THE RELATION OF BIRD SONG TO MUSIC.

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In all save the most severely technical ornithological works, and even in some of those, one finds expressions like " sings well ", " one of the best singers in the region ", " melodious song ", and the like. Are these terms merely anthropomorphic, simple registrations of the fact that the songs have given pleasure to the observer, or at most, predictions that they would give pleasure to almost anyone who is sensitive to musical sounds? If this is indeed all, then to use these classifications is not to contribute anything to the science of birds, but only to the science and art of human recreation. This last is surely an altogether worthy cause, and may well justify the manner of writing in question. But is there nothing more? I believe that there is, and I think most ornithologists suspect that there is, but perhaps without quite knowing how to define or justify this "more". The present paper is an effort to remedy this deficiency.

Our modern attitude toward questions of this kind often shows a curious ambivalence. On the one hand, we suspect comparisons of other animals to ourselves, we are in dread of sentimentalism or anthropomorphism, and —in view of the way many earlier naturalists were given to expressing themselves—we have good reason for this dread ; but on the other hand, we believe with even better reason that man is a further development of tendencies found also in the lower orders. If these two well-founded attitudes are carried to extremes, the result is contradiction or absurdity. To deny that the singing of birds is music at all, in any sense, is to imply that man's musical capacity is something absolutely new and unprecedented. (For no other of the vertebrates are more promising candidates for the status of " musicians on a primitive evolutionary level".) And surely, also, it cannot be held that all species of birds are equally musical. That the capacity for producing what to us, at least, are melodious sounds should be present in the Class Aves, or even in the sub-order of true Song-birds, Oscines, in the same degree throughout, although quite absent in reptiles, is a notion supported neither by *a priori* probability nor by fact. In sum then the notion that birds are, in *unequal* degree, " musical ", deserves to be taken seriously. Hence there should be some biological meaning for the classification, " good singer ".

Music, objectively regarded, is to be characterized in two ways, according as we take into account only the patterns of sound produced, or also the behaviour-setting of this production (Herzog 1941). Let us first consider the sounds alone. Music consists predominantly of " tones " rather than

" noises ", and this means that, instead of wide bands or miscellaneous blends of frequencies, relatively " pure " sounds, each approximately of a single frequency (except for " natural harmonics ", or partials in simple ratio to the fundamental frequency) are produced. Birds utter both noises and tones, and it is the latter which are more conspicuous in " songs ", especially the more " melodious " songs. The tones can be as pure as in human music, though often they are between noises and tones. Instrumental means of testing this are available and will eventually settle the question with all needed precision (Borror & Reese 1953, 1956 a). " Flute-like " sounds from birds are fairly common. They are often higher in pitch than any actual flute notes, but there are many exceptions. For instance, the Pied Butcher-bird *Cracticus nigrogularis* in Australia is comparable even in pitch to a fine flute. There are truly chime or (small) bell-like, truly guitar-like, even organ-like tones to be heard from birds. Some are as tender as a boy soprano.

Besides the tendency toward higher pitches in birds, compared to human musicians, there is a tendency for notes to be very brief temporally. But in this respect there are exceptions. Well-sustained notes are also found (though perhaps not in Europe), e.g. in the Jamaican Solitaire *Myadestes genibarbis*. Moreover, the significance of the high-pitched quality, as well as the brevity, may well be in part anthropomorphic. For the upper limit of hearing in small song-birds (the ones that sing at the highest pitches) seems to be rather higher than the human limit (Schwarzkopff 1955), and hence what to us are extremes of " shrillness ", to the bird are probably somewhat more normal or moderate, more " mellow " sounds. Also birds live at a faster tempo than we, so that " brief " to us and brief to them are probably not quite the same (Ansley 1954). The marked temperature difference alone mildy favours this interpretation, as do the vastly more rapid heart beat and other reactions. Thus in two respects, pitch and tempo, we are by our physiological make-up more apt to under- than overestimate avian music.

Now we turn to the order or pattern of the sounds. " Order is the vast realm lying between the deadly extremes of chaos and mechanization " (Sachs 1953). This dictum of a great musicologist applies to bird song. Very few songs even tempt one to think of them as mere random handfuls of notes ; and equally few seem wholly mechanical in their regularity. As to the second point, there are indeed songs which are repeated over and over almost without significant alteration, but—and this is a very general law of singing which apparently other writers have not formulated—in all such cases, with exceptions statistically insignificant, the singer pauses, between his reiterations, for a period which is variable, not mechanically fixed, but almost always much longer in duration than the song, showing that the succession of songs is not itself a single song, but merely a series of musically

fresh starts. The excessive "repetition" is then a fact for our attention span, not necessarily for that of the bird. He is not primarily singing his song "again" (though he may have a faint sense of this), he is just singing it. So when, at intervals, we put our favourite recording into the record player, we do so not to hear it for the *n*th time, but simply to hear it. The time-span required to make the reiteration a fresh start is shorter for the bird ; but, once more, it lives faster. However, it appears that even birds can stand a prolonged succession of songs or phrases separated by brief intervals of silence (less than two or three seconds) only if there is considerable variety among the songs or phrases. I call this "the anti-monotony principle" or "the monotony-threshold" (Hartshorne 1956). Birds in this respect act musically as we do, save that their temporal span, beyond which monotony is not felt, is brief, and that very simple variations satisfy them. This is exactly what the theory of "primitive music" would lead us to expect. Possibly relevant here is some behavioural and physiological evidence for a special, short-run memory, lasting, even in man, but a few seconds (Thorpe 1956 : 138, 141).

Within a single song or phrase (usually about one to four seconds, occasionally as many as eight), repetition or likeness between successive portions occurs in accordance with the general aesthetic principle of unity-in-variety. Always the similarities, the echoes, are there, and always they are tempered by variety. In short, there is aesthetic form. A simple example is the European Yellow Hammer *Emberiza citrinella*, which repeats a note several times in even tempo and then ends the song with a rise and drop in pitch, the song closing slightly lower than it begins (Garstang 1923 : 51). Or again, the Black-capped Chickadee *Parus atricapillus* sings sometimes but two clear notes ("the purest this side of heaven", as Cheney (1891) says), the second a whole tone below the first, both notes otherwise alike. Let us take a less favourable example, the sort of song which consists in a real monotone or in a mere trill, the alternation of two notes over and over. This comes very close to mechanism ; however, in such songs, at least the length (the number of repetitions) is not fixed. The bird seems to exercise no freedom as to which notes to sing next, but at least it has options as to how many repetitions to include in a given rendition of the song. I accept, for many reasons which cannot be gone into here, Sachs' hint that aesthetic value depends in part upon an element of "chaos" or randomness. (See also Meyer 1956 : 96, 195, 200). The fact is that randomness, quite as much as law, is a key operative concept in all our knowledge, from quantum mechanics and Mendel's laws to the aesthetic principle of the value of surprise and novelty. The bird songs which most of us rate highest are, among other things, those in which the aspect of unpredictability—at least apparent chance—is pronounced. If the bird has a repertoire of phrases or songs, you cannot tell at a given moment which one will be rendered next ; and the larger the repertoire, the greater the uncertainty. Thus a Wood Thrush

Hylocichla mustellina has, say, ten songs, which can follow one another in 90 combinations such as AB, BA, EF, CF, etc. Two songs are sung within the time-span which the bird itself grasps as a whole—the proof being that, whereas by chance it should, one time in ten, sing AA or BB or CC . . . , this happens less than once in a thousand times (my vague estimate). Thus the bird itself is experiencing scores of different contrast effects in the course of a few minutes' singing. Yet all the phrases are musically related, and in some appreciable sense similar. The European Song Thrush *Turdus ericetorum* also has a repertoire (probably larger), sung in random order. Here the phrases are more varied, but less melodic. This is a looser form of music, less pure and concentrated, though freer and farther from possible monotony for our ears. The Woodlark *Lullula arborea* is again more limited in variety, even purer in its tones than the Wood Thrush, but by compensation, with simpler phrases, although these are handled with more freedom. It seems that the bird brain can achieve only a few musical effects, and a gain in one direction is likely to be paid for by a loss in another.

It is perhaps a minority of species in which the only element of freedom is in the number of repetitions of a note or phrase, or in the length of pauses between songs. Usually there is something else to mitigate any impression of a mere mechanism. Thus the Carolina Wren *Thryothorus ludovicianus* in each song gives exact reiterations of a tinkling little phrase (an individual having many songs, each based on a different phrase)—" exact reiterations ", except that the song may begin or end unpredictably in the middle of a phrase, thus : kettle, *tea*-kettle, *tea*-kettle, *tea*-kettle ; or, *tea*-kettle, *tea*-kettle, *tea* ; and that the number of reiterations varies every two to five times or so, being lowered by one or increased by one. Thus 3334332333334332 . . . In this way the bird from time to time makes what have all the appearances of fresh decisions, not dictated by the song-pattern. (There is experimental evidence that birds can count, i.e., distinguish between 2, 3, 4 or 5, 6, 7 successive sounds, Koehler 1951.) Even so limited a singer as the Chiff-chaff *Phylloscopus collybita* has, I believe, unpredictable variations every few seconds. And in birds which sing just one song over and over almost without appreciable variations, not only are the pauses between reiterations too long for the repetitiveness to count as such for the bird, but in addition the pauses are unpredictable as to precise length. Also, the length of the performance (a half minute or an hour) is predictable only within wide limits. The evolution of bird song toward music can be seen in part as a progress from this extremely limited type of free variety, within a unity of pattern, to cases in which the blend of randomness and predictability is much more striking.

It is to be noted that while in human music an entire composition occupying an hour may be " fixed " in advance by the notes, this apparent predictability is in part illusory, because human beings are much freer and less

predictable in their rendering of a given musical pattern than an individual bird, which (except in immature singing and " subsong ") is very precise in its reiterations (Thorpe 1956 : 372–73)—except where it definitely deviates, that is, employs a different pattern. In the singing of an individual bird, departures from a fixed pattern are generally either so slight as to be scarcely detectable even by delicate instruments, including the human ear, or they are more than well over the threshold of the detectable. Everything is almost as if the execution of a pattern were indeed mechanical, and the variations were merely other pieces of mechanism, the freedom of choice being limited in most cases (apart from very young singers) to the decision which record to play next. Human freedom is much more pervasive and insistent than this, as we should expect from the fact that we, and not the birds, are " conscious ", in a sense which is probably not possible without something like language.

Compared with human music, I find but one radical inferiority in the best bird songs,* the best of the subhuman music of nature.

Their one great defect is just their ultra-simplicity, as shown above all in the extremely brief temporal span of the motifs, or musical units. A bird cannot follow a definite musical pattern occupying more than ten seconds (so far as species known to me are concerned), and only a few can manage patterns of even six seconds' duration. (Does this perhaps illustrate the "extremely short-run purposes" which Thorpe (1956 : 46) believes we must postulate in animals ?) The average for all singing birds is probably a unit of less than three seconds. The speech phrases learned by parrots appear to be about this length. A gibbon ape singing—the proper word—in the Melbourne Zoological Gardens had, if I may trust my memory, a similarly brief pattern. True, the only timing of gibbon singing which I know of, 12–22 seconds (Carpenter 1940 : 171), suggests a longer span than in birds ; however, it appears that there may not be a sharply defined pattern, precisely repeated by a given individual. The wide variability in length supports the contrary view. Coyotes have a somewhat patterned howl which is not, as I recall it, much longer than the usual bird song. Horses, donkeys, moose, elk, seal, wolves, lions, so far as one can find definite repetitive patterns in their utterances, there is one law for them all, that they be short. Frogs, toads, the few singing lizards, and still more the insects

*I estimate these as some 225, scattered about the world, ten in Britain, 26 in Europe, 21 in North America above Mexico, etc. Of the total, probably no one has ever known more than one half. I am lucky enough to be acquainted, in part through recordings, with nearly one third. Should the reader wonder how I know that the others exist, I remind him that this subject has a literature—a literature within literatures, for one must skim all sorts of books in diverse languages. One may also question observers from lands one has not visited oneself. There is some guesswork in interpreting such information; but when I went to Australia, New Zealand, Hawaii, the Fijis, Jamaica, Mexico, I found my previous numerical estimates not much altered by direct impressions, though I carefully reconsidered each item. Some were dropped and others added, but the net result was little change.

(Alexander 1957 a, 1957 b), have similarly brief temporal spans. (Insect songs are essentially monotonic, without melody, and hence can compare musically only with the most rudimentary bird songs.) It is man alone who has well-defined (precisely repeatable), timed, and organized sequences of acts extending beyond a few seconds, to a minute—or an hour. This, with the gift of language—must there not be some connection between the two?—is the psychological differentium of man, who is indeed " the time-binding animal ". Of what use would language be if, before a sentence, not to mention a paragraph, could be got through, the pattern was lost, and only vague connections were felt between the early and late portions of the utterance ? One of Mrs. Koht's conclusions from her important work on the Chimpanzee was that though this animal " can form ideas, these last in memory but a few seconds " (Yerkes & Yerkes 1929 : 375 ; Yerkes & Petrunkevitch 1925 : 106–107).

It is to be understood that " memory " is not a single function ; in a certain sense birds remember for years, but this is " recall " (or the exhibition of conditioning) after intervening forgetting ; whereas, to grasp a musical pattern, the sense of the early portions of the pattern must persist throughout. It is such " retention " that is always extremely short-run, save in man ; and even in man, there is reason to believe that it is a different function physiologically after a few seconds. Within the very short run there may well be no great difference between the function in man and in birds ; beyond that, man has something lacking in all the rest of the animal kingdom, something not quite retention nor yet mere recall, but with aspects of both, and it is this which makes him the rational animal. One proof that the short-run function is somewhat similar in man and the birds is that their pauses, as they reiterate a phrase or song, seem fairly satisfying even to us, allowing for their living a little faster. A man can listen to most repetitive birds reiterating a song scores of times, with pauses typically several times the length of the songs (unless these be unusually long), without feeling any very annoying degree of monotony. But cut the pauses to one half or one-third on a recording, and it is a different matter. The song then would become irritating, I believe.

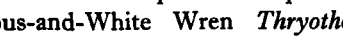
Let us return to the birds, with their exclusively short-run retention. It is true that some birds have a single song lasting nearly a minute or longer, but this—like some insect songs—is a relatively patternless prolongation, arbitrarily variable in length, of a single sound, trill, tremolo or buzz. Thus the Grasshopper Warbler *Locustella naevia* (Peterson, *et al.* 1954 : 231–35) ; or Fuertes's " Noon-whistle ", the ant-thrush *Chamaeza turdina* (Fuertes 1914 (3) : 3 ; Chapman 1917 : 391). Also many birds have a variety of songs or phrases making up a " repertoire " which will not be gone through in less than a minute or two of almost uninterrupted singing ; but such " long-continued songs " (Saunders 1951 : 35) consist of elements each lasting

a few seconds at most, and without fixed order of sequence ; rather, there is much evidence that the order is largely random, so that there is no over-all pattern. Consequently there is no definite ending. That superb musician, the solitaire of the Rocky Mountains, *Myadestes townsendi*, often sings continuously for 20 seconds; but is it a fixed, repeatable pattern? I rather doubt it ; but if it is, it must be among the most complicated ones in the bird world. The music of the neotropical *Myadestes unicolor*, or Slate-coloured Solitaire (" the most beautiful song of all "—Chapman 1917), is a repertoire of songs each lasting 2–5 seconds, and usually repeated, with judicious pauses, about five times. (Because of the complexity of the songs, 15–30 or more notes, with many distinct pitch-intervals, this amount of repetition does not seem monotonous.)

I incline to think that if a human composer were to subject himself to the same drastic limitation in the time-span of his patterns, he could not greatly surpass the birds, and he might easily do less well. True, he could achieve a higher proportion of pure tones than most birds do, but this would perhaps only accentuate the meagreness of the result, since the mixture of tones and semi-noises is one way of securing richness of contrast from a few sounds. Again, the composer might luxuriate in simultaneous chords, whereas, though birds can, and some do, sound two or more harmonious notes at once (Rounds 1957 ; Borror & Reese, 1956 a; Saunders 1951 : 274), and though there is some choral singing and a good deal of duetting (mostly in or near the tropics), still, simultaneous harmony or polyphony, other than random (which is sometimes delightful, as when various species or independent individuals sing more or less at once), is a minor element in bird music. But so is it in much human music outside Europe and the modern period. Accordingly, if very simple musical designs can be unfolded in a few seconds, and if pervasively musical effects can be achieved by random alternations of related designs (and the Wood Thrush and many other birds show how this can be done), there is no reason to deny that bird songs are, as patterns of sound, and even by our standards, primitive forms of music. Take any really simple element of musical form, and it can probably be shown that it is clearly illustrated in the singing of birds. (See Matthews 1904 ; Garstang 1923, 1956 ; Cheney 1891; Koehler 1951.) Thus we have every elementary rhythmic effect : accelerando (Wood Warbler *Phylloscopus sibilatrix*—Garstang 1923 : 252; Field Sparrow *Spizella pusilla*—Saunders 1951 : 264), ritardando (Yellow-billed Cuckoo *Coccyzus americanus*—Saunders 1951 : 52), and other effects not too far from these in simplicity (Black-billed Cuckoo *Coccyzus erthrophthalmus—ibid.*) ; we have crescendo (tenfold graduated increase in volume, applied in turn to each unit in a large sophisticated repertoire by the Heuglin's Robin-chat *Cossypha heuglini* of Africa), diminuendo (South American Misto Seed-finch *Sycalis luteola*—Hudson 1920, 1 : 67–8) interval inversion, simple harmonic relations (thirds, fourths, fifths,

octaves) retention of melody with change of key (Crested Bell-bird *Oreoica gutteralis* of Australia; Fijian Warbler *Vitia ruficapilla*), theme with variations (Pine-woods Sparrow *Aimophila aestivalis* of southeastern United States), etc. Let the simple musical device be named, and I will undertake to find one or more birds whose singing employs it, and in a simple way, employs it well. Koehler (1954 : 332) with justice speaks of the " widely distributed ability to transpose ", and gives a fine example from a parrot. He also gives a supporting citation from Stadler (1934). As a provisional hypothesis, then, I suggest that birds do musically about what can be done with a few very short units of design (and on the whole without polyphony). This hypothesis may require qualification, but it is at least more stimulating to research than the notion that birds do nothing musical at all. From time to time, one or other simple musical procedure has been denied to birds, but always by someone with inexact or narrow knowledge of the phenomenon, as of global extent. Since the songbirds (Oscines) in all Europe constitute but 5% (in England, 2·5%) of those of the world, the absence of certain musical devices in songs of this area is inconclusive. Some European observers have felt that certain songs in Borneo, New Zealand, Australia, Africa, or Tropical North America come closer to human music than those at home.

The hypothesis that the occurrence of musical effects in bird-produced sounds is a chance phenomenon, like their occurrence in the sounds of wind or running water, seems not to express a reasonable probability. In these other things, there are, here and there, some vague similarities to musical sounds, but nothing more ; on the contrary, bird song is usually, and I incline to say always, intelligible as simple music. If we were to undertake to compose musical units complete in from one to six seconds, we could scarcely do better than many birds do, granting that we were to eschew the lower octaves (most birds are too small for them), and that we were in general to maintain a rapid, at times (by our standards) fantastically rapid, tempo. Yet I have heard from New Zealand Tuis *Prosthemedera novaseelandiae* slow songs (two notes a second, or less) which a musician, using so few elements (four to eight notes), might be at a loss to surpass as complete and satisfying compositions. And a Rufous-and-White Wren *Thryothorus rufalbus* gives six or eight leisurely variations in pure flute tones on a simple theme—three slightly sustained (quarter?) notes, followed by a series of much shorter ones (32nds ?), perhaps a minor third lower in pitch, thus :



and the variations (key change, interval inversion, dropping one of the opening notes, accelerando in place of the abrupt tempo change, etc.) could be surpassed, it seems to me, only on a level of complexity higher than the theme itself warrants. The Little Grass Bird of Australia *Megalurus gramineus*, by subtle use of rhythm, achieves eloquent though plaintive music

out of a reiterated three-note phrase, entirely on one pitch throughout. And finally, what better music could be made out of two notes than is furnished by the European Cuckoo *Cuculus canorus* or (octaves higher in pitch) the North American tit above referred to ? But perhaps better music could be made out of a pair of notes—by employing the octave, and this is just what the Queensland subspecies of Olive Whistler *Pacycephala olivaceae macphersoniana* does in its famous " peeee-poooo " song, one of a half-dozen items in an individual's repertoire.

Simplicity is then the essential limitation. The " best singers " reach higher levels than the others in complexity or free variety, in the coherent use of tone, interval, and rhythm. " Complexity " refers, first of all, to the internal variety of a single song, which the bird can repeat with exactitude. It refers also to variety between one song and another within an individual repertoire. Here again birds are drastically limited : a hundred notes, or at most three hundred, will fully define a good individual repertoire, compared to millions for a human musician. Some birds may seem not to have fixed repertoires, but except for young birds, and perhaps a few exceptionally flexible species, I believe the constituent units are generally pretty stable throughout a season, if not a life-time. There are some fine songsters with a few rather complex songs, and some with many simple ones. It is perhaps idle to ask which is better ; what seems clear is that (other things being equal) many simple songs are better than one or a few, and one complex song is better than one simple song. An individual American Winter Wren *Troglodytes troglodytes* in northeastern America has a long complex song, little varied from one utterance to another, but enough longer (one-third or more) than the song of the European subspecies to barely justify calling the former, but not the latter, an outstanding singer. However, most species that have been regarded as highly musical have a repertoire of several songs for each individual, and there seem to be as many as a score, or even fifty or more, for each individual in some species (Eastern Meadowlark *Sturnella magna*—see Saunders 1951 : 224). Each European Blackbird *Turdus merula* has, from my experience, perhaps six or seven rather complex songs, and each Hermit Thrush *Catharus* (*Hylocichla*) *guttata* has five or six still more complex (but in part very rapid) songs. In these cases the same song is very seldom sung twice in succession; hence the anti-monotony principle does not prevent the next utterance from following rather quickly, and this means that the contrasts between songs become musical elements also, and in this way even five songs can yield twenty diverse contrasts additional to those within each song.

I have not discussed the question of conventional musical scales, because surely everyone realizes that human music itself exhibits a considerable range of scales over space and time (Herzog 1941), not to mention that our modern Western scale is opposed by some musicologists (Redfield 1935 :

185–95). Since birds use the basic harmonic relations, they have the gist of the matter, in any case (see Wing 1951 ; Borror & Reese 1956 a). And some sing approximately chromatic scales, e.g., two members of the warbler genus, *Gerygone*, of Australia, or the American Canyon Wren *Catherpes mexicanus*.

What about the behaviour-setting of song ? Does it suggest that the sound-production is an aesthetic affair, in any way comparable to human music ? I think the setting does favour this view. Musical sounds are those which, to some extent, are appreciated for their own sake. Not that music may not serve a practical purpose ; on the contrary, it often has done so. Thus there are war songs, songs of mourning, magic-charm songs, etc. But there is a tendency for aesthetic enjoyment to free itself somewhat from the practical, as when war songs are sung even though no battle is to be fought. When a dog whines because it is on a leash and wishes to scamper about or rush to attack another dog, the removal of the leash ends the whining, which was surely not indulged in for its own sake. Similarly, suppose a dog or cat growls while eating meat as warning to other creatures not to attempt to snatch away the meat ; let the meat be entirely eaten, and there is no more growling, which was directly tied to a specific practical function. Similarly with alarm cries such as some birds have : when the danger has passed, the cries cease. Now consider a bird which, by singing and threat displays has succeeded in bringing about the retreat of an intruding male from its territory. Does it cease to sing ? Far from it, one hears resounding song, as though in proud triumph over the victory. Or again, the same bird may sing vigorously for days before a mate appears. The mate comes, for several days there is little time for singing as the mate is being wooed, "shown about" the territory, the pair bonds firmly established ; but then singing breaks out again, especially if rivals appear conspicuous in the area. In all this there is without doubt a good deal of utility. But it is not the narrowly bound immediate utility of growl, whine, or alarm-note ; its results are not usually to be brought about the next moment, but only in the course of hours or days (a long time for a bird) ; they are not limited to a single outcome, but to several very different ones (securing a mate, warning rivals off the territory, maintaining the pair bond).

Since there is not an immediate and single practical meaning for song, it will not have a crude or narrowly emotional character, like sheer hostility as in growls, or sheer misery as in some piteous howling, but will be such as to fit a more balanced and normally cheerful, though mildly excited state, such as is suitable both to interest in a mate and to interest in the privacy of the territory. Be it noted that maintaining a territory—and still more, attracting a mate—is only intermittently a desperate all-or-none affair like keeping possession of a meat-bone. It is, much of the time, leisurely and pleasant ; there is seldom an extreme emergency, when anything terrible

can happen quickly. It is not to be imagined that a bird engaged in territorial singing for hours is exclusively reacting to the possibility of a successful invasion. There is ample room, and some probable need, for its activity to be sustained by the interest of the activity itself, both as a muscular exercise and as the production of a pattern of sound which the bird itself is well aware of. The more striking cases of imitation prove conclusively that birds hear sounds very accurately indeed, and are often interested in what they hear. And the outstanding instances of synchronized male-female duets, which may be musically exact and perfect joint productions, reinforce the point. Here I know of literally nothing comparable to birds and man in the animal world—admitting that insect males can synchronize their monotones (Alexander 1957 a : 111). These considerations support the idea that birds enjoy the sounds they produce.

It may seem odd that attractive sounds (to our ears, at least) should serve as a warning to keep off. But since the sounds must also attract a mate, and make her residence at least not unpleasant, they could not very well have the sharply hostile, unhappy, or ugly sound of growls, shrieks, and snarls. Moreover, no animal will make such unhappy sounds for long except under stress of actual unhappiness. They issue from a strained and abnormal, emotionally somewhat costly state of the organism. Territory holding is too protracted and constant an affair to be accomplished at such a price. Finally, since the rival bird is also a singer, he has to find the song patterns of his species attractive, i.e., " beautiful " not " ugly " ; the more so as we know that to some extent they are learned imitatively—or at least reinforced—in the bird's first half-year or so. (Growls are not learned, they are forced out of an animal by internal stress.) What the rival is to find unattractive, I suggest, is not the basic song pattern, but the duplication of his own rendering of it by a slightly different one ringing all too loudly in his ears. In the distance, there is some evidence he likes to hear it ; for there is not only no indication that males try to get out of hearing of one another, but there is even some indication that they try to keep within hearing (Gannon 1953 ; Darling 1952 : 188).

An additional reason for suspecting a musical sense in birds is this : songs must be more distinctive than mere threat or alarm notes (Thorpe 1956 : 374–75) ; for they must distinguish the species from a score or two, in some cases perhaps even from hundreds, of other species (singing birds being nearly half of all species) and usually they must also distinguish the sex, and help to set apart a male in breeding condition from one not in this condition. Neither threats nor alarms require any such distinctiveness for most of their functions (Marler 1955). Let us then recall that a musical interest is an interest in the distinctiveness of sounds, so far as it is due to all the principal attributes of the sound pattern. A lion's roar can be recognized by its mere volume and low pitch, without any very special regard to parti-

cular pattern elements of rhythm or pitch interval. But with numerous closely intermingled species of small birds, nearly the same in size and hence in pitch and volume-capacity, much finer details call for attention if identification of species, sex, and breeding attitude is to be efficient. Would it not be a miracle if all this could be done, and yet no pleasure in sound-pattern as such developed? Such a negative hypothesis, it seems to me, explains nothing, and itself calls for explanation.

True, you may ask : If the bird has an aesthetic sense, why does it not enjoy the songs of other species as well as its own ; and in that case, should we not expect all the birds in an area to gather around one or a few of the finest singers? Now my answer is : this is the opposite extreme to the former idea of *no* aesthetic sense, since what we are now asked to consider is a universal, highly flexible musical appreciation, without narrow innate preference or bias, and stronger than other impulses or feelings in the bird. What I am trying to defend is something more moderate or relative than either of these extremes. Birds have an innate preference for their own species' sound pattern, and for this we have some experimental evidence (Thorpe 1954). This preference is a relative, not an absolute force. The rather widespread incidence of obvious imitation under natural conditions, and its much more common appearance under sufficiently favourable artificial ones, demonstrates that a tendency to find songs of other species attractive, or at least interesting, does exist, though it is usually much weaker than various other impulses.

The preferential interest of a bird for the song of its species is strikingly shown when a recorded song is played in the presence of wild birds, producing emphatic response from the one species and no particular sign of attention from the others (Koehler 1951). But yet, in case after case, involving many species, birds artificially reared away from adults of their kind have learned quite the " wrong " songs. I have heard a Western Meadowlark *Sturnella neglecta*, reared by Wesley Lanyon in a trailer, where adult larks could not be heard, sing songs of the Baltimore Oriole and other species occurring in the vicinity. Yet wild meadowlarks have not, so far as I know, been reported to imitate. And were there no innate influences limiting or guiding imitation, how could we possibly account for the relative stability of territorial song-patterns throughout a species, generation after generation? (That this stability obtains—naturally with some exceptions here and there—we now know from recordings, whether or not we knew it before from memory, or verbal and musical descriptions.) Thus we stand before the dual fact : birds, apart from highly imitative species (and to some extent, even including these), are innately limited in the flexibility or catholicity of any " aesthetic taste " which they may be presumed to have ; but nevertheless, their keen interest in sounds, especially musical ones, and in sound production is demonstrable. (We shall presently consider further evidence of this interest.)

Since, however, even a human individual's appreciation of musical patterns is subject to limitations which are often puzzling to others whose taste is wider, or whose incidence of insensitivity is elsewhere, it is not necessary to deny that birds do have something like taste merely because their aesthetic narrowness, compared to ours, must be drastic.

One does not wish to argue about words. I am entirely happy to have it said (Koehler 1951 ; Sauer 1954 : 83) that bird song is only a *Vorstufe* or pre-stage of music, just as bird calls of warning, assembly, and the like may be termed a pre-stage of speech (Koehler 1954). The question whether birds approach human music or speech more closely, is perhaps unanswerable. But if we had to choose, I think we should say music. A bird can utter musical-sounding phrases, can use a repertoire of such phrases to some musical effect for our ears, and can learn a sufficiently brief human melody. I have heard a Talking Myna *Gracula religiosa* in the Brookfield " Zoo " give an exact rendering of a portion—about seven seconds—of " The farmer in the dell ", the bird now and then also enunciating the words of the title of the song. That a deafened Blackbird sang at an abnormally high pitch with " ugly ", harsh tone quality (Messmer & Messmer, 1956 : 362, 377) may be evidence of musical taste in the normal bird. Many good observers credit birds with some capacity, however slight, for musical " composition " (Koehler 1954 : 333–34; Messmer & Messmer 1956 : 374–75, 432, 433, 437 ; Howard 1952 : 177, 183–86, 190). Indeed, with imitative birds, at least, this capacity (or a striking illusion of it) is scarcely deniable, since the imitations are generally interwoven in a rather effective sequence of sounds which cannot possibly be inherited. Of course the capacity for musical invention is very limited, even in these cases, as I shall contend later. But can any bird construct a meaningful sentence, put even two words together to describe a feature of its environment ? This appears to surpass avian brain capacity. Nevertheless, it is exciting to learn on good authority that parrots do sometimes use (and even invent) single words to name things, or to express a definite wish or demand (Koehler 1951 : 17). Evidence is rapidly accumulating that anatomical features, and mistaken physiological theories, have long misled scientists concerning the differences in learning ability between birds and mammals (Howard 1952 : 141–62 ; Thorpe 1956 : 299 ; Schmid 1937 : 214–16). For instance, not even man, and certainly no other mammal, has been proved substantially superior to birds in ability for " wordless counting ", number recognition without the use of conventional symbols. A few human beings have reached eight in such non-symbolic recognition, but most human subjects are in this respect merely equal to those other mammals, and certain birds, whose discernment of number reaches seven (Hassman 1952 ; Koehler 1953).

In one ability birds alone, of all animal classes, even remotely approach man : the ability to manipulate sounds in learned as well as innate fashion.

The full significance of auditory imitation has scarcely been appreciated. Imitation of any kind has been demonstrated in but few mammals, apart from the primates—by " imitation " meaning " the copying of a novel or otherwise improbable act or utterance . . . for which there is clearly no instinctive tendency " (Thorpe 1956 : 122). Yet here are the birds, of which hundreds of species (according to the probabilities, and beyond doubt scores) have the capacity to reproduce, sometimes with high fidelity, sounds made by other species, including man, or by inanimate objects. To find anything comparable to this aptitude for sound-copying one must pass to human beings over a half-year old, omitting all the rest of the animal world.

Anatomy itself should perhaps have prepared us to some extent for this uniquely man-like trait, since birds actually go beyond us in the relative importance of auditory and visual neural areas compared to the olfactory. It is even disputed still whether smell plays any role in avian life (Thorpe 1956 : 396). The birds' emancipation from the " smell brain " thus exceeds ours.

A few cases are known, though not widely known, of sub-human mammals learning to reproduce sounds. A pet fox learned from his owner to hum scales (Schmid 1937 : 138–40—orally confirmed to me by Konrad Lorenz) ; and a Boston bulldog in Utah learned to pronounce 20 words (report in 'The Chicago *Sun-Times* Sunday Magazine', 30 August 1953—confirmed in a letter to me from W. H. Perkins, professor of speech at the University of Southern California, who made a recording of the dog's utterances). Professor Perkins has heard of two other individuals of the same variety of dog " talking " ; in all three cases, as also (in his opinion) in that of birds who have learned to utter words, the animal had been made " far more dependent on its master for its affectional needs than is normally the case with domesticated animals ". But these rare mammalian cases—and to my mind their rarity is harder to believe than their occurrence—are to be set against a virtual infinity of avian and human auditory imitations.

It may be significant that the only group of apes which have repeatedly impressed observers as decidedly musical, the gibbons, also furnish the only reported case among the non-human primates of spontaneous vocal imitations ; that of a Siamang which, according to Mott, copied the barks of a dog and the squeaks of a guinea pig (Yerkes & Yerkes 1929 : 74 ; Mott 1924 : 1168). But all efforts to induce Chimpanzees and an Orang-outang to imitate sounds have had meagre or doubtful results (Yerkes & Yerkes, 1929 : 164–65, 305, 307). Thus the birds appear to be the closest to man in generalized and detached interest in sounds. A partial reason for this is to be seen in the much greater ease with which apes communicate by gestures (Yerkes & Yerkes 1929 : 308–309), owing to their plastic bodily and facial forms, and the greater visibility to one another resulting from their size and their tendency to live gregariously. The relative smallness of the gibbons

may have favoured their auditory concentration, for which evidence was mentioned above. (See also Meyer-Holzapfel 1950 ; 1956 : 447.) Carpenter (1940 : 172) speaks of the impossibility of seeing them in their dense forest. On the other hand, even the highly vocal Howler Monkeys seem to live in a world of gestures far more than songbirds could well do (Carpenter 1934 : 82–9, 105–107). It is true that the two types of mammals just mentioned defend group territories against other groups, which they often cannot see, that these territories are large, and the emphasis must be upon volume rather than fine distinctions of sound pattern. It has been said that gibbons can be heard literally for miles. It is also to be considered that with pairs rather than groups of birds holding territories, the distinctiveness of the song of each individual male may have value. Certainly, there is evidence that a new rival male in an area is noticed. Thus, in sum, the conditions favouring vocal finesse are fully met only in birds. (*A propos* of Schmid's fox, mentioned above, it is possibly significant that foxes are smaller, and more solitary and secretive, than wolves or hyaenas, and therefore may have somewhat greater need of such finesse than these other animals. Possibly they have more need also to attend to the squeaks of small mammals on which they prey.)

Since an " instinct of imitation" could only be an inherited tendency to do something the form of which is not inherited, sound-copying must be regarded as a case of learning—and indeed, in the broad sense of a vague term—" intelligence ". To do what the other is doing, where there is no complete inherited pattern for the deed, is to translate the form of the observed act into terms of one's own behaviour. One must in some fashion " grasp " this form, and sense those features of one's own habits which already fit it, compared to those which do not, rejecting the latter and receiving encouragement (" facilitation ") to persist in or improve upon the former. It is in such fashion that the prattle or babble of infants furnishes the foundation for the later learning of speech sounds (Mowrer 1952—a reference I owe to Professor Perkins) ; and Mowrer shows that the facilitation is due to pleasant associations, and similarly that " birds learn to talk only when the human teacher becomes a love object for them " (cf. Thorpe 1956 : 374). (This may help to explain why young birds normally do not copy songs of other species.) The tremendous difference, not far from the greatest difference on this planet, between birds and human young, that the latter are from the outset interested in the conventional meanings of the sounds they imitate, is the great dividing line (which may be closely connected with the avian limitation in temporal attention-span spoken of above) ; but it does not, so far as has yet been shown, affect the mere aspect of sound-copying. Perhaps we may go so far as to say that if birds ever act intelligently, they do so when imitating sounds and when improving their little musical patterns by practice. And what can this capacity be called but musical intelligence—since it is grasp

of sound patterns as interesting on their own account? Should we not also note that the earliest learning of tunes in children comes rather later, as a rule, than the earliest learning of the uses of speech? My daughter, aged 2½, correctly replied to the query, What bird is that? (one having just sung): "That's a Meadowlark". This performance was far beyond the scope of any non-human creature on the globe. But neither she, nor perhaps most children of that age, could rival a Talking Myna or perhaps a bell-magpie *Gymnorhina*, in the accurate rendering of a human melody? The earliest human learning of a tune I have known about was that of a 12-months'-old boy, son of a psychologist in Germany: I was privileged to hear this child sing himself to sleep, as he did customarily, with a correct little slow tune. But this is rare indeed, and even it is scarcely closer to musicianship than some children of that age are to developed speech. How can we explain such facts except by the supposition that the ability to learn musical patterns requires somewhat the same degree and kind of cortical development as the barest beginnings of speech—which, as animals in general go, is high development? So I do not see how we can reasonably boggle at "musical intelligence" applied to birds.

Further facts confirm this. The primitive mode of singing in an individual bird's life is not the utilitarian territory-advertisement form, but rather the "functionless" immature mode of singing (Sauer 1954), the somewhat random, soft, free-flowing "playful" utterance of young birds, and sometimes of adults at times of sexual quiescence, and in the absence of any special instinctive drive. It is now known that the essential form or style of this youthful singing is, in many species at least, innate and unique to the species; but this does not mean that it is a mere automatic exercise. In its details, it is a spontaneous play-like activity, like the cooing of infants, and we know from observations on wild and hand-reared individuals (Mills 1931 : 21–3; Howard 1952 : 109–112; Sauer 1956 : 179–88; Nice 1943 : 51–4; Thorpe 1956 : 321–322) that play is a prominent phenomenon in birds, often much like the scampering, tussling, and curiosity-evincing investigation of kittens, puppies, and other young mammals. (For an odd case in grown turkey hens, see Schmid 1937 : 39.) Invention, learning, is demonstrable in this avian play, including notably for our purpose, discoveries in sound production. More than all creatures save man, birds play with sounds, and not only sounds produced directly by their own organs, but even those resulting through handling of objects. Four instances have been reported, involving as many species and a larger number of individuals, of songbirds playing at sound-making by means of objects dropped from the bill, or pushed off a house or desk-top, the performance being repeated over and over, the birds giving signs of listening for the sounds as "reward" (Mills 1931 : 22–3; Sauer 1956 : 179–82, 186–88; Jaeger 1951; Marshall 1954 : 80). It is also exciting to learn that young Blackbirds apparently

utter the most primitive form of their youthful singing only in response to some sound or other (Messmer & Messmer 1956: 360).

Youthful singing, like other forms of play, is not (at least, after the most primitive phase just mentioned, which in deafened individuals is omitted) a stereotyped response to fixed stimuli or releasers ; rather, it is what happens when there is no particular stimulus or urge, whether internal (hunger, sex) or external (menacing objects or creatures, rivals, mates) and the bird is "relaxed", "free", "satiated". These, of course, are the very conditions in which man is most apt to turn to music or other of the fine arts. The activity tends toward no definite end-result (after which it would subside, as eating does after the usual amount of food has been taken), but rather, various forms of instinctive behaviour, such as chasing, nest-building, courting, food-catching, are simulated but carried only part way to their normal and utilitarian outcomes, then begun over again from some point or other, or dropped ; while another, often a normally antagonistic form of behaviour is initiated, without sign of frustration or anxiety (Sauer 1956 : 183). This too is what happens in man's artistic activities (Ogden, Richards & Wood 1925 ; Pepper 1937 : 45, 47, 63–78). Groos's (1898, 1901) brilliant interpretation of art as a form of play—which, as Sauer remarks, does not mean that it is trivial, lacking in intense interest—still seems good sense, and it applies very nicely to birds. Activities are enjoyed for their own sakes, the practical upshot being, for the time, not to the point. Avian singing in this fashion has some analogy to human musical performances in which the performer amuses himself. It is significant that neither sound-imitation nor vocal play, such as birds and infants indulge in, is found in chimpanzees, which are evidently very deficient in musical sensibility, in interest in sounds for their own sake. Thus for all their superior tool-using capacities and man-like social traits, they are even further from us in some of the requisites for speech than the birds. Their vocalizations are tied to definite momentary situations with specific instinctive responses (Jacobsen, Jacobsen & Yoshioke 1932 : 61).

Out of the relaxed or playful mode of singing develop the more functional advertisement and courtship songs by a process of simplification, restriction, or stereotyping (Howard 1952 : 178–79, 182–86, 196 ; Messmer & Messmer 1956 ; Sauer 1954), issuing in more sharply defined, relatively brief, standardized patterns, fixed perhaps for years (Thorpe 1956 : 372–73). The highly imitative songs are, of course, somewhat different, being in part creations, so far as the innate patterns of the singer are concerned. For this reason, and it is a cogent one, Sauer regards such songs as on a higher level, more akin to human music. Yet here I venture to propose some reservations. There may be partial justification for the traditional European prejudice against the medley type of song—for that is what, in human terms, the imitative song amounts to. In the first place, is there not a modest but genuine

aesthetic creativity in the development of clear-cut, sharply demarcated and self-complete themes from somewhat rambling, free-flowing, endless sequences of notes, and in the musically judicious alternation and spacing of these themes? And it is judicious—if you doubt it, try to do better. Simplification, limitation, after all are important means to aesthetic enhancement. "*In der Beschränkung* [limitation] *zeigt sich erst der Meister*". I confess to a bias in favour of clarity of musical structure, and it seems to me that the functional songs tend to excel in this respect. At their best, they give a sense of precision and perfection, which no youthful singing that I have heard does. The imitative songs, however, of which I have heard some of the most famous, including the two Lyrebirds and the mockingbird *Mimus polyglottos*, tend toward a certain over-all looseness, as it were carelessness, of structure which impresses one somewhat as do medleys in human music. The prevailing preference in Europe for the not obviously imitative singing of the Blackbird, the Nightingales *Luscinia luscinia* and *L. megarhynchos*, and the Woodlark, in comparison to the medley singing of the Sedge and Marsh Warblers *Acrocephalus schoenobaenus* and *A. palustris*, may have a certain validity.

It is sometimes argued that since imitative species can do whatever any of the birds around them can do musically, they must excel all the others. I cannot accept the alleged omni-competence. I think most observers of tested accuracy in this sphere will agree that imitative singing consists of (a) some astonishingly close, (b) many not so close, and (c) not a few ludicrously remote, echoes of the songs of other species. (Much of the imitating may be copies of copies of copies, a "mocker" imitating a mocker imitating some non-imitative species.) Nor is it true that where the resemblance is remote, the fact of imitation is necessarily uncertain. If a specific song is highly singular in its locality, it may be easily recognizable without anything like faithful duplication. I have frequently heard *Mimus polyglottos* give more or less crude echoes of one or two of the superb phrases of the Wood Thrush, and I think there would be no dispute about the source of the utterances, which are very different from the mockingbird's "own" notes, and which I am confident would not be heard from mockingbirds in the far West, where the Wood Thrush does not occur. I think it would also be agreed by specialists in bird song that such echoes of the Wood Thrush are not only not equivalent to the music of that species, they are far less than half that music. Moreover, the general trend among imitative species is to copy by preference, and with far greater accuracy and completeness, brief and relatively unmusical calls and songs, rather than elaborate or exquisite ones. From the latter, the musically developed songs, one gets chiefly snatches, torn out of musical context, and usually simplified, coarsened, and often caricatured. No recording yet made of mockingbird or lyrebird shows the adequate rendering of anything like the full song (repertoire) of a

single highly musical species. Perhaps the closest to it is the mockingbird giving his versions of the Carolina Wren, but the latter has been demonstrated to be his favourite and most successful target (Borror & Reese 1956 b), and I had reached this conviction independently before the demonstration, by instrumental means, was made known. But the other preferred targets are mostly rather unmusical, for example, the Blue Jay.

Sauer (1954) is careful to say that an imitative song is superior to one which is innate, rather than to one which, for all that we yet know, is perhaps partly learned through imitation of adults of the same species. And it may well be that the almost purely innate or genotypic songs, such as he showed that of the Whitethroat *Sylvia communis* to be, are never on a very high musical level. However, the Messmers' work (1956) on the Blackbird seems to indicate that the innate element is nearly as decisive in its case (yet cf. Howard 1952 : 183–89).

Sauer maintains, and others support him here, that wherever singing becomes sharply functional, where territorial rivalry passes over rather constantly into approaches to actual combat, or where courtship passes into a plea for copulation, song tends to degenerate (Sauer 1955 ; Lorenz 1943 : 394 ; Howard 1952 : 178, 187, 193, 199). This is what we should expect if there be an aesthetic factor in the evolution of song, for to say aesthetic is to say non-utilitarian. But we must be careful to balance this consideration against the seemingly contradictory one, that unless an aesthetic activity has some connection with utility it will be less likely to survive evolutionary change. It could be shown, much more cogently (I suspect) than has yet been done in print, that the highly territorial birds, provided their colouration and habitats are such as to make them visually inconspicuous, are on the whole the ones with the most musical singing. Thorpe (1956 : 374), *à propos* of some remarks of Craig and Lorenz (for both, see Craig 1943 : 161–62), has correctly pointed out that purity of tone might sometimes give a competitive advantage, since purity means definiteness of pitch, and there must be some competition among sympatric species for the various possible frequencies in the few octaves available to small birds. Thus, considering evolutionary origins, musicality is in some degree utilitarian ; nevertheless, it flowers best in particular moments when the utility is not pressing or narrowly focused. For example, late-summer or autumn singing is sometimes particularly good. As I write (2 September), a Yellow-throated Vireo *Vireo flavifrons* sings at its very best, though it seems unlikely that either courtship or territory holding are especially urgent at this time. There may be an optimum here between irrelevance to the survival needs of the species and too close or immediate a connection with such needs, as felt by the individual. Late-summer singing may be indirectly useful, for hearing it may help the young males to begin channelling their exploratory singing in the right grooves. There may also be a safety factor in having an agreeable

outlet for extra energy, such as singing provides, since in exigent circumstances the luxury activity can always be dropped, and thus there is a margin of power.

Two things seem very clear : the colonial and semi-colonial nesters, the relatively non-territorial species, are not especially gifted musically ; and the same is in general true of species which are highly conspicuous in colouration and habits. These two facts establish a pervasive connection between utility and the evolution of song. This evolution evidently compensates for the relative invisibility of at least the males of many species which nevertheless, thanks to territoriality, have to become in effect conspicuous in the breeding season—or during most of the year, as some apparently need to do (e.g. the mockingbird). These facts should not be forgotten while we seek to do justice to the relative detachment of song from utility, which studies like those of Sauer, Lorenz, Nice, and many others have brought out.

I shall cite one more pervasive fact (as I take it to be, though without wishing to prejudge the verdict of others) in support of the notion of an avian musical sense. This fact is what I call the " correlation of quantity and quality of singing ". Take the amount of actual singing which an hour's " performance " represents, subtracting, that is, all pauses too long to count as part of the musical pattern (perhaps all silences over two or three seconds), multiply by the number of hours of singing for the entire year, and let this represent the " quantity " of singing for that individual, or species ; then my proposal is that species which are generally regarded by those who know them as outstanding or superior songsters will prove to have two or three times the average amount of singing, and four or five times the amount produced by the " poor " or very mediocre species. It is true that part of this difference takes place, as it were, by definition, since variety and continuity tend to go together and both are among our chief criteria for "good singers ". But in the first place, there are notable exceptions, due to the fact that some fine singers have what I call " eventual variety " (Hartshorne 1956), and this, for obvious reasons, does not greatly increase continuity. In the second place, there are other criteria for good singing, and singers which are good by these other criteria also tend to have both more continuity and more persistence in singing through the day and the season. Near my home in Georgia, there are about 20 singing species in June, only five or six of which are generally regarded as excellent singers, but in autumn nearly all the singing, and there is a good deal, is done by three species, two of which (the mockingbird *Mimus polyglottos* and Carolina Wren) are properly regarded as outstanding songsters, and one, a northern migrant (White-throated Sparrow *Zonotrichia albicollis*) is very nearly so. Furthermore, the wren sings almost, if not quite, every day in the year, as no inferior singer does in this area, so far as I know. Such reduction in the proportion of poor and middling singers in out-of-season singing is not everywhere so dramatic,

but I find evidence that it everywhere takes place—for example, in England. This suggests that those birds sing better (by our standards) which sing less exclusively under stress of utilitarian need. Or does it rather mean that those birds with more all-year-round-need to sing, also do a better job of it —" better ", be it noted, even according to our aesthetic sense ?

At first glance, the ' Calendar of Bird Song for Great Britain ' (Nicholson & Koch 1936 : 1) may seem in disagreement with the foregoing. But closer study dispels this semblance. Excluding migratory species, which cannot, in England at least, have a long song-season, we find that the five longest song seasons (counting one-third for each month of notable intermittent singing) include two of the five best singers (by Nicholson's rating as well as mine), but only one very poor " singer " (Green Woodpecker *Picus viridis*). Since the very good singers (Nicholson's class 1) are altogether only five out of 40, or one-eighth, of the resident species mentioned on the Calendar, while the very poor ones are fully one-half, the deviation, in the direction called for by our " correlation ", from the most probable chance-distribution is unlikely in the ratio of 8 to 1. Again, if we consider the species in full song for $5\frac{1}{3}$ months or more, we find among them all of the five resident good singers (Robin *Erithacus rubecula*, Song Thrush, Blackbird, Woodlark and Skylark *Alauda arvensis*), whose songs give great pleasure to human ears, but only 11 or 12 middling or poor songsters out of the 35 in this class which are resident. The odds against this distribution, if taken as mere chance, are (a friendly mathematician tells me) more than 100 to 1. Or, suppose we look at off-season singing, say August to mid-February. First-class singers furnish one-half to one-fifth, usually one-quarter, of the species in full song during any of these months, although members of this class form in August but one-sixth, and after that one-eighth, of the total in England—again a pronounced deviation, in the required direction, from chance. Unless or until a region can be found in which the proportions run on the opposite side of the probabilities, I submit that the correlation stands. In North America, as a whole, as in England, the figures tend at least as strongly in the direction predictable from the theory. And in Australia, out-of-season singing is especially notable in the superior singers : lyrebirds (whose season is, oddly enough, in the southern winter, but which sing well also in spring and early summer, i.e., September to early December at least) ; butcherbirds, genus *Cracticus* ; bell-magpies *Gymnorhina* ; and sometimes the Gray " Thrush " *Colluricincla harmonica*.

To compare the song seasons of the more with the less musical species among those which migrate well into the tropics in winter, whether in Africa, New Guinea, the Amazon or elsewhere, is a difficult matter. We know that some of the most musical sing vigorously in their winter homes (for the Nightingale *Luscinia megarhyncos*, Blackcap *Sylvia atricapilla*, and Garden Warbler *S. borin* see, in that order, Bannerman 1954 : 301, 131, 126 ; or

Mackworth-Praed & Grant 1955 : 331, 351, 350) ; but so do some of the middling or poor singers, e.g., the Chiffchaff. A clear picture of the statistical balance is beyond my present information. However, at least a mild excess on the side of the correlation appears to be indicated.

It is also to be borne in mind that the poor singers, in order to rival the superior ones in total output of song, must have considerably longer seasons to balance the lack of continuousness and persistence which they show, even at the height of their seasons. Thus, to take one example of many, the towhees *Pipilo erythropthalmus*, which are humble musicians near my house, although they begin singing about as early in the year as other species, for weeks confine their efforts largely to the early morning, and at best sing with pauses three to five times as long as the songs ; whereas those musical experts, the Cardinal *Richmondina cardinalis*, Carolina Wren, and the mockingbird *Mimus polyglottos* tend to sing through much of the day, and in the last case eventually much of the night, and yet they have proportionally much shorter pauses. I do not know a single strikingly musical singer which habitually pauses, as so many poor ones do, four or five times the length of each song or musical unit.

What is the conclusion ? Simply this : there must be an analogy between our sense of musically "better", and some quite objective and efficacious factor in bird life. Two aspects of singing would not correlate, as I suggest they do, all over the world without some connection ; and this does not cease to be true because we employ, as index of one of the factors, our own musical evaluation. One must ask why this evaluation gives a variable which is strongly correlated with a clearly objective-behaviour variable like total amount of singing. The simple, and I believe the correct, explanation is that there is a measure of congruity between the birds' feeling for sound patterns and ours. For some possible qualifications to be borne in mind in interpreting this, see Nicholson & Koch (1936 : 2–3). The birds which awaken our enthusiasm are themselves, as it were, more enthusiastic about their singing, even or especially when sexually quiescent.

The foregoing are some (though by no means all) of the grounds for believing that birds have, in unequal degree, what may reasonably be termed musical ability and sensibility, and that our own preference among songs is not very far wrong as an index of these differences of degree. To this extent the concept, " good singer ", appears to have scientific import. True, it is certainly not a very exact concept ; but then there is generally some vagueness, and a margin of probable error, in scientific thought. The crucial question in this case, as always, is whether we can have a sufficiently definite notion of the extent of the probable error. I think the answer is a strongly qualified affirmative. Statistical correlations are beginning to appear (I have mentioned but two out of a number) which seem to show that the concept is not too hopelessly vague or subjective for certain

scientific purposes. If we avoid pressing the idea too hard, expecting too much from it, we shall probably not err by taking it into account in trying to interpret this subtle and many-faceted phenomenon.

As an instance of what I mean by " pressing the idea too hard ", I shall mention the old-fashioned practice, I hope by now fallen into disuse, of speaking of a single species as " *the* best " songster in the world. We can speak of the highest mountain (though perhaps not even yet with certainty) because height is a simple and rather precisely measurable factor ; but with all complex and rather vague conceptions it is, to speak frankly, downright silly to attempt such absolute comparisons. Men knew there were low and high mountains long before they could sensibly attempt to name the highest ; in respect to musical excellence, avian or human, we can never be in such a position. Thus the statement, " the Nightingale [or Hudson's White-banded Mockingbird *Mimus triurus*] is the finest singer on earth ", is not so much improbable as nonsensical, for it implies exactitude where that cannot exist. Nor is there any bird which everyone admires, when he hears it, more than all others known to him. Not a few have been disappointed in the Nightingale (whether *luscinia* or *megarhynchos*), and many are not very enthusiastic about the mockingbird, or the Australian lyrebirds, or any other you wish to mention. We must stick to vaguer, less pretentious comparisons, such as those between the very good, the middling, and the poor singers ; and we must expect that no two individual observers will draw up these three classes alike. Nevertheless, there is substantial overlap between the judgements of different observers, and this is all we need for certain theoretical purposes (which, as we are more and more learning, means chiefly statistical purposes). This more modest attitude also favours our enjoyment of the beauty of the world (though not perhaps our provincial pride), since it allows us to realize how many nightingales, mockingirds, or Hermit Thrushes there really are—scores, at the very least. And finally, there is no other attitude which fits the need of our time that we should learn to think and feel in terms of one world, the common home of humanity.

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SUMMARY.

Bird song is considered as a primitive form of music, and as an evolutionary anticipation of human music. Evidence is seen in the use of elementary musical devices :

in the avoidance of mechanical regularity (principle of the "monotony threshold"): in the learning of songs and tunes: in the partial detachment from utility, and the playful cultivation of sound production: and, finally, in the tendency of species with more elaborate and, by our criteria, more "musical" songs to spend a larger fraction of the minute, day, and year singing (the "correlation of quantity with quality"). The best singers are those with more variety and complexity in the use of elementary musical devices.

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