the action of this virus upon cell receptors and egg-white inhibitor that it may be unrelated to known members of the group of hemagglutinating respiratory viruses (*4*).

Although Taylor concluded that the virus ''may prove of little public health import,'' and Hirst noted no significant rises of antibody to it, the present data indicate that it is causally related to a widespread respiratory disease that occurs in epidemic form. Neither Taylor nor Hirst refers to the high incidence of antibodies in the adult population, which to our minds strongly indicates that the population has been thoroughly seeded. On the other hand, in young children titers are generally extremely low and, when present, tend to be quite high, suggesting recent infection. Moreover, tests with sera from as far back as 1936 indicate that the virus has been circulating since that time at least. At present, the frequency with which this virus causes clinical disease is difficult to estimate, but the epidemic herein described not only involved children but also a significant number of adults among the limited number in the institution. The clinical features in adults are not yet well outlined, but fever, cough, and coryza in the children were the common signs. The study emphasizes a frequently neglected opportunity to clarify epidemiological problems by the study of young children.

The association of the epidemic disease with influenza, the basic clinical picture, and the wide distribution of antibodies in the human population, as well as the serological and immunological characteristics of the virus, readily invite consideration of the name ''Influenza C.'' Further studies, a number of which are under way, will determine the appropriateness of this suggestion.

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Kinetic Mechanisms and Hydrocarbon Flame Spectra

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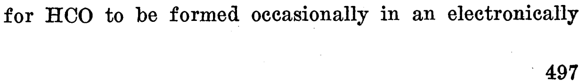
It is now known (*2, 3, 6, 7, 15*) that when hydrocarbons such as C_2H_2, C_2H_4, and CH_4 burn in oxygen or air under various conditions of fuel-oxygen ratio, the flame spectrum exhibits the electronic band systems of O_2, OH, CH, C_2, as well as the hydrocarbon flame bands (2,500–4,100 A) originally obtained by Vaidya and attributed to the HCO radical.[2] The question of the manner of formation of the excited molecules and radicals in hydrocarbon flames has been a matter of considerable discussion (*2, 3*), but it has by no means been settled. The object of the present note is to report some new spectroscopic findings and to suggest kinetic mechanisms that might account for the main types of reactions that occur. The discussion is chiefly confined to the burning of acetylene in oxygen, but will be extended to other hydrocarbons in later papers.

If one designates the oxygen-fuel ratio by ρ, with $\rho = \rho_S$ for stoichiometric proportions, the results of the spectroscopic studies for the acetylene-oxygen flame may be summarized as follows (*2, 3, 6, 7*): When $\rho = \rho_S$, one finds from the inner cone the band systems of OH, CH; the Mulliken, Deslandres-D'Azambuja, Phillips, and Swan systems of C_2; the CO Fourth Positive bands; the carbon line at 2,479 A and the hydrocarbon flame bands weakly. When $\rho < \rho_S$, the Fox-Herzberg bands of C_2 also become prominent, but the hydrocarbon flame bands are very weak, if present at all. When $\rho > \rho_S$, the OH and CH bands remain strong, the bands of C_2 become very weak, the Schumann-Runge bands of O_2 increase in intensity as the oxygen concentration rises, and the hydrocarbon flame bands are enhanced.

Noting that the hydrocarbon flame bands are strongest when burning with air, with excess oxygen, or as a cool flame (*2, 3*), we have used both argon and CO_2 as diluents. The introduction of argon into the acetylene-oxygen mixture enhances the hydrocarbon flame bands somewhat, but the effect of CO_2 is particularly striking. Burning $C_2H_2 + O_2 + CO_2$ in volume proportions of about 1:10:10, and with high mass flow from a multiple-jet burner operating in air, one finds the hydrocarbon flame bands to be the most prominent feature of the spectrum (extending from ~ 2,350–~ 4,100 A), the OH and CH bands to be quite weak, the C_2 bands very weak, and on the long wavelength side of the hydrocarbon flame bands, one finds weak CO flame bands. With a Bausch & Lomb medium quartz spectrograph using a 30 μ slit and type II-O Eastman plates, we have obtained well-exposed spectrograms of the hydrocarbon flame bands in the region 3,000–4,000 A in as short a time as about 30 sec. It is also interesting to note that the CO flame bands are very well developed in the oxyhydrogen flame to which is added CO_2 in rather high concentration.

It would appear that these facts may be explained qualitatively along the following lines. Oxygen is known to interact with unsaturated hydrocarbons by two distinct mechanisms (see, for example, ref. [*1*]), which may be referred to as the addition and peroxide mechanisms. In the case of acetylene the addition mechanism involves such steps as the following:



$$\text{(1)}\quad O_2 + C_2H_2 \rightarrow \underset{H-C-C-H}{\overset{O-O}{|\quad\;|}} \rightarrow 2CHO + \sim 55 \text{ kcal}$$

$$\text{(2)}\quad HCO \rightarrow H + CO - \sim 20 \text{ kcal}$$

$$\text{(3)}\quad O_2 + HCO \rightarrow HO_2 + CO + \sim 40 \text{ kcal}$$

$$\text{(4)}\quad CO + \tfrac{1}{2}\,O_2 \rightarrow CO_2 \text{ (via chain mechanism)}$$

Since reaction (1) evolves about 55 kcal of energy, it is clear that, with the aid of thermal energy, it is possible for HCO to be formed occasionally in an electronically

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[2] In our opinion there is as yet no unequivocal spectroscopic evidence that the emitter is HCO; however, we tend to favor this identification, as our kinetic mechanism makes it seem likely that HCO is produced exothermically.

excited state. Similarly, reaction (4), proceeding by a chain mechanism involving oxygen atoms, is known to give rise to excited CO_2 (*4, 10, 11, 12, 13*). The addition mechanism is therefore consistent with the formation of HCO and CO_2 in electronically excited states.

In the peroxide mechanism the following steps are among those that may be expected to occur:

$$\begin{array}{lllll}
(1) & C_2H_2 + O_2 & \rightarrow & \mathrm{H{-}C{\equiv}C{-}} + HO_2 - \sim 60\ \mathrm{kcal} \\
(2) & \mathrm{H{-}C{\equiv}C{-}} + O_2 & \rightarrow & \mathrm{H{-}C{\equiv}C{-}O{-}O{-}} + \sim 50\ \mathrm{kcal} \\
(3) & \mathrm{H{-}C{\equiv}C{-}O{-}O{-}} + C_2H_2 & \rightarrow & \mathrm{H{-}C{\equiv}C{-}O{-}O{-}H} + C_2H - \sim 10\ \mathrm{kcal} \\
(4) & \mathrm{H{-}C{\equiv}C{-}O{-}O{-}H} & \rightarrow & \mathrm{H{-}C{\equiv}C{=}O} + OH - \sim 30\ \mathrm{kcal} \\
(5) & \mathrm{H{-}C{=}C{=}O} & \rightarrow & CH + CO - \sim 75\ \mathrm{kcal} \\
(6) & \mathrm{H{-}C{\equiv}C{-}} + O_2 & \rightarrow & HO_2 + C_2 - \sim 120\ \mathrm{kcal} \\
(7) & 2CH & \rightarrow & C_2 + H_2 + \sim 30\ \mathrm{kcal}
\end{array}$$

Reactions (4), (5), (6), and (7) would seem to be the most likely reactions producing OH, CH, and C_2, and reaction (7), being a radical-radical reaction, is probably very unimportant. Reactions (4), (5), and (6) are all endothermic; they are therefore slow, and there is a negligible possibility that they will produce OH, CH, and C_2 in electronically excited states.

In order to account for the spectroscopic result that OH, CH, and C_2 are electronically excited in the flame, it therefore seems necessary to assume, as was done in the case of the carbon-monoxide oxidation (*14*), that transfers of electronic energy occur:

$$\left\{\begin{matrix} CO_2^* \\ HCO^* \end{matrix}\right\} + \left\{\begin{matrix} C_2 \\ OH \\ CH \end{matrix}\right\} \rightarrow \left\{\begin{matrix} CO_2 \\ HCO \end{matrix}\right\} + \left\{\begin{matrix} C_2^* \\ OH^* \\ CH^* \end{matrix}\right\}$$

Our interpretation of the spectroscopic results, in terms of the kinetic mechanisms, may be summarized as follows: Reaction proceeds mainly by the exothermic addition mechanism and, of the HCO radicals and CO_2 molecules produced, very small fractions are electronically excited. At the same time very small amounts of C_2, CH, and OH are produced by the peroxide mechanism. In order to explain the fact that in hot flames there is more radiation from C_2, CH, and OH than from HCO, we suppose that HCO* and CO_2* have long radiative lives and may transfer energy to C_2, CH, and OH on collision. This situation is similar to that in the carbon-monoxide flame, in which much of the radiation is due to O_2 (Schumann-Runge bands) (*5, 8, 9*) in spite of the fact that it is the CO_2* molecule that is formed directly.

It is clear that most of the HCO* and CO_2* will only transfer energy to C_2, CH, and OH provided the latter are present at sufficiently high concentrations, i.e., provided the flame is hot. If the flame is cooled, by the addition of CO_2 or by other means, the concentrations of the endothermically produced C_2, CH, and OH will be reduced markedly, and there will be much less energy transfer from HCO* and CO_2*. The enhancement of the hydrocarbon flame bands under these conditions is thus readily explained. The fact that the C_2 bands are most sharply affected by change in temperature finds a ready explanation in terms of our mechanism, for C_2 is produced by the most endothermic reaction, which is therefore to be expected to have the highest temperature coefficient.

We are continuing a variety of experimental and theoretical studies in the hope that more definite evidence may be found concerning the identification of the emitter of the hydrocarbon flame bands and the details of the kinetic mechanisms involved in hydrocarbon combustion. We also hope to publish in the near future a more detailed discussion of the results reported here.

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The Function of the Symbiotic Yeasts of Two Insect Species, *Lasioderma serricorne* F. and *Stegobium (Sitodrepa) paniceum* L.

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It was shown by Fraenkel and Blewett (*3*), and Blewett and Fraenkel (*1*), that the symbiotic yeasts, which occur intracellularly in mycetomes situated at the junction of the fore- and mid-gut of two species of anobiid beetles, *Lasioderma serricorne* and *Stegobium paniceum,* supply vitamins of the B group in significant amounts and make it possible for their hosts to subsist on foods very low in vitamins of that group. Indeed, the larvae grew normally, or almost so, on synthetic diets which were entirely lacking in such important factors as thiamin, riboflavin, nicotinic acid, pyridoxin, or pantothenic acid. When these yeasts were eliminated from the hosts