JOURNAL NOTES

Acoustics and Chemistry

The presence of minute amounts of certain salts such as magnesium sulfate in water may produce large increases in the absorption of sound. This effect is interpreted as resulting from a disturbance of the normal ionic equilibrium present in solution by the passage of a sound wave. The shift in chemical equilibrium is a direct result of temperature and pressure variations in the sound field. At high acoustic frequencies, however, the chemical reaction may be too sluggish to respond to the rapid variations of temperature and pressure, and the sound absorption arising from the chemical reaction may become negligible. By determining the frequency at which chemical absorption vanishes, the reaction rate of the chemical reaction can be established. This technique may be particularly useful for exceedingly rapid chemical reactions.

Other chemical parameters, such as the equilibrium constant, are also related to the magnitude of the absorption and may be obtained from absorption studies. Some of the obscurity surrounding the nature of chemical reactions in solution may be lifted by studying the dependence of absorption on concentration. For example, bimolecular reactions in salt solutions would be expected to depend on the square root of the concentration while unimolecular reactions would depend on the three-halves power of the concentration. In order to illustrate these chemical-acoustic relationships the absorption of the magnesium sulfate solution is discussed in considerable detail. The theory implies that these unusual acoustical effects may not be confined to salt solutions alone but should be looked for in all fluids which contain chemically active components in equilibrium. L.L.

Sound Propagation in Chemically Active Media. By Leonard Lieberman. *Phys. Rev. 76: 1520, Nov. 15, 1949.*

Cool Detectors

In the development of detectors of infrared radiation, mere empirical improvements are no longer sufficient. It is necessary to enquire what are the fundamental limitations to the performance, and how closely existing detectors approach these limits. Since 1943 several papers have discussed these questions from various points of view, and it has emerged that the sensitivity is limited by fluctuations in the temperature radiation received by the detector from its surroundings. These fluctuations are associated with randomness in the arrival of photons at the detector, and resemble in some ways the "shot" effect in an electron stream. In the present work a general method is given for finding the numerical value of the sensitivity limit. It is used to obtain the well known formula for the noise level in a radio antenna, illustrating that an antenna can be regarded as an infrared detector. The limiting sensitivity of certain photoconductive infrared cells is compared with their actual performance. This

yields the rather surprising result that lead sulphide cells, and especially the lead telluride cells developed by Simpson, are already within a factor of about two of the limit for room temperature. Therefore greatly increased sensitivities can only be obtained by using detectors in refrigerated enclosures, for which the limit is more favorable. Recent reports show that even present day cells can be considerably improved by using them in a cooled enclosure. It remains to exploit these observations practically.
P.B.F.

On the Ultimate Sensitivity and Practical Performance of Radiation Detectors. By P. B. Fellgett. *J. Opt. Soc. Am. 39: 970, Noevmber, 1949.*

High Sensitivity

Wartime developments in radar have made available equipment for producing and detecting short radio waves of a few millimeters to centimeters in length so that it is now convenient and easy to study the absorption of various substances, particularly gases, in this region of the electromagnetic spectrum. This paper describes a modification of the standard microwave spectrograph with which it is easier to attain the high sensitivities necessary for studying many molecules. The principle is to use the Stark effect to modulate the absorption of the gas at an audio or radio frequency.

An electric field, applied in the wave guide to split or displace the spectral lines, is turned on and off at an audio or radio frequency. The microwave energy is, therefore, either transmitted freely or partially absorbed by the gas, and the detected output of the apparatus is modulated at the frequency of the applied electric field. This is amplified by a sharply tuned radio receiver or special amplifier. In the present apparatus the amplifier is very sharply tuned and the signal recorded on a pen-and-ink recorder. In this way the noise due to the crystal detector is very greatly reduced, enabling absorption coefficients as low as 10^{-9} centimeter to be detected in a ten-foot length of absorption cell.
E.B.W.

A Stark-Effect Microwave Spectrograph of High Sensitivity. By K. B. McAfee, Jr., R. H. Hughes, and E. Bright Wilson, Jr. *Rev. Sci. Inst. 20: 821, November, 1949.*

Flame Propagation

There is considerable interest at the present time in the behavior of flames and the various factors which control their propagation. This has been motivated by the development of jet engines in which the fuels and operating conditions are not even a second cousin to the conventional internal combustion engines with which engineers have had considerable experience.

We know so little about the mechanism of flame propagation that we cannot tell whether the rate of flame propagation is controlled by hydrodynamics (in the form of diffusion of hydrogen atoms or free radicals) or whether the problem is essentially chemical (the kinetics of the individual chemical reactions being rate controlling). The actual design of combustion chambers and the suitability of particular fuels depend on which one of these factors is predominant. Violent feuds are taking place between exponents of the two viewpoints. We believe there is a critical pressure above which the hydrodynamics is of more importance and below which the chemistry becomes important.

In order to settle the argument, we have set up the honest hydrodynamical equations in which the chemical kinetics is plugged into the equations of continuity, and a staff of able computers is tediously integrating the equations point by point. As soon as the bugs are eliminated from our method of solution, we will place these equations on high speed computing devices and expect in this manner to bridge the gulf between the practical jet combustion problems and the basic chemical kinetics. When this work is completed, it will be possible to tailor-make a fuel and combustion system for any given operating condition.
J.O.H.

The Theory of Flame Propagation. By J. O. Hirschfelder and C. F. Curtiss. *J. of Chem. Phys. 17: 1076, November, 1949.*

Quieting Ram Jets

In 1945 the Applied Physics Laboratory of Johns Hopkins University, in a project for the U. S. Navy Bureau of Ordnance, established a testing laboratory for ram jet motors at Forest Grove, Maryland in relatively open country where high noise levels could be tolerated. After the war, new housing developments close to the laboratory rendered extensive quieting necessary, if operations were to continue. The Kellex Corporation conducted the required acoustical surveys and prepared plans for necessary modifications.

The noise levels inside the test cells reached 155 decibels—one hundred to one thousand times more intense than the noise from a large airplane engine. Some operating spaces in the laboratory suffered the uncomfortably high level of 120 decibels while levels in the street behind the laboratory reached 100 decibels, comparable to those in a noisy subway train. It was necessary to eliminate the noise without interfering with the entrance and exit of large quantities of air and hot gases.

New test cells with double concrete walls, double doors with rubber seals, and observation windows with four panes of thick glass were provided. All joints and openings were carefully sealed. An elaborate system of sound absorbing panels was installed in the exhaust and intake stacks. The modified test cells have been operating steadily for over a year without annoyance to the occupants of apartment houses which now line the street opposite the laboratory.

The project demonstrates that proper application of known acoustical engineering principles will provide quiet test laboratories which need not be at remote locations.
W.B.S.

Method for Quieting Ram Jet Motor Test Stations. By W. B. Snow and C. J. T. Young. *J. Acous. Soc. Am. 21: 626, November, 1949.*

- - - - - - - - - oscopes

An increasing number of scientists and engineers are finding need for instruments to observe events from remote stations. Borescopes, for example, are needed for viewing the inside of rifle barrels, while gastroscopes are