III. Technical Individualization

The principle that recurrent causality individualizes a technical object in its associated milieu makes it possible for us to consider all the more clearly certain technical ensembles and to know whether we should treat them as technical individuals or as an organized collection of individuals. We may say that a technical individual is one having an associated milieu as a sine qua non condition of its functioning. The opposite is true of an ensemble. In the case of a laboratory such as a laboratory for the study of the psychology of sensations, one might ask if an audiometer is a technical individual. If we consider it apart from power supply circuits and the earphones or microphones that are its electroacoustic conductors, the answer is no. The audiometer is defined as having to be placed in certain conditions of temperature, voltage, and noise-level so that stable intensities and proper measurement of thresholds are possible. The room's coefficient of absorption and its resonances at various frequencies have to be taken into account. The locale is part of the whole apparatus. The audiometer has to be operated either in flat, open country or else measurements must be taken in a sound-proof room with microphonic floor suspension and walls heavily covered with glass wool. What, we might ask, is an audiometer essentially, regardless of whether it is factory-made or home-made? It is an ensemble of technical forms with relative individuality. For example, it has two high-frequency oscillators, one of which is fixed, the other variable. Whichever of the two frequencies has the lower beat is the one producing the audible sound. An attenuator makes it possible to regulate the intensity of stimuli. Neither of these oscillators is

alone a technical object because in order it be stable it requires stabilized heater voltage and anode voltage. Generally, this stabilization is obtained by means of a recurrent causality electronic system which functionally constitutes the associated milieu of the technical forms of oscillators. However, what I have called an associated milieu is not quite that. It is, rather, a transfer system, a means of adaptation allowing the oscillators not to be influenced by the external technical and natural environment. It could not be a true associated milieu unless a chance frequency drift in one of the oscillators led to a variation in the supply-current that works against such a drift. This would involve an exchange between regulated supply and oscillators through reciprocal causality. The ensemble of technical structures would be self-stabilized, whereas here the opposite happens: only the supply is self-stabilized and does not react to chance variations in the frequency of one of the oscillators.

There is a great practical and theoretical difference between these two cases. Indeed, if only the supply is stabilized without any connection of recurrent causality with the oscillators, other uses of the power supply at the same time could be limited or extended without inconvenience. For example, one can plug in a third oscillator to the same supply without interfering with its operation, as long as normal limits of output are not exceeded. On the other hand, if one wishes to get an effective retroactive regulation, one must have no more than one single structure attached to a single associated milieu. Otherwise, chance variations opposite in direction to the two structures that are not synergetically connected to the same associated milieu could balance each other and fail

to lead to a regulatory reaction. Structures connected with one single associated milieu should operate synergetically. Therefore, the audiometer comprises at least two distinct parts that cannot be self-stabilized by the same associated milieu--the first, the frequency generator, the second, the amplifier-attenuator. One of these ensembles cannot be allowed to act upon the other, so the two connecting leads must be carefully separated and, in order to prevent interaction of any kind, the partition separating them must be electrically and magnetically screened. On the other hand, the material limitation of the audiometer is not a functional limitation. The amplifier-attenuator is normally extended by the acoustic reproducer, or by the room, or by the outer ear of the subject, depending on whether connection with the subject is made by loud-speaker or earphones. Consequently, it is possible to postulate the existence of relative levels of individualization in technical objects. This criterion has an axiological value: the coherence of a technical ensemble is maximal when the ensemble is made up of two sub-systems with the same level of relative individualization. So, in a laboratory for the study of the psychology of sensations it would not be advantageous to group together the amplifier-attenuator and the two oscillators of the audiometer. There would be an advantage, however, in grouping the two oscillators so that they could respond at the same time and to the same degree to current or temperature variation, so that the lower beat-frequency resulting from these two correlative frequency variations in each oscillator are reduced as much as possible, assuming that both the fundamental frequencies rise and fall together. As opposed to this, it would be totally contrary to the functional unity of the beat-frequency

generator to have two separate power supplies and to connect the power supply of one oscillator with one phase of the circuit and the second with the other phase. This would upset the effect of self-stabilization because it would compensate for the two variations which give the ensemble of the two oscillators stability in low-beat frequencies. Still, it would be useful to plug the oscillators into a different power-phase than the one to which the amplifier-attenuator is attached: this would prevent the supply voltage of the oscillators from reacting to variations in anode consumption by the amplifier.

The principle of the individualization of technical objects in an ensemble is a principle of sub-ensembles with recurrent causality in their associated milieu. All technical objects with recurrent causality in their associated milieu should be separated from each other and should be connected in such a way as to preserve the mutual independence of their associated milieux. Hence, the respective sub-ensembles of oscillators and amplifier-attenuator-reproducer should be independent of each other in power supply and in their coupling. Amplifier intake should high in relation to oscillator outlet, so as to insure that oscillator reaction to the amplifier is as slight as possible. If, for example, the attenuator were connected to the outlet of the oscillators, adjustment of the attenuator would react on the frequency of the oscillators. An ensemble of higher degree which comprises all these sub-ensembles is defined by its capacity to effect various free relationships without destroying the autonomy of individualized sub-ensembles. This is the part played by a general connection command panel in a laboratory. Electrostatic and electromagnetic screening and the use

of non-reactive couplings such as the cathode-follower are designed to maintain the independence of sub-ensembles while allowing for the various necessary combinations between sub-ensemble functions. The availing of the benefits of functioning without any interaction between conditions of functioning is a secondary functional role of the ensemble called the laboratory.

We might ask, then, at what level individuality exists. Does it exist at the sub-ensemble or ensemble level? The answer must as usual be given in terms of the criterion of recurrent causality. Indeed at the higher ensemble level (that of the factory, for example) there is really no associally milieu. If there is, it exists in only certain respects, and has no existence of a general nature. As an example, to have oscillators in a room where an audiometry experiment is being done is often bothersome. If the oscillators use transformers with magnetic circuits made of iron*, magnetostriction in the laminations leads to a vibration that emits a disturbing sound. An oscillator with resistors and capacitators also gives off a weak sound as a result of alternating electric attractions. In order to conduct delicate experiments, it becomes necessary either to place the apparatus in a different room and to operate them by remote control or to isolate the subject in a soundproof room. Likewise, magnetic radiation in power transformers can greatly interfere with amplifiers in electroencephalographic and electrocardiographic experiments. That higher ensemble which is the laboratory is therefore made up of non-connected devices thereby preventing the chance creation of associated milieux. The difference between ensemble and technical individuals lies in the fact that

for the ensemble the creation of a unique associated milieu is undesirable. The ensemble comprises a certain number of devices that prevent any possibility of the creation of a unique associated milieu. It prevents the interior concretization of the technical objects it contains and only makes use of the results of their operation without allowing for any interaction of what conditions them.

Below the level of technical individuals, are there any groupings with some degree of technical individuality? Yes, but the individuality they possess is not structured like that of technical objects with an associated milieu. Its structure is like that of a plurifunctional composition that lacks a positive associated milieu; that is to say, without self-regulation. Let us take the case of hot-cathode tube. As soon as this tube is placed in a lay-out with automatically polarised cathode resistance it becomes the centre of phenomena of self-regulation. If the heater voltage increases, for example, there is an increase in cathode emission and this leads to an increase in negative polarisation. The tube no longer increases amplification and output scarcely rises, and the same is true of its anode dissipation. A similar phenomenon in Class A amplifiers* is responsible for stable levels of output despite variations in levels of input in the amplifier. But such regulatory counter-reactions are not centred only in the interior of the tube. They depend upon the ensemble of the layout and, in certain kinds of fixed layouts, they do not exist at all. Thus, a diode whose anode heats up conducts in both directions, and this increases the intensity of the current that goes through it. The cathode, receiving the electrons coming

from the anode, becomes increasingly hot and, accordingly, gives off an increasingly greater number of electrons. This destructive process is therefore an example of positive circular causality which belongs to the whole layout and not solely to the diode.

Infra-individual technical objects can be called technical elements. They differ from true individuals in the sense that they have no associated milieu. They can be integrated into an individual. A hot-cathode tube is more a technical element than a complete technical individual. It can be compared to an organ in a living body. In this sense it would be possible to define a new science of general organology. This science would involve the study of technical objects at the level of the element. It would be part of the science of technology, including mechanology, whose subject of study would be complete technical individuals.