

of each resonant circuit was variable in steps from 0.001 to 2 microfarads. The inductance L was continuously variable from about 0.3 to 0.7 henry. The resistance R was due largely to a dial box of range 1 to several thousand ohms, and included, in addition, the resistance of the inductometer and the (perhaps 100 ohms) small variable coupling resistances r and r' (Fig. 1).

The nature of the numerical results is indicated in Table I., which gives approximate values of the frequencies and dampings of the recurrent oscillations which characterise six of the more important vowels. Group frequencies (that is, voice pitches) were for each vowel varied over the range 75-300 per second. The first three vowels given in this table are each characterised by a single train of recurrent damped oscillations; the remaining three are characterised by two trains of recurrent damped oscillations. The numerical values are approximate. Indeed, considerable changes in the circuit adjustments in some cases do not materially alter the vowel produced. The problem of determining the permissible range of variation for each speech-sound requires further study. For the latter three vowels the relative values of r_1 and r_2 are of some importance.

TABLE I.

Vowel.	Damping Oscillations.	
	Frequency, f . (Unit of Time, one second.)	Damping constant, a . (Unit of Time, one second.)
rude	320	small (< 50)
law	650	100
father	1000	500
mat	750	800
	1500	800
pet	420	50
	2300	50
cede	320	50
	2500	50

These results seem sufficiently interesting to recommend the apparatus of Fig. 1 to the attention of students of speech-sounds. Although simple in construction, this apparatus possesses considerable flexibility and range. The really difficult problem involved in the artificial production of speech-sounds is not the making of a device which shall produce sounds which, in their fundamental physical basis, resemble those of speech, but in the manipulation of the apparatus to imitate the manifold variations in tone which are so important in securing naturalness.

As for the disagreement between the Helmholtz-Miller, or steady state theory of vowels, and the Willis-Hermann-Scripture, or transient, theory, Rayleigh pointed out that the conflict was only apparent. The disagreement concerns methods rather than facts. Which view-point should be adopted is thus a matter of convenience in a given case. When the transmission of speech over telephone circuits is in question, for example, the steady state theory often possesses obvious mathematical advantages. On the other hand, the quantitative data relating to the physical nature of vowels which are given in Prof. Miller's well-known book, "The Science of Musical Sounds," expressed, as they are, in terms of the steady state theory, are less compact and definite than the data of Table I., which are expressed in terms of the transient theory. The general agreement between the two sets of data is, of course, obvious.

The work described in this communication was performed while the writer was associated with the American Telephone and Telegraph Company, and was carried out in the laboratories of that company and of the Western Electric Company, Inc.

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Princeton University, Princeton,
New Jersey, July 8.

Interspecific Sterility.

DR. GATES, in his letter which appears in NATURE for August 5, p. 179, emphasises the importance of tetraploid species in evolution, and with this position I heartily agree. Nevertheless, I do not think that the difficulties in the way of free crossings amongst diploid, tetraploid, and hexaploid species are so great as seems at first sight probable, at any rate in the Salicaceae.

In this order Miss Kathleen B. Blackburn and myself have been conducting cytological researches for some time, and find the fundamental chromosome number, both in *Populus* and *Salix*, to be nineteen. Up to the present only diploid species have been encountered in the first-named genus, but in *Salix*, on the contrary, diploid, tetraploid, and hexaploid forms have revealed themselves. In this communication I wish more particularly to direct attention to that homogeneous assemblage known as the Capreae group, which includes, in the eyes of most salicologists, three genuine species, *Salix caprea*, *S. cinerea*, and *S. aurita*—an arrangement entirely in harmony with my own views. Still, so closely related are these three plants that many botanists, both British and continental, have refused to see in them more than one polymorphic species; similarly, others, although they admit the distinctness of *S. aurita*, combine *S. cinerea* with *S. caprea*. Despite this, *S. aurita* and *S. cinerea* manifest themselves cytologically as purely tetraploid species, while *S. caprea*, in the main a diploid form, possesses a tetraploid race indistinguishable in the field from the commoner and normal diploid type. Furthermore, what is especially noteworthy, any one of these four forms can be crossed readily with the other three, and the F_1 hybrids thus obtained prove perfectly fertile *inter se*. Not only is this the case, but, in addition, other species can be brought into the chain, as, for instance, in the complex cross [(*Salix purpurea* \times *S. viminalis*) \times *S. cinerea*] \times *S. caprea* (tetraploid), produced in my garden, and in the still more complicated hybrid [(*S. cinerea* \times *S. purpurea*) \times *S. aurita*] \times [(*S. viminalis* \times *S. caprea*)] \times [(*S. viminalis* \times *S. phylicifolia*)], secured by Heribert Nilsson: in the former, two diploid and two tetraploid species have taken part, and in the latter, three (or two) diploid, two (or three) tetraploid, and one hexaploid form.

As a matter of fact, in the genus *Salix*, interspecific sterility depends, not on the chromosome complement of the species concerned, but on the physiological divergence of the groups to which they happen to belong. Experiments designed to cross the diploid *S. triandra* with the diploid *S. purpurea* turn out just as fruitless as similar attempts to hybridise it with the tetraploid *S. cinerea* and the hexaploid *S. Andersomiana*; on the other hand, the hybrid combinations between it and the tetraploid *S. alba* and *S. fragilis* can be obtained with the utmost ease.

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Armstrong College, Newcastle-upon-Tyne.
August 8.

The Mass-spectrum of Iron.

I HAVE recently investigated this element by using the vapour of its penta-carbonyl mixed with carbon dioxide. It is even more troublesome to deal with than the corresponding nickel compound, but by employing intense discharges and long exposures fairly satisfactory results have been obtained.

The mass-spectrum of iron is characterised by a strong line, approximately at 56, and it may be con-