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Wireless Transmission of Music

(THE MYSTERY OF 'BALANCE AND CONTROL' EXPLAINED)

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I - INTRODUCTION

THE operations known as Balance Tests in front of a microphone are necessary because the microphone is an electric device and does not transmit sounds exactly as human ears receive them in a concert-hall, studio, or other building. Vital adjustments are necessary to get all the tones properly blended and focused through the microphone before transmission.

The necessity for the operation known as control (*i.e.*, control of volume output) is due to the fact that the transmitting apparatus will not take or accommodate the complete range of tone from many types of music. If transmitters were so equipped (at an enormous extra cost) volume would still need reducing on many transmissions so that they could become bearable in the average dwelling-house. Just think of the maximum tone of a large orchestra or military band pouring into a good-sized room, or, say, the top notes of a great operatic soprano from Covent Garden driving one to cover from a room twelve by fourteen.

During the past seven years I have been doing this interesting and very responsible work of balance and control for the British Broadcasting Corporation, first at Savoy Hill, then at Broadcasting House, Maida Vale Studios, and elsewhere. In this and following articles I shall endeavour to explain the methods used in balance and control, and the reasons for them, in terms as non-technical as possible.

When music by wireless became reasonably listenable, the importance of balance and control became a matter for serious attention. Up to that time wireless transmission had been an engineer's job from A to Z (apart from the artists' work). The difficulties of mechanically smooth transmissions then were great, but the first group of B.B.C. engineers (now known as the 'old gang') lacked nothing of resource, determination, or brains. Month by month improvements came along, new gadgets, different microphones, new meters; but the later perfecting of the circuits and loudspeakers made the question of balance and control more serious and attention to it more urgent. The early type of gear and microphones were a handful at any time; unexpected happenings were frequent and sometimes alarming, but spiced with occasional dashes of humour. Microphones were prone to 'blasting,' as were individual artists when tempers became ruffled. Blasting as applied to microphones meant that a loud note or tone, or tones collectively, had split up into noise as distinct from music, and was the cause of fear and dread to artists, operators, and the listening public. This blasting effect was guarded against, and to a great degree overcome, by what was then known as microphone technique. Artists were instructed to turn and twist one way or another, to sing to the roof, the floor, or even into a curtain on certain notes and words, instead of directly into the microphone.

It was about twelve years ago that responsible musicians here in England generally became interested in the broadcasting of serious music. At the B.B.C. a musician had an eye and ear to the overcoming of the deadly distortions of the musical dynamics which spoiled most of the performances as heard from the air. By distortion of dynamics is

meant many loud passages transmitted softly, and *vice versa*, in various degrees of opposition to the composer's intentions as marked on his score. The wireless engineers were still performing the functions of volume-control.

I believe I am correct in stating that the first agitation against bad balance and the see-sawing about of dynamics on transmission was put up by Mr. L. Stanton Jefferies, then on the B.B.C. music staff. It was a hard fight to convince laymen, in the persons of important administrative officials at the head of the B.B.C., that to remedy these artistic defects a specially trained staff of musicians would be necessary.

The engineering department was fiercely indignant at the mere suggestion of handing over the functions of balance and control to musicians. So bitter was the antagonism then engendered that smouldering embers of this fire still remain, and flare up into activity about every two years.

For the moment it is enough to chronicle that a committee of known musicians (unattached to the B.B.C.) was formed at the request of the music department. An orchestra was specially called to play a Symphony, the committee went into a listening-room, heard the work performed, and the dynamic volumes controlled, first by an engineer, and then by a musician. It was this listening committee that put balance and control by musicians on the B.B.C. map; and Stanton Jefferies became the head of the new 'B and C' section.

Of the ensuing 'stack ups' between the new section and 'the old gang' one could fill a book, but this is not the place or time to revel in anecdotes.

In my next article I will take you with the musicians 'On Balance' and later 'On Control.'

II - BALANCE

Few listeners have heard of Balance and Control as a part of the processes of broadcasting, and a still smaller number know anything about it. It is strange that so few of the big names among living musicians have been keen to get down to the brass tacks of the job, and most journalists who have touched on the subject have floundered badly. The consistent listener would find his listening even more interesting if he could visualize the preparation for a broadcast and the actual people at work at the microphone end. Outside the members of the 'B and C' section and engineers concerned, I doubt if six people in the B.B.C. could give a detailed account of the work, or stand up to a cross-examination on the subject. There are delightful anecdotes about this absence of knowledge and the easy presumption of it on the part of those who dabble in it superficially. But heaven preserve my late colleagues from the effects of a few thousand listeners becoming critics of the balance and control functions!

Surely most readers will agree that balance and control is, at best, a very obscure subject to them - a mystery. This mystery is not easy to explain to the ordinary listener, and rarely a pleasant task to explain to a musician. An experienced wireless engineer can mentally digest the view of the musician of what was once the latter's job, much as one can digest a dose of unpalatable medicine.

To begin the investigation, let us first be clear as to what balance in music means. Suppose for our purpose you were to go to Queen's Hall to hear a violin concerto, that is, a violin solo with an orchestral accompaniment. A good balance of such a work would mean in effect that in listening to the concerto the solo violin should generally stand out to one's hearing above the accompaniment by the orchestra, except where the composer had in certain places stilled the violin solo and allowed the orchestral work to be predominant. It means also that each section of the orchestra, strings, wood-wind, brass, drums, &c., should be so balanced that it contributed to the general effect its

proper weight of tone. Bad balance is the negation of these highly desirable and necessary conditions. This is the general idea of balance work, but there are many smaller balances involved in the whole. This need of general balance and internal balance (the many smaller balances) at rehearsal in front of the microphone, before broadcasting, is vital. The necessity arises from various causes, chief of which are the acoustics of the various halls or studios, and the type of microphone in use, but there are several other points which have to be watched, viz.: the type of compositions to be performed, the composer's orchestration, the idiosyncrasies of individual players, the correctness of the orchestral parts with the composer's full score of the work, the careful or careless markings, as to dynamics, the composer's special instructions, the conductor's view of the work and his method of obtaining the results that he wants. Each of these factors may affect the work of proper balance involved in an orchestral broadcast. To cover every detail of such broadcasts would fill a good-sized volume, but I will give a brief outline of what can be necessary on each point that I have here raised.

The acoustics of studio or hall vary enormously. In Queen's Hall, London, the type of 'ribbon' microphone now in use by the B.B.C. is satisfactory at a distance of approximately thirty feet from the platform. For the same orchestra in one large studio, using the same microphone, the balancer would need to bring the microphone as near the orchestra as twelve feet. The balancing musician in charge of the show works by trial and error for position and angle of the microphone until he is satisfied with the results. Quality of tone plus definition of notes and texture must be good as he hears it through the loudspeaker in his listening-room. (A listening-room is attached to every studio, and one arranged for in every building from which a broadcast is made.)

The type of composition may need a change of position of a number of performers, or a different distance, height and angle of the microphone. For instance, a work entirely orchestral may be taken through a microphone twelve feet distant from the orchestra, but the following item, say a piano concerto (piano solo and orchestra), will probably need the use of a microphone nine feet distant, and angled more towards the piano, so that the orchestra shall not drown the piano. Another composition may be so heavily scored for brass instruments, and so thinly for strings, that to escape smothering the strings the microphone may have to be lowered and given a more direct bearing on the position of the strings in the orchestra. In most orchestral works there are here and there solo parts for individual instruments that must be heard against the rest of the orchestra.

Although the placing of the players may be normal for a good balance, the scoring may be too heavy for the solo to 'come through,' or the player for one reason or another may not be producing his usual amount of tone. This error is put right by the balancer going to the conductor and explaining the discrepancy, when the conductor either reduces the amount of tone from the orchestra, giving the solo due prominence, or he may ask the soloist to play louder than his part is marked to be played. An alternative is for the balancer to bring the soloist nearer the microphone, but for good reasons this is seldom done.

This adjustment of individual parts that need to stand out from the orchestral texture is called Internal Balance. (The cheap joke is, of course, Infernal Balance.)

When the orchestral parts have dynamics carelessly marked, it is frequently found that the entrance of an important part given to one instrument (or section) is more or less drowned for a short time. Again the balancer goes to the conductor, and it is generally found that a crescendo mark in the accompaniment is in a wrong position, and should come either earlier or later, or that the entrance of the new phrase or tune should have been marked to be played louder.

A composer's special instructions may work very well to the conductor's ears, but may not be good through the microphone. A trumpet call marked 'distant' may be audible to

the conductor, but quite inaudible to listeners from their loudspeakers. Therefore, this passage would need a rearranging of balance by the musician in charge.

I have omitted to mention that balance is done at rehearsals only. The balancer has a full orchestral score, and must watch every bar. The sounds come to him from the microphone into a loudspeaker in his listening-room away from the orchestra. He can talk to the conductor from his room, and the conductor can reply through the microphone in the studio.

There are frequently six hours allotted to orchestral rehearsals for one broadcast, and in the case of symphony concerts there may be several three-hour rehearsals, but the balancing musician detailed for charge of the broadcast need attend only the last two rehearsals. At the final rehearsal he has to time the performance with a stop-watch.

To end this article on a personal note: I just hated the stop-watch business. I left the watch at Broadcasting House when I needed it at Maida Vale, and at 'M.V.' when I went to 'B.H.' When I wanted it at a concert out of town, it was frequently at home. I plead in extenuation that the official stop-watches weighed about a fisherman's pound, cost me half-a-crown for insurance against loss, and when carried on one's person, distorted the hang of one's clothes.

III - BALANCE (continued)

For balancing purposes, small orchestras belong to two kinds; first, those like the Boyd Neel string orchestra, who play works specially written for that type of orchestra; second, those which include all sorts of combined instruments but are comparatively few in numbers. Dealing with the first group, the process of balancing at a 'Balance Rehearsal' is exactly the same as that used for full orchestra. The work still calls for vigilance and close attention to the score, but there is far less difficulty in the way. The score is thinner, more easily checked by the eye and ear, and apart from groupings, rhythms, and time values of notes, there is little that should need much adjustment.

The second group is interesting because most of the playing is from manuscript arrangements from full score, re-orchestrated to suit the smaller number of players and kinds of instruments. For this type of broadcast only a balance test is taken, and a 'run through' of new or unusual items, the time allocated being from half an hour to an hour and a half.

Only very occasionally do conductors have a second copy of their score for the use of the balancer. The checking of the music through the microphone is done by listening for the obvious tunes and important phrases. Looking from the listening-room through the sound-proof window, one can watch the members of the orchestra and see who is playing, and note any individuals or groups who appear to be at work on an important part of the music. If the playing is not coming through the loudspeaker clearly, the balancer consults the conductor, looks at the conductor's score, and suggests what adjustments are necessary. It sometimes happens that the balance is not good even after much care, in which case the balancer suggests an alteration in the score arrangement, such as doubling the weak parts, or alternatively reducing the number of players in one section.

In music of the lighter kind the score arrangements frequently aim at special effects. The conductor during the balance test makes known to the balancer what is the effect required, either by speaking quietly through the microphone, or by pointing to the actual performer whose part for the moment should be predominant. In this way does one balance without the score.

Now we come to the very important question of chamber music. It is seldom that a complete 'rehearsal balance' is given; the normal 'balance test' time allowance is usually sufficient. Exceptions have been made at concerts when strange modern works were performed by Continental musicians.

The balance work here is mainly the accurate positioning of the players before the microphone. This depends on the weight and quality of tone coming from each particular instrument. With a trio for violin, 'cello, piano, the lay-out is made roughly in triangular form, the two less powerful instruments nearest the microphone, and the third nearly central behind them. Difficulties sometimes occur here because the players form a habit of rehearsing all as close together as possible so that each one can see and hear the others clearly. Much care is needed if this balance of quality as well as mere quantity of tone is to be correct. The violin is put nearest the microphone (approximately, seven feet), the 'cello opposite to the violin, a little further away from the microphone, but the distance and position of the piano behind these two varies with the size and make of piano, and the general nature of the works to be performed. Rehearsal (home) positions, all bunched together, make the piano top weight, the 'cello too powerful, and the violin an 'also ran.' If one closes the piano-top, the piano quality and general blend is bad. The weight of tone-balance may be more even, but a dull boxed-piano quality actually becomes more conspicuous to a truly sensitive ear, because it does not blend with the brighter string quality. As one moves the strings nearer the microphone and further from the piano, artists get fidgety about their ensemble, and glance dubiously one to another, and newcomers to broadcasting may raise objections; but with some compromise, much tact and cheerful assurances after watching the scores, things generally settle down.

Balances of quartets, quintets, &c., run on much the same lines. Members of regular broadcasting combinations and the studio attendants soon memorize the approximate positions of the lay-outs for each studio, and the necessary balancing adjustments are generally small but very important. I have known cases when unusual differences in lay-out were necessary.

A Canadian Trio visiting the studios used to carry a 'cello giving beautiful quality, but it had to be placed considerably nearer the microphone than the violin. The B.B.C. policy in relation to balancing of chamber music is the wise one of moving the players as little as possible from the positions they prefer to play in, but there is no doubt that a half-circle formation instead of the usual quartet position is better for broadcasting. One or two groups who play frequently have very sensibly rehearsed in the altered position, and have found that a perfect ensemble can be arrived at and a richer tone sent out to listeners.

Vocal broadcasts seem to be next on the list of balances to be explained. Some years ago a phrase was widely used by music critics; it was 'The Tyranny of the Singer.' This phrase was really voicing a complaint directed against egotism, and particularly against numerous encores. Notices appear on the programmes of public performances that are being broadcast 'No encores allowed,' and singers in the studios find that they cannot 'boss the show' if they value good transmission. Only three times, in the course of balancing several hundreds of vocal broadcasts, do I remember any serious trouble, and opposition never came from the great artists.

Round about the 1931 period, when changes in microphones were going on, singers would politely question the position given them in front of the microphone, as it varied so much from that which they had used when making gramophone records. Different microphone, different studio, different amplification, a different purpose in view, were explanations sufficient to sooth and encourage the most sceptical.

Actual balancing of singers with piano accompaniment depends on three things: the singer's timbre, power, and diction. Quality of voice indicates the quality of piano tone

necessary to blend with it, power of voice is a guide to the distance of singer and piano from the microphone, while diction qualifies the latter. A brilliant and powerful soprano voice needs a bright open quality from the piano. Such a studio lay-out would be with the piano about ten feet from the microphone, the singer about eight feet, the microphone facing the treble end of the keyboard, and about sixty-three inches above the floor. These distances are approximate and should give a good result. The voice and diction clear, the texture of the piano accompaniment also clear, without hiding a single word, is the balance to work for. Now if diction is poor, this quality balance suffers. The big voice must come nearer the microphone until diction is good, and that will have the effect of too much voice, a hard quality, and the piano sounding too far away. If one brings the piano nearer to compensate for the extra volume of voice, the piano quality is likely to become 'slappy,' and compromise is the only way out. Sometimes the difficulty caused by less than perfect diction means that the general balance is not good on the air, and the B. and C. man may have to stand up to complaints coming in from listeners, or answer a memorandum from staff authorities. No purpose will be served by going further into vocal balance except to point out that an old-fashioned Um-tum-tum accompaniment needs less weight of piano than is necessary in Brahms or Wolf Lieder where the piano part is quite as important as the voice.

Balancing solo instruments with piano accompaniment is mainly on the lines indicated above, with the exception that when poor intonation is at all present the performer is better placed further from the microphone, not nearer as with poor diction.

Last of the smaller balance jobs is that of piano solo transmissions. It might appear to be the easiest task of all, whereas some of my late colleagues consider it the most difficult. To obtain pure singing quality and to eliminate percussion noise is never easy, though intensely interesting. I have often fiddled about with the microphone by moving it inches in every direction for, perhaps, twenty minutes, until at last the desired result arrived like the sun breaking through the clouds, and to the great relief of the pianist. The size and make of piano, the individual touch of pianists, from the delicate playing of Cecil Dickson to the pugilistic down-jabs of the heavy-fisted ones, make a standard position for piano balance impossible.

There are two other kinds of balance to be described. I have purposely refrained from placing them in what would seem to be their proper sequence in these articles, because the technique is rather different. They are the work done by 'B. and C.' on opera, and massed choral singing.

IV - BALANCE (continued)

Following voice and piano balances, it will be well to carry on with balances of more voices up to massed choral societies, &c.

Vocal duets, trios and quartets are handled in the same way as one voice, plus the placing of the singers, some a little nearer or further from the microphone, till all voices are about even in weight. Quality here depends very much on the natural blend of voices; three voices of much the same colour with a fourth of a timbre that does not blend well can be improved somewhat through the microphone, by placing a hard voice to sing across the microphone at an angle, while the others face it. Diction again is the first consideration, and if by chance one singer has very poor diction, he or she must come nearer to the microphone, which may mean that all the singers must come relatively nearer, and a first-class quality is spoiled by the compromise. The altered distances to the inexperienced must appear too trifling to be effective, but a space nearer or further, if only six inches, is frequently the difference between good and bad quality, good and bad diction.

The B.B.C. Singers call for special mention, if only because of the general excellence of their work. Their outstanding merit is perhaps quality of tone. This professional body of trained musician singers, picked from large numbers of applicants, has been most carefully selected, I think, by the completely efficient chorus master, and the quality of blend in selection has been studied to a fine degree by an ear extremely sensitive to this factor in singing. To make up a choir of eight, sixteen or twenty-four, it is not perhaps the finest voice that for the actual purpose is the most desirable. Suppose one is choosing a tenor to make up the necessary strength, and a candidate arrives at audition with a fine powerful voice of a trumpet-like timbre. It may be a good voice for solo purposes, with dramatic possibilities, but it may be a bad voice to blend in church services, part-songs, &c., with the body of tenors already engaged. To put a voice of so different a quality among the quite beautiful voices already blended would create continual difficulties in balancing, and become eventually a nuisance rather than a blessing. From this attention to blend of the voices it may be gathered that balancing the B.B.C. singers is a comparatively gratifying and easy job. I found it so, and have revelled in listening and balancing at rehearsals, and have been delighted at the frequent opportunities of controlling their work as it was sent 'on the air.' Most of their singing, away from the concert performances, is done while sitting down, fours and eights at tables, larger numbers on chairs with music-stands for scores in front of them. Morning service used to be four voices S.A.T.B., and was recently made an octet. The positions in use are as follow: Four at an oblong table, the bass at one short end, the tenor at the other, contralto next the bass, but on the long side of the table, and the soprano next to the contralto. The microphone is placed about five feet from the long side occupied, and in height perhaps two feet above mouth level. The angle to left or right for balance depends, of course, on the particular four voices singing for that week, and in a rather subtle way on the singer's mood and the condition of each voice. The human element is very troublesome when only a few voices are at work, and of course becomes less with enough voices to cover up those not in best form. The choir of eight voices is placed in the same way as the four, but each part doubled, a larger table used, the microphone a little higher, and perhaps a little farther away - that depends on the studio in use. The natural blend and balance of the choir is so good, their conductor so sensitive to and experienced in broadcasting, that one rarely has to point out musical discrepancies, and the chief job is to watch for every word. The severe method is to ignore the score and to check the rehearsal for any word that is unintelligible. I say severe, because the tessitura of many part-songs and motets is so high that clear articulation in rapid singing is then only possible to the most highly trained singers, and not then if the voices are tired.

Sixteen voices are grouped much as with the table' lay-out,' but without the table, and are balanced in the same way, but larger numbers are sometimes grouped on a rostrum in perpendicular wedge style, B.A.S.T., and the microphone generally gives the best result if placed level with the highest row.

Chorus with orchestra presents serious problems to the musician balancing, particularly with the double-sided ribbon microphone now in use by the B.B.C. In the studios one can sometimes get a fair balance between orchestra and chorus by placing the chorus on one side of the microphone, the orchestra on the other; but as the conductor cannot see from the back of his head, an angle lay-out is the compromise; orchestra half-left, chorus half-right. The two-sided ribbon microphone is always best used singly and not in multiple. Definition and quality suffer when two or more are in use at the same time, but where public performances necessitate an arbitrary grouping, orchestra in front, chorus raised at the back of the stage, the insistence by the engineering department on the exclusive use of ribbon microphones is wrong. I could give a very glaring example of this, where during a recent important broadcast I could not hear a word from the chorus on my special 'London only' set. A microphone nearer the chorus was used, but the other live side of this microphone picked up so much wood-wind, brass and drums that diction was smothered; nor could one expect the result to be otherwise. Now as this is dangerous ground, and I am partisan, I will only remark that, as the balancer is entirely

responsible for broadcasting results (and the recipient of whatever kicks may come along), he should in fairness be given the tools that he prefers to use for the job in hand.

All very large bodies of singers have to be dealt with by the balancer differently in each building, and no rule as to positioning can hold good for all. For an amateur choir with bad diction, or diction spoiled by acoustics, an excellent result can be obtained by placing about eight selected singers, two of each four parts S.A.T.B., quite close to the microphones (or a microphone if two one-sided microphones are used) so that their diction, coming through clearly, gives point and clarity to the main body of singers, whose words without this 'close up, from the eight would not reach the listener.

My final details of balance concern opera balance.

One cannot go to Sir Thomas Beecham or any conductor at Covent Garden and say, 'Your singer is too near or too far from the microphone,' or complain that the chorus is not where the microphone will give the best results. Neither, as in television, can you chase an artist across the floor (out of the limelight) holding a microphone to catch his words like a beggar after pennies; therefore a different technique for the B. and C. man is necessary.

Let us suppose Covent Garden to be the venue. The balancer arrives at the theatre; a microphone is first placed to take up music from the orchestra. This being considered satisfactory, the B. and C. man familiar with the opera gets the attached engineers to place microphones centre stage (footlight level), facing slightly upwards, for the principals, and other microphones in the wings, high or low as may be judged suitable to action in the opera. From one to six microphones are easily installed, three being generally sufficient. Control of these is centred in a housing known as a 'mixing unit,' with a control knob for each microphone. The stage balancer attends rehearsals, notes the action and the microphones most suitable for the different positions and wanderings of the artists, marks them on his score, at the exact places where to fade from one 'mic' to another, all prepared for transmission. The 'mixing unit' can be anywhere within sight of the stage and conductor. Now the orchestral tone coming from Covent Garden is, more often than not, rather dead and lustreless, and the B.B.C., to improve this, uses the Concert Hall at Broadcasting House as an echo room for the orchestral sounds to pass through. This music is collected again and passed on, together with all stage singing or speech (on another line not echoed), to another mixing unit in the building. Here musician No.2 with a score has, on one line, control of volume from singers and chorus (stage), on another, control of orchestral volume, and on a third line control of the amount of echo added to orchestral tone to give it life. Controlling these values and adjusting the balance as it comes through the loudspeaker, is properly called mixing. Thus microphones are selected for use by A at Covent Garden, and the raw sounds pass on to B mixing at Broadcasting House, and B passes them on to C, the musician controlling the volume output to the transmitter for the air.

The musician B adjusts the relation of weight between orchestra and voice, C adjusts the collective results to suit the transmitter limitations, and the final result is 'broadcast.'

This rough outline of the processes of balancing has taken far more space than I had at first thought necessary. My next article will deal with the volume-control of music as it goes out to the listener, a subject about which it is easy to speculate, but not easy to deal out in the form of facts. Great numbers of users of loudspeakers may not care at all how the music gets to them so long as it forms a background to other domestic sounds. Readers who have passed to more intelligent appreciation of the country's broadcasting achievements will find the subject of control as intriguing as a keenly-played game.

V - CONTROL

At the commencement of these articles I pointed out the necessity for controlling the volume output of most of the music that is sent out 'on the air.' To have to do so is at best a necessary evil. Many people imagine it an unwarrantable interference with the work of the performers and conductors: an arbitrary distortion of the real thing. A little thought of the size of the average room in which loudspeakers are generally used, coupled with some idea of what the effect would be in such a room if the full blast of a large orchestra or a military band were let loose in it, should clear away any doubts as to the need for control. Actual transmitting units are also limited as to the quantity of volume that can be received and passed on. I am not an engineer, and am unable to explain this limitation imposed, but I am told that a transmitter could be made to accommodate an unrestricted volume of tone, but at a cost suitable for a rich man.

The limits of sound-volume for wireless transmission are much the same in all countries, and the method of controlling output has been a subject of much controversy and several large-scale experiments.

According to report, there is no doubt that all handling of control in the early stages of broadcasting was of necessity done everywhere by non-musicians. For reasons that will be apparent later, a method less liable to send out a mangled and flattened version of musical performances was sought after: One stage (A) of this early method still remains in several Continental countries, and it is this: the use of a gauge showing the volume of tone coming from the performers. Engineers watch the indicator, and during the rehearsals communicate to the performers instructions for more tone, or less tone, so that the sounds may be brought within the compass capacity of the transmitting unit. In this way the artists, conductors, performers, are continually being checked and cramped, and their several arts, and not infrequently their tempers, suffer.

Another scheme whereby conductors particularly could limit the tones of their orchestra was devised and tested. (B) The conductor was put into a sound-proof glass box in which was placed a loudspeaker. This box or cubicle was so placed that the orchestra and conductor could see each other, but the conductor heard only the sounds from his loudspeaker. Thus he could check the balance of the orchestra himself, and by glancing at a dial on which the volume of tone was indicated could also check the dynamics and bring them below the danger zone.

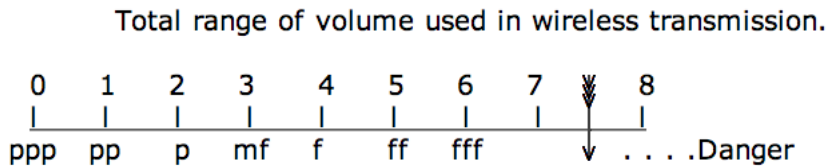
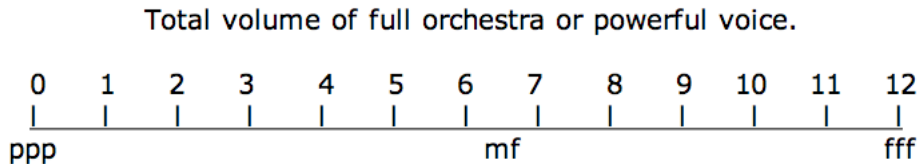
This scheme failed, presumably because of the artificial conditions, and the difficulty of watching a full orchestral score and a pointer swinging across an indicator dial at the same time, plus the same cramping and harnessing of the artist. The scheme was modified (C) by discarding the glass case, and placing a very large volume indicator in the studio or hall, for the conductor to see. This deprived him of the ability to hear the balance from the microphone; he still had two things to watch at once; and the limitation of artistic gradations of tone remained.

These three examples of wireless control make clear the vital importance of finding a better method than either. Let us examine the scheme of control now adopted by the B.B.C. As I said in the introduction to these articles, it is by no means easy to explain, but if readers will follow me closely they will find the effort well worth while. It is a method which places no hindrance upon or interference with the work or temperament of artists, performers or conductors (save perhaps the timpani players). It makes free all the natural curves in tone-phrasing, it destroys no dynamic climaxes, and it rescues very soft sounds from becoming lost to listeners (unless their receiving set is a very bad one). However, all these good points have still to come within the limits of the transmitter, which allow roughly sixty per cent of the full tones of a large ensemble to get to the listeners. To accomplish this better control, the work must be done by a musician, and preferably by the man who checked up the balance of tone from the microphone during rehearsal. His job, in short, is to watch the full score of the work

being performed while he controls the volume of transmitted tone in such a way as not to destroy any musical phrase, or break any climax.

By having the score in front of him plus his memory of the rehearsals, the musician has this vital advantage over the non-musician control: that of seeing and knowing exactly what is coming to him and when, and what must follow immediately. This simple diagram will better help to show, if roughly, what his problem is.

Let 1 to 12 be the complete dynamic range of the large orchestral work to be performed.



The controlling limit is normally 1-7; 8 is dangerous to the transmitting apparatus, and the rest upwards must be considered impossible for transmission. The lower diagram represents the actual figures on the meter dial, and as tone passes, the needle pointer swings over the figures. It is not a slow, gradual movement, but almost as delicate as the swinging point of a compass, and is never quite still. Near the meter is a volume-control knob working in a half-circle; the half-circle is numbered in degrees 1 to 25. The movement of this knob with pointer from, say, 15 to 25 increases the amplification of a given permanent sound from approximately mf to fff. Reverse the movement of this knob towards figure 1, and the same permanent sound becomes fainter until it disappears altogether. So the meter reading follows the movement of the volume-control knob. For the moment we will forget about an orchestra, as control can more easily be understood if we think of a powerful soprano singing, not one of the big arias, but a song specially written for a demonstration of wireless control. Suppose this song to contain eight complete phrases and sentences, each separate phrase to be sung louder, with a pause or breath mark in between. Phrase (A) to be sung ppp, (B) pp, (C) p, (D) mf, (E) f, (F) ff, (G) fff. Now this big voice in the studio actually equals in volume that shown on the line 1-12.

The voice as softly as possible starts phrase No. 1. The meter needle registers only a slight movement from zero. The man on control can just hear it on his loudspeaker, but he knows that thousands of listeners for one reason or another will not hear the phrase, so he alters the plane or level of the sounds by increasing the volume till the meter swings about figure 1. The singer takes breath; instantly, during the fraction time of the intake, the controller reduces amplification very slightly, so that phrase B, though slightly louder, shows less difference in volume on the air than in the studio. The controller has reduced the volume range of the two phrases. Controller, from the score, now notes that the song will increase in tone to the end, and go beyond the capacity of the transmitter. He therefore, at each moment of breath-taking, reduces amplification just a little, carefully watching the needle, and listening intently, until his gradual cutting back allows each phrase to go out undisturbed, and shepherds the final very loud phrase inside the transmitter range. His meter is then registering a full seven points, and the needle throbbing with the voice a shade below and beyond the figure seven. The trick is done; his movements are so rapid that the vocal line is undamaged, and

listeners are unaware that the volume of this big voice has been reduced on transmission by at least one-third of its actual power.

The example of control during the transmission of an imaginary song only illustrates the bare method of control as used by the musician. The non-musician, by comparison, does not know what is in front of him, vocally, and can only guess if and when he should reduce volume. If his amplification is near the limits of the transmitter, and there is greater volume to follow, he can only go on reducing during the louder passages, and so damage the whole artistry of composer and singer. A celebrated Continental conductor, discussing this sort of control, complained to me in these words: 'Ach! ven I conducts ze beautiful soft musik, they make 'im loud, and ven I make ze beautiful crescendo (gesture) they knock ze top off 'im.'

VI - CONTROL (continued)

There is no work quite so simple for control as my imaginary example; the human element is often so variable, and singers in particular are likely to make their actual performance a far more difficult matter to control than their work at rehearsal had led one to expect.

The actual method of controlling any transmission is the same: careful listening, watching one's score, watching the programme meter (volume meter is the term I have used for simplicity, though this definition may not be scientifically accurate), the whole qualified and helped by a musical training, and an artistic perception of musical values. There are a number of unwritten laws of control that normally hold good.

When controlling an orchestral performance it is necessary to note in the score where the great climaxes come, and never to reach maximum transmitting volume till you get there. The time to alter amplification is best at a change of colour, say immediately on the entrance of wood-wind, or a change from brass to strings, or at the commencement of a phrase, never in the middle or nearing the end of it; to alter the plane or level of controlling, suitably to the next movement; to beware of unusual percussion dynamics; to know that certain tone qualities need more amplification than others; and, above all, never to move if by so doing the altered volume will become noticeable.

It is not for ever possible to make one's moves perfectly without a slight interference with the dynamics of a few notes. In such heavily scored orchestral works as those of Richard Strauss, it is no infrequent problem for the musician on control to be holding up a terrific sound, bordering on a smash up of the transmitter at one moment, and without break or pause to have a very short quiet passage, delicately humorous, perhaps, from a single bassoon, then again, without any break, another bombardment. To hold up the great crashes, one has had to work back to perhaps figure 10 on the amplification (control) disc, whereas one would need to be 'all out' with the control knob showing at 20 to 25 if the bassoon is to be heard at all. As one dare not let the crash get any louder, no move can be made towards greater amplification to get the bassoon through until the crash has ended. The controller has either to make a sudden jump in amplification of 12 or 15 points, and probably give a very bad effect to the bassoon already playing, or to do an artistic crescendo and decrescendo to the bassoon passage in time to get back to the required position for holding another crash.

Problems of this kind are endless, particularly in very modern works, and the musician on control has very anxious moments in the usually tense hours at the control-panel.

It may be stated, in general, that as the tone volumes of transmissions become less, in the assorted programmes of the day, so the difficulties of control become correspondingly less.

As I am nearing my final remarks on control, it will be necessary to point out that musician control at the B.B.C. is not used on transmissions where music has not the entire programme value. Incidental music to plays, productions, music-hall shows, television, also dance bands and cinema organs, are controlled by non-musicians.

All serious music and much light music broadcast is sent out by the musician balance and control section. In a very great measure the work of this section has earned for British broadcasting the reputation for being musically 'the best in the world.' Not only has the Musical Director of the B.B.C. said this, but many Continental musicians visiting the B.B.C. have frankly agreed that this is so.

It may not be out of place to remember that three or four years ago some sort of strike occurred among all broadcasting musicians in America. One of their chief demands was that from thence onwards none but musicians should be allowed to control transmissions of music. They obtained this demand, although the procedure adopted is not quite as used by the B.B.C.

Two Continental visiting conductors with whom I was associated, after discovering why I approached them with a full orchestral score, were delighted with the B.B.C. scheme of musician balance and control. Each in turn went back determined to adopt the same safeguards for their own broadcasting. One of them I have not seen since, but the other has sadly explained that the non-musicians were too firmly entrenched in the organization and that the higher officials would not see the necessity of musician control, and so his beautiful crescendos 'still 'ave ze top knocked off 'im.'