term may be indicated as follows: the cumbersome phrase, "first derivative of a phenotypic quantity (facet number, wing-area, etc.) with respect to temperature" is replaced simply by "thermophene."

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THE DETERMINATION OF CARBONATES IN SOIL

IN a recent issue of SCIENCE[1] Schollenberger discusses briefly the error obtained in the determination of carbonates in soil when a strong acid is used as the decomposing agent. He recommends the use of dilute acid and ferrous chloride at a low temperature.

The writer experienced similar difficulty several years ago in the analysis of some Illinois soils.[2] When using 1:1 hydrochloric acid in the Parr apparatus carbon dioxide was obtained from several soils distinctly acid in reaction. Similar results were obtained with sulfuric and phosphoric acids. Nor was the difficulty overcome when the decomposition was carried out at room temperature under reduced pressure. It occurred to the writer that possibly a weak acid should be used in preference to a strong one. Acetic acid was tried with success, no carbon dioxide being liberated from non-carbonate containing acid soils, and in the case of soils containing carbonates a lower value being obtained, the difference being consistent with the amount of carbon dioxide previously found in acid soils when a strong acid was used. No study was made of the causes of the error obtained with strong acids, but it was observed that the error appeared to be independent of the organic matter content of the soil.

Glacial acetic acid diluted 1:1 or 1:2 is used, no other modification in the procedure described by Hopkins[3] being necessary.

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MUSICAL PITCH AND THE PHYSICISTS

I THINK it is time to bring forward once more the desirability of a reform which has long been overdue. I refer to the absurd and unnecessary discrepancy which exists between the usages of the physical and of the musical worlds in the important matter of standard of musical pitch.

For a long time it has been the custom of physicists to make use of a standard of musical pitch based upon a frequency of 256 double vibrations per second for the note middle C, which stands number 40 on the piano keyboard. This frequency actually, however, is rather more than 6 vibrations per second lower than the actual standard frequency of the same note as now universally adopted throughout the United States and in most parts of the civilized world. This latter pitch is usually known as the A440 pitch; that is to say, it is based upon a frequency of 440 D.V.P.S. for the note A which stands number 49 on the piano keyboard. This pitch, or something extremely close to it, has been adopted by virtually all the symphony orchestras of the world, and in consequence by nearly all other musical practitioners, save in France, where the standard still remains the French "normal diapason" of 435 for the same note.

In 1918 the American Federation of Musicians adopted the A440 pitch. In 1925 a committee of the Music Industries Chamber of Commerce, of which I was secretary, representing the manufacturers of every type of musical instrument made in the United States, including the associations of piano, of organ and of wind instrument manufacturers, unanimously recommended that the A440 pitch, based upon a standard tuning fork giving this pitch at a temperature of 68° Fahr., should henceforth be the standard pitch for all musical instruments made in this country. The recommendation was adopted by the directors of the chamber. So far as I know, every manufacturer of pianos, of organs, of wind and of brass instruments in the United States is at this moment using this pitch, which in point of fact represents more nearly than anything else the prevailing standard throughout the world.

As can readily be seen, the discrepancy between this pitch and the entirely artificial pitch used by physicists in their acoustical work becomes extremely serious in the higher regions of the musical scale. Thus, for instance, the note which is represented by 440 D.V.P.S. on the standard scale above mentioned stands at 430.5 on the physicists' scale. In the higher regions the discrepancy is extremely noticeable. Thus, when I sound a fork made on the physicists' scale for the high C, which stands number 76 on the piano keyboard, and compare its sound with that of the same C on our Steinway grand, which is always kept carefully tuned to the 440 standard, the flatness of the tuning fork is extremely obvious and unpleasant, for, as can readily be seen, there is a difference of no less than 44 double vibrations per second. I assume, of course, in both cases, the universal equal tempered systems of tuning.

Instances might be multiplied, but what I have

[1] SCIENCE, 72: 13–14, July 4, 1930.
[2] *Soil Science*, 28: 149, 1929.
[3] C. G. Hopkins, "Soil Fertility and Permanent Agriculture," p. 628, 1910.

said should be sufficient to exemplify the absurdities of the situation. Since the advent of radio engineering and the consequent revival of interest in matters musical among physicists and electrical engineers, the existence of a discrepancy like this becomes extremely important. In most of the scientific papers dealing with acoustical matters in which questions of pitch are taken up, the physicists' scale is used. One is driven to the conclusion that many scientific men are unaware that the scale which they are using is completely artificial and is nowhere used for the practical performance of music.

In matters relating to hearing, to levels of sensation, to discrimination of pitch and to the investigation of musical esthetics, it is obviously essential that all parties to such investigations should speak the same language. It is unfortunate that scientific men and musicians should seem to feel a sort of mutual antagonism, but the fact that their interests are now forcibly merged one with the other ought to bring about some sort of an "entente cordiale" between them. Such consummation is devoutly to be wished for the best interests of the new science of acoustics and for the big practical interests of the recording and reproduction of music. There is not the slightest excuse, save arithmetical convenience, for the persistent use by physicists and engineers of a scale that has not been used for the practical performance of music since the time of Handel. It is high time that when one reads in a scientific paper something about a certain musical note, one should be able to be sure that the writer of the paper means in sound what a pianist, violinist or clarinetist playing that note would actually evoke from his instrument.

I am not alone in the pleas expressed here. Dr. Dayton C. Miller, one of the greatest of American pioneers in the science of musical acoustics, long since called attention to the absurdities which I have ventured to describe once more. In his book "The Science of Musical Sounds," published in 1916, he devotes some space to the discrepancy mentioned, and makes a plea for uniformity and common sense.

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PHYSIOLOGY OF RARE GASES

IT is to be hoped that the article of Professor Hershey in SCIENCE of April 11 last on the "Components of Air in Relation to Animal Life" will command some attention. The idea that the rare gas fraction of the atmosphere has some physiological significance has had a great attraction for me during the past ten years, and as far as my acquaintance with the literature goes, Professor Hershey's work is outstanding in its direct bearing on the subject. The experiments of McDonald and Kellas,[1] Kellas,[2] Tolomei,[3] Regnard and Schlösing,[4] Zaleski,[5] Marcacci,[6] Cannon and Free,[7] Pictet, Scherrer and Helfer[8] and Hackspill, Rollet and Nicloux[9] when taken together have given no decisive answer to such a question.

In describing the results of experiments with nitrogen-oxygen mixtures, Professor Hershey was led to remark that "the rare gases seem to play a part in normal life equally as important as oxygen." On the other hand, when in the nitrogen-oxygen mixtures the latter gas was increased to a proportion of from 25 to 40 per cent., "the animals appeared to be normal and in a few cases better than in normal air." This leads to an inference that an apparent compensation for the absence of the rare gases was accomplished by an increase in oxygen and reciprocal decrease in nitrogen within certain limits.

Since in the complete absence of oxygen the duration of animal life is only a matter of minutes, while in certain mixtures of nitrogen and oxygen with an absence of the rare gases the duration was at least three weeks, the importance of these rare gases does not appear to be vital in the absolute sense unless a longer period of time is required for the demonstration. It may be, therefore, that we are presented with an analogy to the food requirements of the animal organism, where the bulky part or roughage corresponds with the nitrogen, the caloric value with the oxygen and the accessory food factors with the rare gases. Vitamin deficiency takes a much longer time to injure health and end life than the complete withdrawal of food. It may be possible too that the food is itself a means of compensation or source of error, for Tolomei's contribution to the problem was to show that argon is locked up in the root tubercles of legumes which are associated with nitrifying bacteria. In judging of a state of health that is "better than normal," general appearances must be considered, but without some quantitative guide, such as size and weight or rate of growth of the young, one must be wary. The slight flush and bright eye of a low fever may improve the appearance of the human being though he be impaired in health.

1 "The Gases of the Atmosphere," Ramsay.
2 *Proc. Roy. Soc.*, 59: 66.
3 Chem. Cent. I, 1030 (abstract).
4 *C. r. Acad. Sci.*, 124: 302.
5 *B. Dtsch. Chem. Ges.*, 30: 965.
6 *Mem. R. Ist. Lomb. Sc. e Lett., Sc. Mat. e Nat.*, 19–20, Ser. 3.
7 Carnegie Inst. Yr. Bk., 20, 63.
8 *Helv. Chim. Acta*, 8: 537.
9 *C. r. Acad. Sci.*, 182: 719.