EXCERPTS FROM THE FORTHCOMING BOOK
BIO-DYNAMIC AGRICULTURE

Introductory Remarks

From the outset, bio-dynamic growers have endeavored to grow feed and food that has a high nutritional value; in this respect, much experience has been gathered by farmers and gardeners. Thanks to the work that has been accomplished by our research institutions in Europe, we have considerably increased our understanding of what constitutes quality and of how to test for quality. An account of the work done so far is presented in the book Biologische Landwirtschaft (*Stuttgart,* 1974), *by Koepf, Pettersson and Schaumann. The following excerpts are from a forthcoming English edition of this book, to be published under the title* Bio-dynamic Agriculture.

We have included some pages from the chapter on quality, which also touches on such topics as: quality and environmental factors; terrestrial and cosmic growth factors; the interaction of different environmental factors; testing methods employed in bio-dynamic research; and the determination and classification of quality. Also included are the regulations for marketing and the organization that has been set up. This section is meant to give one example of how the task can be tackled, bearing in mind that although we can agree about principles, the bio-dynamic movement in every country must always meet the specific situation.

H. H. K.

RESEARCH ON QUALITY

H. H. Koepf, Bo D. Pettersson, and W. Schaumann

Earthly and Cosmic Growth Factors in Food Production

In the Agricultural Course, R. Steiner describes how we may regard plant growth from the viewpoint of *earthly unfolding and cosmic moulding*. In endeavouring to do this we need not stop short at plant morphology. *Morphology and growth progress are related to the quality* *of substances.* We must, however, exercise caution in drawing conclusions about the material composition of the plant from its external appearance, and we should be patient in training ourselves to form such conclusions.

In order to evaluate the qualities of a food plant we need definite points of reference. Chemical analysis gives us some of these. If, however, we carry the stereotyped yardstick which maintains "the more the better" too far, till obvious negative effects appear, then we shall soon fall prey to distorted judgments. The chemical findings must be classified according to a view of the plant's totality and to this end a division into the two polarities of earthly and cosmic growth factors has proved fruitful.

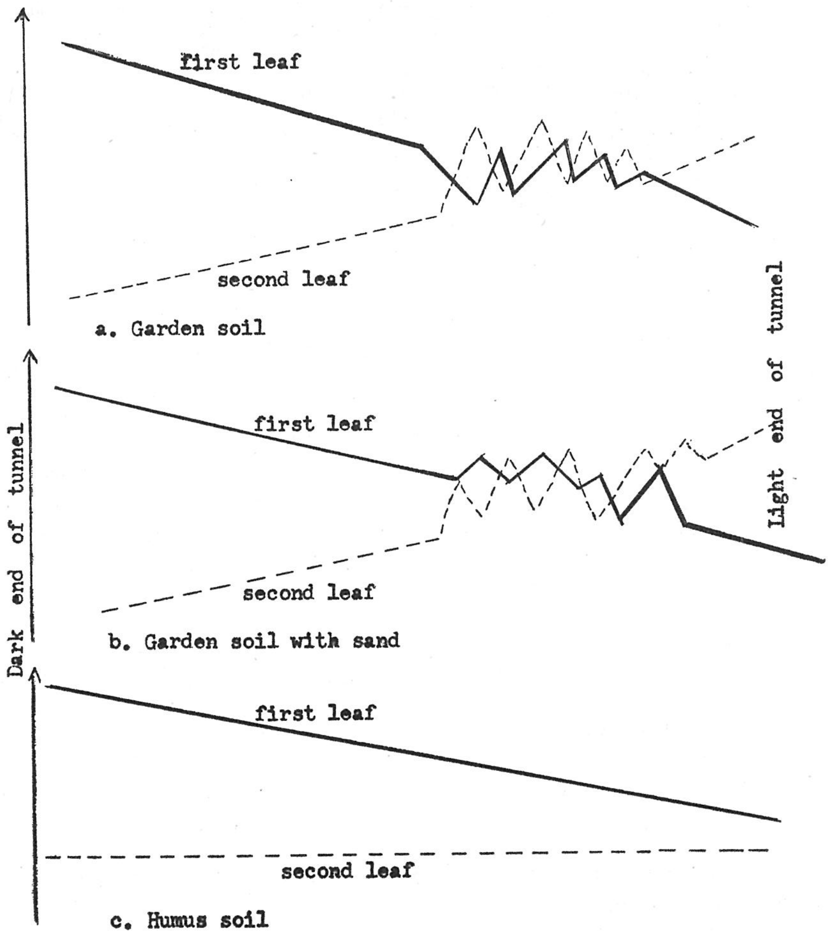
It was thus deemed important in bio-dynamic research to set up and carry out experiments with this in view and the results of some of this research are described in the following pages.

The Plant between Light and Darkness

Light is probably the most important cosmic factor for plant life. When light is predominant, cosmic laws outweigh the earthly laws, and when light recedes, the earthly laws outweigh the cosmic laws. Between light and darkness lie all the degrees of shade. It is impossible to grow a green plant in complete darkness, but we can study the effects of earthly influences by growing plants in varying degrees of shade. Experiments along these lines were carried out by, among others, L. Kolisko (1939), M. Klett (1968), and M. Engquist (1965).

E. and L. Kolisko (1939) placed germinating wheat plants in a tunnel in which light conditions were graded from sunlight to complete darkness. As mentioned earlier [in the book], the comparative lengths of the first and second leaves were measured. As light decreased, the first leaf grew longer and the second shorter. In one experiment, the varying growth in different soil mixtures was studied. The illustrations show the relative lengths of the leaves in diagrammatic form. Forty-five pots, each containing thirty plants, were ranged from the dark to the light end of a tunnel.

The diagram referring to garden soil can be used for comparison. We find that the point where the first and second leaves are of equal length falls in pots 32 to 42. If the same garden soil is mixed with sand, the crossing point shifts towards the dark end in pots 29 to 38. This shows that the sand gives an intensified light effect. In the diagram referring to humus soil, the lengths of the first and second leaves do not cross over at all, which shows that here the effect of darkness is intensified. The experiment demonstrates how different soils either intensify or weaken the cosmic light aspect of the plant.



Growth of first and second leaves of germinating wheat plants in various soils (a,b,c,) and in degrees of shade ranging from complete darkness to sunlight (45 pots) (after E. and L. Kolisko, 1939).

M. Klett (1968) carried out a three-year field experiment with three grades of light (full light, half shade and deep shade) in combination with two kinds of fertilizer (organic and mineral). All combinations were tried with and without BD Preparation 501. Seven different varieties of plant were reared, though not all in the same year. Some results from this copious material are given here.

Spinach in a light-shade experiment (M. Klett 1968)

Items tested	Treatment					
	Light		Half-Shade		Deep-Shade	
	org.	min.	org.	min.	org.	min.
Root length, cm	23	18	13	15	13	13
Shoot length, cm	89	81	98	97	71	59
Crude protein, % d.m.	12.6	15.6	15.2	18.9	16.	18.7
*Relative protein content, %	97	90	86	81	62	66
Nitrate-N, mg in 100g d.m.	7.6	34.6	13.6	40.4	42.4	47.6
Vitamin C, mg in 100g f.s.	90.4	80.1	78.8	80.2	56.1	47.3
†Crystallization standard	95	72	64	51	54	47

f.s. = fresh substance d.m. = dry matter
* = true protein in % of crude protein
† = visual evaluation of crystallization picture expressing quality in figures; best quality = 100.

The length of the spinach tap-root was increased by light, but the shoot length reached its maximum in the half shade. The crude protein content increased considerably with the degree of shade, while at the same time the true protein content decreased and the amount of nitrate not transformed into protein increased. Viamin C decreased with increasing shade since it depends on the effect of light. The crystallization standard also decreased with increasing shade which shows in this case (since the scale is evaluated in this way) that the formative capacity of the plant juices on copper chloride decreased in accordance with the decrease in light.

The comparison between organic fertilizer (composted stable manure) and mineral fertilizer shows two complexes of effects:

the effects of organic fertilizer are similar to those of **light**	the effects of mineral fertilizer are similar to those of **shade**

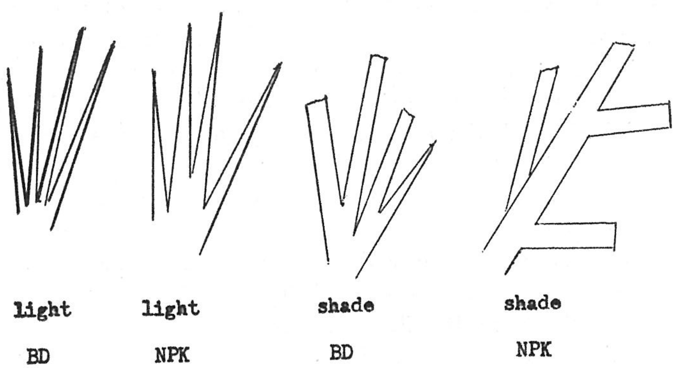
BD Preparation 501, which is not shown here, also gave the same effect as light.

Similar differences also appeared to a greater or lesser degree in the other plants tested. The following table shows the figures for wheat. Some of the items failed to show in deep shade, so this combination is not included in the table.

Wheat in a light-shade experiment (M. Klett 1968)				
Items tested	Treatment			
	Light		Half-Shade	
	org.	min.	org.	min.
Straw length, cm	139	136	135	132
Grain-straw ratio, 1:	3.0	3.3	4.2	5.0
Weight of 1000 grains, g	38.1	42.6	23.0	20.5
Crude protein, % in d.m.	15.8	15.2	18.2	18.5
Free amino acids, mg in 100g f.s.	29	26	45	61
Diastase test, % in maltose	2.5	2.4	3.2	3.4
Dehydrogenase, H_2mm^3/h in 10g f.s.	36	51	62	81
Ash content of grains, % in d.m.	2.26	2.11	2.62	2.65
Crystallization standard	95	84	67	59

The growth differences in light and shade clearly show the increase of vegetative characteristics (grain-straw ratio, crude protein, free amino acids, diastases, dehydrogenases) in half shade. The differences between organic and mineral fertilizers are also expressed, though not as distinctly as with spinach.

In an experiment with spinach, cress and carrots, M. Engquist (1963) shows that the crystallization test method can serve as a sensitive indicator of growth differences in light and shade. Four combinations were tried: compost treated with bio-dynamic preparations (BD) and mineral fertilizer (NPK) each in light and in half-shade. It was possible to characterize the four combinations with a graded series of spikes and incipient spikes as they appeared in the crystallization patterns.



Crystallization test. Diagram of spike types after growth in light or shade with bio-dynamic treatment (BD) or mineral fertilizer (NPK) (after M. Engquist).

This series shows that the half-shade had a stronger effect on the formation of the crystallization spikes than the fertilizer. Shade and mineral fertilizer work in the same direction, however, and when they are combined their effect is increased.

The Influence of Fertilizers

Fertilizers are the most effective means of increasing plant yield. They also influence the plant's qualitative characteristics, in a negative as well as in a positive direction. This has long been recognized in biodynamic practice, but a great deal of time passed before a wide enough range of experimental work in this field was set up and there is still much to be done. Adequate methods had to be developed for the reliable assessment of the experimental plant material. In the last decade, however, results have been published in Germany and the Scandinavian countries. Some of these have already been mentioned: the influence of light and shade, humidity and drought, the seasons. Thus the experiments undertaken by Klett (1968), Engquist (1961) and Breda (1972) show that *mineral fertilizer and decreasing amounts of light effect the configuration of substances in the plant in similar ways.*

The results of several fertilizer experiments are shown in the following.

B. Pettersson (1972) conducted a field experiment on the effects of eight combinations of fertilizer on the quality of potatoes. These were grown in a four-year rotation of wheat, clover-grass, potatoes, and beetroot, so that all four were grown each year. The following average figures are from the ninth to twelfth year, i.e., there had already been eight years of the experimental sequence. We can assume that the different varieties of fertilizer had had sufficient time to influence the biological composition of the soil.

The eight combinations were as follows, the amounts shown being those used for potatoes:

1. Composted stable manure with 1% meat and bone meal, 30t/ha, (12 t/acre), and BD Preparations 500 and 501.
2. As 1, but without the BD Preparations.
3. Crude stable manure, 30t/ha, (12t/ acre).
4. Crude stable manure, 15t/ha (6t/acre) and ½ NPK (see plot 6)
   = 15 : 13 : 22 kg/ha
   13 : 11 : 20 lb/acre.
5. Control plot.

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6. NPK = 31 : 26 : 43 kg/ha
28 : 23 : 39 lb/acre.

7. 2 x NPK = 62 : 52 : 86 kg/ha
56 : 46 : 78 lb/acre.

8. 4 x N + 2 x PK = 124 : 52 : 86 kg/ha
112 : 46 : 78 lb/acre.

(The beetroot was fertilized as the potatoes; for wheat in plots 4, 6, and 7 the amount of N was halved; no fertilizer was used for the clover-grass.)

The individual results were incorporated in a *quality index* in the following way:

Items tested	Quality assessment	
	favorable	unfavorable
Crude protein	low	high
Relative protein content	high	low
Darkening of tissue	slight	considerable
Darkening of extract	slight	considerable
Speed of extract deterioration	slow	fast
Crystallization pattern	better	worse
Growth of pathogenic organisms	slight	considerable
QUALITY INDEX	HIGH	LOW

Flavour trials were conducted in autumn and spring: best flavour = 4, worst flavour = 1. These results are included in the table. Yield is significantly lower in only the unfertilized plot. With regard to the quality index there are three quite distinct groups:

a) Combination 1, 2, 3 in which only organic fertilizers were used; these vary in comparison with one another and the highest grade is achieved by the plot treated with the full bio-dynamic method.

b) The plots with no fertilizer (5), mixed fertilizer (4), weak mineral fertilizer (6) and medium mineral fertilizer (7); the favourable position of number 7 is notable.

c) The combination with the greatest nitrogen content (8) which diverges widely from the other plots treated with mineral fertilizer.

The influence of fertilizers on the qualitative characteristics of potatoes (Pettersson 1972)

Fertilizer	Yield 100 = 34.1 t/ha = 13.6 t/a	Quality Index	Flavour Autumn	Flavour ± Spring
1	104	109.3	3.0	±0
2	108	107.1	3.0	−0.1
3	95	106.1	2.8	±0
4	103	97.5	2.8	−0.2
5	83	98.5	2.9	−0.2
6	98	95.9	2.8	−0.3
7	105	100.0	2.9	−0.5
8	103	85.6	3.1	−0.7
Significant variations when:	Yield	Quality Index	Flavour Autumn	
P = 0.05	12	6.9	0.4	
P = 0.01	16	9.4	0.6	

J. Klein (1968) made field experiments with graded applications of composted manure and supplementary fertilizers such as pig bristles and horn meal. From his extensive material we have selected his records for potatoes in 1965, as this vegetable lends itself well to the detection of qualitative differences. Experiments with potatoes and rye had been in train for two years prior to 1965. Except on the control plot, composted manure and bristles were used in two rates of application and in various combinations with one another, nine plots in all. In order to show the main results in brief, the table shows the values calculated according to Klein's table.

The influence on potato quality of various organic fertilizers in graded application (Klein 1968).

Items tested	no fertilizer	± in comparison with no fertilizer			
		composed manure		bristles	
		1	2	1	2
Fertilizer		22.5	45.0	313	625
t/ha and kg/ha resp.					
t/a and lbs/a resp.		9.0	18.0	125	250
Yield, t/ha	11.3	+2.8	+5.2	+1.9	+2.6
t/a	4.52	+1.12	+2.08	+0.76	+1.04
Crude protein % in d.m.	8.5	−0.5	−0.4	+0.2	+0.7
Relative protein content, %	64.3	+0.4	−0.8	−3.0	+0.8
Free amino acids mg N in 100g d.m.	219	−35	−40	+12	+16
Proteinase activity	58	−7	−7	±0	+13
Starch %	13.2	+1.4	+1.9	−0.7	−1.5
Vitamin C mg/100 f.s.	23.0	+1.2	+0.8	+5.1	+2.4
Crystallization standard	57	+24	+32	−17	−27

Both composted manure and bristles brought about a distinct increase in yield over the unfertilized plots, but their influence with regard to quality differed, as is shown in the next table.

With a few exceptions, composted manure clearly tended to have an influence similar to that of light, while bristles worked more like shade. However, the difference between the fertilized and unfertilized plots was not great. Bristle tends towards the effects of shade less strongly than does mineral nitrogen, though the direction is the same.

Item tested	light tendency effected	by fertilizing with	shade tendency effected	by fertilizing with
Crude protein	diminished	man. compost	enhanced	bristles
Relative protein content	enhanced	no difference	diminished	no difference
Free amino acids	diminished	man. compost	enhanced	bristles
Proteinase activity	diminished	man. compost	enhanced	bristles
Starch	enhanced	man. compost	diminished	bristles
Vitamin C	enhanced	man. compost bristles	diminished	———
Crystallization standard	enhanced	man. compost	diminished	bristles

B. Pettersson (1970) tested the effects of the following fertilizer combinations on potatoes:

a) composted stable manure, 60t/ha, (24 t/a).
b) meat, meal, bone meal, sulfate of potash-magnesium, as NPK = 103:102:145kg/ha (93:92:130 lbs/a).
c) ½ a + ½ b.

The influence of composted manure (a), an organic supplementary fertilizer (b), and a combination of both (c) on the quality of potatoes (Pettersson 1970)

		a	b	c
Yield, t/ha(t/a)	1965	25.4 (10.0)	26.7 (10.7)	23.8 (9.1)
	1966	29.4 (11.8)	29.8 (11.9)	32.7 (13.1)
	average	27.4 (11.0)	28.3 (11.3)	28.3 (11.3)
Quality Index	1965	104.4	99.4	102.8
	1966	108.1	96.8	108.6
	average	106.3	98.1	105.7

Yield was approximately the same for each treatment in each year. Quality was distinctly negatively effected only by the combination with meat meal, bone meal and sulphate of potash magnesium. When these were composted together with stable manure, no significant negative results occurred.

L. Furst (1967) studied the effects of different fertilizers on apple trees and their fruit over a number of years, combined with intercropping of legumes in order to quicken the soil. Detailed reports referring to the years 1964, 1966, 1967 are available on one of these experiments (The experiments continued till 1972). A number of organic fertilizers with an annual N application of 55kg/ha (50 lbs/a) were compared with inorganic compound fertilizer (N as ammonium nitrate) in an application of 82kg/ha (74 lbs/a). It was assumed that the legume crop brought a further annual amount of 85 kg/ha (76 lbs/a) of N.

The apple varieties were Pearmain, Cox, Winston and Boskoop. The trees were intensively planted at 2.5x2m on M-IX root stock. There is no report on yield, but records were kept of the commercial grades achieved and of attack by a number of fungi and insects. The only pest control used against scab was Tecoram (AAteck 0.2%) and from early August sodium silicate (1.3%).

Commercial grading: the percentage of Grade 1 fruits are shown.

Mildew: the following scale was used to record this:

grade 0 = no tips attacked = none
grade 1 = 8 tips attacked = very slight
grade 2 = 16 tips attacked = slight
grade 3 = 24 tips attacked = medium
grade 4 = 32 tips attacked = extensive
grade 5 = 40 tips attacked = very extensive

Scab and codling moth: infestation with these is given in percentage of harvested fruit.

Fertilizer experiment with apple cultivation showing commercial grades, and infestation with mildew, scab and codling moth.
Averages over 3 years. (L. Furst 1967)

Fertilizer	Commercial Grade 1, %	Mildew Grade	Scab %	Codling Moth %
Inorganic compound Fertilizer	71	3.5	1.6	4.9
Vita-Nova (=blood, horn, bone)	77	0.9	0.4	3.5
Oscorna (=horn, bone)	77	1.4	0.9	3.8
Peru-guano (in 1966 chicken manure)	79	1.6	1.3	4.1
Composted manure	81	2.7	1.8	3.0
½ peru-guano + ½ Oscorna	81	1.4	1.5	2.9
½ composted manure + ½ Oscorna	84	1.7	0.7	2.4

All the organic combinations compare positively with the inorganic compound fertilizer. The organic combinations differ considerably among each other, particularly in regard to the commercial grade of the fruit. It is striking that the horn/hornmeal (Oscorna) is at the bottom of the organic scale when applied alone and at the top when applied together with composted manure. As in the previous example, this implies that a combination of composted manure with commercial organic materials has a favourable effect on quality.

BIO-DYNAMIC PRODUCTION AND THE CONSUMER

As mentioned in Chapter One, bio-dynamic products were brought on to the market in Germany in 1928, only four years after the work began, by the "Verwertungsgenossenschaft Demeter" (*Demeter Co-operative*) which had its headquarters in Bad Saarow in Mark Brandenburg. In 1930 the organization was reconstituted as the "Demeterwirtschaftsbund" (*Demeter Association*) which continued to function till it was banned in 1941. The adoption of the brand name *Demeter* was an important step. This was in all probability the first attempt to market *basic foodstuffs* which offered more than the conventional market qualities which encompassed in the main only appearance and certain cooking characteristics. The name Demeter indicated the *biological value of the products,* arising out of a particular production method. In those days the number of people interested in such foodstuffs was limited but today there is a wide demand for foods which are qualitatively good.

These consumer requirements apply not only to products which travel straight from the producer to the kitchen table but also to those which have been processed or stored for longer or shorter periods. Therefore not only the producer, but also the processor and distributor influence the quality. *So if high quality products are to come on to the market, the services and interests of grower, processor, distributor and consumer must all be taken into consideration.*

In the Federal Republic of Germany it is the task of the "Demeterbund e. V." (*Demeter Association*) to develop this area and create secure legal foundations. In 1954 this Association took up the work which had had to be abandoned for a while in 1941. Its work will be briefly described here, since it is both in commercial and idealistic terms a direct sequel to the endeavours of bio-dynamic farmers and market gardeners. The producers hope, as far as is possible, to receive fair prices for their products. These can nowadays, however, not be high enough to make economics their sole motivation. It must be recognized that they are also motivated simply out of devotion to their work. Experience has shown repeatedly that the agricultural code of ethics is a reality provided that the way in which the work is carried out is able to foster this ethic. The consumer, on the other hand, must be able to rely on the quality offered being as high as he wishes. So the interests of producers and consumers must be co-ordinated. *Based on the work achieved so far, the Demeter movement provides a possible model for such co-ordination.* The discernment necessary to give confidence to the consumer still needs developing to a great extent.

Environmental conservation is a matter much in the public eye at present, and it has many points of contact with agricultural and horticultural production methods and also with processing. Environmental problems have stimulated the interest of wider circles than ever before in residue-free and also "organically" grown goods. Words like "natural," "pure," "organic" and many others are on everybody's tongue. There is a danger in this. Over a number of years interests of the most divergent kinds, based both on understanding and on the crassest lack of understanding, have been competing for attention. This applies more to some countries than others so far. We must now see to it that a justified striving for high quality can win through. Otherwise it could become discredited. *Availability of information about production methods on the one hand, and production according to properly supervised quality guidelines on the other, can contribute to the generation of confidence in the quality of the produce offered.*

Bio-dynamically grown products must reach the consumer either directly or after processing without any chemical preservatives or cosmetics. Marketing under the brand name and trade mark of "Demeter" guarantees this. The owner of this trade mark in the Federal Republic of Germany is the "Forschungsring fur biologisch-dynamische Wirtschaftweise" (*Experimental Circle for Bio-Dynamic Agriculture and Horticulture*). This circle encompasses farmers, scientists and consultants who want to take responsibility for the further development and dissemination of the bio-dynamic method. Its members develop the guidelines for production and processing of Demeter products. Consequently these guidelines stem from on-going knowledge and quality research and not from a group consisting only of producers or distributors.

The only legal entity in the Federal Republic of Germany entitled to put into effect Demeter guidelines and standards is the Demeter Association. This fulfills its tasks through the collaboration of its members who are producers, processors, distributors and consumers. The executive committee consists of representatives of all four groups. The Demeter Association itself does no trading. Its activities are born by support contributions which are incorporated in the final price of products. The income from these support contributions is used not only for administration and the regular issue of the Demeter News Letter, but also for quality control, research and advisory services to member farms and market gardens.

The above as described for the Federal Republic of Germany also applies to all countries in which the Demeter name and trade mark are protected. Regular conferences of all groups in European countries serve to bring about standardization of guidelines and labeling.

Protection of Demeter standards is enforced by covering contracts between the Demeter Association and producers, processors and distributors. Contract partners are entitled to use the protected Demeter name and trademark and the words "Produced by bio-dynamic methods" or "Produced by bio-dynamic cultivations." There is an annual harvest registration regarding proper application of the methods. A contract can be entered into once a representative of the Experimental Circle has pronounced the products in question to be up to the required Demeter standard. Similar contracts are entered into with processors and wholesale distributors. The production programme is enlarged and controlled in collaboration with the Working Group for the Processing and Distribution of Demeter Products. We have therefore what is probably a unique situation: *The protection bestowed by the Demeter name extends from the soil to the kitchen table.*

The Institute for Bio-Dynamic Research in Darmstadt runs a *testing service* which carries out systematic quality control tests. Random samples of primary and secondary products are sent to the State examination laboratories to be tested for chemical residues. The work of the testing service also assists the Experimental Circle's advisers in their task of helping the producers to improve and maintain high standards. The samples sent in by the producers are accompanied by a report on the growing method used. In this way a body of experience on varieties, cultivation and quality characteristics is gradually built up which the consultants can combine with their own soil analysis and knowledge of the individual farms.

The above points have been mentioned for the sake of completeness. The central question we are concerned with here is: How can one determine quality in a reliable fashion? This is certainly not easy. Yield can be measured, and so, to a sufficient degree of accuracy, can pesticide residues, lead or other poisons. The question of cost determines how many samples one can have tested. But it is not easy to determine the nutritional quality of foods in their physiological and health aspects. Here again cost prevents the routine laboratory investigation of numerous individual factors. There are of course methods of testing protein content, relative protein content, sugar, fat, unsaturated fatty acids, vitamins, minerals, shelf life, enzyme activity and much else. Apart from the cost of such tests, the evaluation of the results is a problem in itself. Each characteristic is influenced by a variety of growth conditions. In one year weather conditions might be dominant, and in another the fertilizers used. *Rational quality control must take the totality of growth conditions into account.* These are determined in the first place by the fertility and vitality of the soil and are influenced by fertilization and cultivation methods. The quality characteristics, too, must be seen in their totality. The manner in which orthodox analytical methods and the more recent "picture creating" methods are applied to this end was described in the previous chapter.

In practice the totality of growth conditions is taken into account in the definition of standards (in addition to which the above-mentioned quality and residue tests are applied). Cultivation takes place along lines which experience and present research results show can guarantee balanced growth conditions. These, together with the choice of varieties and the suitability of the arable land, determine the qualiy. It is the aim of the bio-dynamic methods described in this book to achieve balanced growth conditions. Without going into detail, the main features of the guidelines as they are applied at present are set out in the following.

The first condition for recognition of Demeter quality is that, in the main, bio-dynamic cultivation methods should have been in use for not less than two years. Fertilizer use must be aimed at building up na-

tural soil fertility. This must be achieved through the application of farm manures, with preparations, in such a way that neither organic nor inorganic forcing manures are required. Commercial organic fertilizers should, as far as possible, be applied via compost, and their manurial value must not exceed that of the manure derived from the farm itself. Synthetic nitrogen compounds, soluable phosphates, and chlorine-containing potash salts are out of the question. Sewage sludge, physiologically questionable dressings, other pesticides and weed killers are not used. The purchase of fertilizers and soils must be undertaken only in agreement with the representative of the Experimental Circle who is also a trustee of the Demeter Association. Similar conditions apply to horticultural products. Here, too, if recognition is sought, the manurial value of bought-in organic fertilizers must not exceed that of the garden's own compost, green manure and stable manure. Bought-in young plants must be bio-dynamically cultivated. Any additional bought-in materials may have to be analyzed for residues. With regard to livestock, the farm must carry out its own breeding programme or buy in animals only from other bio-dynamic farms (except male animals of course). The proportion of bought-in feedstuffs in the total ration is laid down. And feeding is aimed at lasting good performance, fertility and health rather than at record yields, which anyway tend to be short-lived.

The system of annual reconfirmation of recognition, presupposes a close collaboration between the farms and the advisory service. As will have been seen in earlier chapters, importance is attached to the development of each farm as a biological unit. Variety of production and the combatting of weeds by crop rotation and tillage means there is extra work. The carefully considered and progressive use of modern equipment can also redress the balance to a certain extent. However, the overall state of agriculture also has its consequences for bio-dynamic farms. The general aims of agriculture and its extension services at the present time with regard to agrarian structure and productivity are in many ways opposed to those of Demeter farms. Whether the Demeter aims, as they stand at the moment, are the right ones, remains open for discusssion. The bio-dynamic farms and Demeter organizations are in their own way and within their own possibilities developing models for the realization of an agriculture which is guided by ecological principles, which is favourable for the environment, which encourages people to remain on the land, and which achieves the production of high-quality foods free from undesirable residues.
