as to what parts of me were "the majority" and which the "most."

About the year 1884, Newton prepared courses of lectures on Geographical Distribution and Evidences of Evolution. He was to lecture on Monday, Wednesday and Friday at noon. He discovered, however, that the lectures, as written, would not stretch over a whole term, so he told the class that next Monday he would unfortunately not be able to lecture owing to urgent business, and this would continue throughout the term.

Dr. Guillemard, in the passage quoted above, has referred to the difficulty of changing Newton's well-considered opinions. It must be added, however, that he was able to keep an open mind on certain subjects of great importance to him. Thus he readily appreciated Darwin's theory at the time of its publication, and only four days after the publication of the Darwin and Wallace papers by the Linnean Society wrote a long letter on the subject to Canon H. B. Tristram. This led to the circumstance that Tristram was the first zoologist of note to publish his adherence to the doctrine, though unfortunately he was reconverted to the old faith shortly after. He also came to see that the old classification of birds was faulty, and recognized the necessity for fundamental revision.

Professor Newton was an ardent field naturalist, and in his earlier days visited the West Indies (St. Croix and St. Thomas), Iceland, Spitzbergen and other countries, always making interesting observations. He did his best to discover the haunts of the great Auk in Iceland, but although he talked with men who had seen it, it was apparently extinct before his visit. He left copious materials for a history of the great Auk, which he intended to publish had his life been prolonged a few more years.

Newton died in 1907, his last wish being "may the study of zoology continue to flourish in the University." Since then, much good and important work has been done, but there is great need for more room, more assistance, more apparatus, and adequate salaries for the staff. The whole British Empire is concerned in this matter, for in such centers must be trained the men who go out to solve the innumerable problems of the dominions and colonies. Nor is it merely a matter of training specialists, for modern life requires that the leaders in all fields shall know something of biology. Thus, even if conditions in Newton's time could have been described as adequate (which they were not), they would no longer suffice for modern needs.

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ACOUSTICAL NOTES

Musical Notation.—The recent interesting letter in SCIENCE describing a new musical notation and proposing a new keyboard therefor, calls for a brief historical note, even though it should make two ingenious gentlemen "curse those who said our good things before us."

It is obviously true that the staff which best conforms to our chromatic scale of twelve equal steps to the octave, and best appeals to the mind accustomed to grapho, is one of 12 (13) equally spaced lines for an octave; or since it is difficult to distinguish among so many lines alternate lines may be omitted so leaving a 6-line or whole-tone scale. These facts are so obvious that both forms have been invented repeatedly, as is shown by patents long since expired. The earliest use found was by Joshua Steele in "Melody in speech," London, 1775. To distinguish between the numerous lines he superposed the ordinary five lines and used some dotted lines. For many years I have found this notation very convenient for writing non-harmonic scales or music and have referred to it occasionally in print, but it seems never to have appealed to musicians.

Modifications of this many-lined staff have been proposed; one uses only four or three lines, but any note, as C, will come in the same position in all octaves; sometimes the note-heads are of different shapes. The most frequent modification is to retain only the five lines that correspond to the black keys of the piano—a scheme closely analogous in principle to the old tablatures. This was advocated by Busoni who published a few pages of music written on what may be called the "black key staff."

Corresponding to the whole-tone staff the very logical whole-tone keyboard has likewise been proposed by several patentees and is most notably found in the Janko keyboard; this had considerable vogue in Germany and a few were built in this country some twenty years ago; but the instruments with this keyboard are so rare that the musician could scarcely afford the time to practise on it if he had access to one.

A Question of Tuning.—One of the musical trade papers reported some months ago that a phonograph dealer in Chicago had two similar pianos tuned alike, except that in one of them one string belonging to each set of these unisons was tuned to give a slow beat with the other two. Then the public was asked which tuning it preferred; a large majority chose the one with the beat. This preference quite disconcerted the editor who reported it; "What is the use," he says, "of trying to keep a piano in tune when a mistuned one is really liked better?"

This does not seem to me to involve the question of being out of tune in the ordinary meaning of the term; if a chord is struck two thirds of the strings will sound together in the usual way, though the accuracy of tuning will be somewhat blurred or masked by the beats due to the other strings.

But a similar even more marked effect has long been obtained in other ways and has often been proposed by inventors. It is akin to the tremolo which is familiar as a means of expression on many instruments and which in vocal music may be a sign of emotion or even weakness. On the violin a tremolo may come from the rolling of the player's finger along the string, and on mechanical violins from intermittent pressure on the tail piece. Even more closely analogous to the effect in the piano experiment and long known are the results of the "Celeste" stop on the reed organ that brings into use two sets of reeds which beat slightly with one another; and in the pipe organ of the "Vox Celeste" or "Unda Maris" stop that brings on two sets of pipes which beat producing a very few waves per second.

So the Chicago experiments seem to me to indicate, not that hearers object to having the notes of the piano in tune, but that they welcome a new way of introducing variety, vitality, into piano tone. After the key is struck there comes the loud thud characteristic of the piano sound and then the gradual dying away of the sound; the musician can do nothing with the tone but let it die away till he is ready to drop the damper. The player of most other instruments has considerable control over the loudness of a continued sound and occasionally to some extent over its pitch and quality; this is obviously true of most orchestral instruments, and of the organ with its swell and the harmonium with its "expression" due to pumping.

This double control, of loudness and pitch, was realized in the old clavichord and was sought for in the "Steinertone" patented and built by the late Morris Steinert fifteen or twenty years ago. I have recently learned from the makers that in the reproductions built some years ago by Chickering & Sons under direction of Mr. Dolmetsch "the clavichord was tuned with one string of each note two or three waves sharper than the others, and on the harpsichord the second unison was slightly sharper than the first." In the electrical "Choralcelo" exhibited in Boston some years ago there was control both of loudness and quality while a note was sounding.

So the Chicago experimenters and listeners are in good company.

Of course the piano must have some great compensating advantages to lead the world to overlook so great a defect as this lack of variety, but they do not concern us now or here.

The Tuning Fork.—In a recent article in a psychological journal the tuning fork is considered as composed of two bars each attached at one end to a solid block; in a current book for piano tuners a fork is illustrated as sending off a train of waves in one direction, both prongs being bent in the same direction. These surprising disclosures led to an examination of a number of text-books, etc., on sound, from which it appeared that only rarely was there any reference to the true theory of the fork; even the Britannica supports the view of the psychologist. So a note on the subject may not be superfluous.

The theory of the fork is due to Chladni's researches of a century ago. He had found that a horizontal straight uniform bar could vibrate when supported at points about 0.22 of its length from the ends; obviously portions each side of these nodal points must at any instant be moving in opposite directions. Then he bent the bar a little and found that the nodes had moved toward the center, and when the fork-shape with long parallel prongs was reached, the nodes were near the base of the prongs. Assuming the prongs vertical, when they separated the intermediate part near the bends would of course rise a minute distance. In any practical case the center portion is loaded by the stem which will therefore move up and down and deliver regular blows to a sounding board or resonance box on which it may be placed. Such an effect can not be accounted for by the crude theory that prompted this note.

It will help to clear thinking to recall the curious fork shown by the Standard Scientific Co. at the exhibit of apparatus at the Bureau of Standards about a year ago. This had a relatively large hole near the upper end of the stem, the effect of which was to make the pitch much lower than that of a similar fork unperforated.

In this connection it may be added that measures I made some years ago showed that a Koenig's fork of the middle octave on its box, when vibrating at an average amplitude, expended its energy at the rate of about one millionth of a horse power or less than a thousandth of a watt; of course only a small part of this produces sound and only a very minute fraction of this part could reach the ear of any one of the hundred who could hear the fork.

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SPECIAL ARTICLES

THE RELATION OF SOIL FERTILITY TO VITAMINE CONTENT OF GRAIN [1]

THIS study was undertaken at the suggestion of Professor F. J. Alway, who has made a study of the relation of phosphate-hungry peat soils to the grain produced on them,[2] at Golden Valley, Minn.

Burning of the peat rendered mineral matter more available to the plant and increased the yield. It also increased the amount of phosphoric acid in the grain and, as we shall show, increased the vitamine. Two experiments were made, one with barley grown on untreated and on burned peat, and another on oats grown on peat soil as contrasted with ordinary mineral soil. The barley grown on untreated peat yielded 7.4 bushels per acre and the grain contained 0.5 per cent. P_2O_5 in the dry matter, or 17.9 per cent. in the ash, whereas the barley grown on burned peat yielded 42.6 bushels per acre and contained 1.06 per cent. P_2O_5 in the dry matter and 35.5 per cent. in the ash. The oats grown on untreated peat soil contained 0.52 per cent. P_2O_5 in the dry matter and 17.9 per cent. in the ash. The oats grown on ordinary mineral soil in the same locality contained 1.1 per cent. P_2O_5 in the dry matter and 32.4 per cent. in the ash. It was at first attempted to determine the vitamine content of these grains by the quantity necessary to prevent or cure polyneuritis in pigeons. It was very difficult, however, to feed these grains quantitatively to these pigeons, and they all died of polyneuritis before the end of the experiment.

The next attempt was to feed the whole grains quantitatively to white rats, but this method failed also.

The next method was to grind the grains and mix them to the extent of 5 per cent. in a

[1] Contribution from the laboratory of physiological chemistry, University of Minnesota Medical School.

[2] F. J. Alway, "A phosphate-hungry peat soil," *Journal of the American Peat Society*, Vol. 8, 1920.