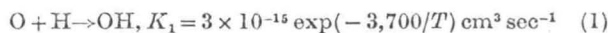
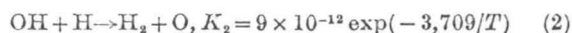


that $\text{OH}/\text{H} = 3 \times 10^{-9}$ after a shock passes. Photodissociation ($\tau = 10^4$ yr) between shock passages ($T = 10^7$ yr) reduces OH/H to an average value of 3×10^{-12} , which is four orders of magnitude too low. According to Carroll and Salpeter⁵, the chemical exchange reaction $\text{O} + \text{H}_2 \rightarrow \text{OH} + \text{H}$ produces comparable amounts of OH if $\text{H}_2/\text{H} \sim 10^{-4}$. According to Stecher and Williams⁶, however, H_2/H is kept to the extremely low value of 10^{-7} by photodissociation of H_2 .

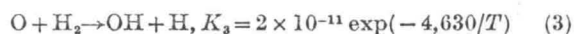
We have calculated the OH production caused by pre-association, as suggested by Solomon⁷,



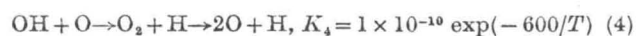
where $K_1 = \dot{n}(\text{OH})/n(\text{O})n(\text{H})$. Obviously this reaction proceeds even if H_2 is absent, but, like the reactions involving H_2 and grains, it requires the high temperatures present behind a shock wave. The primary destruction mechanism is⁸



Starting with no molecules, reaction (1) builds up OH behind the shock front, while reaction (2) converts some of these molecules to H_2 . The inverse of reaction (2),



and the low-temperature reaction,



were also included; we assumed that O_2 is photo-dissoci-

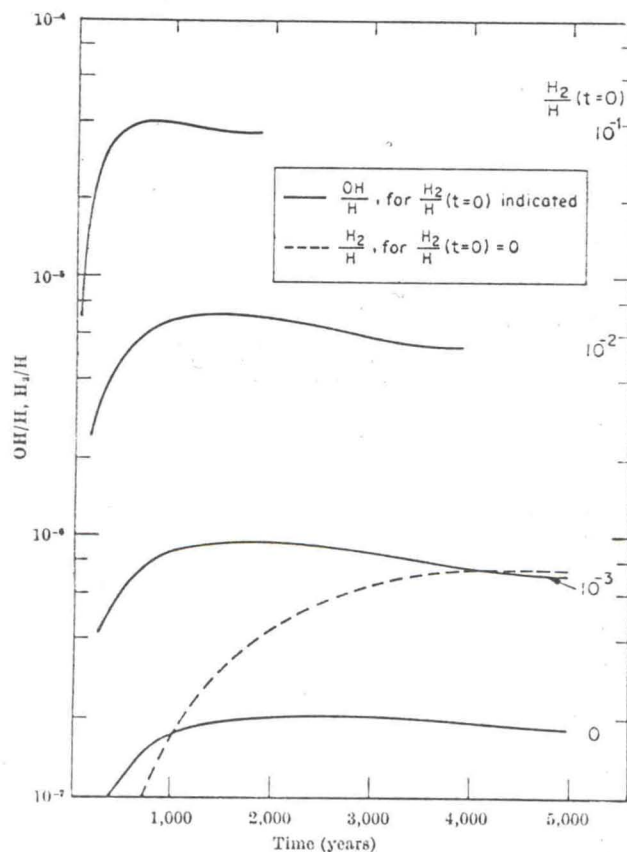


Fig. 1. Production of molecules as a function of time elapsed since passage of a shock front in an H I region. The shock speed is 8 km/sec, and the temperature varies from 2,000° K at $t=0$ to 100° K at the end of the calculation. OH is produced by reaction (1) when $\text{H}_2/\text{H}=0$, and also by reaction (3) when $\text{H}_2/\text{H} \neq 0$. The hydrogen produced by reaction (2), starting with $\text{H}_2/\text{H}=0$, is also shown.

ated immediately. The reaction $\text{OH} + \text{H}_2 \rightarrow \text{H}_2\text{O} + \text{H}$ was neglected because it becomes comparable with reaction (2) only when H_2/H approaches 10 per cent.

Both Stecher and Williams⁴ and Carroll and Salpeter⁵ used estimated postshock temperature density profiles. We used a grid of profiles depending on mach number, initial H_2 abundance and preshock magnetic field strength calculated by Field, Rather, Aannestad and Orszag⁸. Their calculations, for preshock densities $n(\text{H}) = 10 \text{ cm}^{-3}$ and $n(\text{O}) = 6.8 \times 10^{-3} \text{ cm}^{-3}$, show that the cooling time ($\sim 10^4$ yr) is reduced from previously accepted values because of frequent inelastic OH collisions with subsequent 63μ radiation. The short cooling time tends to limit molecule production, although it is somewhat compensated by increased densities far behind the shock.

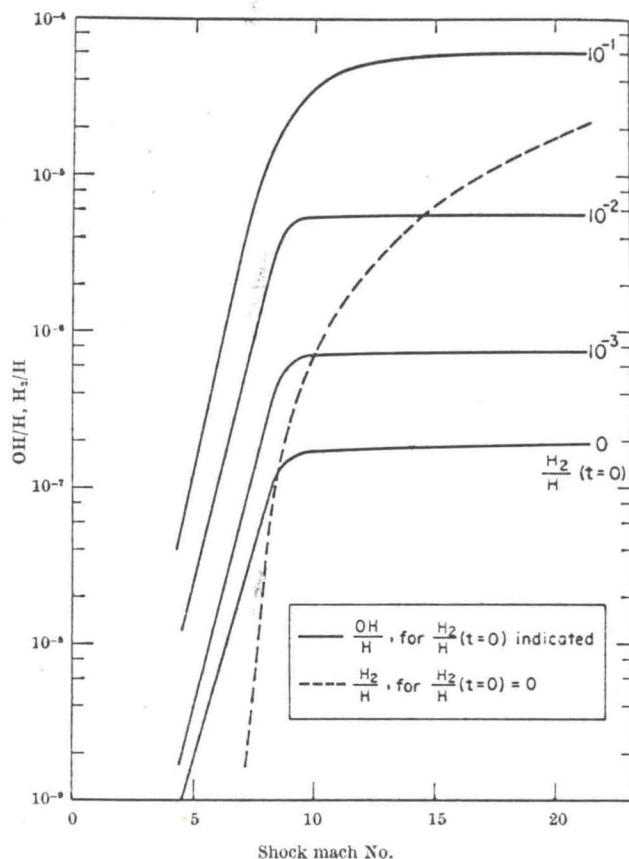


Fig. 2. The final molecular abundances after shock passage as a function of mach number (= speed/0.8 km/sec). Significant contribution by reaction (3) requires $\text{H}_2/\text{H} > 10^{-3}$.

Fig. 1 shows the OH production for a mach 10 (8 km/sec) shock; the abscissa represents time elapsed since shock passage. The calculations are terminated when the material behind the shock has returned to its preshock temperature, assumed to be 100° K. For $\text{H}_2/\text{H}=0$, equilibrium between reactions (1) and (2) is rapidly attained behind the shock, at $\text{OH}/\text{H} = 2 \times 10^{-7}$, independent of temperature. Reaction (2) produces some H_2 as shown, but the amount is so small that reaction (3) and the reaction $\text{OH} + \text{H}_2 \rightarrow \text{H}_2\text{O} + \text{H}$ are safely neglected.

Although at present it seems likely that the interstellar hydrogen abundance is very low⁹, calculations were made for $\text{H}_2/\text{H} = 10^{-3}, 10^{-2}$ and 10^{-1} to assess the importance of reaction (3). Photodissociation of H_2 was ignored.