their leaves wet, and sprinkling will probably be the better method whenever possible.

Sprinklers must be chosen with care. Many popular

sprinklers, especially in California, deliver the water in a violent jet which beats the life out of the soil. The best sprinklers are designed to approximate the effect of gentle rain. None achieve this goal, but the closer they come to it, obviously, the better. Water should never be applied faster than the soil can absorb it. If the water is applied too fast, the resulting surface puddling and washing can destroy soil texture for the rest of the season, and the plants in that area can be seriously stunted.

It is important to know the rate at which a sprinkler system lays down water, and how far this water will penetrate the soil. To measure the first, place a vertical-walled can (e.g. a tuna fish can) well within the spray area. The edges of the sprayed area get less water and must always be over-lapped. The depth of water in the can will be exactly the amount laid down by the sprinklers. The depth of penetration can then be measured either by digging a straight-edged hole, if there is sufficient open space between the rows; or by pushing a 1/4-inch metal rod into the soil. It should go down as far as the water has penetrated. Of course, the amount of water required to penetrate to any given depth in thoroughly dry soil and in partially saturated soil will be quite different. Since the plants should always be watered before they dry out completely, the second measurement will usually be the more important.

In any diversified planting there will be a good deal of furrow watering to be done. This will call for a number of little skills, easy to demonstrate but tricky to describe clearly. A beginner confronted with two or three furrows to

keep in balance, will be so confused he will panic; whereas an experienced waterer can keep a large number of furrows in order with apparently little effort. In fact he is likely to get bored and be tempted to take off for awhile, but this is a job which must never be left to itself for more than a few minutes at a time, or it will soon run wild and at the very least make a mess.

The ease with which the furrows can be kept in balance depends a great deal on how they are laid out in the first place. This should always be done so that once a balance has been established, nothing more than minor adjustments should be necessary.

As soon as furrow one has been established—in fact an experienced waterer can draw the furrow part way down, turn on the water, and then keep safely ahead of it with the water—as much water as the furrow can safely carry should be started down it. All flooding and spreading of water over the surface should be avoided, because it can have disastrous effects on soil structure. It is important to get the water to the bottom of the row as quickly as possible so the whole row can be evenly watered. When the water is near enough to the end of the row so there is enough water in the furrow to carry it the rest of the way, most of the water should be drawn off into furrow two, and the process repeated. In this way all the necessary rows can be established in regular succession.

As soon as a row has been wet to the bottom, it should be adjusted until the water just reaches the bottom. As long as there is any water in the furrow, the soil is taking up water

as fast as it can. Any more will not hasten the process, and can only run out at the bottom of the furrow and be wasted, probably also making a mess as it goes.

As many furrows can be run from the water source as there is enough water to reach the bottom of the furrows. With later furrows there may not be enough water to do this and still fill the latest furrow. In this case there is no harm in turning off some or all of the lower furrows until the latest furrow has been wet to the bottom.

It will be noticed that all the furrows after the first one are drawn off against the current, rather than straight into it. This is done to slow down erosion at the mouth of the furrow. It is such erosion that causes the furrows to get out of balance, and the more it can be reduced, the less adjustment will be needed. Pushing a pebble or chip of wood into the point where the current hits the mouth of the furrow will help to cut down wear. When all the furrows have been established, they should be kept adjusted so that the water just reaches the bottom in all of them. If a furrow needs a little more water, it requires only the lightest touch with the edge of a hoe to make the necessary difference. Beginners nearly always tend to overdo and have difficulty learning how delicate a touch is necessary. It usually takes a good deal of fiddling to undo an overadjustment.

With all watering it is essential to make a habit of thorough watering, if possible down below the roots of the crop, to keep them advancing deeper and deeper. This holds for orchard trees as well, where it may be necessary to water for

several days at a time to gain sufficient depth—but in this case, one thorough watering a month should be adequate. When furrow watering, it may take some keen observation to judge correctly the necessary length of watering.

For one thing, it is necessary to realize that water does not move through the soil by gravity. It exists in a gravitational field, and therefore gravity must have some effect, but except in the case of a very open sandy soil, this effect is not noticeable. In most cases the controlling force is capillary attraction, and in all soils with good tilth the water will move about equally to the sides and downwards. Water moves so slowly and with such difficulty in clay because the soil is too tight to allow capillaries to form. This is why there is no such thing as drainage in clay, only runoff, which certainly disposes of the excess water, usually at the cost of erosion, and with none of the beneficial effects of true drainage, which is movement of water down through the soil.

In all climates where watering is a major task, methods of conserving water are a corollary necessity; and of these, mulching is by far the most important.

Especially in large-scale operations, the dust mulch is the most common method of mulching. If the top inch or two of soil is kept loose and fine, this "mulch" is effective in delaying (but not stopping, of course) the escape of water into the air. If the capillaries are allowed to reach the surface, the soil will look beautifully moist after watering, but this only means that the water is escaping into the air at a maximum rate. Maintaining a dust mulch means cultivating after every

watering and leaving not even a footprint on the surface. In a few minutes the surface will look dry and barren, but the practical effect is quite the opposite.

Whenever and wherever they are available, such materials as shavings, sawdust, and straw can be used even more effectively, and with a great saving of time in cultivation. The depth of the mulch will depend on the nature of the crop and of the material. Naturally the deeper the mulch, the more effective it will be. It will be especially effective if it can be deep enough to prevent weed germination. In any case, weeds which do manage to push through the mulch can easily be pulled.

Mulching has two other purposes besides water conservation. Probably the most important of all is damping the action of the expositive forces, and slowing the rate at which the organic matter in the soil is being exhausted. Clean cultivation and a dust mulch are equivalent to opening to its full extent the draught on a furnace, and letting it go full blast. This is turn means a maximum demand for replenishment of the organic matter in the soil.

Mulching also alter soil temperature, raising it somewhat in winter and lowering it in summer. One must have all these effects in mind when deciding where to mulch, when to mulch, and what time to apply mulch. Take the case of tomatoes for instance: Tomatoes will not begin to set fruit until the minimum night temperature reaches a certain level, varying somewhat with different varieties. If soil temperature is lowered it will, therefore, delay fruit set. Hence tomatoes

should not be mulched until the first fruit cluster is safely set. After that, mulching will benefit them greatly.

Since running winter squash vines cover a large area, the ridges (hills, if prepared by hand, ridges, if by tractor) should be spaced 12 feet apart, with a really deep mulch, if at all possible, covering the space between—at least 6 inches of sawdust or similar material. This will smother most weeds and keep the fruits clean and off the ground. The ridges will have to be furrow watered, so it is essential to establish deep, clean furrows on both sides of each ridge before the vines begin to run. Obviously it will be impossible to run or clear cut furrows once the vines have crossed into the centre space.

If orchard trees are in danger of late frosts when in bloom, the time of bloom can be delayed somewhat by applying a deep mulch in the fall—always keeping the mulch at least 6 inches clear of the trunk to discourage mice from gnawing at the bark.

In climates such as this North California desert, subject to winter deluges, the soil must be protected from erosion. There are two ways to do this. In areas set aside for late plantings, such as tomatoes or squash, a cover crop of barley, planted early enough to be well-rooted before the rains begin, will hold the soil and can be turned under in spring in plenty of time to prepare the land for planting. Areas required for early spring planting should be prepared in the fall and covered with an inch or so of sawdust. This should prevent washing, and can be raked off for planting long before the land is dry enough to work properly.

An outstanding example of how one gardening technique can be pushed to extremes in special conditions was provided by Ruth Stout, who reduced almost the whole of gardening activity to a matter of mulching. She kept her garden under a really deep mulch of hay the year around, simply pulling the mulch aside and dropping in seeds as required. As the mulch broke down and gradually disappeared into the ground, she simply added more hay on top. Her garden flourished for years with no other fertilizer, and produced an abundance of delicious and wholesome vegetables in wide variety.

But the most remarkable thing was that in a neighbourhood where there were long summer droughts and gardens normally would not survive without extensive watering, she did no watering at all because she had no water available, and yet her garden flourished and continued in full production throughout the summer.

One is reminded of a terminal forest which will stand in robust health for centuries with no other fertilizing than its own wastes, and gradually build up a reserve of humus over its roots from this source alone. But there is the essential difference that Ruth Stout's garden could never have survived on its own wastes, but only with the help of a generous and constant importation of hay. This suggests the two basic limitations of her method.

In the first place, no farmer could make a living by employing it. This is itself is not a general criticism, because there are a number of things one can do on a kitchen garden scale which cannot be applied on a farm scale. However, far

more seriously, if all kitchen gardeners tried to follow her advice, the supply of hay would soon run out.

It may seem strange to complain of an inefficient use of organic matter at a time when almost the whole available supply is being recklessly thrown away, but nevertheless it is a valid and necessary complaint. The time has come when all available organic matter must not only be used, but used efficiently.

All this discussion of dates calls to mind the important of keeping a garden diary. As planting dates, harvesting dates, success or failure of crops, additives used in soil preparation, details of pests and controls used, late frosts, early frosts, storms and rainfall, are recorded year by year, the accumulation of local information becomes more and more valuable.

CHAPTER SEVEN: ORCHARDS: PLANTING, PRUNING, CARE

An orchard should form part of any well-designed homestead wherever local conditions make it possible, and such a non-commercial planting should be as varied as climate permits. It is best to visit the nursery personally, and select with all possible care the best specimens among the group offered in each variety. Look for trees with the best spacing of the future scaffold limbs, and pay particular attention to the graft scars. Badly neglected graft scars are common, and can easily result in a diseased tree from the very beginning. With all the deciduous fruits, budding appears to be the standard type of grafting, and it is when the surviving top of the rootstock is cut out that the trouble begins. A stump is left which cannot possibly heal. This should be carefully pared flush with the trunk so that the surrounding bark can grow over it. The wound should then be coated with tree seal to keep out spores until the wound can heal and protect itself.

The grower's goal should be a healthy, long-lived planting, which will survive and continue producing indefinitely. Therefore, he should not allow any of his methods to be influenced by the greedy impatience which has become characteristic of commercial practises. When longevity is

the purpose in view, the basic planting must be of standard trees, and the only legitimate use of the increasingly popular dwarf trees would be as temporary inter-plantings before the standard trees reach maturity. Used thus, the dwarfs can more than pay for themselves, with their welcome earlier yield, and without prejudicing the long life of the ultimate orchard.

It is common practise to dig a large hole at planting time, and fill it with biological dynamite to give the tree a quick start. To that extent the trick certainly works, but when he tree's roots hit the edge of the hole and are suddenly confronted by the true local conditions with which it must cope for the rest of its life, it becomes quite disoriented by the sudden check, developes gumosis and/or related ills, and may even die. As Dr. Pfeiffer says, it is far better to make the hole just big enough to accommodate the roots of the young tree, put back the soil in its original state, and force the tree to face normal local conditions from the start. It will grow more slowly at first, but with a healthy, balanced growth.

Of course, if really good soil is available for the orchard planting, most of these grim warnings will not apply. Failing that, it would be ideal to devote several years to improving the soil before planting. In these days of crisis, however, it must seldom seem wise to exercise such patience. Fortunately it is possible to give the trees an early start in whatever the existing conditions may be, and then improve the soil more gradually as the trees grow. This is best done by keeping a generous layer of compost around the trees at all times, always protected from sun and air by a mulch of sawdust or similar materials. Especially when the soil is treated in this way, a dense layer of

feeder roots will develop at or near the surface. Consequently any attempt to cultivate would do more harm than good, and working the compost down into the soil must be left to the worms. These conditions should attract and support a generous worm population. It is wise to keep checking to see whether this is happening, and if not, to do whatever may be necessary to make it happen. In most places it will happen quite normally and easily, but there are places where it will be necessary to release worms under the trees. As long as the soil is treated consistently as described, they should establish themselves and flourish indefinitely.

Now to complete the planting: The tree should be set at the level it has been growing, in which case the graft scar will be several inches above ground. Shape the bottom of the hole to permit a natural spreading of the roots. Before setting the tree, trim off all bruised or broken roots. Spread out the roots, making certain all the tips are straight, and begin working soil among them, and firming it down. (The roots of trees must be more firmly packed than those of herbaceous transplants.) The trunk must be kept steadily at the right level and consistently vertical while the hole is being filled, or it will not be firmly established in the right position when the job is finished. Several times during the filling, water should be used to complete the settling.

Since the root system has inevitably been severely reduced, the top must be pruned to restore at least approximate balance. If this is not done, the tree will begin dying back to accomplish the same purpose, and will usually carry the process too far—or even to completion, and die. This pruning may be

done either when the roots are trimmed or after the tree is in place. As far as possible the tree should be carefully pruned, with the eventual growth and shape of the tree in mind, and not just chopped about as one would clip a hedge.

In a well-run orchard an annual pruning, preferably in late winter, should be a regular chore. In the first few years, this is especially important toward establishing a well-formed and productive orchard, but the operation must be based on sound principles. An unpruned tree will bear earlier and bear more than a pruned tree, so there must be good reasons for whatever pruning is done, and there is never any virtue in over-pruning. The first reason for pruning is to establish a sturdy, well-balanced form which can bear heavily without breaking or splitting. A set of scaffold limbs, well spaced around the trunk, with wide-angled crotches, must be selected and encouraged. One must always work with the ideal shape in mind, but all trees will not necessarily oblige with branches at the ideal points, and in practise various compromises will have to be accepted. With all varieties of a strong upward growth, the first limbs can be set low, no more than a foot above the ground. This applies particularly to pears, sweet cherries, and most plums. Pears and sweet cherries require a minimum of pruning. In varieties with drooping limbs—prunes, many apples, sour cherries—the lowest limbs must be set higher to keep them off the ground. This downward tendency can be counteracted to some extent by subsequent pruning, but loads of fruit will largely thwart these efforts. Some propping will probably have to be accepted as normal, but a well-pruned orchard should require a minimum.

There will be cases where, for want of other choices, it will be necessary to accept a branch with an acute-angled crotch. Such crotches are always weak, and under load will inevitably split and ruin the tree if they are not securely braced. Fortunately this can be effectively done. There is no hurry and it is better to wait until it can be done correctly once and for all. Put two small screw eyes facing each other in trunk and limb, as far above the crotch as possible. Screw them in right down to the head. Then tie them together by threading a small-gauge rustproof wire back and forth between them, under tension. The limbs will grow off the screw eyes until they disappear completely, yet this will do the tree little harm. It is important to use only high quality wire. Any wire which rusts easily will soon break, and if this happens after the screw eyes have disappeared, the whole operation will have to be repeated.

The second purpose of pruning is to keep the tree opened up so that light and air can penetrate throughout the tree, and fruit on the inner parts can develop and colour normally. This will also counteract the tendency to overload, and reduce, but not remove, the necessity for thinning.

After any heavy fruit set, thinning will almost certainly be necessary—this applies particularly to apples, and with apples it should be delayed until after the so-called "June drop". Some time after pollination, when the fruits are already the size of a small cherry, the stems of some will turn yellow, and these fruits will fall. Thinning before this happens will result in over-thinning.

Thinning intelligently requires an understanding of the

principles involved. Suppose we are confronted with a tree capable of developing a hundred pounds of fruit. Obviously the more fruits share in this growth, the smaller they will be. The purpose of the tree is to grow seed. Every fruit will have a core, and every core will contain seed. Even if the fruits are so numerous that they contain little else, the purpose of the tree will be well fulfilled. However, such fruits will be of little use to us—even to the rugged type of character who eats "core and all". At the other extreme, limits are set by the characteristics of each variety of apple. A Jonathan, for example, is by nature a small apple, and will not grow large even if there are only two or three on the tree. To over-thin such a tree would result in the loss of potentially fully-developed fruit. A hundred-pound tree could support and bring to maximum size something like 600 apples. Now no one would suggest, least of all me, that you should begin by counting the fruits on the tree. The way to go about it is to decide how many well-developed fruits a foot of limb should be able to support: two, four, six? The better you know your trees and the more familiar you are with the characteristics of your varieties, the more accurately you can learn to form this judgment.

It would be difficult to go into further subtleties of pruning without the trees on which to demonstrate, but perhaps some of the most important principles and skills can be described clearly enough to be understandable.

All trees, in order to grow consistently and live long, must have leaders. This simply means that in every tree, whatever growth is functioning as the main trunk must be kept higher than all other parts of the tree. This may require cutting

competing growth back to some extent. The difference in height need not be great, but it must be maintained.

The commonest and most destructive beginner's mistake in cutting out branches is to leave stumps. A tree's only method of healing a wound is to grow the surrounding bark out over it until it is again sealed and protected by a covering of bark. When a stump is left, it becomes a dead end—no sap goes into it. The wood dies. The surrounding bark cannot climb over it, and the stump becomes a permanent wound, perennially open to infection.

In order to make clean cuts, flush with the trunk or limb, the cutting blade of the pruning shears (secateurs) must be against the trunk. In order to have the shears always in the correct position, it is necessary always to work clockwise around a tree. When attempting to cut through thicker growths, the temptation is to twist the shears from side to side. This will wrench the blades apart, soon ruining the shears. If the branch to be cut off is gripped firmly in the left hand and pressed steadily away from the direction of the cut, good shears will go easily and safely through a growth at least an inch thick.

A saw will have to be used for larger cuts. Start with a cut upwards from below, flush with the trunk, and then come down to meet it from above as accurately as possible. The disadvantage of even the best saws is that they rough up the bark around the wound, however carefully they are used. It is best to trim this lacerated bark carefully toward the wound with a sharp knife. At least all these larger wounds should then be coated immediately with treeseal.

In many, probably most places, small fruits (strawberries,

raspberries, gooseberries, blackberries in many varieties, white, red, and black currants, and grapes) will be a welcome addition to a mixed planting, if time is available to take proper care of them: they take constant care if they are to be successful, or to lapse into current jargon, they are extremely "labor intensive"! However, there is not much to be gained from discussing them in detail here. Apart from the obvious necessity of substituting compost and organically harmless insecticides for chemical fertilizers and pesticides, methods of planting and care should be those locally successful, and are best learned locally from nurserymen or neighbours.

CHAPTER EIGHT
PESTS AND PEST CONTROL

Somewhere recently I read an article on organic farming, and now when I want to quote from it I find myself unable to trace it. Anyhow, it spoke of a general belief in a golden age in the recent past when there were few pests, and everything grew healthily and easily with little need for pesticides. It then went on to insist that this was pure myth.

I would not dare to contradict this as flatly as I am about to if I had not myself lived in that golden age. When my father retired, he bought seven acres of fruit land in the Okanagan Valley in British Columbia. I was then eight or nine years old, and it was there and then that I began my serious gardening. That experience spoiled me for gardening anywhere else in the world.

We had rich virgin soil which would support lush crops with no fertilizers of any kind—although, of course, that could not have gone on forever, and my father being a good farmer, immediately began returning all possible organic matter to the soil. There were few pests, no codling moth, and hence no apple worms. The orchard got one dormant spray to dispose of any insects and eggs which might be overwintering in the bark. As far as I can remember, that was just about all the spraying

that was done. Thinking back, I have been trying to remember any occasion when there was a serious multiplication of a pest, but have not been able to recall a single case. Of course, there were sometimes aphids among the vegetables, but the damage was never more than negligible. We probably used a squirt of Blackleaf 40 now and then—nothing compared with what normally goes on these days.

I got into trouble myself with root diseases among sweet peas, which were my specialty. I discovered that this resulted from growing the sweet peas in the same soil for several successive years, when the infestation in the soil accumulated from year to year until it became too much for the sweet peas. As soon as I gave up this misguided practise, the trouble disappeared—an early example for me of the dangers of a persistent monoculture and the importance of systematic crop rotation.

We grew, beyond any doubt, the finest apples in the world, one perfect apple after another, with excellent texture and marvelous flavour. In the small mixed orchard planted for our own use, we had sweet and sour cherries, pears, peaches, apricots, plums, white, red, and black currants, red and yellow raspberries, strawberries and everbearing strawberries (I can remember brushing six inches of snow off the plants to pick the last of the berries) all loaded year after year with the finest fruit imaginable. The vegetable garden was equally varied and generous. It certainly was a golden age, and no myth either!

If natural methods, organic methods, were restored to agriculture, nature would heal herself in a fairly short time—although the actual time required would vary widely

with differing local conditions: in a desert climate such as exists throughout most of California, healing would take longer than in gentler climates. There would remain few opportunities for enjoying the natural fertility of vermin soils, and in most cases the soil would have to be rejuvenated by the various methods already discussed. But in general, conditions could refer to, or nearly to, the ideal state in the "golden age". Pests and plant diseases would resume their minor role in the overall scheme of things, and the need for pesticides would be greatly reduced, and should cease to be a major problem.

In these days, this does not happen for the individual organic grower, for he is normally surrounded by the pollution attendant on chemical commercial farming. His planting will constantly be invaded by pests resulting from the misguided methods of his neighbours, and he will have to give battle almost as relentlessly as they are forced to do. However, his weapons must be consistently different, and he can enlist the aid of the pests' natural enemies, which can be a great help indeed, one which the chemical farmer has willfully denied himself. For it is one of the great evils of the violent pesticides of today, that they kill off the pests' enemies along with the pests. Having once achieved this heroic end, the grower is left entirely on his own and can look for no further help from nature. He faces a future of more and more spraying, usually with a succession of new and ever more violent pesticides.

The organic grower, on the other hand, can protect and encourage the predators provided by nature to pasture on his pests. He can even import a wide variety of pest enemies: praying mantises, ladybugs, trichogramma wasps,

lacewings—all of which are commercially available with full instructions for effective release.

Then there are various preventive measures. Organic farming is derisively referred to as "trash farming", and indeed in many cases it is unwise to be too tidy, but in the orchard all leftover fruit, whether clinging to the tree in a desiccated state as it sometimes does, or lying on the ground, should be collected and taken to the compost pile. Otherwise it will provide shelter for both diseases and pests to overwinter.

Where electricity is available, a dark-light insect trap, hung in a strategic spot, will attract and dispose of all night-flying insects for several acres around. As it happens, all night-flying insects are the parents of destructive progeny. As a spectacular example, several times during the growing season, when there is an emergence of the hawk moths which are the parents of tomato horn worms, the trap will be filled for several nights in a row with hordes of hawk moths, thus taking out of circulation large numbers of potential eggs.

Seedlings, especially in flats or cold frames, are subject to damping off, which can be a serious problem. This is a fungus disease which attacks the seedlings at ground level, weakening the stem so that the plant falls over. When the disease strikes, whole flats of seedlings can topple over within a few minutes, and when that has happened, the plants are beyond help. Wet conditions encourage the disease, so the surface of the soil should be kept as dry as possible, and air should be kept moving. Watering should be done early in the day.

Sphagnum moss contains a natural fungicide and is a helpful preventive. Milled sphagnum is the easiest form to

use, but may be difficult to find, and can be quite expensive. The coarse moss can be refined by rubbing between the hands, but this is a tedious process for any considerable quantity. As soon as the seeds are planted, they should be covered with the moss rather than soil, and a layer of sphagnum spread over the whole surface of the soil. With careful watering and ventilation, this precaution should go a good way toward preventing damping off.

It takes courage to face up to these brave fellows armed to the eyebrows with the big artillery and put forward pure water as an effective insecticide, but it must be done, for in the right conditions that is exactly what it can be. With water under good pressure an accurately controlled by a high-quality nozzle, there is nothing more effective that knocking the aphids off cabbages or other members of the cabbage family, or wiping out a red spider infestation with plain water. Care must be taken, of course, not to use any more force than necessary, or the plants themselves will be badly knocked about.

A number of plant extracts have proved their effectiveness over a long period of time. Blackleaf 40 is the trade name for a company supplying nicotine sulphate, effective against aphids, root aphids, cabbage worms, and similar pests. Blackleaf 40 is very concentrated as purchased. Formulas for dilution are given on the container and should be carefully followed. Blackleaf 40 can burn plants if too strong. It is far better to try first a solution on the weak side, followed by a stronger if the first doesn't work. Root aphids are most likely to appear on carrots, and can seriously reduce the crop. There is also a vegetable weevil which can do a lot of damage in a carrot bed.

In both cases soaking the soil around the plants with Blackleaf 40 will dispose of the pests. Obviously the only way to discover an infestation of root aphids is to pull a carrot here and there for inspection.

Blackleaf 40 is most effective when used in a strong soap (not detergent) solution as a spreader. It is important to make certain the soap is completely dissolved. Otherwise the undissolved particles will clog the sprayer. It is best to dissolve the soap in some really hot water and dilute with cold water. A piece of cloth in the funnel as a strainer when pouring into the sprayer is a worthwhile added precaution. Such solutions should be mixed as needed, and not left in the sprayer for any length of time.

There is a dust, 1% Roteneone, commonly available, which is effective in a number of cases, perhaps most effective against thrips. These insects are so small they are barely visible to the naked eye. They hide in the heart of a plant, typically and most disastrously onions, sometimes also lettuce. They rasp the youngest leaves as they emerge and suck their juices. The thrips stay down in the heart of the plant, but as the leaves mature they will be covered with surface scars which signal the presence of the thrips. Immediate action is called for, or the onion crop may be completely ruined. Obviously it is essential to dust straight down into the centre of the plant: there is only a small area where the dust will have any effect.

Tri-excel is a trade name for a combination of three plant extracts: roteneone, ryana, and pyrethrum. Obviously there must be advantages to having three pesticides on the job at

once. Unfortunately it is not widely stocked, but should be obtainable with reasonable effort.

Dipel is one of the trade names for a culture of bacillus thuringiensis—there are other essentially equivalent. This bacillus fatally upsets the digestive systems of a wide range of soft-bodied larvae with most gratifying results—for the gardener that is. The containers carry full instructions for application.

Diatomaceous earth is the one insecticide which acts mechanically rather than chemically. It must be prepared for this purpose, as supplied by Perma-Guard: the form used with swimming pools would probably be useless. The plain dust is not very effective unless it is applied through a duster with a special electrical attachment which charges the dust with static electricity as it leaves the spout. (This duster should be obtained through Perma-Guard.) This makes the dust actually seek out the leaves and cling to them. There is no need to load the plants down with the dust. A thin layer on both upper and under surfaces, just enough to make the leaves look a little dull, is all that is necessary. The dust is composed of sharp crystals which puncture soft-skinned larvae exposed to them, and gradually let their juices leak out. The effects take some time to appear, which is why farmers accustomed to the instant action of chemical pesticides are not much impressed with this method; but it is nevertheless sure and inevitable: the unfortunate larvae soon lose all interest in life, and are eventually reduced to empty hides clinging to their host.

The dust is so effective as a repellent that plants kept consistently dusted are unlikely to be visited by any pests at all.

If sprinklers are used, the plants will have to be redacted after each watering—a small chore. Since tomatoes should not have their foliage wet, keeping them dusted is a matter of dusting the new growth as the plants develop, except, of course, in climates where there are summer rains. One of the most important uses of diatomaceous earth is as a defense against tomato horn worms, which can quickly wipe out a planting if allowed to get established.

Perma-Guard supply diatomaceous earth with various additives for specific purposes, e.g., for dusting pets against fleas. These are effective but are, naturally, more expensive. Also, the plant extracts will lose their strength with time. The plain dust will keep indefinitely, but must be kept dry or it will clog the duster.

A light oil spray, used as a dormant spray on deciduous trees during the winter, will suffocate insects and eggs overwintering in bark crevices. The traditional name is Volck oil, and it is widely available, most commonly with violent and quite unnecessary pollutants added. It is also available, although less widely stocked, without the additive, but with stern instructions to add them. It is essential to read the small print to make sure of getting the plain oil.

This spray can also be used on evergreen trees, and is very effective against scale on such trees as citrus fruits. It is used at half strength, and one must be careful to cover the tree only once. Successive applications would build up to the dormant strength, with the risk of suffocating the foliage as well as the pests.

If general conditions reach anything near a crisis

stage, they will precipitate problems in this as in all other departments. Many or all of these products will no longer be available. Many will not keep very long; but three, Blackleaf 40, diatomaceous earth, and Volck oil, will keep indefinitely, and it would be worthwhile stockpiling them. At best this would be but a temporary solution, but it would at least provide a breathing spell for seeking other means of coping.

CHAPTER NINE
HARVESTING, STORAGE, AND GIBLETS

Down through the ages country communities have celebrated the joyful harvest season with appropriate rites to thank mother nature for her bounty. There isn't much of that spirit left in modern commercial circles. Perhaps the organic grower, living again closer to nature, will revive something of the old spirit.

(Spring fertility rites were a significantly different matter: supplication for good growing conditions and good crops. There were also attempts at bribery with sacrifices which could take a very cruel turn.)

With a mixed planting comprising a wide variety of vegetables and small fruits, harvesting will go on more or less throughout the whole growing season. Really efficient harvesting will depend on a myriad of small skills, if the maximum benefit is to be derived from each crop. Methods will vary somewhat with the size of the planting. In a family backyard garden, the cook can run out and collect just what is needed for each meal—even observing the old rule to have the water boiling before picking the corn. With a larger planting, the methods will have to be more formal, and carefully adapted to whatever system is used to get the harvest to the

users. The most alert attention and greatest care will be needed with short season crops which come on quickly and go past equally quickly.

A planting of sweet corn will be at its best for only a few days. A practiced harvester can tell which cobs are ready to pluck simply by wrapping a hand around the husk and feeling through it. Usually it is best to peel off most of the husk and leave it in the field. This is not so important if all kitchen waste is dependably returned to the compost pile, but a considerable amount of much-needed organic matter can easily go astray, and it is best to allow for the irregularities of human behavior.

Especially in hot weather, lettuce will come on very quickly and from then on there is danger of bolting at any time. Once it has begun to bolt, a lettuce head isn't much use. Being careful to cut the maturest heads at each picking will reduce waste.

Peas are without doubt the most difficult crop to harvest correctly. In fact the most experienced and conscientious picker can hardly hope to achieve a perfect score. Nevertheless there is a vast difference between this near-perfect score and the devastation caused by a picker who merely tears pods off the vines and hopes for the best. Peas should be picked when the pods are well filled out, but before the peas have begun to turn starchy. With some varieties of peas, the pods grow to full size and width, and then the peas fill them out. This type of growth is the most difficult to judge, particularly since it isn't good to pinch to pods to find out. If a pod is given a firm pinch, found hollow, and left to fill out, the next time around

it will be badly bruised, even too bruised to be worth picking. The pods which fill out as they grow are far easier to judge.

It is important to pick all the pods which are ready at each picking. Again perfection is almost impossible, but any pods which are missed will be old and woody by the next picking. Fortunately the pods ripen consistently up the vines, so there will be a definite level at which most of each picking will take place. Pods are often missed because they lurk behind the foliage, and it is a good trick to look backward along the row to foil this maneuver. This is especially important with sugar peas.

It is important, especially in the early pickings, to handle the plants as little and as gently as possible. If they are roughly knocked about, they will soon stop growing, considerably reducing the total crop.

There are two ways to pull the pods. The easiest and quickest, and therefore the best, requires both hands. If a carton is pulled along the row and kept constantly within easy reach, both hands will be left free. Then the stem where it leaves the plant is held firmly by the left hand while the pod is pulled away from it with the right. The same effect can be achieved by gripping the stem with thumb and first finger and pulling the pod away from it with the rest of the fingers pressed against the palm. If the pods are simply yanked off without some such protective action, the plants will be hopelessly damaged.

It takes most beginners some time to learn the trick of correct, efficient, and yet quick harvesting—but all these operations must inevitably be carried out against the pressure

of time. It really costs no more energy to move the hands rapidly, especially in the longer movements, than it does to indulge in the graceful arabesques which seem to appeal to most beginners.

Picking green beans is closest to picking peas, with the same requirements, but far easier to carry out. It is first necessary to learn at what stage the pods are at their best: well developed but before they begin to toughen, and not showing much bean. To pick them too soon is pure waste. With some varieties of pole bean, which set in large clusters, care is necessary in pulling the lower pods not to come away with the whole cluster. The aim should be to have the whole picking of pods as near the same stage of development as possible, so that they will cook in the same time. It is also important to pick the plants clean. In many cases this will keep them bearing longer.

Zucchini is a crop which must be harvested every day or every other day. They are usually at their best two days after blooming. They will, of course, grow on until they are enormous, but are very inferior past the early stage. The plants must be kept picked clean, even if larger ones which have been missed are left lying in the row or taken off to the compost pile. Otherwise the plants are likely to stop bearing. They must be harvested with the stems on, or they will not keep. The easiest way is to cut them with a knife, but if there is any danger of virus, the knife will soon have the whole row infected. Hence the safest way is to grip the stem firmly at about half way and twist the fruit off. The fruits bruise very easily, and if they are not handled with great care, they will look terrible by the time they reach the cook. Yellow squash require the same treatment.

Tomatoes must be picked regularly and frequently throughout the season. They should be picked before they are fully ripe, or they will go past very quickly. If they are to be kept for any length of time, they should be rolled off with one joint of the stem left on the fruit. In this state they easily punch holes in each other, and must be handled and packed carefully. The safest way is to lay one layer of stems down in a lug, and put one layer stems up on top. If they are for almost immediate consumption, there is no harm in picking them without stems, in which case they can be packed with less care.

Strawberries are another crop which must be picked regularly and often throughout the season. They should be picked while still firm and, of course, with the hulls on, which nearly always means also with the stems. Like the tomatoes, they must be put in the baskets carefully, so they won't puncture each other.

With root crops like carrots, beets, and parsnips, there is no critical moment for harvesting. In many climates they can be stored in the soil until needed. In fact parsnips do not develop their best flavour until they have been frozen. In most cases a deep mulch over carrots will keep the ground unfrozen so they can be easily dug. They are more likely to rot from poor drainage and too much water than from the cold.

All winter squash should be harvested as late as possible, although they must not be caught in a heavy frost. Ideally the vines should be drying down before they are cut, and where they have been depending entirely on irrigation, all watering should be stopped a month before harvesting to make sure of this. In all cases, the more thoroughly they are ripened, the

better they will keep. Toward the same end, they must be harvested with the stems on. When collected, they must be handled gently, for any bruises are likely to initiate decay. The stems make unreliable handles.

Storage is the next equally important, and equally exacting stage in the process. This is one place where experienced neighbours would be the most reliable source of advice, because storage techniques must be so carefully tuned to local conditions. In a mild climate most crops can be stored right in the field. Of course, in a really mild climate, growth, and even planting, will go on throughout the season, and there will be much less that can even be called storage—a very fortunate state of affairs. In a severe climate there will be little, if anything, which can be left in the field, and storage facilities must be arranged for the whole winter food supply. Under such conditions storage is indeed critical.

Root crops are typically stored in a root cellar. In mild conditions any surface building can be adapted for storage, but underground, temperature fluctuations will be less, and therefore a cellar will be more reliable. A well-designed basement under the house can be subdivided to perform all the storage functions.

Traditionally potatoes have been stored in sacks, especially when they were still made of jute. Potatoes will keep fairly well that way, but will keep with much less shriveling and general loss if stored in boxes or bins, packed in slightly damp sawdust or sand, whichever is the more readily available. This packing should be changed each season, or if that is not possible, at

least spread out in the sun to kill disease spores before being used again. Potatoes must be protected from all frost.

All the root crops, carrots, beets, etc., can be stored in the same way, and can be some degrees cooler than potatoes. Parsnips, as the one exception, can be left in the ground through almost any winter. In really severe winters, where the ground is frozen hard for long periods, they may be unavailable until a thaw sets in. A deep mulch can be used to keep the soil from freezing hard, so that the roots can be dug as needed.

In mild winters cabbages are best left in the field. Savoys are not only the best quality, but will stand more frost. In colder weather cabbages can be stored indoors, but not very reliably. One method is to pull the whole plant and hang it head down in the root cellar.

So far all the store suggested has been moist, but there is an important group of crops which must be stored dry. One good way to accommodate both is a root cellar with a story above ground, which may be no more than an attic, but well enough insulated to be kept dry with an even temperature. The available space can provide the maximum storage if it is filled with a carefully designed set of shelves, against the walls and throughout the centre, spaced just far enough apart to accept a single layer of the vegetables or fruits to be stored.

Winter squash is likely to be the largest and most important item in this class. The squash should be spread on newspaper (or straw, or sawdust) and carefully kept from touching each other. Each variety has its normal keeping span,

and of course, they should be taken from shortest through to longest, which will be a hard-shelled variety like Gold Nugget.

However, all varieties are subject to sudden decay, and the store should be inspected frequently throughout the winter—quite easily done when removing squash for use. Decay usually begins with a small spot at a scar or bruise. If discovered at this stage, the squash can be used with almost no loss. If left for only a few days, it will be reduced to a sodden mass, and any squash touching it will be be gone as well.

In all storage there is inevitable loss and shrinkage, and all that can be done is to keep this to a minimum by preventing individual items from infecting each other. For the same reason, before the next storage season, the material on which is crop is spread should be removed and replaced by fresh.

Dryness is the necessary condition for onions and garlic. They should be hung in net bags, or with the tops braided Italian fashion. Many of the finest onion varieties are not keepers, but are worth growing for their own season. Long keepers are typically small and very firm.

Apples are likely to be the main fruit stored for any length of time, but if they are to be kept from ripening too quickly, they must be held near 32°F. They can be stored in boxes, even individually wrapped, but rotting can be controlled better if they can be spread out in the same way as the squashes. If at all possible they should be kept by themselves to prevent the gas they give off from affecting crops stored around them. Under ideal conditions long-keeping varieties like Yellow Newtons can be help in good shape until June of the following year. In

fact Yellow Newtons will then not ripen until spring, or even late spring.

Several books have been recommended in passing, all well worth careful attention, but there is one book which must not be missed on any account. It is unique, an account of a completely new principle, as revolutionary as Sir Isaac Newton's law of universal gravity. The book, published by Swan House Publishing Co., P.O. Box 170, Brooklyn, New York 11223, is called *Biological Transmutations*. It is a compilation by Michel Abehsera of the publications issued in French over a considerable period of time by Louis Kervran. It proves beyond any doubt, in my estimation, that living tissue, plant or animal, can and does transmute elements at normal temperatures and with small expenditure of energy. It deals in such equations as N2-CO, and proves, for example, that broken bones will heal faster on a diet high in Silicon rather than Calcium, since the body would rather create its own Calcium from Silicon.

Now with a very earnest hope that enough people will be converted quickly enough to organic methods to avert the otherwise inevitable catastrophe, I must admit I have shot my bolt—and sign off.

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NOTES