# Some Guidelines for Experimentation in Biodynamic Agriculture

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## A Forgotten Mandate

At the end of his course of eight lectures on agriculture, which inaugurated the biodynamic movement, Rudolf Steiner made the following remark:

> In these lectures I have only been able to supply certain guidelines, of course, but I am sure that they will provide a foundation for many different experiments extending over a long period of time, and that they will lead to brilliant results if worked into your agricultural practices on an experimental basis. That should be a guideline for dealing with the material presented in this course.[1]

During this "Agriculture Course" Steiner was able to give many broad guidelines for the renewal of agriculture, and he indicated that these should be a basis for experimentation. However, he did not get around to giving many guidelines for the process of experimentation itself, even though at one point in the last lecture he himself said:

> Setting up experiments naturally becomes very complicated here, because they have to be individualized. What we must do, therefore, is establish general guidelines on how to set up such experiments. (SFRA, p. 159)

Although Steiner did not give many specific guidelines for experimentation, he did state very clearly from what source he thought they should be derived. In his address to the members of the newly established "Agricultural Experimental Circle," he urgently cautioned them not to repeat the mistake that others had made when they had tried to unite anthroposophy (Steiner's science of the spirit) with some field of practical endeavor. These people, he said, "with good and faithful hearts … did not make things quite clear to themselves when they began working within anthroposophy. They always proceeded from the mistaken opinion that they should do things in exactly the same manner as science has done them up to now" (SFRA, p. 182). Instead of copying the methods of others, Steiner urged his audience to remain true to anthroposophy and declared: "we will find the most exact scientific methods and guidelines out of anthroposophy itself" (SFRA, p. 183).

However, soon after giving the Agriculture Course in June 1924, Steiner fell ill and did not give any further suggestions for experimentation before his death in March 1925. Since that time other urgent issues have apparently pushed the task of developing guidelines for experimentation out of common consciousness. If anyone has ever developed these, they have not been widely disseminated, which they need to be.

The present report consists of three main sections: the first discusses Steiner's views on experimentation and methodology, the second offers relatively detailed guidelines for the outer aspects of experimentation, and the third gives a more pictorial overview of the inner or spiritual aspects of experimentation, focussing especially on the process of individualization. This report should be regarded as an experiment in itself; comments or suggestions for improvement are welcome.

## 1. Rudolf Steiner's Concept of Experimentation

Rudolf Steiner's scattered comments on experimentation in the Agriculture Course can be quite confusing if one is not already familiar with the rest of his life and work. His concept of experimentation is broader than that of many other people, but it is also more differentiated. These differences will be pursued in the first two sections, followed by a consideration of some of his comments to the Experimental Circle.

### 1.1. Practical Experimentation

Steiner describes how in earlier times farmers knew what to do simply by quoting a proverb, and he stresses that these proverbs contained a great deal of wisdom (SFRA, p. 17 & 24). As the old traditions have faded, however, people have resorted to the method of trial and error. In Lecture Eight of the Agriculture Course, Steiner describes this new situation in connection with the question of animal fodder:

> People still know a few things from the old traditions, but they no longer know why the things were used. And so for the rest, they experiment; they try this for the milking animals, and that in order to fatten the animals, and so on. The result is similar to what happens

when things are tried out on humans, especially when this experimentation is simply left to chance. Just think what happens when you are with many friends and happen to have a sore throat. Each of your friends gives you something or other for it, and in half an hour you've collected enough to stock a whole pharmacy. If you took all of those things, they would cancel each other out, and you would probably end up with an upset stomach and still have a sore throat. In these circumstances, something quite simple becomes something quite complicated.

It is similar when you start experimenting with all kinds of fodder. You try something out, and it works in one respect but not in another. So you add a second kind of fodder, and then a third, until you have any number of fodders, each of particular value for young animals, or animals to be fattened, or whatever. Very soon it all gets so complicated that you no longer have an overview of the situation; you can no longer see how the forces interact. Or the effects of the different things start to cancel each other out. That is actually what often happens, especially with people who take up farming in a semi-academic way. They look it up in their books, or they recollect what they were taught. They look it up, but this doesn't help much, because what they read in their books may well conflict with what they are already doing. This situation can only be dealt with rationally by thinking along the lines I have indicated. In that way the question of animal nutrition is considerably simplified, so that it is possible to have an overview of it.

… A lot of what has been discovered through trial and error is perfectly correct, but unsystematic and imprecise. (SFRA, p. 162f)

Steiner wished to establish a rational method of agriculture, but not in the sense of modern "rationalized" agriculture, where fixed thought-models are imposed on any and every situation. On the contrary, what Steiner offered in the Agriculture Course was *rational insight into the principles* of agriculture, which he had derived from his spiritual research. Thus he says at the beginning of the eighth lecture,

The practical matters that we will be dealing with today are not easily expressed as general formulas or the like, since they are subject to a great deal of individualization and personal discretion. And that is why it is so important to acquire spiritual-scientific insights into the subject; they enable us to adapt our practices to individual situations in an intelligent manner. (SFRA, p. 152)

This process of adaptation or individualization is, in fact, the central theme of the Agriculture Course. Every farm, he says, "ought to aspire" to become a self-contained individuality (SFRA, p. 27).[2] The nutrients must be recycled but also the species numbers and composition need to be adjusted:

… you see, a farm is a kind of individuality, and you will soon realize that your animals and plants should participate in this as much as possible. Nature is impaired in a certain sense if the farm animals are eliminated and fertilizer brought in from Chile [for example], instead of manure being supplied by the animals on the farm. You then step out of what used to be—and should continue to be—a self-contained cycle. You must arrange things so that the cycle becomes self-sustaining. You must simply have the right number and kinds of animals on a farm so that you get enough of the right manure. And you must also make sure that you plant what your animals will instinctively search out and want to eat. (SFRA, p. 158f)

Immediately after this description, Steiner turns to the question of experimentation and makes the statement quoted earlier:

Setting up experiments naturally becomes very complicated here, because they have to be individualized. What we must do, therefore, is establish general guidelines on how to set up such experiments. (SFRA, p. 159)

The situation, therefore, could be summarized as follows: In order to make use of Steiner's agricultural insights, we need to individualize them; in order to individualize them, we need to set up individualized experiments; and in order to set up individualized experiments, we need general guidelines on how to do so. Clearly, the general guidelines for experimentation are crucial to the whole process. Steiner then continues,

After many experiments, practical rules will emerge, but they will all have to be derived from our primary guiding principle, which is to make each farm so self-contained that it can become self-sustaining … (SFRA, p. 159)

In other words, any practical rules (i.e., general rules of thumb) that are promulgated should be derived from the experience on farms where many experiments have been carried out to individualize these farms.

Such practical rules are very useful for newcomers getting started in biodynamics, but they can take them only so far. If farmers cling to them too long, the rules can become a hindrance, for no farm can be truly individualized with generalizations. Individualization can occur only if farmers are encouraged and enabled to *experiment*. This is why individual farmers need guidelines for experimentation and why experiments cannot be carried out only at research institutes.

## 1.2. Scientific Experimentation

In Lecture Six of the Agriculture Course, Steiner strikes a quite different note with regard to experimentation:

In all these instances, I am simply giving you indications to serve as starting points for applying these things in practice. Since people are of the opinion—I don't want to call it a prejudice—that everything has to be verifiable, well, you should go ahead and try to verify them. If you do the experiments properly they will surely be confirmed. But if I had a farm myself, I would not wait for the confirmation: I would start right away because I am quite sure these things work. As far as I am concerned, spiritual-scientific truths are true in and of themselves, and do not need to be confirmed by other circumstances or external methods. Our scientists have all made the mistake of looking to external methods, of wanting to verify spiritual-scientific truths by external methods. This has happened even within the Anthroposophical Society, where people should have known that things can be true of themselves. But in order to get anywhere nowadays, we have to verify these things outwardly, we have to compromise. A compromise is necessary here, but in principle it's not necessary. (SFRA, p. 119)

Despite appearances to the contrary, Steiner in this passage is not advocating blind acceptance of his authority as a spiritual scientist, i.e., as a clairvoyant researcher.[3] The issue here is whether the farmers should go ahead and try out his indications in practice, or whether they should wait for the scientists to verify them experimentally. It is apparent that he believed the need for agricultural renewal was urgent and that the farmers would find his indications fruitful.[4] On the other hand, he had good reason to believe that the scientists with their conventional methods and sometimes less-than-clear thinking might indeed have trouble confirming his indications by means of experiments. He still encouraged them to try, but did not want the farmers to wait for them (and, after all, if the farmers were successful, this would itself be confirmation). He was disappointed that even scientists who were members of the Anthroposophical Society did not understand that spiritual things cannot be observed or demonstrated in the same way that physical things can be. Spiritual things do not appear "on demand," at the whim of a scientist, but only if the scientist has made himself worthy and there is good reason for them to appear.[5]

Steiner therefore goes on to emphasize how careful one must be in interpreting negative experimental results. He illustrates this by noting that one might assume that hiring three times as many workers would result in three times as much work getting done. And yet, if it were found experimentally (statistically) that this often did not hold true, this would not cast doubt on the inner truths of arithmetic (multiplication); it would show only that the wrong *assumption* had been made (in fact, more workers may actually mean more opportunities for talking). In this case, then, the laws of arithmetic would not have been disproved but only *wrongly applied*.[6] Steiner concludes: "The experiment can yield a contrary result—but that proves nothing. If you are proceeding carefully, you must also examine this contrary result quite exactly. Then what is inwardly true will also be confirmed outwardly" (SFRA, p. 120).

Later in the same lecture, after describing the rationale for the horsetail preparation, he says:

> In this way, if we acquire insight into the various aspects of nature's workings, it is entirely possible to take hold of the processes of growth … Only at this point does real science begin. The type of experimentation current today is not real science, it is merely a recording of individual phenomena and isolated facts. Real science begins only when we are able to take hold of the effective forces.
>
> The plants and animals on Earth, even the parasites of the plants, cannot be understood in isolation. … Nature is a unity … (SFRA, p. 129)

For Steiner, real science is not about collecting ever more detailed data; it is about achieving *insight* into the data, into the *unity* of nature. This is not possible through any process of speculation or inductive inference (reasoning from the parts to the whole); it is possible only by strengthening the mind itself, by enhancing the mind's capacity for direct, intuitive perception.[7]

In a certain sense, we exercise direct, intuitive perception all the time; we exercise it whenever we recognize something "at a glance." Even when we have to puzzle something out—like someone's poor handwriting in a letter—when we finally succeed, the whole, the coherent meaning of the letter, is then a matter of direct perception for us. This process of deciphering the handwriting is like the process of scientific experimentation; we ask ourselves whether the author of the letter could have meant this, or that, or even another thing, until we find one meaning, one hypothesis, that fits all the details. Then the letter "makes sense," i.e., the details of the letter now make our hypothesis into something we can see with our senses; they reflect our hypothesis back to us. Real science is not about accumulating details, but about developing appropriate hypotheses—hypotheses that become direct perceptions when the details of the world reflect them back to us. Perception, in other words, is literally a matter of "re-cognition"; the hypothesis or meaningful concept that we cognize inwardly, we then cognize again in the outer sense-world. The only difference between the concept we experience inwardly (intuitively) and the concept we experience outwardly (perceptually), is that the latter has become specialized. Hence in one of his earliest writings Steiner declares:

> All sciences should be permeated by the one conviction that their content is solely a thought-content and that they sustain no other relationship to perception than that they see in the perceptual object a specialized form of the concept.[8]

Intuitive perception requires greater mental exertion than ordinary perception; to perceive the unity of the processes of nature, we have first to generate concepts that are adequate to these processes, concepts that can then find their reflection in them. This is what Steiner hoped the scientists in the Anthroposophical Society would begin to do, also in connection with their experiments. In a lecture to science teachers in 1920 he says:

> The art of experimentation reached its full flower in the nineteenth century, but a development of clear, definite concepts did not parallel this flowering of the experimental art. And today, lacking clear, definite concepts, we often stand perplexed before the phenomena that unthinking experimentation has produced over the years. When the way has been found not only to experiment and to observe the outer results of the experiments but really to enter into the inner course of the natural phenomena, then only can these results be fruitfully integrated into human cultural evolution.[9]

Steiner was not against producing new phenomena by means of experimentation, but he wanted the scientists also to produce new concepts and to develop their capacity for intuitive perception. He often pointed to the type of science practiced by Goethe, the great German poet, dramatist and scientist, as a model of healthy scientific investigation.[10] Goethe was an experimentalist who also had a highly developed capacity for intuitive perception. In his classic essay, "The Objective and Subjective Reconciled by Means of the Experiment," Goethe describes his method of research and makes the following statements:

> We give the term experiment to the process of systematically repeating the experiences of predecessors, contemporaries, or ourselves, and of reproducing phenomena that have arisen in part by chance, in part by plan. … Meritorious as each individual experiment may be, it nevertheless can have value only in connection with others … we find that the greatest success is achieved by those who do not cease to investigate and work out all possible aspects and variations of a single experiment. … The real duty of a scientist is thus to modify each and every single experiment …[11]

By systematically varying the experiments it becomes easier to discover (or confirm) the element that remains constant, i.e., the "law" of the phenomena, nature's unity.

## 1.3. The Research Community

The purpose of practical experimentation is to achieve a specific goal, to actualize a particular idea in the real world; in the case of biodynamics, it is to make each farm into a self-contained unity. The purpose of scientific experimentation is quite different; here the aim is to resolve the real world into a world of ideas, to understand how each real thing is part of an ideal unity. Thus, the series of experiments that a scientist will want to pursue will tend to be quite different from the series that is of interest to a farmer. The farmer wants to adapt the series to the needs of his individual farm, the scientist wants to adapt the series to the needs of his particular research subject. It is good, therefore, if the scientist can have his own research center and the farmer his own farm. It is also good if the scientist can associate with other scientists, and the farmer with other farmers, so that their common problems can be discussed and tackled jointly. This is obvious, yet it also goes against the grain of the modern tendency toward specialization, which exists in both science and agriculture.

During the Agriculture Course the sixty farmers in attendance established themselves as the "Agricultural Experimental Circle" and then took the further step of announcing their resolve to work together with the scientists in Dornach (the headquarters of Steiner's School for Spiritual Science). This resolution was very much welcomed by Steiner:

> Deciding to work together like this will be a solidly conservative and yet also extremely radical and progressive beginning. It will always remain with me as a lovely memory if this conference can become a starting point for genuine peasant wisdom to enter into the methods of science, which have become perhaps not stupid—that might be too insulting—but which have indeed become dead. Dr. Wachsmuth [leader of the Natural Science Section in Dornach] has also rejected this dead science and has called for a living science fructified by peasant wisdom. In this sense may Dornach and the Circle grow together like Siamese twins! It is said that twins feel and think alike, and if we are also able to feel and think alike, then we will make the best possible progress in our common endeavor. (SFRA, p. 188f)

Prior to these words, however, Steiner explained that the relationship he envisioned between Dornach and the Circle was not one where the farmers just implemented what the scientists proposed. He emphasized that what was needed were full-fledged co-workers and that the farmers themselves should be as active as possible (SFRA, p. 183f). In other words, in order to work with the individualities of their farms, the farmers themselves had to become strong individualities. At the same time, however, he also stressed the great need for social tolerance (there had indeed already been some dissension within the Circle). This call for strong individuality on the one hand, and social tolerance on the other, closely echoes words that he had written thirty years earlier in his fundamental book, *The Philosophy of Freedom*:

> To *live* in love for one's actions, and to *let live* in understanding of another's actions, this is the fundamental maxim of *free human beings*.[12]

The union of science and practice is possible only through the work of free human beings. Steiner spoke very warmly of the living connection between research and practice that had already been established in the field of anthroposophical medicine,[13] and in describing the Agriculture Course to members of the Anthroposophical Society he affirmed:

> … it is possible for anthroposophy to work from both the most highly spiritual side and from the most practical. In actuality we are only working in the right way when these two sides are woven together in complete harmony. (SFRA, p. 9)

The collaboration between farmers and scientists is not an easy matter to arrange, but it can be one of the most fruitful. The present report is an initial attempt to stimulate a revival of this collaboration.

# 2. The Art of Experimentation

The difference between practical and scientific experimentation lies not in how a particular experiment is set up or conducted, but in the *choice* of the experiment or the experimental series. The following guidelines can be used by anyone interested either in understanding or in individualizing the cosmic and earthly forces that are the foundation of bio*dynamic* agriculture. Since these forces manifest through substances as well as in space and time, specific experimental designs are given here for demonstrating or testing their presence in substances (Section 2.1), in space (2.4), and in time (2.5). General principles of experimental design are described in Sections 2.2 and 2.3. The final section (2.6) touches briefly on literature reviews, record-keeping and publication.

The main area *not* covered by these guidelines are the ecological aspects of agriculture, i.e., the influence of individual plants and animals on each other and on the whole farm. This is a major project for the future.

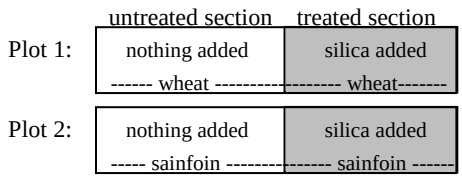
## 2.1. Steiner's Experiment - Testing Substances

Although Steiner did not give many detailed guidelines, he did give one example of how an experiment could be set up. To

demonstrate the influence of the silica in the soil, especially on seed formation, Steiner suggested the following:

> In this case it will be relatively easy to set up the experiments. Let's say you plant two experimental beds of wheat and sainfoin[14] side by side. You will find that wheat, which has a strong natural tendency toward seed formation, will be hindered in this respect if you add silica to the soil, while with the sainfoin you will see that seed formation is completely suppressed, or perhaps simply delayed. When you want to research things like this, you can always compare the features shown by a grain like wheat with analogous features in sainfoin or some other legume. In this way you can set up very interesting experiments on seed formation. (SFRA, p. 82)

The design that Steiner suggests here is essentially two beds or plots each split into an untreated and a treated section:




There is nothing unusual about splitting a plot and leaving the untreated section as a comparison or "control"—this is the most fundamental principle of experimentation—but it is unusual to specify *two* plots planted with two *different* species. Ordinarily one would think either that *one plot* would be enough to establish the principle, or that *many plots* (replicates) would be needed to establish statistical reliability. Similarly, one would expect either that using *one species* would be enough to establish the principle, or that it would be best to test this principle with as *many species* as possible.

Let us first examine the question of the species. Steiner does not merely suggest two species, he suggests two species—or two plant groups—that are *exceedingly* different. Wheat and sainfoin, or grains and legumes, belong to entirely different taxonomic subdivisions of the whole class of flowering plants (the Monocotyledoneae and the Dicotyledoneae respectively). Even more importantly, the grains are a group that naturally emphasize the *seed stage* of their life cycle, while the legumes (especially sainfoin) emphasize the opposite: the *vegetative stage*. (Steiner makes the point that even the fruits of the legumes, the pods, are still like leaves; SFRA, p. 58.) Thus, when wheat and sainfoin are exposed to the same influence of silica, their outer responses will tend to be *quite different*. Steiner suggests that the seed formation of the wheat will merely be hindered, whereas that of the sainfoin will be wholly suppressed or at least delayed, which means that in compensation its vegetative growth, including its roots, will probably be somewhat promoted.[15]

Why is this difference important? Because thereby one is enabled to grasp what lies "between" the phenomena, to perceive the forces of silica *independently* of their manifestation in one species or another. One is enabled to *intuitively perceive* silica's *potential*, its *"dynamic gesture."* If only a single species were used—or two similar species—one would get a very narrow and misleading idea of silica's potential. Using many species, on the other hand, may be quite unnecessary and impractical. In any case, the species chosen must have features that are comparable ("analogous"). This may be why Steiner did not suggest using potatoes instead of legumes in this experiment, even though earlier he had specifically indicated that potatoes as a *crop* would benefit from silica in the soil (SFRA, p. 39). In many varieties of potatoes, seed formation is already completely suppressed, which would make it difficult to compare them with grains. (The choice of species for an experiment is further discussed in Section 2.3.)

In principle, the two unreplicated plots mentioned by Steiner are sufficient to demonstrate silica's potential. In practice, however, replicate plots in space or time may very well be necessary. But this does not mean that "more replicates bring more certainty," as a statistician might assert. For Steiner, the purpose of scientific experimentation is to enable people to experience the outer world as a reflection of an inner lawfulness (see Section 1.2). How many replicates or repetitions are needed to achieve this depends not only on the outer circumstances but also on *the perceptive capacity of the observer*. Achieving *insight* is not a matter of probability or statistics. The truth of an insight is not affected by how many experiments it took to achieve it, nor, on the other hand, is observing a consistent pattern the same as having insight into its inner necessity (it is an elementary truism of statistics that "correlation does not equal causality"). Thus the ordinary concept of replication—i.e., identical, randomized repetition serving as a basis for inductive inference—is irrelevant here.[16]

However, what *is* usually needed in practice is *varied repetition* or *systematic variation* as Goethe recommends in his essay on experimentation (see Section 1.2). For example, instead of just one "treated" section having a certain amount of added silica, one could extend the plot and make a *graded series*, i.e., a series of sections containing increasing amounts of silica. Or one could vary how thickly or thinly the plants were sown, or which species were used, etc. These variations need to be pursued until one's intuitive perception of silica's influence becomes *perfectly clear*.

Steiner's experimental design can be used to test any kind of soil amendment or also any kind of spray. However, in all such experiments it is important not to make any final evaluations based on the growth of only one generation. In other words, the *seeds* from the plants grown in the untreated and treated sections should be grown again, or at least germinated, side by side in a *uniformly* prepared plot. This may reveal whether the reproductive capacity of the test plants has been impaired by the treatment of the parent generation.[17]

## 2.2. Distinguishing the Message from the Medium

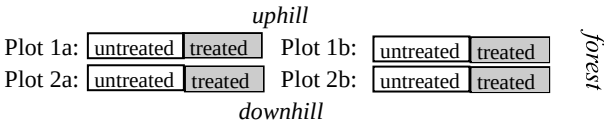
In the preceding section it has been implicitly assumed that any influence not mentioned would affect all parts of the experiment equally and could therefore be ignored. In practice this requirement is often quite difficult to fulfill. In fact, in a strict sense, it is impossible, insofar as every place and every moment are unique. Two plots may be *similar*, but one of them is

inevitably a little bit further north, or a little bit drier, or a little bit firmer, and so on. And successive days are not exactly alike, nor are successive years, and so on. In the biological world, things are still worse: if one looks carefully, even the peas in a pod are not really identical. All these variations can obscure the particular variation in which we are interested—the variation due to our experimental treatment. The situation is like trying to converse with someone in a noisy room; for our words to be intelligible to each other we must either shout (*amplify* our messages), or quiet the noise around us (*dampen* the medium that carries our messages), or both. Our art as experimenters is to arrange for sufficient *contrast* between the *message* and the *medium*.

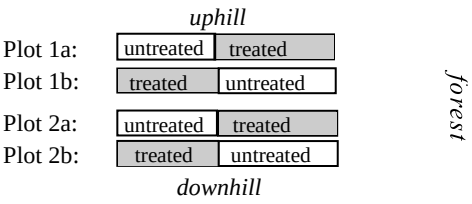
Sometimes it is quite easy to amplify our message to nature—in Steiner's experiment, for example, we can increase the amount of silica we add to the soil. But this always has its limits; thus we also need to know how to clarify our messages by dampening the noise of the medium.

To do this we must first of all select or create a plot of ground that is *as nearly uniform as possible*, so that we can divide it into two or more *highly similar* sections (possibly with "buffer zones" between them—see below). These will be the sections (of "Plot 1") that will receive the different treatments. Another, similarly uniform plot is needed as "Plot 2," but it does *not* have to be *exactly* like Plot 1. Rough similarity is sufficient *between* plots (they will, after all, be planted with dissimilar crops); only the sections *within* the plots need to be as similar as possible. This similarity applies to soil, water, wind, warmth, light, proximity to highways, electric lines, etc; the more similar one can make these beforehand, the easier will it be afterwards to detect the experimental effects (nature's "message"). But one should also not become fanatical; do what seems reasonable the first time, and reconsider this level of preparation only if the experimental results are inconclusive or inconsistent with other experiments and experience.

Specific single environmental gradients like sloping land, which will probably also be correlated with microclimatological gradients like moisture and soil type, can easily be equalized by running the plots at right angles to the gradient (like terraces). However, doing this will sometimes conflict with another environmental gradient such as proximity to a forest. In such cases one can use the technique of *doubling* each plot:




By comparing the results of Plot 1a and 1b (or of 2a and 2b), one can distinguish the effect of the treatment from the effect of the proximity of the forest (this latter effect will be more evident the more distance there is between the "a" and "b" plots, all other things being equal). If this spatial layout does not work well in a particular situation, the distinction between the effects can also be detected (with almost the same sensitivity) by doubling the plots in the other direction and then reversing the sections in the new plots:




These principles of spatial arrangement can readily be extended to compensate for further complicating factors and are also applicable to indoor or laboratory experiments. To gain real insight into the world, each factor must be studied and compensated for *rationally*; this cannot be achieved by randomly replicating the plots. If there are too many conflicting factors to compensate for at once, it is also possible to run several *consecutive* experiments and study the influence of a few different factors each time. This is much less desirable, however, because it introduces the major complicating factor of time (see Section 2.5).

No general guidelines can be given regarding the absolute size of the plots; this depends on the kind and number of plants that will be grown there. For specific crops, however, a considerable body of experience may exist, which can be accessed via regular university extension service channels. In any case it is prudent to leave a "buffer zone" between individual sections, particularly when testing the biodynamic preparations or sprays that might drift. Steiner speaks several times about the "radiations" of the biodynamic preparations, and even draws a picture of them acting within a manure pile (SFRA, pp. 95 & 110), but no concrete experiments have been published as far as I know to determine their actual range of influence (see Section 2.4). Until more is known, a reasonable precaution might be a buffer zone at least as large as the sections themselves (this is not shown in the diagrams here).

The other major consideration is the *temporal* aspect of the medium, i.e., the experimental procedure or *protocol*. We have to maintain consistent conditions and be consistent in our actions; whatever we do to one plot, we must also do to the others (apart, of course, from the one differential treatment that we are studying). Ideally we should also do everything to all the plots *simultaneously*, but in practice this is often not feasible. It is good, therefore, with repeated actions to practice the standard technique of *counterbalancing*; for instance, instead of always watering Plot 1 and then Plot 2, we should deliberately alternate which one gets watered first.

Furthermore, *who* does the actions (watering, weeding, etc.) and *how* they are done must also be consistent. In the Agriculture Course Steiner mentions the personal influence of people on plants, and the influence of thoughts and emotions on plants have also been shown experimentally.[18] Here it is not a question of eliminating this influence, but only of keeping it consistent so that it can be distinguished from other influences. If the same person cannot always maintain the plots, then care should be taken that each person involved spends about the same amount of time with each plot. As a further precaution against subjective influences, all the people involved in the experiment can be *"blinded,"* i.e., their knowledge limited to only one aspect of the experiment. The tasks of designing,

preparing, and maintaining an experiment, for example, could be strictly divided among three or more people.

## 2.3. Choosing an Indicator

All the foregoing steps ensure that the medium of our experiment will not interfere with the message that we wish to communicate to nature. However, to be able to receive a return message, we must ensure that our experimental eyes and ears are in good working order. The instruments or indicators that we use in an experiment are like extensions of our own sense organs. To be useful to us, they must be *selectively* sensitive (i.e., they must react to certain things but not to everything), and they should also be *proportionately* sensitive (i.e., able to detect the intensity of something as well as its presence or absence). A vast array of specialized physical and chemical measuring devices ("indicators") exists, and these certainly have their place, but *to begin with* we need to use and refine our own perceptive capacities and rely on *biological* indicators, especially plants.[19]

In Steiner's proposed experiment described earlier, he said it did not matter too much which species were chosen as long as they belonged to the contrasting polar groups of the grains and the legumes. However, it seems evident that it is not just the contrast that is important, but *which* contrast. All the grains have a special affinity for the substance that was being tested in that experiment, namely, silica (while the legumes have a particular affinity for lime, silica's antagonist).[20] Thus, when testing the qualities of particular things (not only substances but also the quality of space or time—see below), it seems wise to try to select species that have either a positive or a negative affinity for the thing in question. In many cases this will be easier said than done, but there are many clues in Steiner's work and in the general scientific literature about these affinities.[21] On the other hand, some species may function as adequate indicators for a variety of things.

The other consideration in choosing plants as indicators—especially in quantitative experiments—is their *proportionate* sensitivity, which depends on the *uniformity* of their growth pattern as a group. The finer the effects one is trying to detect, the more uniform their growth pattern has to be. To obtain extremely uniform plants, one must choose either a variety that has been highly selected by breeders, or a wild population from an extreme habitat subject to high natural selective pressures. Whether in fact they are uniform enough, can be determined only retrospectively or by preliminary experimentation.

Steiner's basic experimental design can also be used with biological indicators other than plants: for example, one could use two pairs of compost piles, two with high carbon/nitrogen ratios and two with low carbon/nitrogen ratios, to study different compost amendments. Animals too can be used as indicators, but it is not in keeping with their intrinsic sentient nature to *subject* them to different treatments; rather, they should be allowed to *move themselves* and thus choose between two or more foods or environments. Again, the preferences of *different* animals faced with the same choice may reveal a great deal about the qualities of what is being tested.[22]

## 2.4. Testing the Quality of Space

We saw that Steiner's experimental design was appropriate for studying the influence of any kind of substance. A different design, however, is needed to study the quality of different regions of space. In Lecture Four of the Agriculture Course, for instance, Steiner suggests that the *height* of a compost pile or a garden bed has an influence on its vitality independent of such factors as moisture or warmth (SFRA, p. 64ff). To demonstrate this experimentally it is easiest to start right away with a graded series, or rather, with two graded series. Here one can either make two series of compost piles of different heights and compare the quality of their decay, or two series of raised beds of different heights and compare the quality of the plant growth on them.

As mentioned earlier, the biodynamic preparations have radiant qualities, which have not been thoroughly investigated. Determining their range of influence, however, should not be all that difficult. For example, the manure preparations (BD #502-#507) could be inserted *at one end* of a long windrow and the rate and quality of decay regularly checked at different distances. (It might also be instructive to have two more, similar windrows, one fully treated with the preparations and one untreated.) A similar experiment could be done with the biodynamic spray preparations (BD #500 & #501) using a row crop or a field crop (the spraying is best done when the crop is at a sensitive stage of development). In both of these cases a graded series is created simply through the effect of increasing distance.

## 2.5. Testing the Quality of Time

Experiments to test the effect of doing something at different ages or *times* require a new design. For example, to determine the *stage of growth* at which to administer the biodynamic spray preparations, one could plant a crop at weekly intervals in sections of two plots and then, as simultaneously as possible, spray Plot 1 with BD #500 and Plot 2 with BD #501 (and also record the exact stage of growth in each section: e.g., "5 inches tall," "3-leaf stage," etc., since due to weather conditions this will not always match their chronological age):

| | | | | |
|---|---|---|---|---|
| Plot 1: | freshly sown * BD #500 * | 1 week old * BD #500 * | 2 weeks old * BD #500 * | etc. |
| Plot 2: | freshly sown * BD #501 * | 1 week old * BD #501 * | 2 weeks old * BD #501 * | etc. |

Further plots can be added to demonstrate the effect of multiple or alternate sprayings or sprays of different strengths (the sowings, of course, can be done at shorter or longer intervals, depending on the crop). From the resulting growth patterns a rational spray schedule can then be devised to guide crop growth in the desired direction.

It is considerably more difficult to demonstrate the effect of doing something at a certain time during a particular *environmental cycle* (e.g., the daily or yearly cycle of the sun, the synodic cycle of the moon, etc.). The problem is that there are very many environmental cycles, often with periods of very

similar length, and at any given moment one is somewhere within all of them. Therefore, in order to distinguish the effect of a particular cycle (the message) from the effects of all the others (the noise), either the message must be amplified or the noise must be dampened.

Just as the influence of a particular substance can be amplified by concentrating or accumulating it in space, so can the influence of a particular cycle be amplified by concentrating or accumulating it in time. This temporal concentration is accomplished by repeating a certain action every time a specific part of a cycle occurs (e.g., full moon), and by refraining from this action at all other times. The number of repetitions needed increases in proportion to the similarity of the two cycles to be distinguished.[23] The efforts of Maria Thun have popularized the idea of amplifying the effect of particular cycles on specific plants by reserving specific times for any gardening activity around those plants (including cultivating, seeding, weeding, spraying, and harvesting).[24] Although she emphasizes the sidereal lunar cycle in her work, this technique could theoretically be used with any cycle if the activity were continued long enough (perhaps over several years or several generations of plants).

The second and potentially easier way to distinguish a particular cycle, is to dampen the effects of the other cycles. Here one must find something that does not react to the other cycles, but only to the particular cycle of interest; in other words, one must find a substance that "resonates" selectively. In addition, to show the effect of a particular part of this cycle, one must also find a way of either exposing this substance to, or shielding it from, this cycle. By single or repeated exposures to a part of the cycle, this substance then acquires or accumulates a particular influence that can be tested in the same manner as any other substance (see Section 2.1). This seems to be the principle behind Steiner's suggestion that wireworms could be combatted by soaking the soil around them with rainwater that has been exposed to the waning moon for 14 days (SFRA, Appendix B, p. 252). Water, Steiner emphasizes, "is the ideal substance for bringing to Earth those forces that come from the Moon" (SFRA, p. 23). Since moving or stirred water seems to be more exposed than still water,[25] Steiner's suggestion could easily be tested by finding some wireworms, putting them in two clay pots with some soil, and watering one pot with rainwater stirred during the waning moon and the other pot with rainwater stirred during the waxing moon.[26]

Experiments such as these would train us to perceive the exact qualities of the environmental cycles and their parts and would teach us the significance of actions undertaken at these times. If we think not only of mineral substances as "resonators," but also of plants and animals, the possibilities of this technique seem endless—indeed, the making of the biodynamic preparations themselves appears to be a practical application of such a technique.

These basic types of experimental design can be expanded, modified and combined in an infinite variety of ways; to use one's imagination in this fashion is to begin to practice the art of experimentation.

## 2.6. Records: Past, Present and Future

Before embarking on an experiment, it is sensible to try to review what others have already done in one's area of interest. While there is no harm in repeating other people's experiments, knowledge of their work may help one refine one's own experiment. If possible, this review should include personal interviews as well as a study of the literature.[27]

Once an experiment is designed, it is essential to start a journal and record not only the "results" but also the design and the protocol (and the lapses in protocol!). In fact, for the duration of the experiment it is good to make daily entries about the weather and to note any human activity that might impact the experiment as well as any changes observed in the different plots. This is made easier if one's journal is already laid out in a clear way so that one is automatically prompted to record the relevant information. For Steiner's experiment one could set up the following columns, using as many lines as necessary each time to record all the information (u = untreated section; t = treated section):

| | | | *observations* | | | |
|---|---|---|---|---|---|---|
| *date/time* | *weather* | *human activity* | *Plot 1u* | *Plot 1t* | *Plot 2u* | *Plot 2t* |

Record or measure whatever seems appropriate, but also anything unusual (including even subjective "impressions"); look for overall trends or tendencies and then try to find a way to measure them. Although one can hardly help bringing some expectations to an experiment, you should make every effort to remain open to the unexpected. Besides keeping the journal, take photographs and keep samples from each plot. These records enable you (or someone else) to review the experiment and gradually come to an objective understanding of why it turned out the way it did. (Remember, experimentation is an art and cannot be learned overnight.) The records will also be of invaluable assistance in designing follow-up experiments to further refine one's understanding or to individualize one's farm.

Complete the circle by writing a detailed but succinct report of the experiment, letting the facts speak for themselves as far as possible. If the experiment has been done carefully, even "negative" results can be valuable. Writing this report is a social obligation and also a privilege, for the full significance of a particular experiment may emerge only later through the work of a community of researchers.[28]

# 3. The Paths of Individualization

In Section 2 we have discussed at length the outer set-up for an experiment; every experiment, however, also has an inner dimension, a moral or spiritual dimension. This dimension cannot be overlooked in biodynamics if our experiments are to serve the concrete process of individualization. The guidelines that can be offered here will have a different character than the foregoing ones; they will be more pictorial than analytical, more intensive than extensive.

## 3.1. The Scientist and the Farmer

Scientists and farmers in general have quite different relationships to nature. The scientist confronts the differentiated multiplicity of outer nature and strives to discover an inner unity, the universal laws of nature. The farmer, on the other hand, starts with natural unities, with seeds or tubers or cuttings, and strives to produce an outer multiplicity, to multiply them in time and space. The scientist is outwardly passive and inwardly active, the farmer is inwardly passive and outwardly active. The scientist studies the past but dreams of the future; the farmer faces the future but is rooted in the traditions of the past. Nature, in the broadest sense, is experienced quite differently by these two types of person.

For all their differences, however, scientists and farmers often share a common attitude: they seek to control nature. Farmers seek to control nature materially, and scientists seek to do so intellectually, and together they have succeeded within the last century in radically altering the practice of agriculture around the world. Scientists have developed a whole array of high-yielding breeds of plants and animals and also a whole battery of fertilizers, pesticides, and machinery. Many farmers have been tempted by and have embraced these tools, and thereby have brutally succeeded in controlling nature. But their satisfaction has been short-lived. Most have now noticed "side-effects," which the scientists in their arrogance had not anticipated: soils that are more dead, more polluted and more compacted, plants and animals that are less disease-resistant, less fertile and less nourishing. The scientists say they have a solution for these problems too, but some scientists and some farmers are beginning to recognize the trend for what it is: an unholy alliance of arrogance and brutality. They are beginning to recognize the truth of what Goethe, the great German poet, dramatist, and scientist, voiced long ago through the protagonist of his drama *Faust*:

> Mysterious even in the light of day
> Nature keeps her veil intact;
> whatever she refuses to reveal,
> you cannot wrench from her with screws and levers.[29]

More and more people are realizing that living nature cannot be controlled by coercion, and that it is time to seek for a more cooperative relationship with her. But how do we go about doing this? Do we get down on our knees and weep and beg her forgiveness for our years of disrespect and mistreatment? This might not be a bad start, but in the Agriculture Course Steiner suggests something more specific: that farmers should take up active meditation. In Lecture Three he describes very delicately yet concretely how meditation brings one into a different relationship to nature, and how nature then begins to speak:

> Let's ask ourselves what we are actually doing when we meditate. In the Orient, people used to do it in a particular way. We in the West, in Europe, do it differently. Our kind of meditation is only indirectly dependent on the breathing process; we live in the rhythm of concentration and meditation.[30] Nevertheless, what we do in devoting ourselves to these soul exercises still has a bodily counterpart, even though it is very delicate and subtle. In a very subtle way, the regular pace of our breathing, which is so closely tied to human life, is always slightly changed during meditation. While meditating we retain somewhat more carbon dioxide than we do in a state of normal waking consciousness. A little extra carbon dioxide always remains behind in us. Usually we are eager to thrust the full force of the carbon dioxide out into our surroundings, but in this case we hold some back. We don't thrust the full force of the carbon dioxide out there, into the environment that is filled with nitrogen. We hold some back.
>
> You see, if you bump your head against something hard—a table, for instance—you will only be aware of your own pain. If, however, you rub against it more gently, you will become aware of the surface of the table and so on. It is the same when you meditate. You gradually grow into an experience of the nitrogen that surrounds you. That is the process involved in meditation. Everything becomes known, including everything that lives in nitrogen. And this nitrogen is a very smart fellow who can teach you about what Mercury and Venus and the rest of them are doing, because it knows these things and is sensitive to them. Activities like meditation are based on very real processes.
>
> And in fact, it is at this point that the spirit in our inner activity begins to acquire a certain relation to farming. … It is not a bad thing, you know, when a farmer can meditate and thus become ever more receptive to the revelations of nitrogen. Our agricultural practices gradually change once we become receptive to what nitrogen can reveal. Suddenly we know all kinds of things, they are simply there. Suddenly we know all about the mysteries at work on the land and around the farm. … Take a simple farmer, someone an educated person would not consider educated. The educated person may say the farmer is stupid, but in fact that is not true, for the simple reason that the farmer is actually a meditator. He meditates on many, many things during the winter nights. And indeed he arrives at a way of acquiring spiritual knowledge; he is only not able to express it. It just happens that it is suddenly there. As he is walking through the fields, it's suddenly there. He knows something, and afterwards he tries it out. I lived among farmers when I was young, and I saw this happen over and over again. It really does happen. (SFRA, p. 55f)

Steiner explains earlier in Lecture Three that nitrogen is the physical carrier of the activities of nature's "astral body," the body of its soul. The farmer's meditative contemplation of his farm and the ensuing revelations, therefore, are like the beginning of a dialogue with nature, which continues into the actual practice of farming. The farmer's actions on his farm, on the body of nature, are his response to nature's revelations within his soul. By engaging in meditation, the farmer becomes able to cooperate ever more intimately with nature; he acquires some of the "peasant wisdom" that Steiner refers to so often. When this "feeling wisdom" enters into the farmer's actions it purifies his will—it transforms its latent brutality into conscious devotion. As the farmer consciously masters his will, he becomes a stronger, freer individual. As he allows this wisdom to shape his farming practices, he elicits nature's grateful cooperation. He fertilizes his fields with wisdom, and they respond with renewed life.[31]

During the Agriculture Course Steiner naturally focussed on the personal development of the farmer, but there is no less of a

need for this among scientists. For the scientist, Steiner describes elsewhere a path of personal development that is opposite to that of the farmer.[32] Instead of meditation, he emphasizes the need to practice concentration, i.e., to develop a pure, willed thinking that is not reliant on remembered perceptions. This capacity for strong and mobile thinking is exercised in pure mathematics, but Steiner suggests that this capacity may also be trained through the effort of studying his book *The Philosophy of Freedom*. With this inner preparation, the scientist acquires the strength and courage to lay aside the intellectual armor of his preconceptions and thus experience more of outer nature's subtle multiplicity. Instead of reducing nature to fit his mechanistic models, he humbly learns to follow her living gestures. However, he cannot totally acquiesce, or else he would fall asleep. At regular intervals, therefore, he gently resists her lead and thus maintains awareness of the route he has taken, which is to say, of the logical structure of the phenomena, of their unity. In this connection, Steiner recommends a study of Goethe's brand of phenomenological science, especially his work on color.[33]

When the scientist infuses his thinking with will, he frees himself from his habits of thought and purifies his thinking of its latent arrogance. Whereas the farmer in his dialogue with nature oscillates between inner soul receptivity and outer bodily activity, the scientist oscillates between outer soul receptivity and inner spiritual activity. In outer perception the scientist allows his soul to be drawn out into nature's specialized forms and offers only slight resistance to this. If he exerts his will more strongly, he pulls back from the outer world and engages in pure thinking. Here he can explore the inner side of nature, the laws of nature, the mobile concepts of pure mathematics, the wisdom of the spirit of nature.

In *The Philosophy of Freedom*, Steiner demonstrates that only the concepts of pure thinking can serve as motives for human deeds that are fully individual, i.e., fully self-determined and therefore truly *free*. However, before these pure concepts can serve as motives for specific actions, they must be specialized and adapted to the possibilities of the particular situation. For example, I may want to help someone, but until I conceive of some specific way to do so, I cannot begin to act. The general concept of helpfulness must be individualized, and as I do so, I also individualize myself. This capacity to creatively individualize a pure concept into a concrete mental picture, Steiner calls *moral imagination*. Furthermore, to actually help someone, I must also have certain practical skills. The skills needed to incorporate an individualized concept into the physical world Steiner terms collectively *moral technique*.[34] As a scientist develops the capacity for pure, mobile thinking, he will also strengthen his capacity for moral imagination, but in many instances he will lack the moral technique to fully embody his idea. A farmer, on the other hand, must have many practical skills, and may also have a meditative life, but still may lack the capacity for moral imagination. Nevertheless, Steiner writes,

> … it is perfectly possible for persons without moral imagination to receive such mental pictures from others, and to embody them skillfully into the actual world. Conversely, it may happen that people with moral imagination are without technical skill, and must make use of other people for the realization of their mental pictures.[35]

As the scientist purifies his soul, his scientific experimentation becomes a dialogue with the spirit of nature. As the farmer purifies his soul, his practical experimentation becomes a dialogue with the body of nature. When the scientist and the farmer have practiced their respective dialogues separately and successfully, then their collaboration can become a blessing for nature and for humanity.

## 3.2. Human Individuals and the "Agricultural Individuality"

The collaboration of two or more human beings, especially if they are as different as farmers and scientists, brings about the possibility of a wholly new kind of dialogue. If these persons have strengthened and purified their souls through their separate dialogues with nature, i.e., if they have individualized themselves in the sense of Steiner's *Philosophy of Freedom*, this human collaboration then becomes the opportunity for *nature* to individualize itself.

The scientist's dialogue with nature takes place at the level of the *soul* and *spirit*; the farmer's dialogue with nature takes place at the level of the *soul* and *body*. Now, in the third kind of dialogue, the collaboration of the scientist and the farmer provides the opportunity for the *spirit* of nature to enter into direct dialogue with the *body* of nature. Nature is thus enabled to dialogue with itself. In consequence of their contact with each other, both the spirit of nature and the body of nature become individualized. The spirit of nature becomes conscious of itself: it becomes *an individual soul*. The body of nature becomes more differentiated and acquires an independent life: it gives rise to *a localized organism*. This soul and this organism are two aspects of *a new individuality*. Through individualization, nature becomes renewed.

This new individuality is related to a particular locality because of the farmer's role in the dialogue. This individuality may, therefore, be called a *farm individuality* or an *agricultural individuality*. This is the term Steiner chose to use in the Agriculture Course, and it is the term familiar to most people involved in biodynamic agriculture. From another point of view, however, this individuality could also be called a "group-soul," since it arises through and unites the work of a group of human beings. On at least one occasion Steiner also spoke of it in this way.[36]

The "agricultural individuality" is not an abstract "ecosystem," and it is certainly not merely "the sum of a farm's component parts and their interactions"; on the contrary, it is a farm's *living soul*, the living wholeness that heals the separateness of the component parts. This soul lives in a state of potentiality until it can incarnate into a farm where the right conditions are present. These conditions are, first and foremost, the conditions of the *human* souls on that farm. These human beings must share a heartfelt desire to collaborate on a holy task.

If this feeling is present, then the *idea* of a farm individuality can become their common *ideal*. In that case the farm individuality—or group-soul—will already have begun to actualize itself on earth; it will have incarnated at least as far as their own souls. To incarnate it any further, they will have to continue what was described above as the third dialogue.

The third dialogue begins when a scientist, such as Steiner, goes to the spirit of nature and with his moral imagination brings back a concrete idea, in this case, the idea of a farm individuality. Now the farmer, or farmers, enamored of this idea, must supply the moral technique, i.e., through their farming practices they must shape the body of nature in harmony with this ideal. As they do so, the potential individuality of the farm incarnates into the physical farm and thereby becomes more and more of a reality. All life evolves in stages, however, and at first the farm individuality on earth is no more than a new-born babe. This infant individuality will develop into a fully self-regulating organism, but only if it receives continuing care and support during its process of incarnation. The scientists and the farmers must continue their collaboration; they must learn to perceive the presence and the needs of the farm individuality and then find creative ways of meeting them. The scientists' task in particular is to bring knowledge of the outer situation back to the inner spirit of nature and from thence derive new, more detailed ideas of how the farmers can assist the farm individuality in its maturation. This is exactly what Steiner did and as a result farmers now have the unique biodynamic preparations.[37] These are not an end-point, however, but were intended to be part of a continuing dialogue between the spirit and the body of nature.

This dialogue, mediated by human beings, is a process of *cooperative experimentation*. In biodynamic agriculture, experimentation serves—or ought to serve—not just to educate ourselves, but at the same time to educate *a developing farm individuality*. This education does not mean that we impose our expectations or preconceptions on nature, but rather that we enable it to unfold its own potential.

Education, like experimentation, is an art. As we become more skilled in this art, our experiments will become less formal and cumbersome and will gradually take on the character of a living dialogue. But we must be methodical and patient. And we must also be tolerant and positive, for at the stage of cooperative experimentation we are engaged not just in an art, but in a social art. Here it is good to remember that there is also an element of playfulness implicit in the idea of experimentation. Without a doubt, experimentation in the service of nature's individualization is serious, sacred work, but this work does not become enhanced by the admixture of either fanaticism or sentimentality. Humor and joy are entirely compatible with inner reverence and seriousness.[38]

For the sake of simplicity, the collaboration of a scientist and a farmer has been taken here as a kind of archetypal social unit. Experimentation only becomes *efficient*, however, when as many people as possible participate in the general research community by sharing their ideas and their experiences. On the other hand, experimentation only becomes *possible* to the degree that society at large recognizes the *economic value* of research and gives scientists and especially farmers enough breathing space to seriously undertake the process of individualizing the farms. Although experimentation is expensive in the short run, it is incredibly worthwhile in the long run—much like the education of a child.[39]

In this report the effort has been made to sketch the grand vista that opens up when one meditates on Steiner's comments on experimentation. No one should be discouraged by the dimensions of this vista from starting their own experimental dialogue with nature. While it may not be possible to individualize a garden in the same sense as a farm, a garden is an excellent place for many simple experiments, which may also yield profound insights. Although I have focussed on the scientist and the farmer, there is a scientist and a farmer in each of us, and if we foster an atmosphere of love in our groups we will discover all kinds of hidden talent in each other. What we may lack in professional experience will be made up for by the very fact that we are experimenting, because to be willing to experiment is to have learned to learn.

*Where two or three are gathered in my name,*
*there too am I in their midst.*
*(Mt 18:20)*

## Notes

Publisher Abbreviations:

AP-H: Anthroposophic Press, Hudson, New York
AP-SV: Anthroposophic Press, Spring Valley, New York
BDGFA: Bio-Dynamic Farming and Gardening Association, Kimberton, Pennsylvania
BDL: Bio-Dynamic Literature, Wyoming, Rhode Island
MP: Mercury Press: Chestnut Ridge/Spring Valley, New York
RSP: Rudolf Steiner Press, London
RSV: Rudolf Steiner Verlag, Dornach, Switzerland

1. *Spiritual Foundations for the Renewal of Agriculture*, translated by C.E. Creeger & M. Gardner (BDFGA 1993), p. 168; hereafter abbreviated in the text and the notes as SFRA.

2. Steiner intended, for example, that even the specific biodynamic preparations would be modified and adapted to individual situations. In the Second Discussion, after having just introduced the manure preparations (BD #502-#507), he says:

*As a general rule, what I said today is valid for any kind of fertilizing, for improving all your fertilizing materials. We still need to discuss how to adapt this specifically for pastures and hayfields, grains, orchards, vineyards, and so on.* (SFRA, p. 107)

3. On this point Steiner expressed himself as follows:

*I have repeatedly emphasized that clairvoyance is not necessary for understanding the findings of clairvoyant research. Clairvoyance is indeed necessary for gaining access to spiritual facts, but once they have been communicated, anyone can use unprejudiced reason to understand them. Impartial reason and healthy intellect are the best instruments for judging anything communicated from the spiritual worlds. A true spiritual scientist will always say that if he could be afraid of anything, he would be afraid of people who accept communications of this kind without testing them strictly by means of reason. He is never afraid of those who make use of unclouded intelligence, for that is what makes all these communications comprehensible.*

He goes on, however, to stress that trust is not the same as blind belief:

*... It need not be blind belief if you accept communications springing from spiritual research because you trust the researcher. You may have learnt that his statements are in strictly logical form, and that in other realms, where his utterances can be tested, he is logical and does not talk nonsense. On this verifiable ground the student can hold a well-founded belief that the speaker, when he is talking about things not yet known to the student, has an equally sure basis for his statements.* (Lecture of Nov. 11, 1909, in *Metamorphoses of the Soul*, vol. 1, tr. C. von Arnim [RSP 1983], p. 88f)

4. E.E. Pfeiffer reports:

*When I asked him whether the new methods should be started on an experimental basis, he replied, "The most important thing is to make the benefits of our agricultural preparations available to the largest possible area over the entire Earth, so that the Earth may be healed and the nutritive quality of its produce improved in every respect. That should be our first objective. The experiments can come later.* (SFRA, p. 260)

5. See Steiner's book *Theosophy*, tr. H.B. Monges & G. Church (AP-SV 1971), Addendum 13 to chap. 3.6; and his book *The Case for Anthroposophy*, tr. O. Barfield (RSP 1970), p. 65ff. See also Steiner's lecture of Oct. 3, 1914, in *Occult Reading and Occult Hearing*, tr. D.S. Osmond (RSP 1975).

6. Instead of simple multiplication, one would need to apply a formula like the following:

$$(\text{jobs} \div \text{day}) \times (\text{workers} \div \text{talkers}) = (\text{jobs done} \div \text{day})$$

7. It should be noted that *intuitive perception* is not the same thing as *clairvoyance*. Clairvoyance depends on having functioning spiritual sense-organs, just as physical perception depends on having functioning physical sense-organs. *Intuitive perception* is the perceptive ability of the *mind*; it may be exercised in conjunction with either spiritual or physical perception.

8. Steiner, *A Theory of Knowledge Implicit in Goethe's World Conception*, tr. O.D. Wannamaker (AP-SV 1968), chap. 11.

9. Lecture of March 2, 1920, published in: *Warmth Course*, tr. G.F. Karnow (MP 1988); tr. revised by M.I.G. (Malcolm Ian Gardner).

10. Johann Wolfgang von Goethe (1749-1832). See Steiner's book, *Goethean Science*, tr. W. Lindeman (MP 1988), and his lectures of Nov. 1, 1918, in *From Symptom to Reality in Modern History*, tr. A.H. Parker (RSP 1976), and Sept. 29, 1918, in *Das Problem Faust* (RSV 1981).

11. From *Goethe's Botanical Writings*, tr. B. Mueller (Honolulu: Univ. Hawaii Press 1952), p. 220ff.

12. *The Philosophy of Freedom*, tr. M. Wilson (RSP 1964), p. 136; translation revised here by M.I.G.

13. Lecture of Nov. 15, 1923, in *Anthroposophische Menschenerkenntnis und Medizin* (RSV 1971).

14. Sainfoin (*Onobrychis viciaefolia*) is a European legume grown for hay and pasturage.

15. Absurdly enough, I can find no record of this simple experiment ever having actually been done, so for now this must remain a thought experiment.

16. A distinction must be made between *inferential* statistics and *descriptive* statistics. The latter simply summarize quantitative data in a convenient form.

17. It is also possible that some effects will not become evident for *several* generations. One of the primary motivations for arranging the Agriculture Course was the observed degeneration in plant vitality and nutritive quality (SFRA, pp. 3, 26, 40 & 257, see also pp. 247, 249 & 254). In connection with the feeding of animals, Steiner states:

*In the sphere of vitality—if I may so express it—the law of inertia must prevail. It is possible that the effects of such measures will not be visible in the present generation or the following, but only in the third generation. The vitalizing influence extends beyond the first few generations. If you restrict your investigations to the present day and do not extend them over generations, you get a totally wrong picture; and then in the third generation one looks for quite different causes than the feeding of the grandparent generation. Vitality does not collapse immediately, but in succeeding generations the vitality does collapse.* (SFRA, p. 46f)

18. See SFRA, First Discussion, p. 85; and P. Tompkins and C. Bird, *The Secret Life of Plants* (New York: Harper & Row 1973).

19. It should be noted that anthroposophical researchers have developed several types of "picture-forming" indicators that are somewhat intermediate between the biological and physio-chemical realms. These are laboratory techniques that make use of inorganic processes such as crystallization and capillary action to reveal comprehensive force-patterns, which also exist in plants, but which are hidden in their physiological processes. These indicators are frequently used for quality testing. On the technique of "sensitive crystallization," see E.E. Pfeiffer, *Sensitive Crystallization Processes* (AP-SV 1975); on "capillary dynamolysis," see E. & L. Kolisko, *Agriculture of Tomorrow* (Bournemouth: Kolisko Archive Pub. 1978); on "circular paper chromatography," see E.E. Pfeiffer, *Chromatography Applied to Quality Testing* (BDL 1984); on the "drop-picture method," see T. & W. Schwenk, *Water—the Element of Life* (AP-H 1989), p. 191ff.

20. See N. Remer, *Laws of Life in Agriculture* (BDFGA 1995), p. 42ff.

21. For Steiner's indications on plant-substance affinities, see SFRA, pp. 21 & 94ff, and the anthroposophical medical literature (e.g., W. Pelikan, *Healing Plants*, tr. A. Meuss [MP 1997]). See also E.E. Pfeiffer's books, *Weeds and What They Tell* [BDL n.d.] and *Soil Fertility, Renewal and Preservation* (East Grinstead: Lanthorn Press 1983), p. 117ff, as well as C.P. Randles, "Geobotanical Prospecting," *Bio-Dynamics*, #129, Winter 1979, and the agricultural and geobotanical literature on "indicator plants" and "accumulator plants."

22. To a certain degree, plants too are capable of expressing "preference." See, for example, the root growth preference experiments described by E.E. Pfeiffer in *Soil Fertility, Renewal and Preservation* (East Grinstead: Lanthorn Press 1983), p. 135.

23. To clearly distinguish, for example, a 28-day cycle from a 30-day cycle, one would need at least 14 repetitions or 392 days (i.e., the shorter cycle [28 days] divided by the difference between the two cycles [2 days]).

24. See, for example, *Work on the Land and the Constellations* (East Grinstead: Lanthorn Press 1990), p. 36; and *Working with the Stars–1996* (Launceston: Lanthorn Press 1996), p. 12.

25. See T. Schwenk, *The Basis of Potentization Research* (MP 1988), and *Sensitive Chaos* (RSP 1976).

One could also try exposing still water to *concentrated* or *magnified* light from the waxing or waning moon (see J. Schultz, *Tierkreisbilder und Planetenlicht*, [Dornach, Switzerland: Mathematische-Astronomische Blätter, neue Folge, n.d.]).

26. J. Schultz also experimented with *shielding* growing plants with various organic materials (e.g., peat or horn) and then exposing them to different part of the day for a period of 10 days (*Wirksamkeit der Tageszeiten in Wachstum und Substanzgeschehen* [Dornach, Switzerland: Schriftenreihe der Naturwissenschaftlichen Sektion 1951]).

27. In biodynamics, unfortunately, reports of research are scattered over dozens of journals in several languages, and useful reviews of the "state of the art" are very scarce. To be truly useful a review must not just enumerate past observations and experiments; it must "digest" them and present an overall picture of what is known and, especially, of what is not known. However, no one should wait for such a review if the need is urgent, for no two experiments are ever exactly alike and any solid experiment strengthens the biodynamic movement (especially if it is published!). For an initial overview of the research literature, see the editorial notes and bibliography in SFRA, and also H. Koepf, *Research in Biodynamic Agriculture: Methods and Results* (BDGFA 1993).

28. Research reports may be submitted to *Applied Biodynamics*, the newsletter of the Josephine Porter Institute.

29. J.W. von Goethe, *Faust*, tr. P. Salm (New York: Bantam Books 1962), Part 1, Act 1.

30. Compare Steiner's succinct explanation of concentration and meditation in his lecture of May 26, 1914:

*Meditation and concentration are not some kind of miraculous mental accomplishment; they are merely the supreme enhancement of mental processes that we also find on an elementary level in our everyday life. Meditation is infinitely enhanced devotion of the soul, such as we may experience in the most joyful religious feelings. Concentration is infinitely enhanced attentiveness, which we also employ in an elementary way in ordinary life.* (*The Presence of the Dead on the Spiritual Path*, tr. C. von Arnim [AP-H 1990]; tr. revised by M.I.G.)

Note that Steiner also often uses the term meditation more broadly to cover both of these processes. For further details on meditation (in the broad sense), see his basic book *How to Know Higher Worlds* (tr. C. Bamford [AP-H 1994]).

31. Compare Steiner's remark that meditation enhances the meditator's "personal influence" on plant growth (SFRA, First Discussion, p. 85).

32. See Steiner's lecture of Oct. 3, 1920 (in *The Boundaries of Natural Science*, tr. F. Amrine & K. Oberhuber [AP-H 1983]).

33. See J.W. Goethe, *Scientific Studies*, tr. D. Miller (New York: Suhrkamp 1988); R. Steiner, *Goethean Science*, tr. W. Lindeman (MP 1988); H. Proskauer, *The Rediscovery of Color*, tr. P. Stebbing (AP-SV 1986); and H. Bortoft, *The Wholeness of Nature* (AP-H 1996).

34. See note 12, chaps. 9 & 12.

35. See note 12, chap. 12, p. 165; translation revised here by M.I.G.

36. Steiner spoke extensively about the group-soul aspect of the agricultural individuality at a private gathering on Whitsunday, June 8, 1924, between the first and the second lectures of the Agriculture Course. No stenographer was present, however, and apparently no one ever made detailed notes from memory, so we have only sketchy reports (see: *The Birth of a New Agriculture: Koberwitz 1924* , edited by Adalbert Graf von Keyserlingk [London: Temple Lodge Press 1999], p. 66ff.; and *Erinnerungen an frühe Forschungsarbeiten*, by A. von Keyserlingk [Dürnau: Verlag der Kooperative Dürnau 1993], p. 82f.). Steiner also discussed the subject of new human group-souls on several other occasions; see his lectures of Nov. 23, 1905 (*Brotherhood and the Struggle for Existence*, tr. unknown [MP 1980]); June 1, 1908 (in *The Influence of Spiritual Beings Upon Man*, tr. unknown [AP-SV 1961]); June 7, 1908 ("Whitsun, the Festival of United Soul-Endeavor," in *The Festivals and their Meaning*, tr. G. Adams, J. Davy & D.S. Osmond [RSP 1981]); and Feb. 27 & Mar. 3, 1923 (in *Awakening to Community* , tr. M. Spock [AP 1974]).

It is also relevant to note the similarity of Steiner's descriptions of the agricultural individuality and the "threefold social organism." Both of these entities have three-membered bodies, and both are "upside down" with respect to the three-membered bodies of the individual human beings within them. For further details, see SFRA, p. 28f, and his lecture of Jan. 25, 1919 (*Anthroposophic Newssheet* 1944, 1 & 2 [GA 188]); see also his book *Towards Social Renewal*, tr. F.T. Smith (RSP 1977), chap. 1.

37. The six manure preparations are particularly relevant here (BD #502-#507). Of the nettle preparation (BD #504) Steiner says:

*When you add this to your manure—just like the other preparations—the effect will be to make the manure inwardly sensitive and receptive, so that it acts as if it were intelligent and does not allow decomposition to take place in the wrong way or let nitrogen escape or anything like that. This addition not only makes the manure intelligent, it also makes the soil more intelligent, so that it individualizes itself and conforms to the particular plants that you grow in it.* (SFRA, p. 99f)

38. See H. Eppinger's book, *Humor und Heiterkeit im Leben und Werk Rudolf Steiners* [Humor and Levity in the Life and Work of Rudolf Steiner], (Dornach, Switzerland: Verlag am Goetheanum 1985), esp. p. 158.

39. In his Course on economics, Steiner went so far as to say:

*What are the most productive of all transformations of capital in the economic process? Follow out such connections as I have just described, especially those amounts of capital which go into foundations, scholarships and so on, which in due course fertilize inner creativity and enterprise of every kind—and you will perceive that free gifts are the most fruitful thing in the whole economic process.* (Lecture of Aug. 1, 1922, in *Economics: The World as One Economy*, tr. O. Barfield, T. Gordon-Jones & C.H. Budd [n.p.: New Economy Publications 1993])