



Tommy & Fred
Gold & Hoyle
Dolomites 1963

photo by
Ed Salpeter

Ph.D. thesis of

R. Gould 1963: Early calc. of $H + H$

→ H_2 formation on grain surface
[also thesis advisor of present NAIC Director]

→ better calc's in Hollenbach, Werner F.
Salpeter 1971 [also no L.W. destruction
of H_2 in Gould et al]
[cloud chemistry papers by Solomon, Klemperer,
Herbst, Watson, etc. in early 1970's]

T. Gold 1963 and earlier: H_2 could be
important in our Disk near the
Galactic Plane, EVEN IF NOT
MUCH MASS IN TOTAL.

Even T.G., usually so exuberant,
did NOT anticipate MOLECULAR
CLOUDS sufficiently.

[Salpeter, 2]

First direct detection of H_2 by
Carruthers (1970) $\rightarrow$ Copernicus observations
1972/73. NOT much interest
in H_2 before that. [Occam's Razor]

[21 cm line of HI predicted by
H. C. van de Hulst; not detected till 1951
by Ewen & Purcell and by Muller & Oort

Hugo van Woerden
(this afternoon)

First interstellar matter detected
was NOT hydrogen, but
in 1903: J. Hartmann (Potsdam Observ.)
saw "fixed Ca lines", i.e. H & K lines
of Ca II in a spectroscopic binary, i.e.
did not show orbital motion in spectrum.

Eddington before 1925 gave upper and
lower limits of ~ 1 atoms (of something) cm^{-3}
and 10^{-6} atoms/ cm^3 .

[salpeter, 2]

Arthur EDDINGTON (1882-1944)

Last Chapter of "Internal Constitution of the Stars", written in 1924/25 on Diffuse Matter in Space:

- (i) Lower & Upper Limits to n_{ISM} .
- (ii) Starlight energy density
temp. = 3.2°K .
- (iii) (Knew Saha equation) All ISM
ionized, matter temp. $\sim 10,000^\circ\text{K}$.
- (iv) NO H_2 , molecules,
solid particles! in spite
of Dark Clouds

Even exuberant Eddington
missed out on things!

Occam's Razor (simplest hypothesis)

One argument AGAINST:

Sometimes self-fulfilling prophecy.

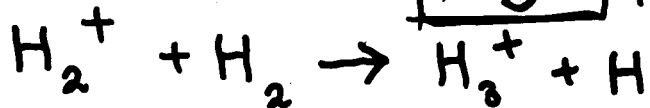
ex.: Arthur Eddington on ISM:

Assume NO solids, $\therefore$ NO dust grain
opacity.

Derive : (i) No obscuration of stellar UV;
(ii) $\therefore$ all ISM atoms ionized, i.e. + charge;
(iii) 2 +ve ions repel and cannot combine
to molecule, (iv) without molecules
cannot form solids; QED.

Are WE missing out on things
for the early universe ISM? e.g.

(a) Interstellar $\boxed{\text{H}_3^+}$ from



[e.g. Herbst & Klemperer 1973, Watson 1973]

→ Takeshi OKA, PNAS ¹⁰³, 12232 (2006).
Efficient Catalyst!!

(b) Peter Bierman et al: If dark matter
is a medium-mass decaying sterile neutrino;
e.g. Ap. J. ⁶⁵⁴, 290 (2007)

? More ionization in early universe
than we think?

(c) Is "canonical" assumed ratio ^{10^{-4} by number}
of CO/H₂ too large, i.e. do we
underestimate H₂? [Burgh et al Ap. J. ⁶⁵⁸, 446
(2007)]

We should take more time off from
orthodoxy for broader view!
[Salpeter, 6]

Two organisations funded by private donations

Union of Concerned Scientists:

WWW. UCSUSA.ORG

↑ global warming/energy conservation;

Dishonesty on B.M. Defense; new nuclear
Weapons —

Center for Constitutional Rights:

WWW. CCR-ny.org

↑ habeas corpus; legal defense ↓

Scientists should speak out { technical
moral
Hans Bethe (1995): "Cease & desist" from
weapons work. Martin Rees (now): Danger
from other new science.

→ "Hypocratic Oath"

Protest impending U.S. Disasters
(Iraq → IRAN!)

[Salpeter, 7]