

Scambi – description of a work in progress (1959)¹

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English translation by Christine North.

I had two ideas in mind when, in the spring of 1957, I started work on this piece². First, I intended to create structures which would allow the listener some freedom of perception (opportunities to participate in the time-formation). Secondly, I thought it essential to use material which expressly stood apart from the *periodicity* of traditional music.

Although, in Webern and most post-Weberian instrumental works, something like the permanent expression of a negative principle can be found, and although many of their structuring principles (especially in the area of harmony) can be interpreted as deliberate, willed challenges to forms of tonal language (the most tense dissonances, non-linear polyphonies, irregular temporal development, discontinuous instrumentation and dynamic discourse etc.), this essentially arises from the fact that there was a radical clash between the desire for a generalized asymmetry (intended to spread the interest over the whole chronological development and to prevent it from resolving into mechanical necessity) and sound material with defined pitch, which we still felt we should use almost exclusively. As the means of production of this material had been chosen for quite different purposes (and has also given rise to quite different linguistic forms), we eliminated from it everything that was not absolutely periodic³. Indeed, only the simplest, most regular material forms could express transparently enough the causal relationships that we sought in order to convince the listener of their inevitability. As we wanted to carve out a space and a time completely separate from the concepts of polarity and causality of classical thought (consider Webern’s desire: “Es soll

¹ Original publication: “Scambi”, *Gravesaner Blätter* 13 (1959), pp. 36-47 (German) and pp. 48-54 (English); in Italian in *La musica elettronica. Testi scelti e commentati da Henri Pousseur*, Milan, Feltrinelli, 1972, pp.135-147.

² In Italian, “scambio” means exchange, “Scambi” is the plural form.

³ It is remarkable, for example, that in the classical orchestra the percussion section is reduced to tympani alone, which as we know are the only “drums” which can produce relatively well-tuned pitches.

alles schweben” -“Everything must float”), and as we wanted to bring back a dimension of “freedom” into music (and this - even if some people cannot accept it - is the driving force behind the whole musical revolution today), it was necessary, at least while we only had the above-mentioned material, to proceed with the utmost caution: this material was, as it were, just waiting for us to take our eyes off it for a moment to clot together again and recreate the links *for which* in fact it had been intended. This is why, with Webern, chromatic relationships already predominate (still, most often, in the tensest form of ninths and sevenths), associated with avoiding - as Schoenberg had already stipulated, but which was only fully realized here - formations of (simultaneous or consecutive) *perceptible* octaves, empty fifths, over-harmonious chords etc., i.e., in short, with the caution already mentioned, with an austerity which has been too often admired - in the abstract - for its own sake. This was then extended to the point where such complex, irreducible sound phenomena, based on periodic material, were obtained (i.e. Webern’s fifth *Bagatelle* or the famous “sound blocks” in the *Variations* for orchestra and - in particular - the first movement of the *Second Cantata*) that ultimately a new and entirely positive dimension opened up to the aware listener: the field of what had negligently until then been called “noise”, but which nonetheless concealed an unbelievable diversity, an undeniable wealth of finely-differentiated sensations. However, today, only electronic means of production, released from the “natural” sound-production of our traditional instruments, give us the opportunity to consider this field as anything other than a - carefully constructed - exception, and to manipulate and evaluate the “goods” they offer with a new freedom. Indeed, the new techniques and the objectives being sought seem suited to each other in a way that is entirely functional.

Finally, I had to keep a third condition in mind: I had a relatively short time to carry out my work. I had to find methods for producing and developing my material which would give fairly rapid results - without, of course, in any way compromising the quality of form and matter. This is why from the outset these methods had to differ from the microstructural techniques which even today are almost exclusively accepted in electronic composition.

At the Milan broadcasting studio I found a little piece of equipment built by Dr. Lietti, the studio’s technical director, which might be called an “amplitude selector” or a “dynamic

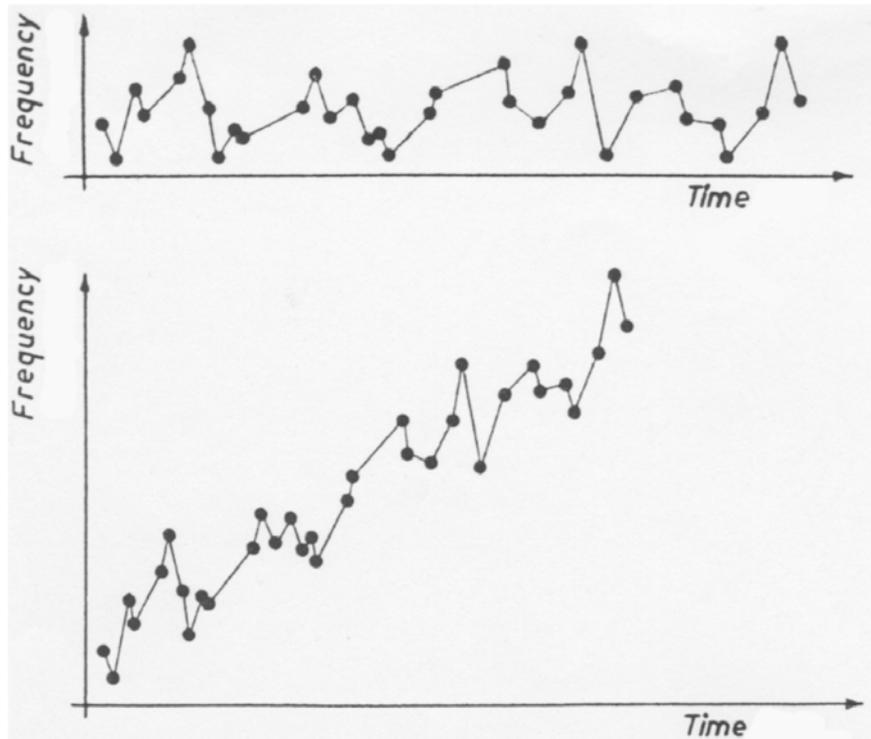
filter”⁴. With the help of this filter it is possible to select from a group of signals (or from a longer, more complex sound phenomenon), only what exceeds a given dynamic level. The threshold, which can be adjusted so that the cut-off is very steep, or alternatively, is achieved gradually by adjusting the setting downwards, can be raised or lowered at will. In other words, depending on the position of the cut-off point, it is possible to isolate from the same sound-reserves a more or less dense, short-lived “foam”.

If, for example, a highly-filtered band of white noise is fed into the machine, so that the level at which it goes through - set at steep cut-off - is quite high, the continuous, uninterrupted character of the noise-band is lost, and we hear only a series of short signals, comparable, depending on their average pitch, to drum-beats or *pizzicati*. As the texture of white noise is extremely irregular (and - in any case - depends on which generator is used) the time-sequence of these signals is totally aperiodic. Only mean, statistical information can be given on their speed, and only after a period of listening. Similarly, the signals present subtle and unpredictable differences in dynamic level and pitch (the latter, in such dense spectra, are only approximately perceptible). Everything above the cut-off point is not, however, of the same maximal intensity: hence the dynamic differences. These “peaks” in the band of white noise, on the other hand, occupy different points of fixed pitch in very different ways, depending on their distance from the centre: hence the differences in frequency (which, independently of the width of the band, create little non-tempered variations around its centre).

The statistical speed mentioned above can be changed due to the fact that the speed of passage through the selector (or the overall strength of the white noise which is fed into it) can be very finely adjusted. It is thus possible, from one white noise-band, to produce both a sequence of relatively infrequent, dry, and isolated signals, and a sort of “bubbling” in which the elements fuse together almost like continuous white noise (ex. 1). These two extremes can be reduced to a common dynamic maximum (which seems to me to be the essential condition for eventual structural manipulation) by recording them, amplifying them as necessary and then putting them through the selector again. The result of this back to front way of proceeding is: first, to bring everything back to the same maximum (0 dB): secondly, to get rid of some sequences of signals (especially the slowest, where the “gaps” are the most

⁴ In effect it is a cut-off amplifier. See also Alfred Lietti, “Soppressore di disturbi a selezione d’ampiezza”, *Elettronica* 4/5 (September/October 1955).

perceptible), of little crackles or impulses (during which the spectrum had not had time to develop), and of all the noises of amplification: and thirdly, to give the sound phenomena thus obtained a final rounded form⁵.



Example 1 - The “score” of an amplitude-filtered “coloured” noise-band.

Top: before, bottom; after the change of speed.

The material obtained in this way conforms - to some extent - to the two previously mentioned conditions: it is very asymmetrical and can be produced quite rapidly. Without having first to compose the spectrum of signals partial by partial, and then arrange them in a non-periodic sequence, we obtain a raw material already full of life - elementary life maybe, but all the more undeniable⁶. The famous “alea” is present only within precise limits, determined by conscious thought and structurally exploitable: however, with regard to the pitches of the sound, the dynamic level and the mean speed of playing the material (i.e. in short, all the signs that show its perceptual effectiveness), absolute control is still maintained.

⁵ The technician Marino Zuccheri helped me greatly in ensuring the cleanness and quality of this material.

⁶ We should briefly mention the helpful “Biologie de l’Art” by Wladimir Weidlé (*Diogenè* 18th April 1957, pp. 6-23), where the relationship between life - natural or artificial - and some forms of asymmetry are already demonstrated.

So the systematic production of a reserve of this material, differentiated both in pitch and temporal density, was the first phase of my work. I chose eleven different bands of white noise, filtered into half-octaves (140-200, 200-280 etc. up to 4500-6400 Hz), from which each time I ran off five tape speeds from different “settings” - from the highest to the lowest speed. Then, and for a reason which I cannot justify until later, the results were mixed 3 by 3 (each time three layers of identical speed and immediately adjacent pitch, e.g. 1-2-3, 2-3-4, etc.). This changed the “band-width” (ambitus) of the levels and had the further result of appreciably increasing their capacity for inner movement (particularly in pitch), yet without affecting the spectral character of the signals themselves. Instead of the eleven degrees of pitch I now only had nine different ones within each of the five mean speeds.

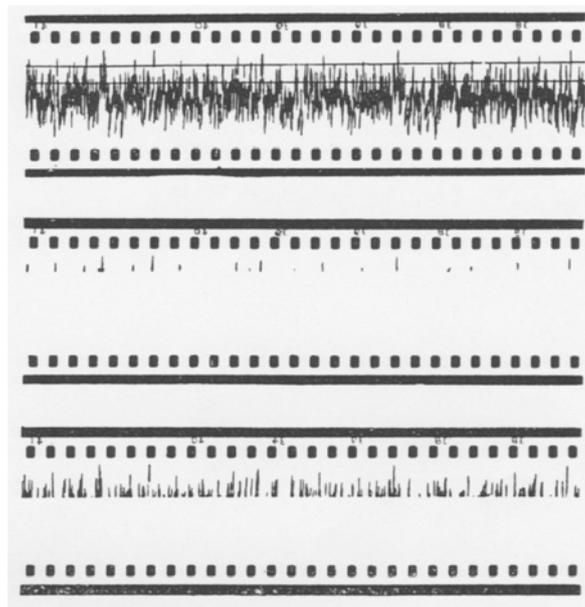
In the next phase of my work, I had to resolve two separate problems. First, it was not possible - or even desirable - to construct a whole piece from this one dry and “plucked” type of material. It needed the contrast of another, more sustained, sound family with the additional properties of internal asymmetry and structural suppleness which could then be put into continuous relationship with the first in a situation of progressive exchange. Secondly, I needed to draw even more external suppleness from the first material, which was both statistical and graduated. More precisely, I needed to be able to produce, both in the timing and pitch of the sounds - but each independently - forms of progressive movement, changes and continuous passages (and this could not be reduced to the simple juxtaposition of short statistical pieces in different degrees).

Although in reality I solved the first problem before the second, or, to be more precise, I pursued the work on every “front”, in the interests of clarity and simplicity I should like to describe the solutions I adopted in reverse order.

The forty-five layers of basic material were recorded on endless loops, long enough (eight to ten metres at a speed of 38 cms/sec) to avoid a too rapid repetition of the same aleatoric figures. These loops were played on a variable speed tape-recorder. The recording tape-recorder was “loaded” with loops consisting partly of magnetic tape (8 to 80 cm) and partly of leader tape: thus, during the recording, short extracts of the first loop were dubbed on to these loops. As this recording was taking place I gradually varied the speed of the first tape-recorder (the play-back), the speed-change being read off from the speed control of the

first recorder, and the duration from watching the second tape passing on to the recording head. Immediately after the recording I listened to the recorded passage again, wiped it and remade it as often as necessary until I was satisfied with what I had obtained, i.e. until it was fit for purpose (not an absolutely precise representation, which - with this aleatoric way of proceeding - would have been unlikely).

Theoretically, the consequence of changing the speed of the master-tape should be a proportionate change in the pitch of the recorded sounds, and in their speed. However, because of the shortness of the dubbed extracts, their aperiodic structure and the very small movements, changes in time in most cases were not apparent: only the changes in pitch could be perceived! Thus, the two fields of variation were more or less separate from each other. Time variation needed to be achieved by other means, which will be discussed later. However, even the variations in pitch were not simple, and it can now be easily understood why the varieties of initial material had to be mixed three by three. It was the only way to avoid an unwanted linear development of pitches; it made it possible to give it a leaping, discontinuous movement, which could only be perceived in a general way (do not some internal intervals of a layer - conditioned by the superimposition of the three elements which compose it - often run contrary to the overall picture!). - ex. 2.



Example 2. - Top: oscillogram of white noise.

The horizontal lines indicate two settings of (cut-off) selection.

Middle: the result of the higher cut-off. Bottom: the result of the lower cut-off.

The groups, varying in length between one quarter and two seconds, were then spliced to give forms with larger-scale movement (both longer and occupying more space). Only at this stage did real, perceptible changes in the statistical speed of the groups of signals happen, and this in a very simple way, from the fact that the spliced segments of tape come from different speed groups. This produced no break in movement. The statistical, aperiodic composition of each group, the fact that in the slower groups there could be some shorter intervals and in the faster groups, longer ones, made a seamless linkage possible. The splice passed unnoticed (except in some particular places where it was intended), and the changes made to time and pitch could be perceived only after some time: by which, perhaps, a new direction had imperceptibly been embarked upon.

So now I had four base models, already longer (eight to sixteen metres i.e. more or less twenty one to forty two seconds), and made from one dry material; they differed from each other in various ways in which their pitch and average speed developed overall:

- from high-fast to high-slow
- from high-fast to low-fast
- from low-slow to low-fast
- from low-slow to high-slow

These four models, which were to be the basis for later developments, could also be used in reverse. As the basic signals did not have an absolutely symmetrical structure, their “reverse play” was not exactly the same as their normal play. But normal and reverse groups had been included in each sequence model in such a way that the proportion of each type remained approximately the same when a sequence was reversed.

It was now possible to apply to these basic forms the solution - which had already been found - to the second problem mentioned above - the production and incorporation of other types of sounds with longer resonance. The most organic method seemed to be to derive the new sound-family from the first. The *echo-chamber* - used not to create sound-effects, but as a true means of sound production - could be the tool (as had been the case - of course very differently - with Stockhausen’s *Studie II*). If I injected a signal from the “dry” material into the echo-chamber, and then reversed the recording of this procedure - i.e. played it backwards

- I naturally obtained the echo *before* the original signal. The impression given was no longer of an echo, but of a sound in itself (a sort of very thin band of noise), slowly expanding, ending on a maximum dynamic which stopped abruptly, increasing suddenly and in a distinctive manner before it stopped (this was the original signal). If I again put this “crescendo” form through the chamber, the new echo, this time coming after it, was to some extent contaminated by the first, and also appeared, no longer as an echo-effect, but as *what it really was*, a sound phenomenon freed from the pseudo-realism of optical-illusion acoustics. What would normally have been interpreted by perception as the sign of a reverberating space was now, as it were, included in the material, had been seized by it: it had materialized! Through this procedure, the material had been endowed with an inner space, as it were, a distinctive depth, it preserved deep within itself the relationship of reciprocity between space and matter (which might be considered as a pole of modern sensibility and imagination).

If I now put not one signal, but a whole group of signals articulated in pitch and speed through the chamber, this double echo was even more reinforced by the fact that the sound “rays” produced by the isolated individual signals resonated within each other and more or less flowed together. If the groups were dense enough, the original signals could be almost completely absorbed into the texture which their reverberations had created, with the result that once more we had noise “surfaces”, comparable to homogeneous white noise, but much *purified*. These surfaces still preserved a certain “granularity” (a “bubbling” of dry elements) and moved slowly - in keeping with the overall movement of the original group - in the pitch-registers of the sound. It is interesting to note that what, in the first material, functioned as time density (speed), became, as a result of the change in form brought about as it went through the echo-chamber, spatial (“harmonic”) density: the greater the number of original signals, the denser and more noise-like the result; the fewer there were of the former, the more transparent the result, like a chord or a melody. So - *through a purely technical process* - I had achieved a new, close relationship, an organic link between the dimensions of *time* and *space*.

I still needed to make this potential relationship perceptible in reality, articulated in time, i.e. to place the dry and the homogenized materials in a perceptible relationship of reciprocal interchange; this was easily done.

It was possible to control two potentiometers from the same control-console. With one I could adjust the 'dry' materials coming out of the tape recorder, with the other I adjusted the feedback from the echo chamber itself, through which I passed this material independently of my first procedure. In this way it was possible to mix the two forms freely, and this was how the material now presented. If the first potentiometer alone was used, only short signals were heard, if the second alone was used, only sound events distorted by the echo could be heard. By controlling the two potentiometers independently of each other I was finally able to produce every intermediate form, even when constantly varying the load, as I could, of course, vary the speed of regulation. These new modifications of the material also behaved dialectically in pitch and speed.

Each of the four models which I had already made (dry signals) were thus subjected to eight different mixing processes, four forward and four in reverse. The four types were further differentiated from each other by an overall - but irregular, interrupted - direction in the mixing process:

from dry to homogenous

from dry to dry

from homogeneous to dry

from homogeneous to homogeneous

The "front" echo and the "rear" echo were of course adjusted separately one after the other. This procedure - like the two preceding phases of my work - still presented as a concrete, direct operation on the sound material, taking place in "real-time" and immediately monitored by the ear, as if it were a sort of instrumental performance (this is important for an understanding of what follows). If one mix was not good enough for the plan of composition it could be re-done as often as needed, until its form was quite satisfactory.

One question remained to be resolved before the structures could be considered as finished, fulfilling the initial requirement, i.e. before they could be presented to the "listener" for the purpose of manipulation. The thirty-two sequences which I had were continuous sound processes, varying only in pitch, speed ("inner" movement of the material) and qualities of articulation (dry or homogeneous). Before they could be (as I wished) juxtaposed in any order, superimposed polyphonically in a variety of ways and their dynamic levels modulated

in a free and constantly changing way, I felt I needed to introduce long pauses to break the flow, still too linear, and to allow new psychological syntheses of these isolated figures, thus stimulating the listener-collaborator's imagination even more.

I was reluctant to use scissors at this late stage; the finished material now had its own complex integrity, which would have been interrupted, physically injured as it were (at least that is how I felt about the organic cohesion of the material). From the point of view of form, the slightest cut would have had unforeseeable consequences, it would have introduced new ideas into the structure and necessitated further work which could have taken quite a long time. Unfortunately I didn't have the time and I didn't want to develop this work any further. So once again I decided to turn to the amplitude selector, which I had used at the outset to produce the material. The structures would be played back by a tape-recorder, and its potentiometers would allow me to adjust the dynamic levels as the tape passed through: when they emerged they would be put through the selector - now set at a gradual, not as steep setting - then re-recorded. Depending on the setting of the dynamic level, the material would either go or not go through. However, it was impossible to determine the precise point at which the sound suddenly appeared, or disappeared: to a large extent this depended on more or less subtle dynamic differences which constantly occurred in structures which were in part aleatoric. So, to a certain extent, my manipulations were "blind": in particular I could not follow the sounds going through the potentiometer when it was turned off, nor what could emerge when it was turned on. I had only a very vague idea, despite my knowledge of the sequences I was interrupting. Of course, I could continue with this manipulation as long as I wanted before recording, and I could even record several "versions" and then choose "the best". But there was still a certain percentage of chance which could only have been eliminated by further long-term work. This was not the purpose of the piece: for this dialogue with an external and to some extent unknown event, the partly unpredictable intervention in a series of events taken from the "world" seemed to me to be a model for a way of working which would give truly creative freedom. This was yet again a development of the principle of validating the aleatoric which I had applied from the beginning. The production of "general pauses" depended on the nature of the existing material: did not the quality of the material itself determine how it went through the selector!

It could still perhaps be objected that this way of proceeding led to some of the things which I had initially striven to create being lost to me. So should I abandon it as non-

functional? But it mustn't be forgotten that on each occasion colour variations of a series of "dry" signals resulted in an ensemble of four sequences. However, this variation could not disguise the identity of the source, and the four sequences were very similar, with many, almost "literal" repetitions (even in the quality of the material). However, by adding general pauses, and inserting them in the places where the similarities were greatest, and at the same time deliberately creating different groupings, four structures were produced, related, it is true, but now without any over-long, noticeable repetitions (due to the consistency of each unit, these were the only ones that could be perceived). Moreover, everything, *grosso modo*, was heard at least once, so that this objection (which I had considered myself for some time) seemed to me to be invalidated.

I now regarded the thirty-two sequences, with pauses - of different lengths and each developing in different ways - as my finished work. It was thus possible to produce a great number of different versions⁷. I then realized that two sequences could be linked together when the end of one and the beginning of the other were entirely similar from the point of material (e.g. when the two "points" were both high, fast and homogeneous). This made absolute continuity possible, eliminating any impression of discontinuity at the joins (now - after the addition of the pauses - the main breaks were within the sequences). Four sequences out of thirty-two started with the same characteristics, then diverged into four directions and ended at four different final points. However, four other sequences, coming from different directions, ended with identical characteristics. So, in addition to the many successive combinations, it was possible to attach the beginning of two (or more) different sequences beginning with the same characteristics on to the end of one single sequence. This gave rise to a more ramified development and more layers in the great polyphonic structure. The intention was that each of the layers should be followed independently, until they met anew at one characteristic point and could be re-united into one "arm". This was made more difficult, in part because the sequences were not all of the same length. The structures could also, from beginning to end, be divided into an equal number of independent layers, and not all the structures had to appear necessarily in every "version".

The overall dynamic level as a "free dimension" had always remained completely undefined. There were certainly considerable dynamic differences in the structures -

⁷ The beginning and the end of each separate layer, with their dynamic levels significantly adjusted, could possibly become the beginning and the end of a complete development.

particularly after the last phase, the addition of pauses - but nevertheless, everything had been recorded on the basis of the same maximum (0 dB). Hence it was possible, either to make large dynamic variations and record them before or during montage, or to make an interpretation at the time of performance (from a pre-prepared plan), or even to improvise one on the spot. Each polyphonic layer could be controlled separately and performed by one or several “interpreters”.

I myself made two fairly different versions in Milan. Since then, three other versions have been produced: two were made by Luciano Berio (the musical director of the Studio di Fonologia), and a third by Marc Wilkinson (London)⁸; and it is remarkable to see how very different personalities can express themselves through the same single material - itself so characterful. Neither of them followed the linkage directions which I made, and I was quite happy with this: they were only a sort of way of “guaranteeing” a coherent performance. If anyone sees a way of producing a meaningful event without this “aid”, I cannot, and would not wish, to prevent him⁹. The freedoms that Wilkinson chose led to a total form rich in contrasts. I think he sought this contrast effect for very specific reasons. In Berio’s version, where there are even more contrasts, there is not the slightest break, and here the form has a diffuse, ungraspable character, which expresses a typically modern time-consciousness. These two musicians were able to make montages themselves in the Milan Studio. I can, however, easily imagine a day when works such as these will be offered to the public itself. All that is needed is one or, if possible, two or three tape-recorders¹⁰ at home - this can always be done if several “amateurs” get together - a little splicing-glue and leader tape¹¹, to be able to attempt an assemblage of one or several layers oneself. The pleasures of adjusting the dynamics - maybe “concertante” - or even using fairly simple stereo (which does not need very expensive machines), would help to give the - now ‘active’ - listener the experience of an event in time

⁸ See Marc Wilkinson, “Two Months in the ‘Studio di Fonologia’”, *The Score* 22 (February 1958) pp. 41-48.

⁹ Nor can I forbid someone using structures produced at another playback speed. The material can easily stand being transposed down an octave without any loss of interest. On the contrary, some things which are usually absorbed by the “homogeneous surfaces” (sustained noise) suddenly appear as a result of the slowing down which is thus offset by inner acceleration.

¹⁰ Here a perfect synchronization of tape speeds is not necessary and, on the contrary, the little shifts in superimposition give rise to constantly changing figures which seem to me worthy of interest.

¹¹ Or again, all the material could be made available to “amateurs” in new types of “music workshops”.

to which he can contribute, and which, consequently, can become a living, creative form of freedom.

Translation: Christine North, London, December 2007