

when told afterwards that they had rated the same chord throughout.

The ratings of the test chord were tabulated and their frequencies are shown in the accompanying table:

Rating	..	+3	+2	+1	0	-1	-2	-3
Frequency	..	62	119	101	52	164	124	78

This distribution of frequencies is quite incompatible with the possible hypothesis that the test chord was of constant or even of approximately constant dissonance-level. They are significantly different from a purely chance distribution of the total of 720 ratings into the seven classes, and show that the chord was most often considered moderately dissonant.

Analysis of variance of the table of ratings showed that the variance due to differences between contexts outweighed the error variance by an amount of which the probability was less than 1 in 1,000. This result is very strong evidence that the dissonance-level of the test chord varied with its musical setting. The variance due to differences between individual subjects was significantly greater than the error variance, and significantly lower than the variance due to differences between contexts. This is evidence that the musical standards, opinions or preferences of the subjects were factors in determining dissonance level, but of far less importance than the effects of varying the musical context.

It may be suggested that 'dissonance-level' is a *Gestalt* phenomenon. It is determined by several factors, of which the chief are (a) the physical composition of the chord, (b) the 'schemata' in our minds which arise from experience and depend on musical ability, on training and on tradition, and (c) the musical effect, import or intention of the passage as a whole. The latter was the outstanding influence in this experiment, and it has been dealt with in a letter to us by Mr. John L. Dunk. This is too long for quotation, but in it he has given passages from Beethoven, Elgar and Wagner, showing that sometimes a chord 'theoretically' correct may be excessively harsh in relation to the musical import of the context; whereas in other passages a dissonance which could scarcely be defended in theory, at least at the period when it was composed, may be completely appropriate from the point of view of the import of the passage as a whole.

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¹ *Nature*, 152, 358 (1943); 152, 570 (1943); 153, 85 (1944).
² Myers, C. S., "Experimental Psychology", Part I, 26-27.

Science and the Fisheries

In his admirable discourse at the Royal Institution¹ Michael Graham declares with good reason that "the Great Law of Fishing is that unlimited fisheries become unprofitable", and he deduces that "the only adequate measure to conserve the fishery is to set some limit to the amount of fishing". Fishery legislation, with its restrictions upon fishing areas, upon the mesh of nets, upon the size of fish landed and so on, has not succeeded in staying the downward drift, and more restriction is necessary. The Great Law of fishery legislation, based upon sound scientific advice as things stand, is restriction.

Now an outstanding lesson of the United States contribution to the International Fisheries Exhibition of 1883 and its Conferences, to which Graham refers, was, so far at any rate as freshwater fisheries are concerned, the reverse of restriction. The United States Fish Commission realized that "were the governmental policy directed towards preventing the people from catching the few [fishes] left after generations of improvidence, the expense would be enormous, while such laws would be evaded constantly, and almost with impunity"². The Commission therefore dropped a negative for a positive policy and decided "to expend a comparatively small amount of the public money in making fish so abundant in the rivers and lakes that the public itself may fully and freely enjoy the result"². That was the ideal.

May we not look to the same sort of positive policy in regard to sea fisheries, instead of accepting as axiomatic that restriction of fishing is the only adequate means of keeping up the fish population? Scientific workers know enough about the fundamental relations between the chemistry and physics of the sea and the organisms that live in it to attempt some control of these for the benefit of the fisheries. On a small scale the success of such control, by the addition of chemical nutrients, has been indicated by the work on oyster culture in Norway, and by the limited and still incomplete but developing experiments of Dr. Gross and his colleagues in Loch Sween in Argyllshire. In fresh waters, where the basic problem is similar, I am told by the chief of the Biology Division of the United States Department of Agriculture, Edward H. Graham, that it has been encouraging farmers to add chemical nutrients to ponds for the purpose of increasing growth of selected species of fishes, and thus increasing the war-time supply of food.

If the Loch Sween experiments in their wider range are successful, they will point to the possibility of improving sea fisheries instead of curtailing them. If they are not successful, other experiments with the same end in view should be considered. My plea is that scientific workers in fishery matters should turn more attention to the progressive and productive, rather than to the restrictive, possibilities. There is one important point, however, which must be borne in mind. In his paper on the fishery industries of the United States, read at the Conference associated with the International Fisheries Exhibition of 1883, Prof. G. Brown Goode pointed out that "public fish culture is only useful when conducted upon a gigantic scale—its statistical tables must be footed up in tens of millions" [of fishes, not dollars]. In the sea the scale must be vastly greater, it must be international; so that we may be allowed to speculate upon a day, perhaps not many years hence, when the International Fisheries Commission of the nations bordering the North Sea may discuss, along with its programme of researches, the allocation of the sums to be contributed by each nation for chemical nutrients, in the assurance that these will support a larger fish population and an increased fishing fleet in the North Sea.

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¹ *Nature*, 154, 105 (1944).

² Whymper, F., in "The Fisheries of the World: an illustrated and descriptive Record of the International Fisheries Exhibition of 1883 [1884]", 251.