they have no hope of meeting such standards, despite the fact that they might lead to lower overall emissions than anything else in sight. As an example, the extremely strict NO_x requirements have slowed the development of gas turbines.

Furthermore, the exacting standard of 0.4 g/mile for NO_x emission will undoubtedly force the car manufacturer to base his design on the use of rich fuel mixtures, thereby loading the afterburner with copious amounts of HC and CO that will be produced during the combustion of the rich fuel mixture. This is certain to reduce the reliability of the entire system.

Some of the designs proposed as the most promising to meet the NO_x requirements not only are very complex, but also will perform poorly. What is worse, the performance of the car could be significantly improved by adjustments (such as the ignition timing and air/fuel ratio) that will restore NO_x emissions close to their present levels. Another case in point is the cold-start problem. Research efforts have unduly emphasized the development of an afterburner capable of controlling emissions during cold start. One way of getting the afterburner to respond promptly to cold-start emissions is to decrease its thermal inertia. This, however, would make the afterburner particularly sensitive to any temporary malfunction of the engine. Another way of reducing cold-start emissions would be to add a second afterburner designed for start-up only. This again will increase the complexity of the system and thereby reduce its reliability. Indeed, the importance of the cold-start problem is questionable. In Los Angeles, cold-start emissions, calculated on the basis of two cold starts a day for each car, contribute less than 5 percent of the total HC and CO emissions from cars.

To reliably achieve low overall emissions requires design compromises that take into account the interactions between different requirements. To obtain optimum results by legislative control, the government agencies must therefore develop the proper technical expertise, to provide the total system development guidance to the legislative body.

Effective control of pollution from cars requires a total system approach rather than solely the legislation of emission standards for new cars. Specifications for new cars should:

1) Specify emission levels that each car has to maintain throughout its useful life. These levels will form the basis for an annual inspection.

2) Provide safeguards to prevent unusually high emissions in case of partial failure of the control equipment.

3) Provide guidelines to facilitate ease of maintenance, replacement, and inspection of control equipment.

The present allowable emission levels should be relaxed to enable available technology to furnish reliable solutions. These levels can be subsequently decreased as new technology becomes available. New designs of control equipment and engine modifications should take into account the need for simple maintenance and high reliability.

Solutions that will induce the driver to tamper with the control equipment in order to improve the performance of the car should be avoided. We therefore need a nationwide inspection policy, which will require vastly improved maintenance facilities and properly trained people.

There is still time to take a fresh and rational look at the problem of car pollution before the predictable lack of effectiveness of present measures create a climate of dissatisfaction in which sensible solutions are harder to obtain.

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Jupiter: Observation of Deuterated Methane in the Atmosphere

Abstract. *A positive identification of singly deuterated methane has been made in the 4- to 5-micron spectrum of Jupiter.*

During May 1971 we obtained a number of whole-planet spectra of Jupiter in the spectral region from 1800 to 2200 cm^{-1} at a resolution of 0.55 cm^{-1}, using a Connes type Fourier spectrometer (*1*) at the coudé focus of the 2.7-m telescope of McDonald Observatory, University of Texas. The spectra were combined into a grand average having a signal-to-noise ratio of about 150. Comparison solar spectra were also obtained during the same period with the same instrument configuration in order to identify telluric features and to aid in the definition of continuum levels.

Strongly evident in the spectrum of Jupiter are several J-manifolds in the P-branch of the ν_1 parallel band of CH_3D. We believe this to be the first observation of deuterium in any astronomical source.

We made the identification using the high-resolution laboratory data of Allen and Plyler (*2*), in which the frequencies are accurate to better than 0.03 cm^{-1}. As a consequence of our limited spectral resolution, pressure broadening, and smearing from the high rotational velocity of the planet, the manifolds are not resolved in the astronomical spectra. Furthermore,

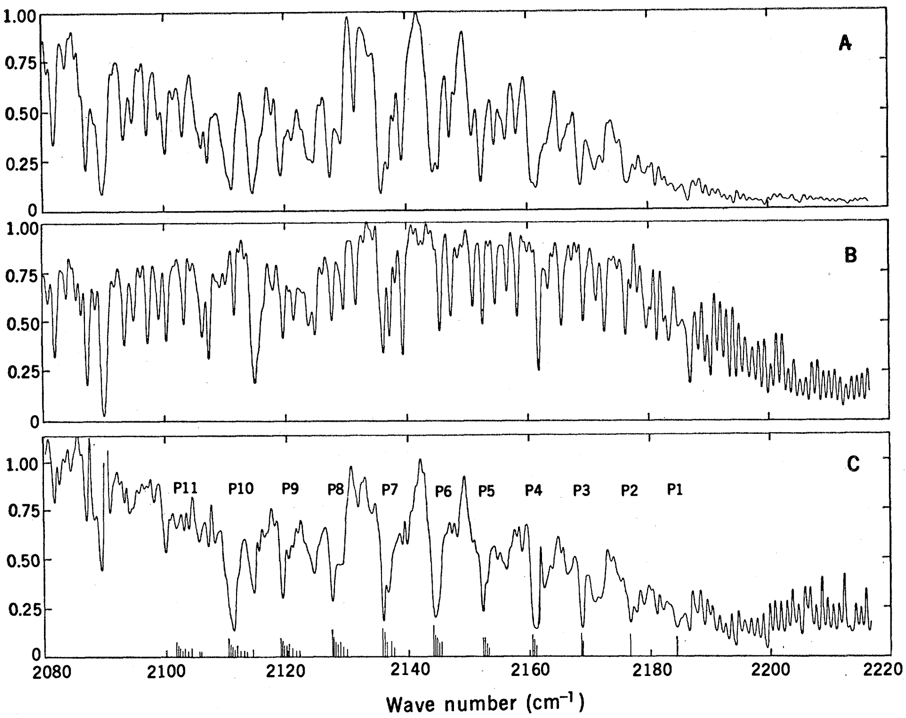

Fig. 1. The spectrum of Jupiter (A), the spectrum of the sun (B), and a ratio of the spectrum of Jupiter to that of the sun (C). The ordinates are given in arbitrary units. At the base of the spectrum in (C) are marked the individual components of the J-manifolds (*2*); the intensities are representational only. Furthermore, the ratio has not entirely eliminated the effect of telluric absorption, because the telluric air mass in the solar spectrum is significantly less than that for Jupiter.

none of the observed lines (as we shall call the unresolved manifolds) is free of telluric blending. Figure 1 shows some of the lines and a comparison solar spectrum.

This spectral region is strongly absorbed by Earth's atmosphere. Among the most evident absorptions are the center of the 1-0 CO band, the high-frequency wing of the 6.3-μ H_2O bands, the P-branch of the ν_3 N_2O band, and the low-frequency wing of the 4.2-μ CO_2 bands. In particular, the N_2O and CO_2 bands are so strong that all trace of the CH_3D Q- and R-branches disappears. Nevertheless, for all the P-branch from P2 to P11, there is a jovian line absorption in a position appropriate to each of the manifolds.

It is not possible, at the present time, to give either a CH_3D abundance or a D/H ratio. The determination of the CH_3D abundance will require a detailed experimental and theoretical consideration of line-formation in the jovian atmosphere under conditions wherein both thermal emission and solar reflection may be important. The D/H ratio will, in turn, be very model-dependent because first the CH_3D/CH_4 ratio must be determined and the CH_4 abundance can be found only from examination of overtone bands at much higher frequency. Because of its great strength, the nearby ν_3 CH_4 band at 3.3 μ is virtually unobservable in the jovian atmosphere (*3*). The 4- to 5-μ window of the atmosphere of Earth roughly coincides with a window in the jovian atmosphere. The jovian window occurs in the interval between the ν_4 ammonia band centered near 1627 cm^{-1} and the ν_3 methane band centered near 3020 cm^{-1}. Both of these bands are very strong so that the resultant window is only a few hundred reciprocal centimeters wide. The ν_1 CH_3D band, fortunately, falls within this window but the effective depth of the jovian atmosphere is much greater at these frequencies than at higher frequencies (shorter wavelengths). The great strength of the CH_3D band is therefore only apparent, and it should not be construed that the D/H ratio is necessarily much greater than on Earth.

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Action Spectra for Photoperiodic Response in a Diapausing Mosquito

Abstract. *While 540 nanometers is the most effective wavelength in provoking development, larvae are far more responsive to 540-nanometer light if it is provided immediately preceding rather than followng a white-light photophase which otherwise serves to maintain diapause. This difference in sensitivity is probably due to bleaching and implies that the larvae experience an asymmetric day.*

Last-stage larvae of the nonbiting mosquito, *Chaoborus americanus*, overwinter in a state of developmental standstill which is provoked (*1*) and sustained by exposure to short-day conditions. When overwintering larvae are collected from the shallow ponds in which they often abound, the diapause persists if the larvae are maintained under short-day conditions at 5°C or at room temperature. By contrast, the larval diapause is terminated, and pupation takes place about a week after exposure to long-day conditions (*2*). On the basis of laboratory studies, the transition from inhibitory short days to stimulatory long days begins at 13 hours of daily illumination (*3*).

In my study, the photosensitivity of *Chaoborus* has been studied with special reference to spectral sensitivity at "dawn" and "dusk." Groups of 50 diapausing larvae were exposed to 12 hours of white light plus 4 hours more