Nature of Vowel Sounds.

THE following observations as to the nature of the vowel sounds of a single voice (my own)—details of which form the subject of a separate communication to the journal of the International Phonetic Association—may be of interest.

The sounds were observed by ear, first, for the whispered vowels, and afterwards with a larynx note superimposed. In the whispered series it was found that each of the separate vowels was characterised by two resonant notes, an upper component ranging from about #d' (608-) to e^h (2579-), and a lower component ranging from #d' (304-) to #a' (912-).

The upper components are produced in a manner analogous to that of whistled notes, and their pitch is mainly controlled by the distance of the tongue from the palate and teeth. The same note may be produced with almost any degree of opening of the mouth; about one octave of the scale can be produced—through the nose—with the mouth closed altogether. These notes, for convenience, are referred to as "whistle notes."

The lower components appear to depend, like the pitch of a Helmholtz resonator, largely on the area of the mouth opening—they are referred to as resonator notes.

The two series are independent of each other, so that, for example, an ascending scale of resonator notes and a descending scale of whistle notes may be produced (whispered) simultaneously.

The characteristic whistle and resonator notes for each vowel sound are not absolutely fixed (for an individual voice), but may vary in some cases over as much as 5 semitones without loss of the vowel characteristic.

The ranges of "neighbouring" vowels often overlap, so that two different vowels may have the same whistle or resonator note, but in such cases the other component will be substantially different.

In one or two cases, such as "ii" (eat) and "i" (it) the ranges of both components overlap, and the difference between these vowels may be produced in some cases mainly by difference of stress.

When a larynx note is added—as in singing or talking—the pitch of the resonator note does not appear to be affected at all by variations of pitch of the larynx note.

The whistle notes generally are not affected, so long as the pitch of the whistle note in question differs sufficiently widely—say by 2 to 3 octaves—from that of the larynx note.

As the pitch of the larynx note is further raised towards that of the whistle note, the latter tends to adjust itself or "draw" towards the nearest harmonic of the larynx note which lies within its characteristic range for the vowel in question.

Thus, if a chromatic scale be sung to a given vowel sound, the resonator note will remain constant, but when the note sung approaches within say 2 octaves of the whistle note, this latter may be heard to alternate between or jump from one to another of 3 or 4 neighbouring semitones at each change of pitch of the larynx note.

This last phenomenon has, I find, been already observed by Mr. Perrett.

From these observations it would appear to be possible to make an exclusively acoustic classification of the vowel sounds depending on the range of their whistle and resonator notes respectively.

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Protective Colloids—A Pretty Lecture Experiment.

AS the result of a large number of experiments carried out in the Chemistry Department of this School by Messrs. Vallance, Dennett, Trobridge, Hammond, and Tidmus in conjunction with the writer, it appears to be a general law that protective colloids or organic emulsoids tend to retard the velocities of such reactions, whether chemical or physical, as involve a change of state in one or more of the components.

Thus it is found that the rates of solution of metals in acids, of corrosion in neutral media, of solution and precipitation of salts, of replacement of one metal by another, as, for example, in the familiar lead-tree experiments, etc., are all retarded by protective colloids. In many cases the rate of retardation conforms to the requirements of the adsorption law. Details of these experiments will be published in due course elsewhere.

A very pretty lecture experiment illustrating this retardation is afforded by the precipitation of mercuric iodide on addition of the chloride to potassium iodide. If this is effected in fairly dilute aqueous solution, the unstable yellow form is first precipitated and rapidly turns from orange to red as it becomes converted to the more stable variety.

If, however, the reaction is carried out in the presence of gelatin, say one per cent., the liquid first turns momentarily yellow, due to the formation of colloidal mercuric iodide, then becomes turbid, and a beautiful canary colour develops, which remains practically unchanged for half an hour or more, according to circumstances. Only very slowly does it change to the red polymorph. The protective colloid retards the growth of the yellow particles. Sunlight accelerates the change markedly. With the aid of the ultramicroscope (1/16th inch oil immersion) these changes may be seen beautifully. Drops of gelatin and dilute potassium iodide are mixed under the coverglass and the ultramicroscope focussed as usual. A drop of mercuric chloride solution is brought to the edge of the coverglass and is drawn under by capillary action. The field of the ultramicroscope becomes swept with a stream of luminous particles moving with dazzling velocity—the Brownian movement of the colloidal mercuric iodide. The velocity slows down as the particles increase in size, until the colloid range has been passed, and in a few minutes a fine precipitate is obtained evincing scarcely any movement.

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A Problem in Economics.

MANY economic applications of meteorology depend upon the use of forecasts in deciding whether or not to incur expense by taking precautions against some particular phenomenon which would cause damage. A good example is provided by forecasts of ground temperature in deciding whether to pay men to spread sacking over newly-laid concrete road surfaces which would be injured by frost. In the simplest form of such problems the three possible lines of action are (1) to take precautions only on occasions when the phenomenon is forecasted, (2) to take precautions on all occasions, (3) to take no precautions at all. It is of interest to examine the circumstances under which (1) is the most economical line of action.

Let a be the cost of precautions against an event whose probability is P and which will cause damage b if it occurs in the absence of precautions. Suppose the forecast to take the form of a plain "Yes" or "No," and let p be the probability that an occurrence of the event will be preceded by a forecast of "Yes."