British Association, at its meeting at Bradford, appointed a committee, the function of which was to see what arrangements of this nature could be carried out. I am not aware, however, that the committee has ever made any report, or if it has arrived at any conclusion on this subject. INQUIRER

Nov. 24

Discovery of Remains of Plants and Insects

I THINK I informed you about two years ago of the discovery of a bed of plants, with leaves, and a great variety of seeds, in this locality; also the wings of a Libellula, and the beak of a bird. As little interest was attracted, I have not hitherto informed you of the subsequent finding of a bed of insects—flies, gnats, and the larva and pupa of the latter, the larva in countless thousands—also the wings, in great numbers, of a variety of flies, butterflies, and one or two grasshoppers; also a wing resembling that of the Mole Cricket. There are, likewise, two or three beetles. The insects and wings are frequently associated with a very pretty Lymnea, in considerable numbers, and an occasional Planorbis, both retaining a high polish. I have also noticed a solitary small white Cyclostoma in the same bed. There are, I think, two feathers among the specimens obtained. Perhaps, as some interest has been shown in a similar discovery in Scotland, some of your readers may like to be informed of this. I am much indebted to the Rev. T. G. Bonney, of St. John's College, Cambridge, to whom you referred me, for advice and encouragement in examining these beds.

Gurnet Bay, Nov. 23 E. J. A'COURT SMITH

Sounding and Sensitive Flames

IN a letter which I have just received from Dr. A. K. Irvine, of Glasgow, my attention is drawn to a short abstract of some of his experiments with Barry's sensitive flame, which appeared in the *English Mechanic* of Dec. 15, 1871, a few months previously to the appearance in the *Journal of the Franklin Institute*, and in the *American Journal of Science*, of the description, referred to briefly in my last letter (NATURE, vol. xi. pp. 6 to 8), of Mr. Geyer's researches on the acoustic properties of the same flame, some particulars of which Dr. Irvine appears also to have noticed independently. The few lines in which his observations are recorded corroborate so fully the character and mode of action of the flame as now pretty perfectly established, that a short extract from them will scarcely be without interest, from the satisfactory support which it offers to the accounts and explanations that other investigators of this flame have elsewhere given in graphic terms of its appearance.

After noticing that it can be produced with an ordinary street-lamp burner (perhaps the straight quill-form, still to be met with in some streets of Glasgow, is here meant), as well as with pin-hole jets of steatite; and that whatever kind of gauze may, with slight differences of the effect, be used, the further the wire-gauze can be removed from the burner without the flame breaking or flattening (? fluttering) on the gauze, the more sensitive is the flame,—Dr. Irvine continues to describe the further characters of the flame as follows:—

"4. The roaring which takes place when any sound disturbs the flame is evidently in consequence of the greater proportion of air which mixes with the gas before passing through the wire-gauze; in short, when it roars and flattens on the gauze, it is an explosive mixture that burns.

"5. If a suitable tube (for instance, a paraffin lamp chimney of proper dimensions) is placed on the wire-gauze, it will be found that a musical note is produced every time the flame is disturbed by a sound with which it sympathises.

"6. A mixture of any inflammable gas and air passing through wire-gauze, over which a suitable chimney is placed, will give a note varying in pitch with the dimensions of the chimney and size of the flame."

Proceeding on this principle, Dr. Irvine adds that he had recently constructed and patented a form of miner's safety-lamp, which, when an explosive mixture of gas and air enters it, gives an audible signal of the dangerous condition of the mine.

It may be questioned if it is quite safe to excite rapid vibrations of a gas-flame burning on the wire-gauze inside a safety-lamp placed in an explosive atmosphere; but if any vibrations of the flame that are thus produced are limited (as it appears possible to ensure, by a proper construction of the lamp) to the extremely small oscillations of a high-pitched note, then no elements of danger in this new contrivance need necessarily be introduced or apprehended from the sounding action of the flame. In this and in other cases of their employment which have suggested themselves to experimenters on the acoustic properties of gas-flames, there seem to be hopeful promises of advantageous application of the sensitive and sounding properties that certain gas-flames possess in a very high degree. But it is to the explanation of the cause of the prostration, and to the account of the case of musical sensitiveness in Barry's wire-gauze flame when disturbed by external sounds, that it is particularly desired to direct attention in the foregoing extract from Dr. Irvine's brief description. The reason that the author assigns to them, and thence to the monitory action of his singing safety-lamp, that increased inflammability of the burning gas-mixture is at once the source of the sensitiveness, silent or sounding, of the wire-gauze flame, and the necessary condition of the atmosphere for the alarm note sounded by the newly invented safety-lamp, is so clearly expressed and illustrated by the order of his experiments, that as regards the probable mode of action of the disturbed gas-current adopted to explain the sensitive effects observed, there can be no doubt of the correctness of Dr. Irvine's view.

The gas-current, before reaching the wire-gauze, will naturally entangle and mix with a larger quantity of air when it is disturbed, by presenting a greater surface to the air in that state than when it issues smoothly. In the latter case it is not inflected into the tortuous wave-line of many folds and curves into which it must be bent on leaving the burner and passing from a fixed jet into an atmosphere oscillating rapidly to and fro under the action of external sounds. The sound-wave of the air into which it flows thus serves to incorporate more air with the upward stream and to render the combustion of the mixture more condensed and prompt, and the appearance of the flame in consequence more contracted and boisterous than when the gas-jet burns in a surrounding atmosphere of quiescent air.

Newcastle-on-Tyne, Nov. 14 A. S. HERSCHEL

SCIENCE IN MUSIC

AT the first meeting of the Royal Society on Thursday evening, the 19th ult., a paper was read by Mr. A. J. Ellis, F.R.S., on "Musical Duodenes." This formed the conclusion of a series of papers (the preceding ones having been published in the Minutes of Proceedings) on Just Intonation and Temperament in Music.

The author explained the defects of the ordinary keyed instruments, such as the pianoforte and organ, which were limited to twelve sounds in the octave, and were now tuned by a system which he characterised as the "worst possible," every element of harmony in them being put out of tune in all keys. To produce just intonation, it was necessary to have many more than twelve sounds in the octave; and he exhibited a chart giving a classified list of seventy-eight such notes, distinguished by the ordinary musical signs, with the addition of certain other marks which defined exactly the pitch of the notes, while their respective positions in the chart gave, by simple inspection, a correct idea of their relations to each other. Mr. Ellis then stated that as the large number of notes required by correct theory became troublesome in practice, the plan had been adopted of sacrificing absolute truth in some instances, and introducing a trifling error, by which means the requisite number of notes was much reduced, while the error was so small as not to offend the ear in any sensible degree.

Having determined thus on the number of notes to be used, the practical problem arose how best to introduce them in an instrument. Many contrivances had been suggested, involving new key-boards and modes of fingering; but considering the difficulty of introducing changes of this kind, preference was given to other plans, which retained the twelve notes of the ordinary key-board. To enable such a system to be carried out, it was necessary to make choice of certain *sets* of twelve notes, to be used when playing in certain keys; and to furnish information to guide these selections was the chief object of the paper. Such a set of twelve notes was called by Mr. Ellis a musical *duodene*, and the chart exhibited many of these

combinations, the properties of which and their appropriateness for particular cases were easily ascertainable.

Mr. Ellis, while deprecating the introduction generally of musical performances under the guise of lectures, illustrated his propositions by showing the effect of several instruments of fixed tones, concertinas and harmoniums, tuned in different ways. Some short harmonical passages were played, first on a harmonium of the ordinary kind, secondly on another with absolutely just intonation, and thirdly on a newly-constructed harmonium tuned on Handel's plan of the old organ temperament, but with the addition of several other notes enabling music to be played in all keys, equally well in tune. These additional notes were brought into use by draw-stops, each of which made an enharmonic change in one note, as from C sharp to D flat, G sharp to A flat, and so on. The stops were arranged before commencing the piece according to the key it was in, and they could be instantly altered at any time during its progress, if required by modulation. In this instrument the major thirds (the intervals to which the ear is most sensitive) were all justly in tune, but the fifths and minor thirds were a little flat; the ear, however, tolerated these slight errors much better than the extremely discordant error of the major third in equal temperament, and the effect of the harmony as played upon it was a great improvement on that plan.

Mr. Ellis, in the course of the paper, made frequent mention of the views of Helmholtz on harmony and temperament, and illustrated them by examples.

After the reading of the paper, Dr. Pole, F.R.S., remarked that Mr. Ellis's method of treating the elements of the musical scale had much originality, and had an interesting bearing on the structure of harmony generally; its principal object appeared, however, to be, in continuation of the author's former labours, to facilitate the production of correct intonation in music, an object of much importance. He would remind the meeting what was the present state of matters in regard to this. The fact was, that at present it was but seldom possible to hear what true harmony was like, as the great majority of music-producing instruments, namely, all those with fixed tones, were deliberately and systematically tuned false, with an amount of error painful to a sensitive ear. When he, a day or two ago, put his fingers on Mr. Ellis's just harmonium, he uttered an involuntary exclamation of surprise, for he had not heard the true harmony of a common chord for some time before. The public had only two opportunities of hearing true harmony: one when a stringed quartett was played by fine players; the other when a vocal unaccompanied piece was sung by first-rate singers. In each of these, the performers, being untrammelled by the odious temperament, gave way to the dictates of their correct ears, and produced true harmony. Every person of musical taste knew well the delightful impression produced by this kind of music. In modern oratorios it was very customary to insert, as in "Elijah," for example, an unaccompanied vocal piece, which was always rapturously applauded. Yet few people thought of the cause; it was not the composition, for the same music, when played on tempered instruments, was quite another thing; it was not even the skill of the performers, which could be manifested in other ways; it was purely and simply the fact of the harmonies being in tune, which was an agreeable novelty to the ear.

On the pianoforte, where the sounds were not long sustained, the errors of the temperament were not so offensive, but on instruments with sustained tones, such as the organ and harmonium, the defects were much more prominent. In olden times musicians had more sensitive ears, and organs were tuned (as Mr. Ellis had stated in regard to Handel's organ) on a temperament which put the principal keys in good tune, and threw the defects into keys seldom or never used on an organ in those days. But since that time, as modern music, and especially what the Germans called *Fingerfertigkeit*, had increased in popular favour, organists had made up their minds to play in all sorts of remote keys, and had demanded that the organ builders should favour this by applying the equal temperament. For show organs this course might be defended, but for church organs, where nothing was required but the use of the simplest keys, it was perfectly indefensible, as it was spoiling the tone of the organ for its ordinary use, for the sake of a purely imaginary want. The organ was half a century ago a sweet-sounding instrument; now it was a harsh, offensive one, which made attendance at church a penance to persons with musically sensitive ears. A curious proof occurred a few years ago as to the mischief the equal temperament did to the tone of an organ. Dr. Pole had to superintend the construction of two organs of tolerable size: in one he was obliged to give way to popular prejudice by having it tuned equally; in the other he pleased himself by adopting the old tuning; and although the instruments were precisely alike in other respects, and made by the same builder, the latter acquired the reputation of a peculiarly sweet-toned organ, while the former was considered a harsh tone.

It was time something was done to correct the evil, but there had been difficulties both theoretical and practical. Theoretically it had been difficult to determine what should be the exact pitch and number of the notes to be used, but he conceived Mr. Ellis had now exhausted that subject, and that for the future no person who wished to carry out plans of just intonation would find difficulty in selecting from Mr. Ellis's data, exactly such *duodenes*, or series of notes, as would answer his purpose. There were still difficulties in practice, for as it was certain that more notes than twelve must be used, the problem how to enable the player to arrange them easily was not an easy one. In this particular, however, progress was being made; Mr. Ellis had pointed out several important simplifications, and Dr. Pole especially looked on the harmonium with shifting tones now exhibited as a promising invention. It was pleasant to hope there was some practical possibility of getting music in tune.

The continued discussion of the subject of just intonation was very desirable, for the reason that practical musicians, probably from a feeling of hopelessness as to getting anything better, were beginning to consider equal temperament as a necessary evil, and to look upon its harshness with indifference. Indeed, it was to be feared that the ears of musicians were becoming actually deteriorated in sensitiveness to errors of intonation. In our best orchestras, for example, although the strings might play in tune (for our orchestral violinists had no superiors in the world), yet the wind instruments were often false; and our conductors, even the best of them, seemed callous to the cacophony. He might remark here that the efforts at producing just intonation had been hitherto confined to instruments with the pianoforte keyboard, but there was a wide field open for the improvement in this respect of orchestral wind instruments, in regard to the just intonation of which absolutely nothing had yet been done. The utmost wind instrument makers had aimed at was to make them play correctly on equal temperament; he was not aware that anybody had thought it worth while to make enharmonic distinctions in their scale.

On all these accounts Mr. Ellis's labours to improve the general knowledge of the subject were most valuable, and earned for him the gratitude of all true lovers of music.

THE TREE-ALOES OF SOUTH AFRICA

THE flora of Southern Africa is extremely remarkable, not merely for the number of its species and their generally very restricted range, but also for the frequent singularity of their aspect and manner of growth. In