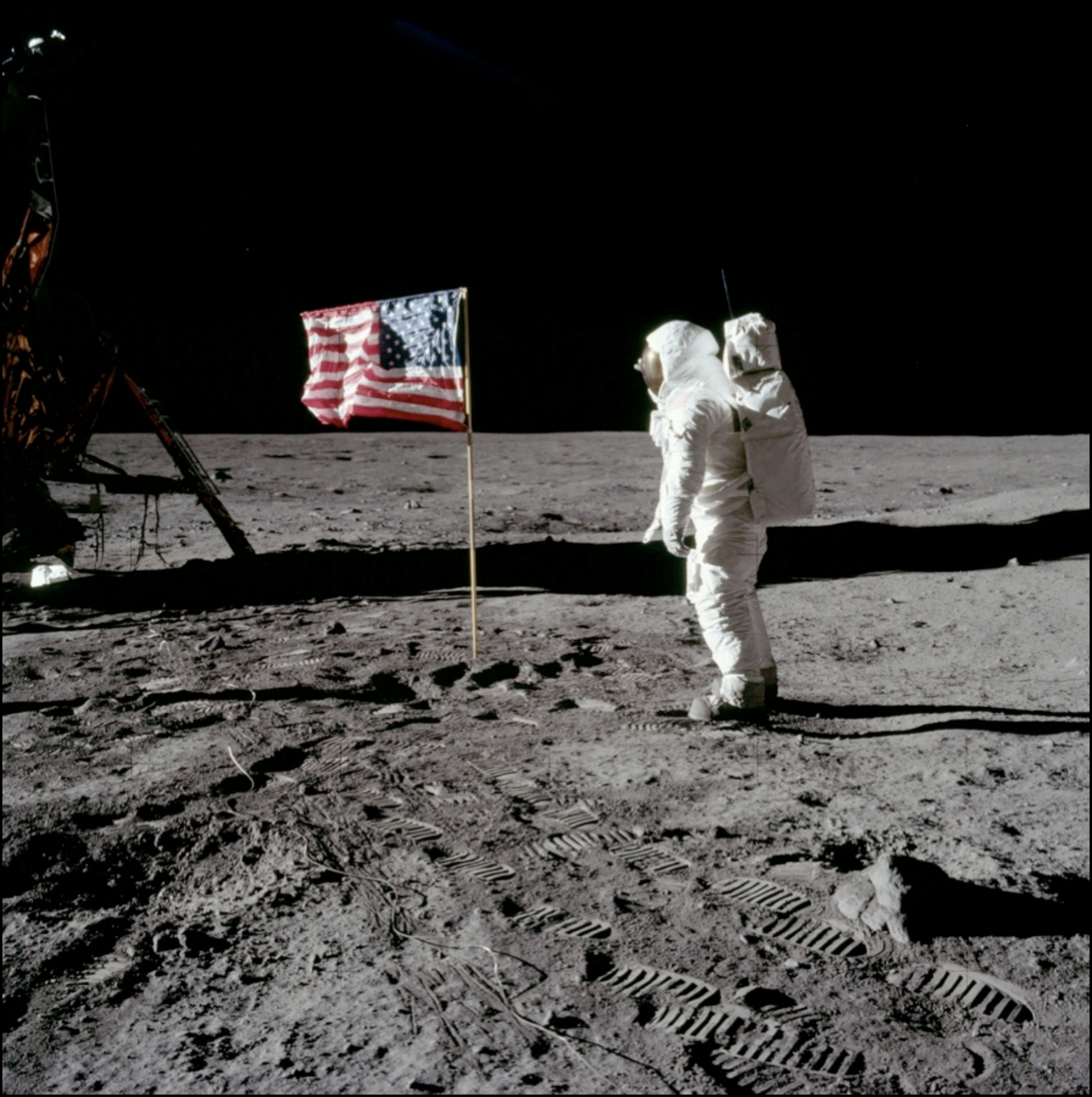
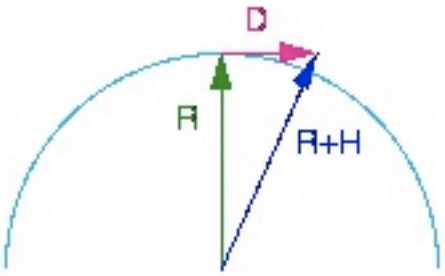
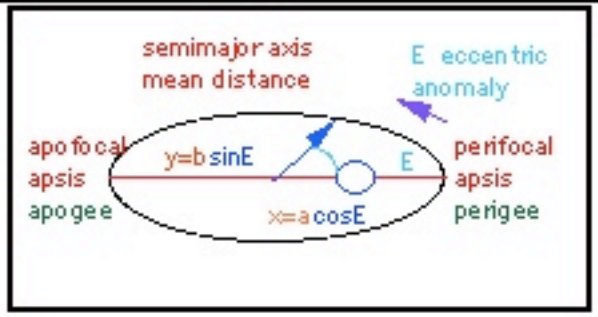
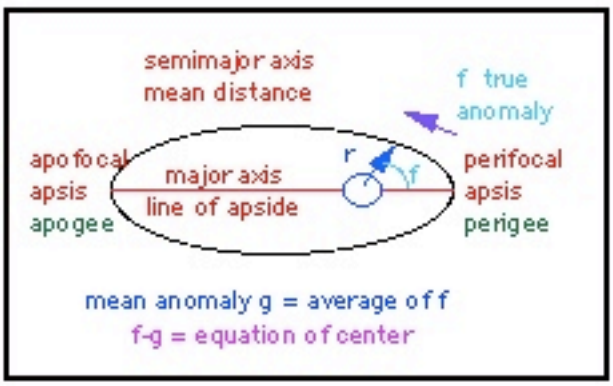
	average distance from the sun, in units of the earth's average distance from the sun	mass, in units of the earth's mass
sun	—	330,000
mercury	0.38	0.056
venus	0.72	0.82
earth	1	1
mars	1.5	0.11
jupiter	5.2	320
saturn	9.5	95
uranus	19	14
neptune	30	17
pluto	39	0.002

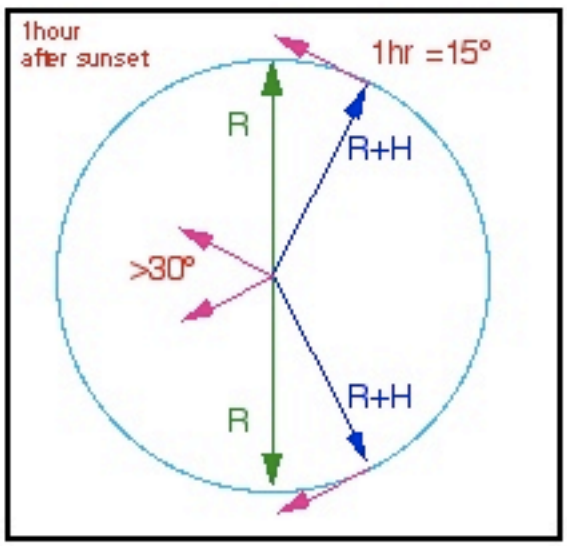

Vega
North America Nebula
Deneb
Cygnus Star Cloud
Northern Coalsack
Cygnus
The Great Rift
Altair
Scutum Star Cloud
M24
Lagoon Nebula
Pipe Nebula
Galactic Center
Antares
Babak Tafreshi

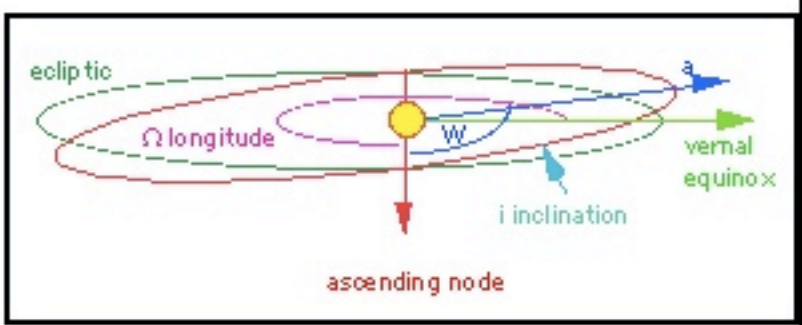




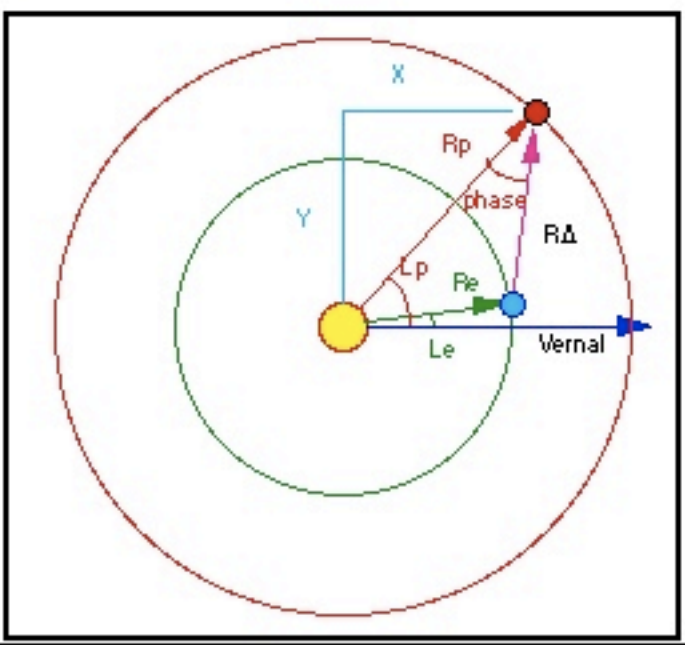








find geocnetric coordinates
Re=radiuus earth
Le=long earth
Ae=atlitude earth
RΔ=radiuus earthto planet
Lp=long planet
Ap=atlitude planet
RΔ*cos(Ap)*cos(Lp)=x +Re*cos(-Ae)*cos(-Le)
RΔ*cos(Ap)*sin(Lp)=y +Re*cos(-Ae)*sin(-Le)
RΔ*sin(Ap)=z +Re*sin(-Ae)

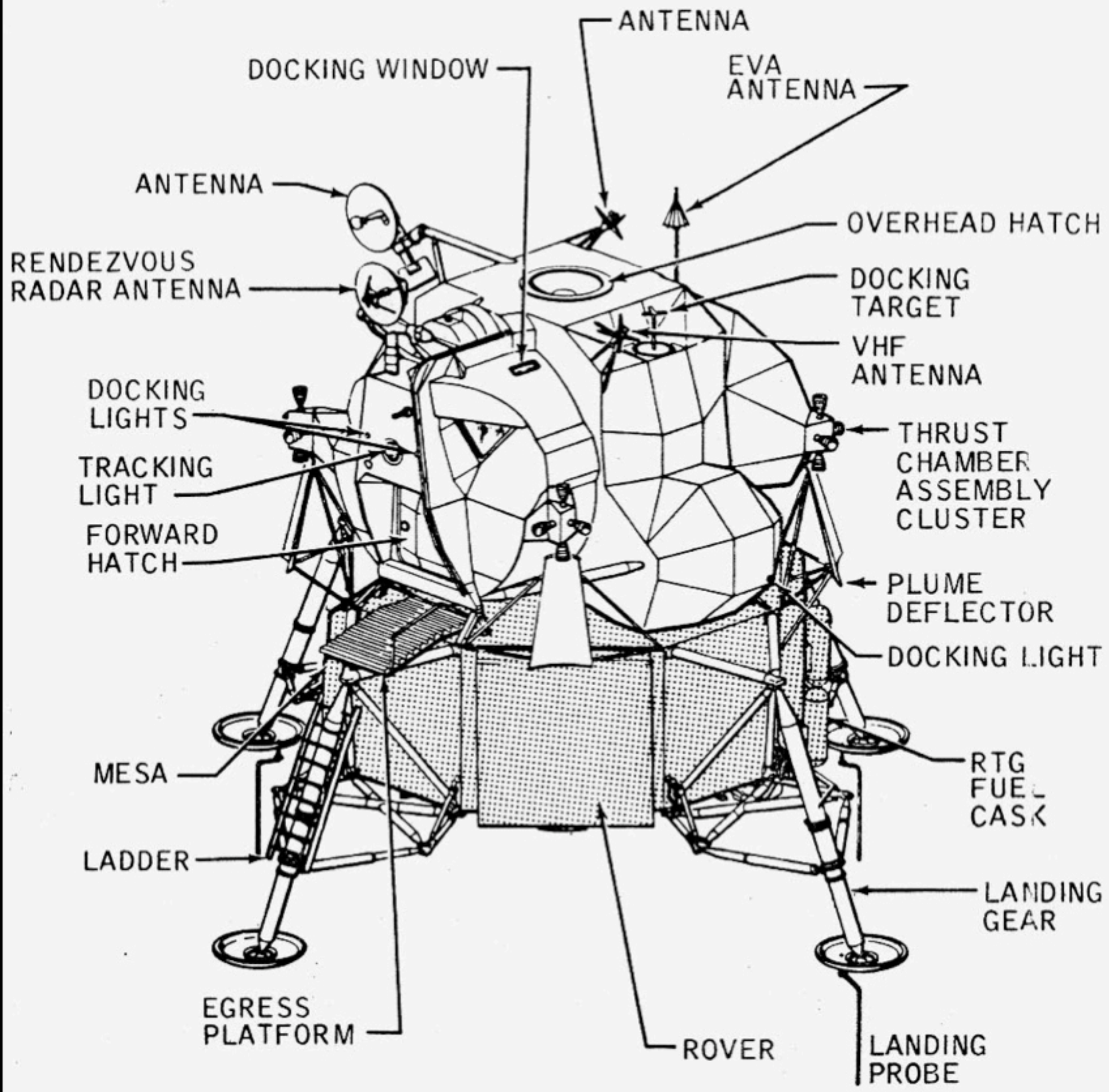


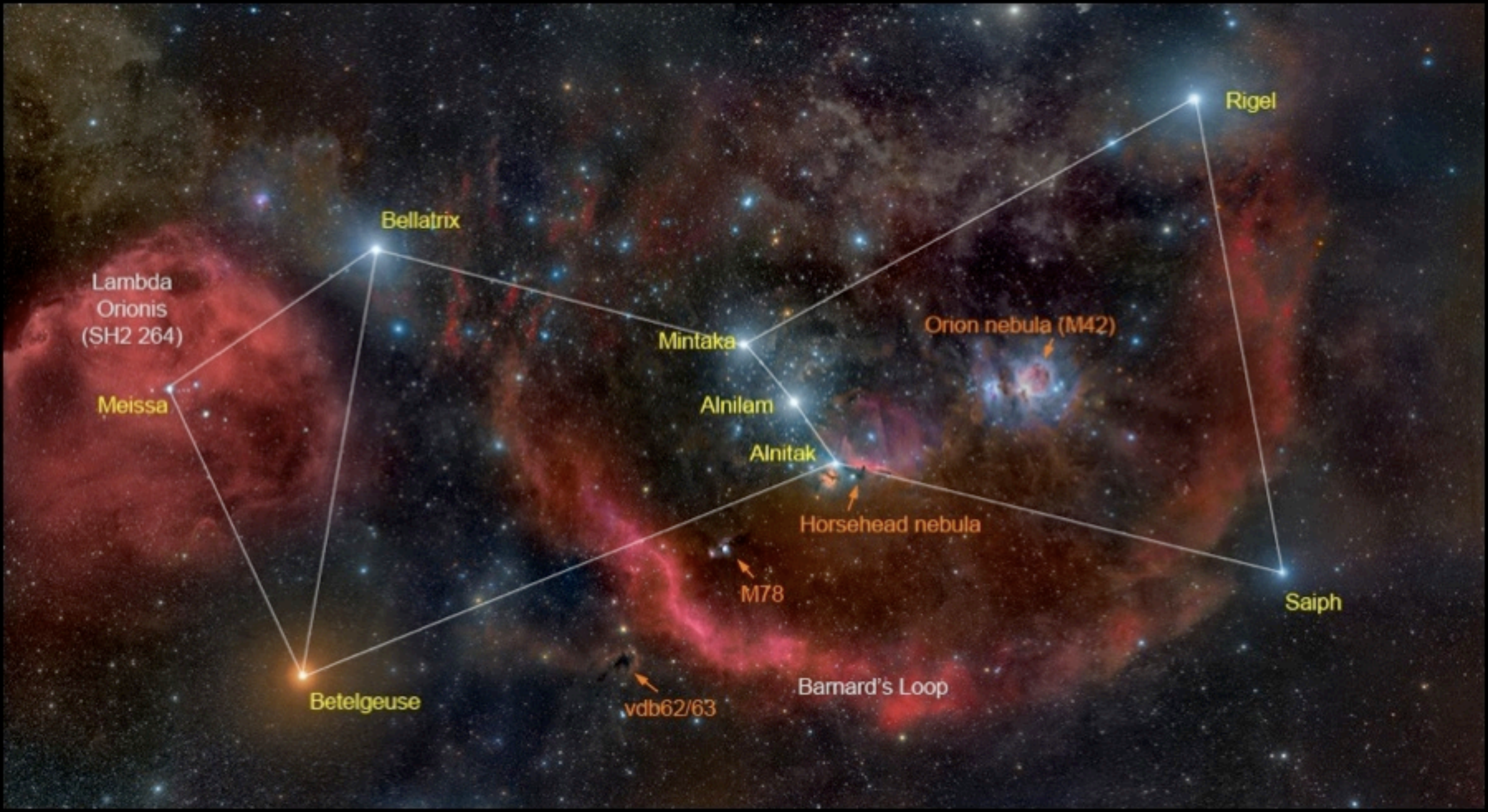
THE MEANING OF MAGNITUDES

This difference in magnitude . . .	. . . means this ratio in brightness
0	1 to 1
0.1	1.1 to 1
0.2	1.2 to 1
0.3	1.3 to 1
0.4	1.4 to 1
0.5	1.6 to 1
0.6	1.7 to 1
0.8	2.1 to 1
1.0	2.5 to 1
1.5	4.0 to 1
2	6.3 to 1
2.5	10 to 1
3	16 to 1
4	40 to 1
5	100 to 1
6	251 to 1
7.5	1,000 to 1
10	10,000 to 1
15	1,000,000 to 1


Southern Cross
Carina Nebula
Beta Centauri
Alpha Centauri
Coalsack Nebula
South Celestial Pole
Canopus
Sirius
Large Magellanic Cloud
Small Magellanic Cloud
Babak Tafreshi

LUNAR MODULE




Rigel
Bellatrix
Lambda
Orionis
(SH2 264)
Mintaka
Orion nebula (M42)
Meissa
Alnilam
Alnitak
Horsehead nebula
M78
Saiph
Betelgeuse
vdb62/63
Barnard's Loop

FURLONGS TO FORTNIGHT by DON SAUER

LENGTH/VELOCITY
10008 ftm = pole to equat
1 mile = 5280 feet
= 1000 Roman 2 steps
1 foot = Charlemane's
1 cubit = elbow to finger
1 fathom = 6ft arm/span
1 furlong = 1/8 mile
=10 chains
1 naut mile = 6080 ft
=1 minute of a degree
1 league = 3 naut mile
1 in = 2.54 cm
1A = 1E-10 meters
1 parsec = 3.094E13 Km
Light = 2.99792E8 m/s
Sound = 1127 ft/sec
1 mile/hour = 1.47ft/s

AREA
1 acre = 1 chain/day
= 10 square chains
1 mile^2 = 640 acres
1 hectare = 10E4 m^2
1 circular mil
= (PI/4)E-6 in^2

Monthly Payments =
Prin[i/(1-[1+i]^-N)
=int(12 N=#months

C = 2.99792458E8 m/s
G = 6.67E-11m^3/Kgs^2
q = 1.6021892E-19Cou

VOLUME
1 liter = 1000 cm^3
= 1 Kgm H2O
1 milliliter = 1cm^3
1 fl oz = 30 cm^3
= 1/16 pint
1 tsp = 5 cm^3
1 Tbsp = 15 cm^3
1 cup = 1/2 pint
1 quart = 2 pints
= .9363 liters
1 Gallon = 4 quarts
1 Bushel = 8 Gal
= 4 Pecks
1 Gill = 1/4 pint

trillion 10^-12
billion 10^-12
exa ^18 deci ^-1
petra ^15 cent ^-2
tera ^12 milli ^-3
giga ^9 micro ^-6
mega ^6 nano ^-9
kilo ^3 pico ^-12
hecto^ 2 femto ^-15
deka^1 atto ^-18

R=F+459.67
K=C+273.15

h = 6.626176E-34 J*s
N = 6.022045E+23
R = 8.314 U/mole*K

MASS and FORCE
1 Kg = 1liter H2O
= 2.2046 lbs
= .0685 slugs
1Kgf = 9.807 Newtons
1 lbf =slug weight
= 4.448 Newtons
1 lbm = 16 ozm
1 ozm = 28.35 grams
= 437.5 grains
1 metric ton = 1000 Kg
1 ton short = 2000lb
g = 32.1740 ft/sec^2
= 9.807 m/sec^2

GAS
1 Atm = 76.0 cm Hg
=14.7 lb/in
=101.3KPa
1 pascal=N/m^2
1 torr = 1mm Hg
1 millibar = 100 Pa
1 mole = 6.022045E23
volume = 22.4139 liter
PV=RT R=8.31441 J/K
Air = 1.29grams/liter
=75%N,21%O, 94% Inert,
.04% CO2,0-2% H2O

V= 22.41383 liters
k = 1.380662E-23 J/K
F = 9.6649E4 Coul/mole

ENERGY
1 cal = 1gm H2O 1C
= 4.186 joules
1 BTU = 1lb H2O 1F
= 778.28 ft/lbs
1 Therm = 105 BTU
1 cord wood = 4X4X8 ft
= about 240 Therms
1 Watt = 3.413 BTU/hr
= 860 cal/hour
1 ft/lb = 1.356 watt
1 horsepower = 746 watt
= 550 ft/lb/sec
Man = 3 Megcal/day
= 3/4 pounds fat
running = 600Kcal/hour
walking = 200 sit = 100
1 Phon = 2E-5 N/M^2

DENSITY
H2O=62.431lbm/ft^3
=1E+3 Kgm^3
Alum=2.7 Lead=11.3
Steel=7.9 Gold=19.3
Copper =8.9 Hg=13.6
Tin =7.3 Brass=13.6
Silver=10.5 Nickel=8.9
Silicone=2.42 Sulfur=2
Air = .0013 H2=.00009

u = 4*PI*E-7 H/m
e = (1/36*PI)*E-9 F/m
SB = 5.670E-8W/m^2*K^4

ELECTRIC
Weber = Joul/Amp
Tesla = Weber/m^2
Gauss = 1E-10W/cm^2
B = uH V = NA*d/dt/R Nk/HL
Energy = V^2*C/2 = eE^2/2
I^2/R = u H^2/2 P = H/E

LIGHT
Red/Yellow/Violet
=.7um/.57/.45um
1 ftcandle = 1Lum/ft^2
1 sphere = 4*PI*ster
1 Lumen = candela/ster
40 Watts = 40 candlePer
100 Watts = 125 candlePer
12.56 Lumens=1candlePer
680 Lum = 1watt @blue
photons = ei*watt/A*o
Sun = E+5 Lum/meter^2
Moon = 3E-1 Lm/meter^2

mn = 1.6749643E-27Kg
mp = 1.6726485E-27Kg
me = 9.1095344E-31Kg
mr = 5.29177706E-11m

1 fortnight = fourteen nights

SPHERE
S=4*PI*R^2
V = (4*PI*R^3)/3

ELEMENTS	Atom Num		gm/ mole	Water/ Air Std.	Melt C	cal/ gm	Boil	cal/ gm	cal/ gm*C	watt/ cm*C
Aluminum	Al	13	26.98	2.70W	659.7	93	2057	27.01	.217	2.18
Antimony	Sb	51	121.8	6.69W	630.5	38	1380		.049	.19
Arsenic	As	33	74.9	5.73W	814		615		.082	
Barium	Ba	56	137.4	3.6W	850		1140		.068	
Bismuth	Bi	83	209	9.75W	271.3	12.5	1560		.029	.084
Boron	B	5	10.8	3.33W	2300		2550		.309	
Bromine	Br	35	80	3.12W	-7.2	16.2	58.8		.107	
Cadmium	Cd	48	112.4	8.64W	321	13.2			.055	.91
Calcium	Ca	20	40.1	1.55W	842		1240		.145	
Carbon	C	6	12.0	1.7-3.5	3600		4200		.165	.24
Cesium	Cs	55	133	0.9W	640	3.8			.05	
Chlorine	Cl	17	35.5	2.49A	-102	23	-34.6		.226	
Chromium	Cr	24	52.0	7.1W	1890	75.6	2480		.12	.69
Cobalt	Co	27	58.9	8.9W	1495	59.4	2900		.099	.69
Copper	Cu	29	63.54	8.9W	1083	50.6	2336	1211	63	.92
Fluorine	F	9	19.0	1.312A	-223		-187			
Gallium	Ga	31	69.7	5.91W	29.8	19.2	2403		.079	
Germanium	Ge	32	72.6	5.36W	937.4		2830		.073	
Gold	Au	79	197.0	19.3W	1063	15	2600	377	.031	
Helium	He	2	4.00	.1664A	3.5K	1.25	4.2K	5		
Hydrogen	H	1	1.008	.0696A	13.4K	14	20.3K	108	3.41	
Iodine	I	53	126.9	4.93W	113.5	15.8	185		.052	4E-3
Iron	Fe	26	55.85	7.86W	1535	65	3000		.113	.79
Lead	Pb	82	207.2	11.3W	327.4	5.86	1620	208	.031	.35
Lithium	Li	3	6.94	.534W	186	159			.79	.79
Magnesium	Mg	12	24.32	1.74W	651	70	1107		.249	1.55
Manganese	Mn	25	54.94	7.2W	1260	64.8	1900		.107	
Mercury	Hg	80	200.6	13.55W	-38.9	2.82	357	630	.033	.084
Molybdenum	Mo	42	95.95	10.3W	2500	2.7			.065	1.45
Neon	Ne	10	20.182	.9387A	-248.		-245			4E-4
Nickel	Ni	28	58.71	8.90W	1455	73.8	2900		.112	.9
Nitrogen	N	7	14.0	.987A	63.2K	6.1	77.3K	48	.247	
Oxygen	O	8	16	1.105A	54.4K	3.3	90K	51	.218	
Phosphorus	P	15	30.97	2W	44.1	5.0	280		.177	
Platinum	Pt	78	195.1	21.4W	1773	27.1	4300		.032	.69
Putonium	Pu	94	242		639		3235			
Potassium	K	19	39.1	.86W	62.23	14.5	760		.177	.99
Radium	Ra	88	226	5W	700		1140			
Silicon	Si	14	28.09	2.42W	1420		2355		.176	.84
Silver	Ag	47	107.88	10.5W	960	24.1	1950	558	.056	4.08
Sodium	Na	11	23	.97W	97.5	27.5	880		.295	1.35
Strontium	Sr	38	87.6	2.54W	800	25	1150			
Sulfur	S	16	32.06	2.0W	115	9.1	444	78	.175	2E-3
Tantalum	Ta	73	180.9	2.0W	2800				.036	.036
Tin	Sn	50	118.69	7.28W	232	14.4	2270		.054	.64
Titanium	Ti	22	47.90	4.5W	1800		>3000		.142	
Tungsten	W	74	183.85	19.3W	3370	44	5900		.034	1.99
Uranium	U	92	238.06	18.7W	1132		3818		.028	
Zinc	Zn	30	65.38	7.14	419		907			6E-5
Air				1A						.004
Water				1W	0	79.7	100			.002
Glass										.002
Concrete										.0015
Wood										

PHYSICS
c = speed of light
= 1/(e*u)^1/2
Z of space = 377 ohms
= (u/e)^1/2
e = 1.06E-9 F/meter
u = 4*PI*E-7 Henry/m
c = (Su)^1/2
S= tension on wire
= pressure per volume
u = mass per length
= mass per volume

Force = Kqq'/r^2
k = e for electric
and q = coulombs
k = G for gravity
and q = mass
Magnetic Force=
1 Amp=2E-7 Newton/m

energy per degree free
=(1/2)*m*v^2
=(3/2)*n Rt , R/Nk=k
No = 6.02 E+23
heat capacity diatom gas
=4.99 cal/mole*C
Max-Boltzman dist=
#atom s/sec ras=dN/dr
4*N*i^(1/2)*
(m/2kT)^(3/2)*
v^2*exp^-(mV^2/2kT)

Entropy =ds
ds = dQ/T delta heat/temp
Uncertainty
= dE*dT=dp*dx=h/(2*PI)
QUANTUM NUMBERS
s,p,d,f sharp,principal,
diffuse,fundamental
2,6,10,14
n=energy quantum
l=orbit angle momen quan
l=0,1,...n-1
m l= orbital magnet quant
ml=-l,...-1,0,1,..l
s=electron spin quant
s= 1/2, 1/2

SNELL'S LAW
n*sin@=n'sin@
400nm to 700nm
index for wavelength
flint glass 1.65-1.61
crown glass 1.52-1.505
fused quartz 1.47-1.46
1a+1b=1/f

THERMAL COUPLE
=a*T +(1/2)*b*T^2
Alum - .47/.000 uV/C
Copper 2.76/.012 uV/C
Gold 2.90/.0093 uV/C
Iron 16.6/-.030 uV/C
Nickel 19.1/-.030 uV/C
Silver 2.50/.012 uV/C
Platinum 2.5/.012 uV/C
Steel 10.8/-.016 uV/C

SOUND PRESSURE
sound press level
= SPL=20log P/.0002
P measured in bars
1 bar = 1ATM
I=P^2/p*c
I=sound intensity
p=density,speed
of sound in air
.0002=bars=
I ref[0dB]=
1E-16 watts/cm2

TV DATA
Horz = 15734.24
=2/455 times Chroma
Vert=59.94 Hz =2/52H
Horz Blank =.16 H
Vert blank = 21H
Color Vector
red x=.67 y=.33
blue x=.21 y=.71
green x=.14 y=.09
Video 45.75 Meg
Sound 41.25 Meg
LINEAR EXPANsi/°C
Alum 23 [E-6/°C]
Copper 17/Steel 6.5
Glass 11.2-2.7/Hg 118
Gold 14/Lead 28
Nickel 13/Silver 19
Platinum 8.9/

POWER
cord wood =240 therms
Nat Gas 1000 BTU/ft^3
Gasoline 11E3 cal/gm
R-30 FACT OR = 1.00
BTU/ft^2 @ 1hr/hr
walls x 20 windows x 2
man =100Kcal/hr sitting
WIND POWER
P=(E*M*PI*D^2*V^3)/8
E =efficient =.35%
M= mass air =.081lb/ft^3
D = dia blades
V= velocity wind
NUCLEAR
Fusion = 2 EB ev/atom
ev = 1.6 E-19 Joules
U235 1 mole =235 grams
critical mass U235 = 20 lbs
1/2 life Neut = 12 min

Mass earth =5.976E24 Kgm
49% O,26% Si,7.5% Al
4.7% Fe,3.4% Ca,2.6% Na
2.4% K,1.9% Mg,0.9% H2
0.6% Ti,0.7% other
Mass sun =1.99E30Kgm
Mass moon=7.35E22Kgm
1AU =to sun =1.49E11m
to moon=3.84E8m
Dia sun=1.39E9m
Dia moon =1.738
Earth incline 23.45 deg

SILICON
5.00E22 Atm/cm^3
Diamond 8 atoms/unit
5.43 A lattice constant
energy gap 1.11ev
ni = 1.45E10/cm^3
mobity 1350cm^2/sec
400 cm^2/sec holes
Breakdown field 30v/u
Glass 600 V/u
Dielectric =11.7 Si
Dielectric glass =3.9
Thermal expansion
2.5E-6 Si
5E-6 Glass
Specific heat .76joule/gr°C
1.0 joule/gr°C
thermal condutive
=84 Watts/meter*°C

ELECTRIC
Resistance = p*(1+aT)
ohms*m / 1/ C
Alum 2.63E-8/.0039
Carbon 3.5E-5/-.0005
Copper 1.72E-8/.00393
Silver 1.47E-8/.0038
Gold 2.44E-8/.0034
Glass 10E10-10E14
DIELECTRIC
Air 1/Glass 5-10/Tio 173

Fix=4*(1-1.0e-15+etc)
ln=2.3025850/log10
ln x=(x-1)/x+
[(x-1)/x]^2/2+etc
e^x=1+x+x^2/2!+etc
sin x=x-x^3/3!+x^5/5!+etc
cos x=1-x^2/2!+x^4/4!+etc
1/[x-1]=1+x+x^2+x^3+etc
Note 0! = 1! = 1

(H+T)^N = sum of all n
terms: Cn*H^n*T^(n-1)
Cn =N!/(n!*(N-n)!)

e^jw=cos x-j sin x
x=-b/2*a +/-
(b^2-4*a*c)^1/2/2*a

area triangle=
(s*(s-a)*(s-b)*(s-c))^1/2
where s=(a+b+c)/2

integer square
1+3=4 1+3+5=9 etc...

Permutation
N draws of M objects
P(m,n)=m!/(m-n)!
Combinations
P(m,n)=m!/ C(m,n)
Mean x=Mx=Σ f(x)/n
Sx=([n Σx^2-Σx Σx]/n[n-1])^1/2
Sy=([n Σy^2-Σy Σy]/n[n-1])^1/2
Sxy=([n Σxy-Σy Σx]/n[n-1])^1/2
Covariance=
Sxy=(nΣxy- ΣyΣx)/n(n-1)
Correlation R= Sxy^2/(Sy^Sx)

NORMAL DIST F (x)=
(1/s/sqr(2*PI)) exp^(-(x-y/(2s))^2)
Q(x) =[∫f(x) dx for 0<x<∞
Q(x)=∫(x)^[b1*x+b2*x^2+etc]
b=1/[1+c^x]
x=0.2316419
b1=0.31938153
b2=-0.356563782
b3=1.781477937
b4=-1.821255978
b5=1.330274429
INVERSE given area find x
x=t-(c0+c1t+c2t^2)/(1+d1t+d2t^2+d3t^3)
c0=2.515517
c1=0.802853
c2=0.010328
d0=1
d1=1.432788
d2=0.189269
d3=0.001308

CURVE FIT
fy(t)=b*b(t)+a
b=(nΣtfy-ΣxΣy)/(nΣ(tx)^2-(Σtx)^2)
a=(Σfy/n-b*Σt/n
r^2=SDxy^2/(SDx*SDy)
SDxy^2=(Σtfy-ΣtxΣfy/n)^2
SDx=Σ(tx^2)-(Σtx)^2/n
SDY=Σ(fy^2)-(Σfy)^2/n
coefficient of determination=
a probability term=
b*(Mxy-MxMy)/(MSy-My^2)
1) y= bx +a fy= y bx= x
2) y= A*exp^bx
ln y=ln A +bx
fy=ln y bx= ln x
3) y= a +b*ln x
fy= y bx= ln x
4) y= a*x^b
ln y = b*ln x +ln A

POWER POLY FIT
y=b0 +b1x +b2x^2+etc
for n terms/n equations
Σyi=n b0+b1Σx+b2ΣX^2+etc
Σyx=b0Σx+b1Σx^2
+b2Σx^3 +etc
Σyx^m=b0Σx^m+b1Σx^(m+1)
+b2Σx^(m+2) +etc
use Cramer to solve for b terms

ECLIPSE
x^2/a^2+y^2/b^2=1
Foci=ae
e=(a^2-b^2)/a)^1/2

PARABOLA
x^2=4yp
p=foci

HYPERBOLA
x^2/a^2-y^2/b^2=1

Wood=$1/Therm
Gas = $.4/Therm
Electric=$2.70/Therm
Therm=27.77kWHR

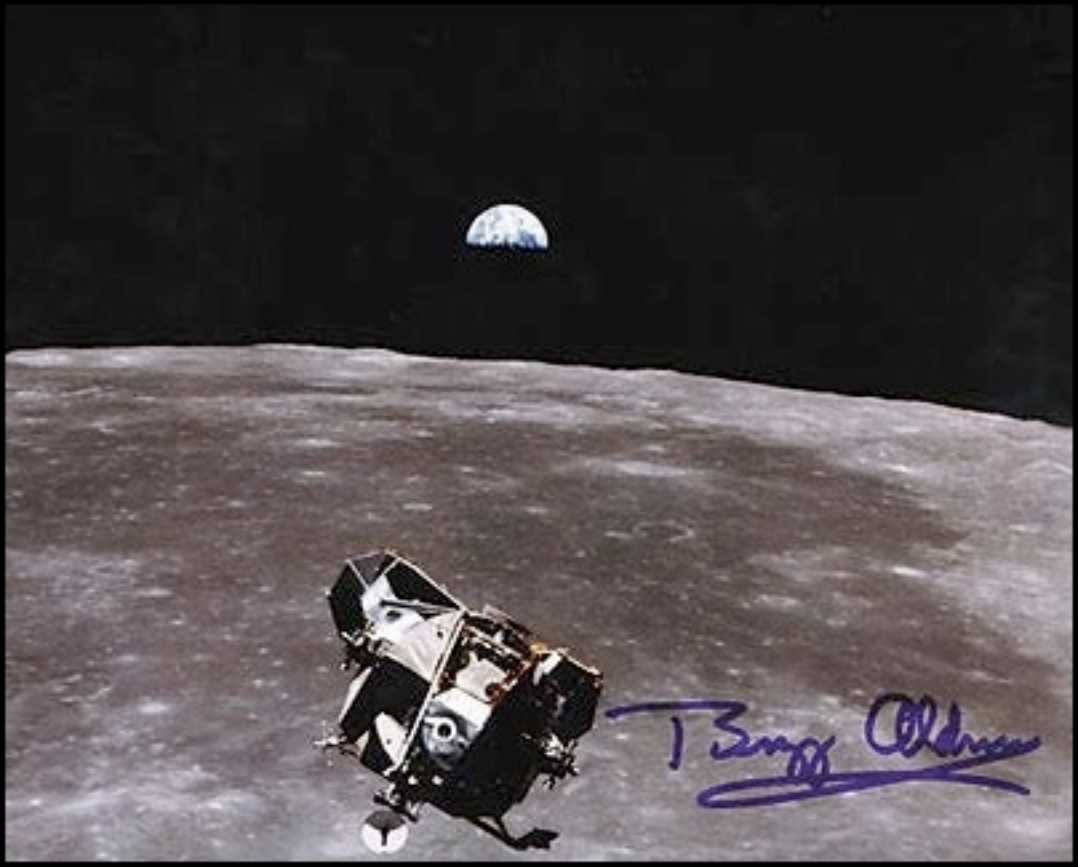
DATA/PHYSIC2

Equilibrium Constant K
3A+B⇌2C+3D
C^2*D^3=K*A^3*B

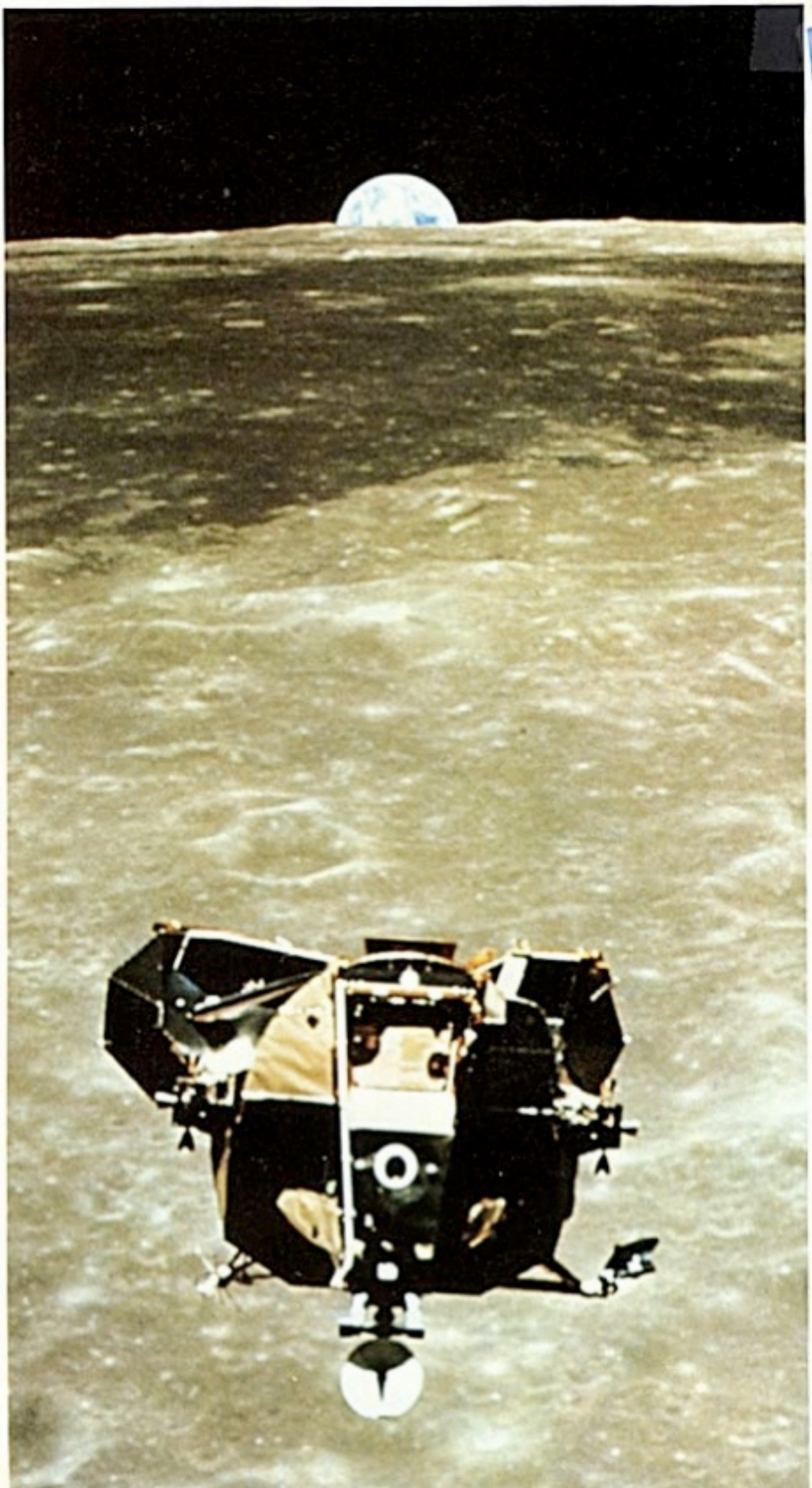
Reduce strong	Oxidize weak
Li 3.0	Li+
K 3.0	K+
Ca 2.9	Ca++
Na 2.7	Na+
Mg 2.4	Mg++
H 2.1	H+
Al 1.7	Al+++
S= .92	S
Zn .76	Zn++
Cr .74	Cr+++
Fe .44	Fe++
Ni .25	Ni++
Sn .14	Sn++
Pb .13	Pb++
H2 0	H3O+
H2S	S
Cu -.34	Cu++
I-	I2
Mn O4=	Mn O4-
Fe++	Fe+++
Hg -.79	Hg+
Ag -.8	Ag+
Hg	Hg++
NO2-	NO3-
Br-	Br2
Mn++	Mn O2
SO2	H2SO4
Cl- -1.3	Cl2
Cr+++	Cr2O7=
Mn++	Mn O4-
F- -2.9	F2
weak Reduce	strong Oxidize

NONMETALS
METALS
TRANSITION ELEMENTS
ATOMIC RADII
IONIZATION ENERGIES
TO REMOVE AN ELECTRON
ELECTRONEGATIVITY (ARBITRARY SCALE)
(BONDING ATTRACTION)
(OF OUTSIDE ELECTRONS)

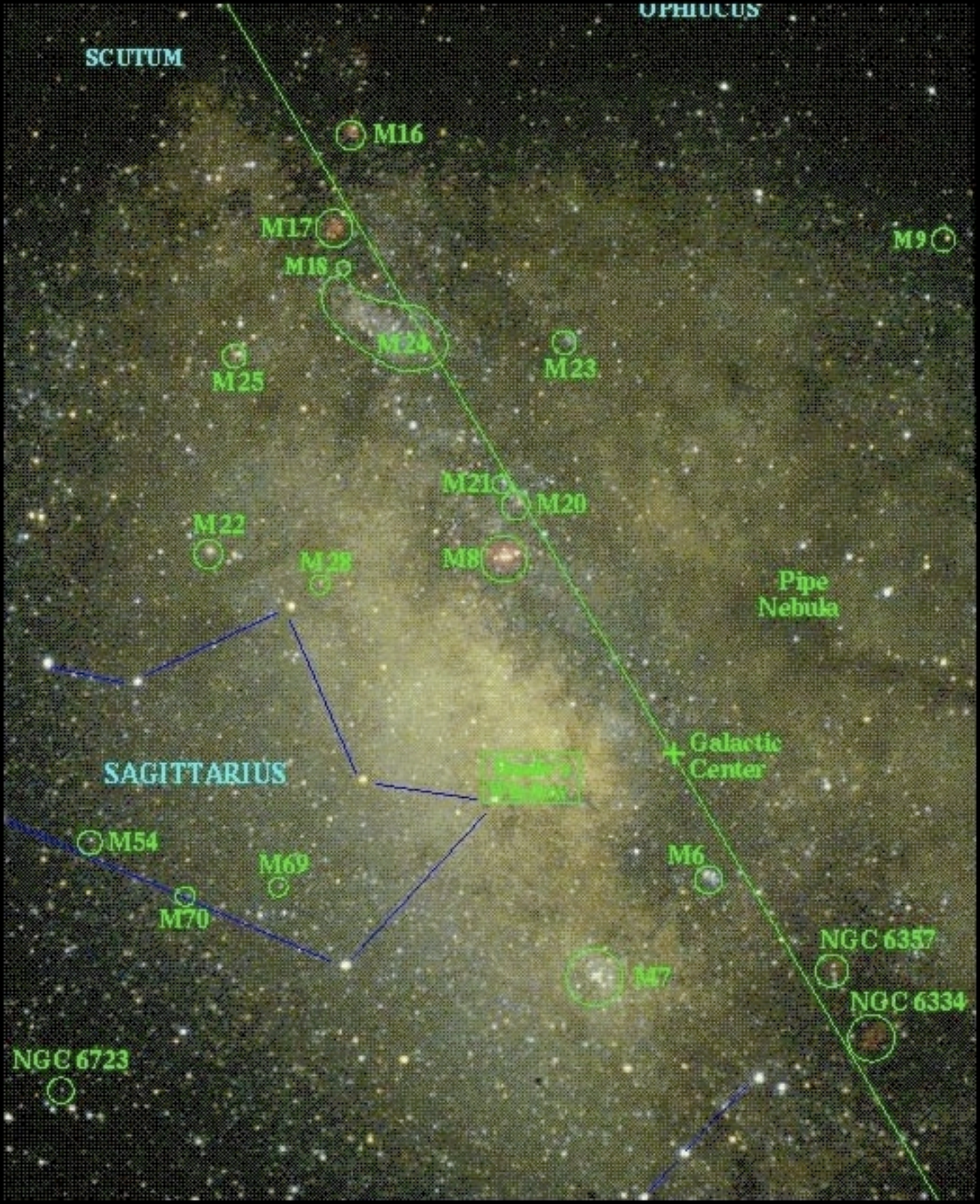
Oxidizing Agent take up electrons
Reducing Agent furnishes electrons


Buzz Aldrin

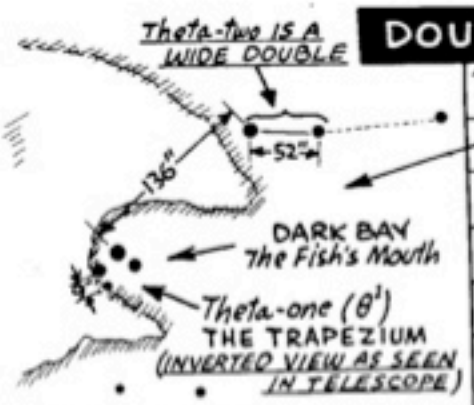

July 20 1969



Photographed by Collins, landing module of Armstrong and Aldrin returns from moon to dock with *Columbia*. Beyond, Earth rises comfortingly into view.


OPHIUCUS
SCUTUM
M16
M17
M18
M24
M25
M23
M9
M21
M20
M22
M28
M8
Pipe
Nebula
Galactic
Center
SAGITTARIUS
M54
M69
M70
M6
NGC 6357
M7
NGC 6334
NGC 6723

elected SKY OBJECTS



THE TRAPEZIUM IS SEEN PLAINLY IN 6" AT 50x. *DIAGRAM SHOWS ABOUT 1/10 THE AREA YOU SEE AT 50x*

DOUBLE STARS	R.A.	S.H.A.	DEC.	MAGN.	SEPARATION	POWER* NEEDED	REMARKS
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θ¹ (theta-one) ORION *THE TRAPEZIUM*	5h 33m	277°	-5° 25'	A1 C5 B8 D7	A-B 9" A-C 13" A-D 22"	30-150	MOST POPULAR MULTIPLE STAR. NICE IN 6-INCH
ζ (zeta) CANCER	8h 09m	238°	+17° 48'	5½-6-6	A-B 1" A-C 6"	240-1200 40-200	TRIPLE WITH 6-INCH AT HIGH POWER. ALWAYS A GOOD DOUBLE
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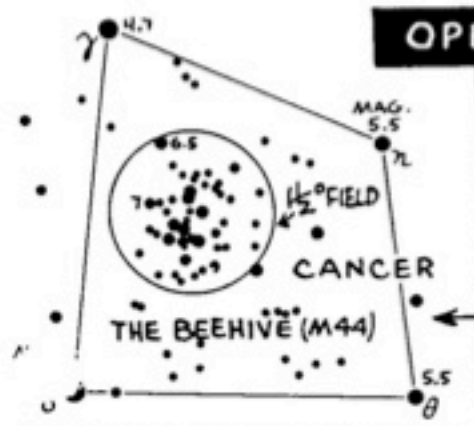
β (beta) Albireo CYGNUS	19h 29m	68°	+27° 53'	3 and 5½	35"	7-35	ORANGE and BLUE. COLORS ARE BRIGHT IN 3-INCH
ζ (zeta) AQUARIUS	22h 27m	23°	-0° 12'	4½ and 4½	1½"	160-800	CLOSING SLOWLY, WAS 3" IN 1920. WHITE STARS

*POWER FOR 4' AND 20' APPARENT SEPARATION



LOW POWER NEEDED TO COVER 1½° FIELD... *A 1¼" ERFLE EYE-PIECE AT ABOUT 38x WILL COVER*

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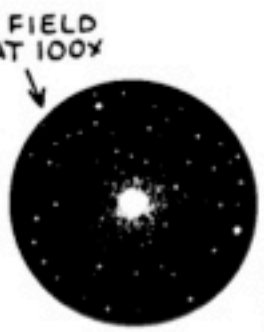
NGC 884 - PERSEUS	2h 19m	325°	+56° 53'	7	35'	OVER 200	CLUSTER. GOOD VIEW AT 40x
M37 - AURIGA	5h 50m	272°	+32° 33'	10	25'	150	BEST OF CLUSTERS IN AURIGA. RED 9th MAG. STAR AT CENTER
M35 - GEMINI	6h 06m	268°	+24° 21'	9.5	30'	120	GOOD VIEW AT 40 TO 80x
M41 - CANIS MAJOR	6h 45m	259°	-20° 42'	9.5	30'	50	RATED 5th MAG. OVERALL
M44 - CANCER *THE BEEHIVE*	8h 38m	230°	+20° 07'	6.7	90'	200+	BIG, BRIGHT LOOSE CLUSTER IS EASY TO SEE OR PHOTOGRAPH
M23 - SAGITTARIUS	17h 55m	91°	-19° 01'	11	30'	120	ONE OF MANY IN THIS AREA
M16 - SERPENS	18h 16m	86°	-13° 48'	10	10'	50	NICE VIEW AT 160x
M11 - SCUTUM	18h 48m	78°	-6° 20'	10	15'	200+	ONE OF THE BEST... PRETTY AND SPARKLING IN 6" AT 60x

*APPROX. AVERAGE OF 10 BRIGHTEST STARS



M13 - GREAT CLUSTER IN HERCULES. *THE INDIVIDUAL STARS OF ABOUT MAG. 14 ARE NOT SEEN AT ALL WITH TELESCOPES UNDER 10" APERTURE*

GLOBULAR CLUSTERS	R.A.	S.H.A.	DEC.	MAGN.*		DIA.	REMARKS
M5 - SERPENS	15h 17m	131°	+2° 13'	6.2	14	13'	11 TO 16th MAG. STARS. BRIGHT CENTER
M13 - HERCULES	16h 40m	110°	+36° 32'	5.5	13.5	10'	BEST-KNOWN GLOBULAR. EASY TO SEE BUT NEEDS 6" OR MORE TO RESOLVE
M12 - OPHIUCHUS	16h 45m	109°	-1° 52'	6.6	14	9'	BLAZE AT CENTER ABOUT 2' DIA.
M92 - HERCULES	17h 16m	101°	+43° 12'	6.1	14	8'	VISIBLE WITH 3" ALTHO NOT RESOLVED INTO SEPARATE STARS
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M2 - AQUARIUS	21h 31m	3T	-1° 03'	7	14	8'	FINE OBJECT WITH 8" OR LARGER

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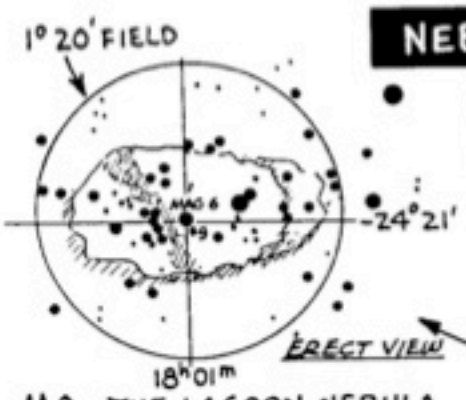
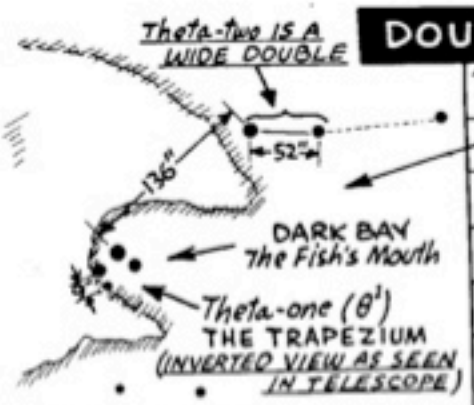


M8 - THE LAGOON NEBULA IS SEEN BEST AT LOW POWER OF ABOUT 40x OR LESS

NEBS and GALAXIES	R.A.	S.H.A.	DEC.	MAGN.	SIZE	REMARKS
M31 - ANDROMEDA	0h 41m	350°	+41° 03'	6	40'x160'	EASY TO SEE WITH ANY TELESCOPE, THIS SPIRAL GALAXY IS WELL-KNOWN
NGC 2392 - GEMINA	7h 27m	248°	+21° 00'	8	20"	PLANETARY NEB. MAG. 9.5 CENTER STAR
M64 - COMA BERENICES	12h 54m	166°	+21° 47'	8	4'x 8'	BRIGHT SPIRAL GALAXY
M51 - CANES VENATICI	13h 28m	158°	+47° 24'	8.5	6'x12'	SPIRAL GALAXY -- *The WHIRLPOOL*
NGC 6543 - DRACO	17h 59m	90°	+66° 37'	9	24"	BLUE-GREEN PLANETARY NEBULA
M8 - SAGITTARIUS *THE LAGOON*	18h 01m	90°	-24° 21'	6	35'x60'	DIFFUSE NEB WITH CLUSTER
NGC6572 - OPHIUCHUS	18h 10m	87°	+6° 51'	9	10"	PLANETARY. "SMALL BUT BRIGHT" - Norton
NGC 7009 - AQUARIUS	21h 02m	44°	-11° 32'	8.5	25"x45"	BLUE PLANETARY - *SATURN NEBULA*

elected SKY OBJECTS



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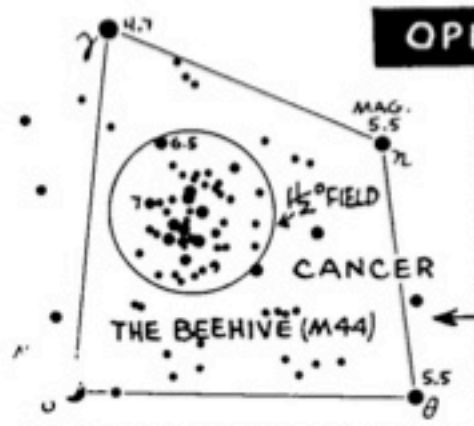

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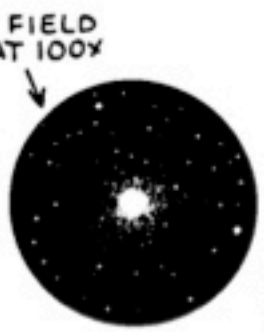

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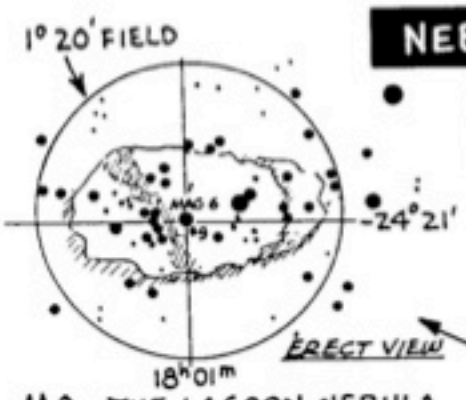

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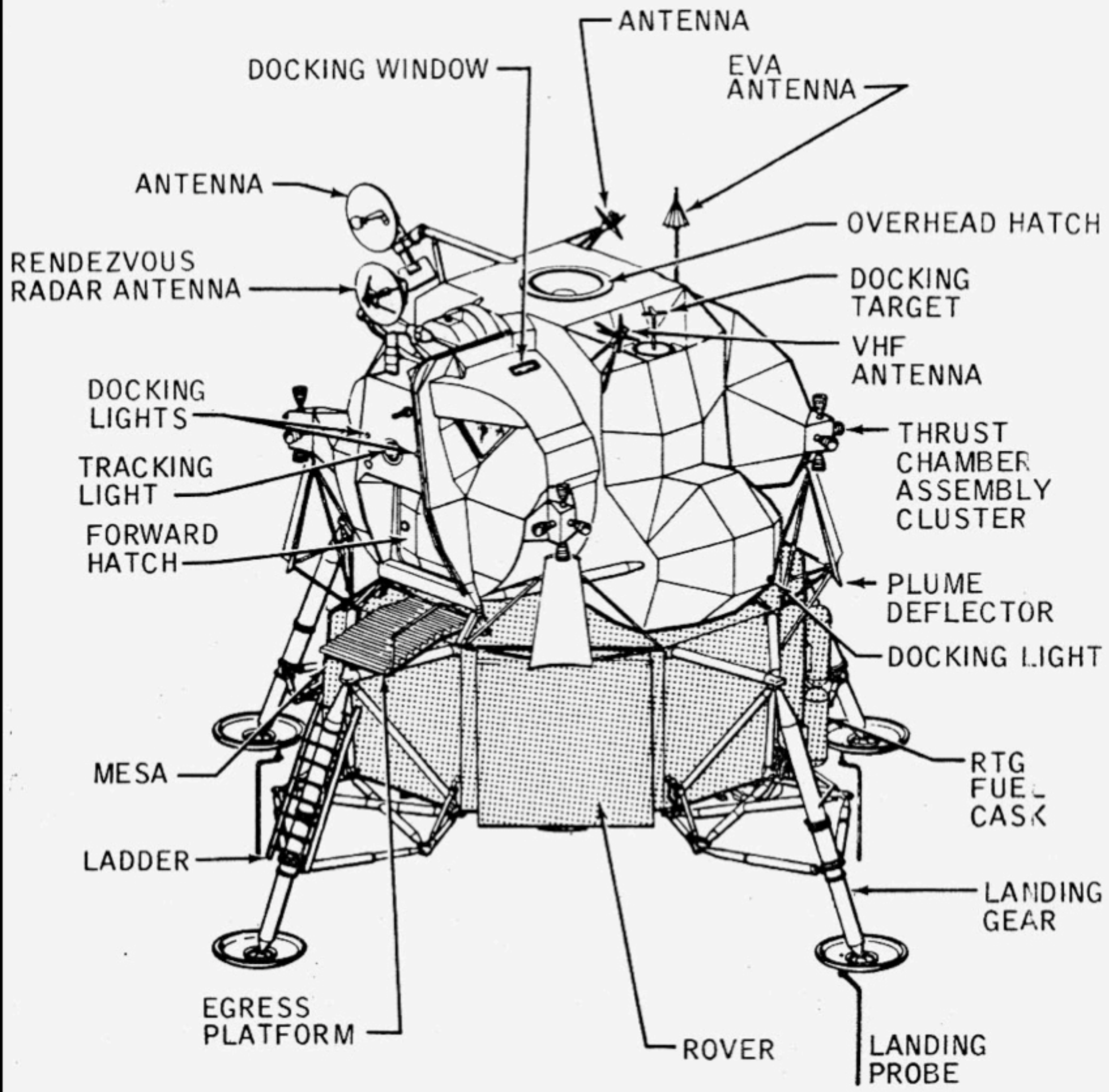
LUNAR MODULE



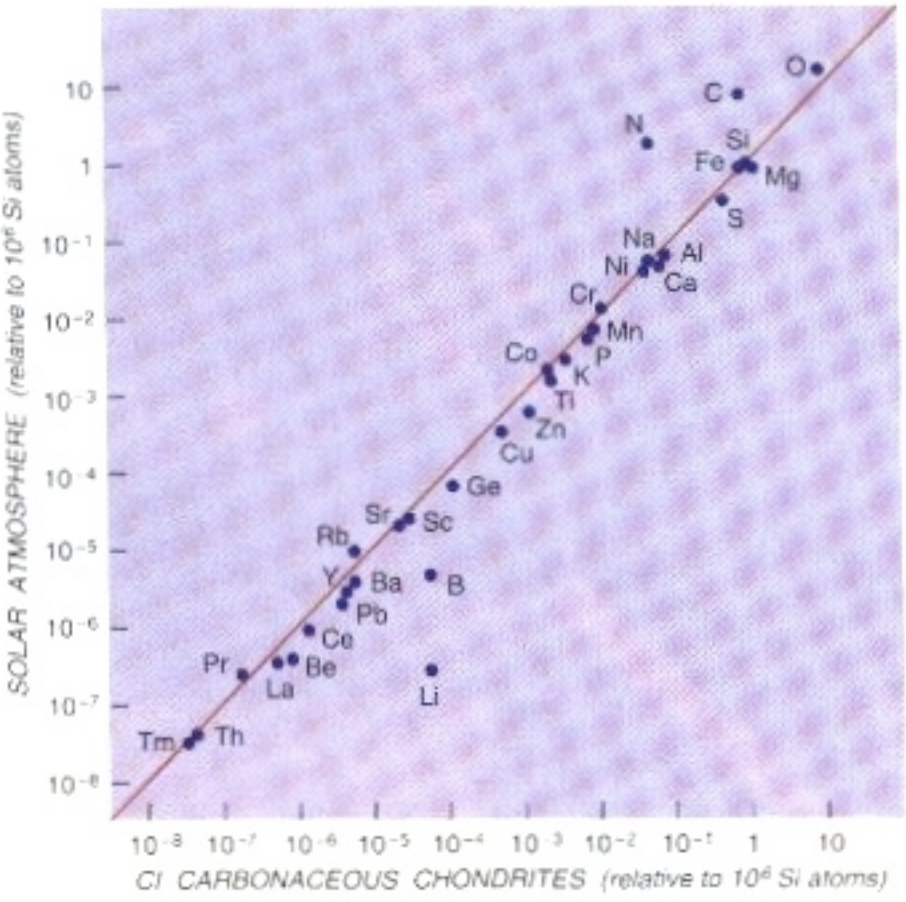
Doing the Math

$$\text{Telescope magnification} = \frac{\text{telescope focal length}}{\text{eyepiece focal length}}$$

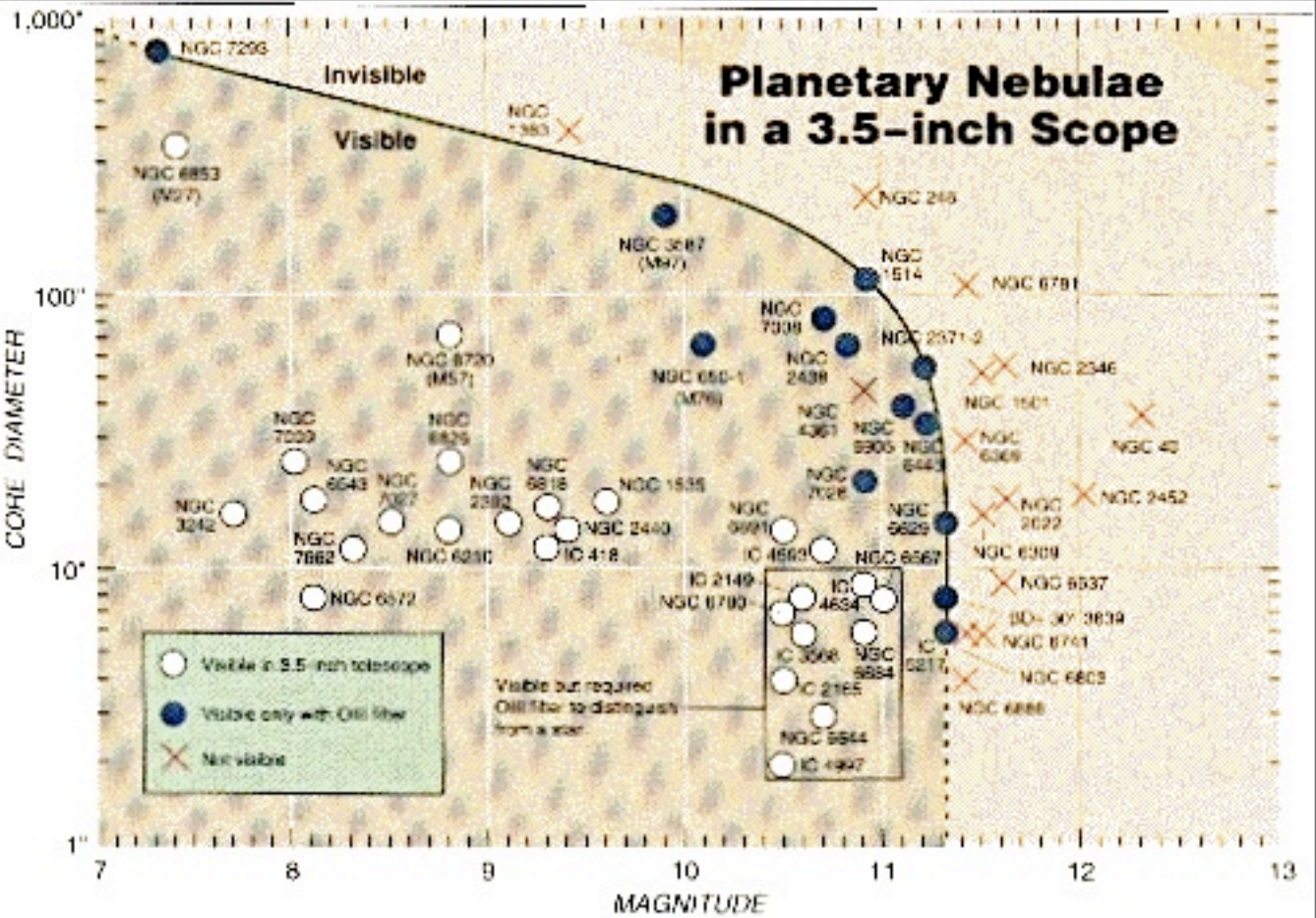
$$\text{True field} = \frac{\text{field-stop diameter}}{\text{telescope focal length}} \times 57.3$$

$$\text{Exit-pupil diameter} = \frac{\text{aperture}}{\text{magnification}}$$

Longest useful eyepiece focal length =
telescope f/ratio × maximum exit-pupil diameter



The concentrations of 33 elements found in the solar atmosphere and in a type of carbon-rich meteorite are nearly identical. Therefore, these meteorites appear to be ancient, chemically unaltered objects that preserve the chemical state of the solar system when it formed. Abundances are plotted relative to one million silicon atoms. Data courtesy H. Holweger.



The relationship between a planetary nebula's magnitude, diameter, and visibility in the author's 3½-inch telescope. Some of these nebulae are difficult to find and identify, but well worth the effort for the satisfaction of pushing eye and instrument to their limits. Data are from *Planetary Nebulae* by Steven Hynes.

KEY TO CONSTELLATION ABBREVIATIONS

	Name	Pronunciation	Genitive	Pronunciation	Meaning
And	Andromeda	ăn-drŏm′ĭ-də	Andromedae	ăn-drŏm′ĭ-dē	Andromeda
Ant	Antlia	ănt′lē-ə	Antliae	ănt′lē-ē	(air) pump
Aps	Apus	ā′pəs	Apodis	ăp′ō-dĭs	bird of paradise
Aqr	Aquarius	ə-kwâr′ē-əs	Aquarii	ə-kwâr′-ī	water carrier
Aql	Aquila	ăk′wĭ-lə	Aquilae	ăk′wĭ-lē	eagle
Ara	Ara	ăr′ə	Arae	ăr′ē	altar
Ari	Aries	âr′ē-ēz	Arietis	ă-rī′ĭ-tĭs	ram
Aur	Auriga	ô-rī′gə	Aurigae	ô-rī′jē	charioteer
Boo	Boötes	bō-ō′tēz	Bootis	bō-ō′tĭs	herdsman
Cae	Caelum	sē′ləm	Caeli	sē′lī	graving tool
Cam	Camelopardalis	kə-mĕl′ō-pär′də-lĭs	Camelopardalis	kə-mĕl′ō-pär′də-lĭs	giraffe
Cnc	Cancer	kăn′sər	Cancri	kăng′krī	crab
CVn	Canes Venatici	kā′nēz vē-năt′ĭ-sī	Canum Venaticorum	kā′nəm vē-năt′ĭ-kôr′əm	hunting dogs
CMa	Canis Major	kā′nĭs mā′jər	Canis Majoris	kā′nĭs mă-jôr′ĭs	larger dog
CMi	Canis Minor	kā′nĭs mī′nər	Canis Minoris	kā′nĭs mĭ-nôr′ĭs	smaller dog
Cap	Capricornus	kăp′rĭ-kôr′nəs	Capricorni	kăp′rĭ-kôr′nī	horned goat
Car	Carina	kə-rī′nə	Carinae	kə-rī′nē	keel
Cas	Cassiopeia	kăs′ē-ō-pē′yə	Cassiopeiae	kăs′ē-ō-pē′yē	Cassiopeia
Cen	Centaurus	sĕn-tô′rəs	Centauri	sĕn-tô′rī	centaur
Cep	Cepheus	sē′fyōōs	Cephei	sē′fē-ī	Cepheus
Cet	Cetus	sē′təs	Ceti	sē′tī	whale
Cha	Chamaeleon	kə-mē′lē-ən	Chamaeleontis	kə-mē′lē-ŏn′tĭs	chameleon
Cir	Circinus	sûr′sə-nəs	Circini	sûr′sə-nī	pair of compasses
Col	Columba	kə-lŭm′bə	Columbae	kə-lŭm′bē	dove
Com	Coma Berenices	kō′mə bĕr′ə-nī′sēz	Comae Berenices	kō′mē bĕr′ə-nī′sēz	Berenice's hair
CrA	Corona Australis	kə-rō′nə ôs-trā′lĭs	Coronae Australis	kə-rō′nē ôs-trā′lĭs	southern crown
CrB	Corona Borealis	kə-rō′nə bôr′ē-ā′lĭs	Coronae Borealis	kə-rō′nē bôr′ē-ā′lĭs	northern crown
Crv	Corvus	kôr′vəs	Corvi	kôr′vī	crow
Crt	Crater	krā′tər	Crateris	krā-tē′rĭs	cup
Cru	Crux	krŭks	Crucis	krōō′sĭs	cross
Cyg	Cygnus	sĭg′nəs	Cygni	sĭg′nī	swan
Del	Delphinus	dĕl-fī′nəs	Delphini	dĕl-fī′nī	dolphin
Dor	Dorado	dō-rä′dō	Doradus	dō-rā′dəs	dorado [a fish]
Dra	Draco	drā′kō	Draconis	drə-kō′nĭs	dragon
Equ	Equuleus	ē-kwōō′lē-əs	Equulei	ē-kwōō′lē-ī	colt
Eri	Eridanus	ē-rĭd′ā-nəs	Eridani	ē-rĭd′ā-nī	Eridanus [a river]
For	Fornax	fôr′năks	Fornacis	fôr′nə-sĭs	furnace
Gem	Gemini	jĕm′ə-nī	Geminorum	jĕm′ə-nôr′əm	twins
Gru	Grus	grŭs	Gruis	grōō′ĭs	crane
Her	Hercules	hûr′kyə-lēz	Herculis	hûr′kyə-lĭs	Hercules
Hor	Horologium	hôr′ə-lō′jē-əm	Horologii	hôr′ə-lō′jē-ī	clock
Hya	Hydra	hī′drə	Hydrae	hī′drē	water monster
Hyi	Hydrus	hī′drəs	Hydri	hī′drī	water snake
Ind	Indus	ĭn′dəs	Indi	ĭn′dī	Indian
Lac	Lacerta	lə-sûr′tə	Lacertae	lə-sûr′tē	lizard

ELEMENTS OF AN ORBIT

NAME	SYMBOL	DEFINITION
Semimajor axis	a	Half the long axis of the ellipse.
Eccentricity	e	A measure of the shape of the ellipse—the distance between the foci of the ellipse divided by the major axis.
Inclination	i	Angle of intersection between the orbital planes of the planet and of Earth.
Longitude of the ascending node	Ω	Represented by Greek capital omega. Angle from the vernal equinox (where the ecliptic and celestial equator intersect with the sun crossing the equator from south to north), measured to the east along the ecliptic plane, to the point where the planet crosses the ecliptic traveling from south to north (the ascending node).
Argument of perihelion	ω	Represented by Greek lower-case omega. Angle from the ascending node, measured in the plane of the planet's orbit and in the direction of its motion, to the perihelion point (its closest approach to the sun).
Time of perihelion passage	T	One of the precise times that the object passed the perihelion point.

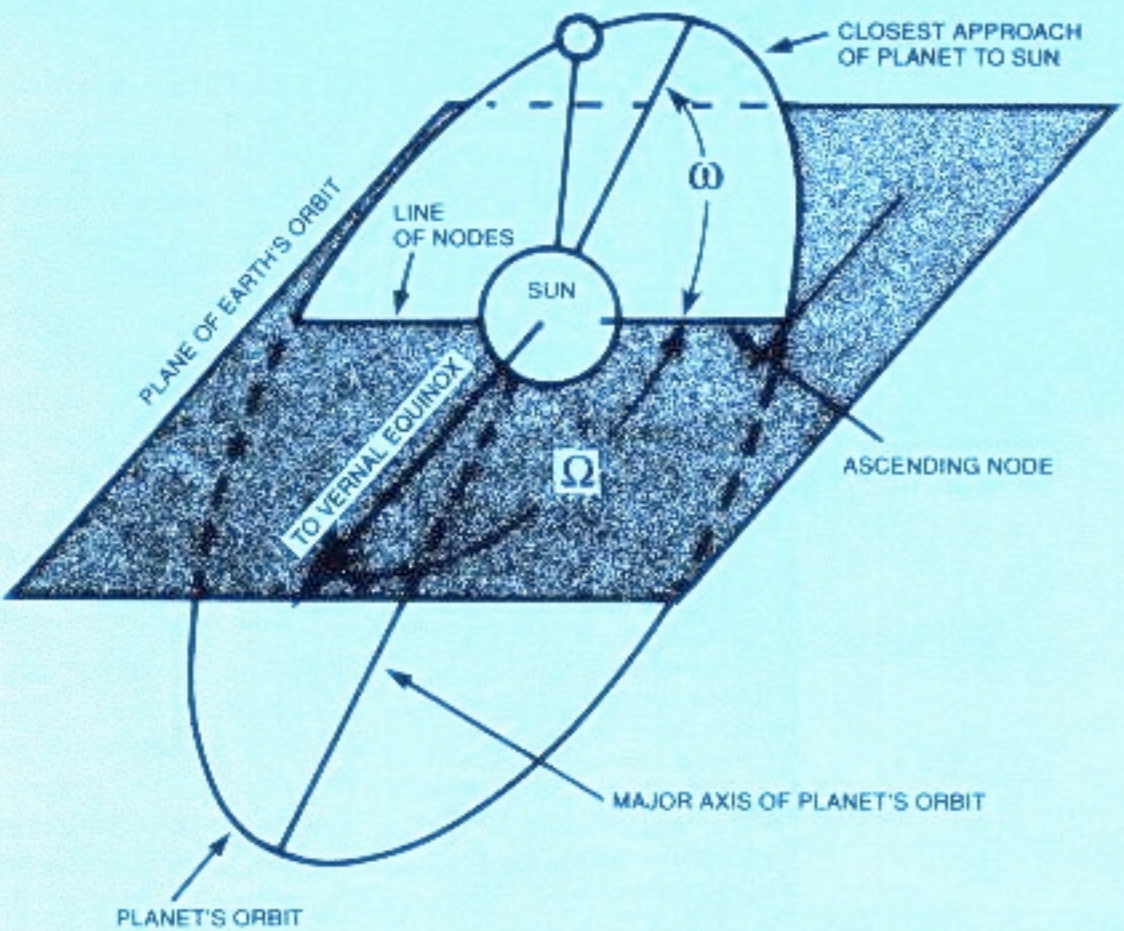


ILLUSTRATION S. A. SMITH

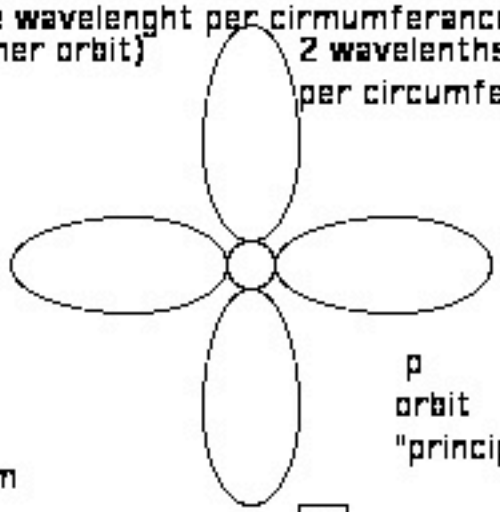
energy of photo = W = hf 6.63e-34 joules.sec

electron in orbit around atom can only have
angular moment in in multiple of h/2π.
In order words...
mvr = n*h/2π n is called the quantum number of orbit
because...

lamda = h/mv
2πr = n*lamda = n*h/mv

force = F = q^2/4πeO*r^2 = mv^2/r = centripetal force
(solve for mvr)
so first n has one wavelenght per cirmumferance
(less force for higher orbit)

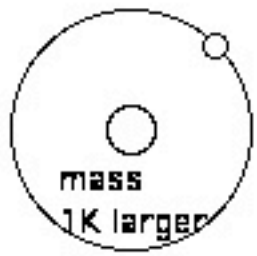
r0 = .53 e-8 cm
r1 =2
r2= 5
r3 =8
r4 = 13
r5 = 19



2 wavelenths per circumference

p orbit "principle"

r= .53 e-8 cm



s orbits "sharp"

1 wavelenths per circumference

2,6,10,14
s,p,d,f

f orbit "fundamental"

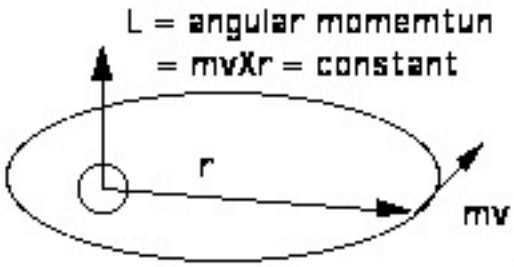
d orbit "diffuse"

spectrum lines
n = energy quantum

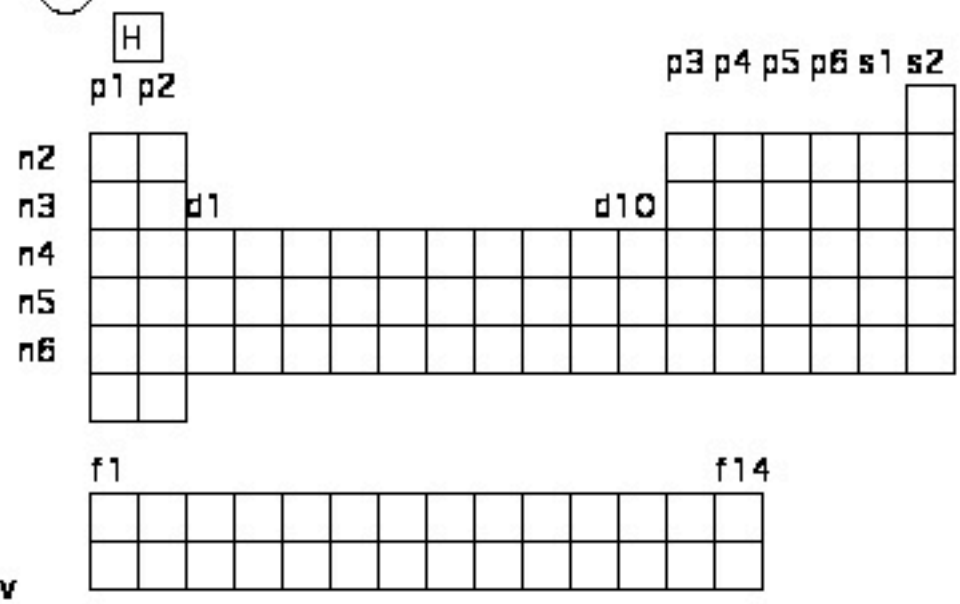
l = orbit angle quantum
= 0,1,....n-1

m = orbit magnetic quantum
= -l,..-1,0,1,...l

s = spin = -1/2,1/2



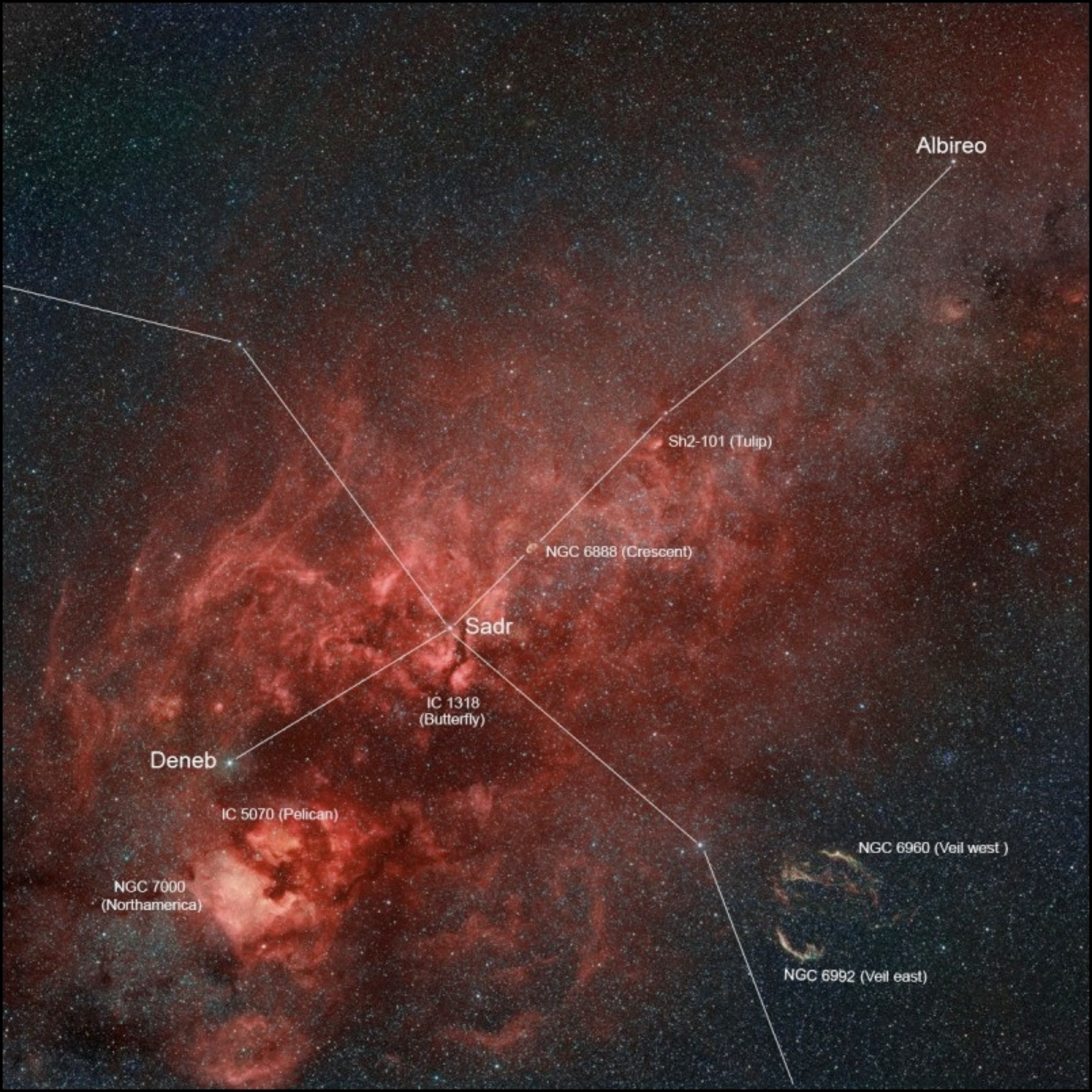
L is quantize 0,1, n-1

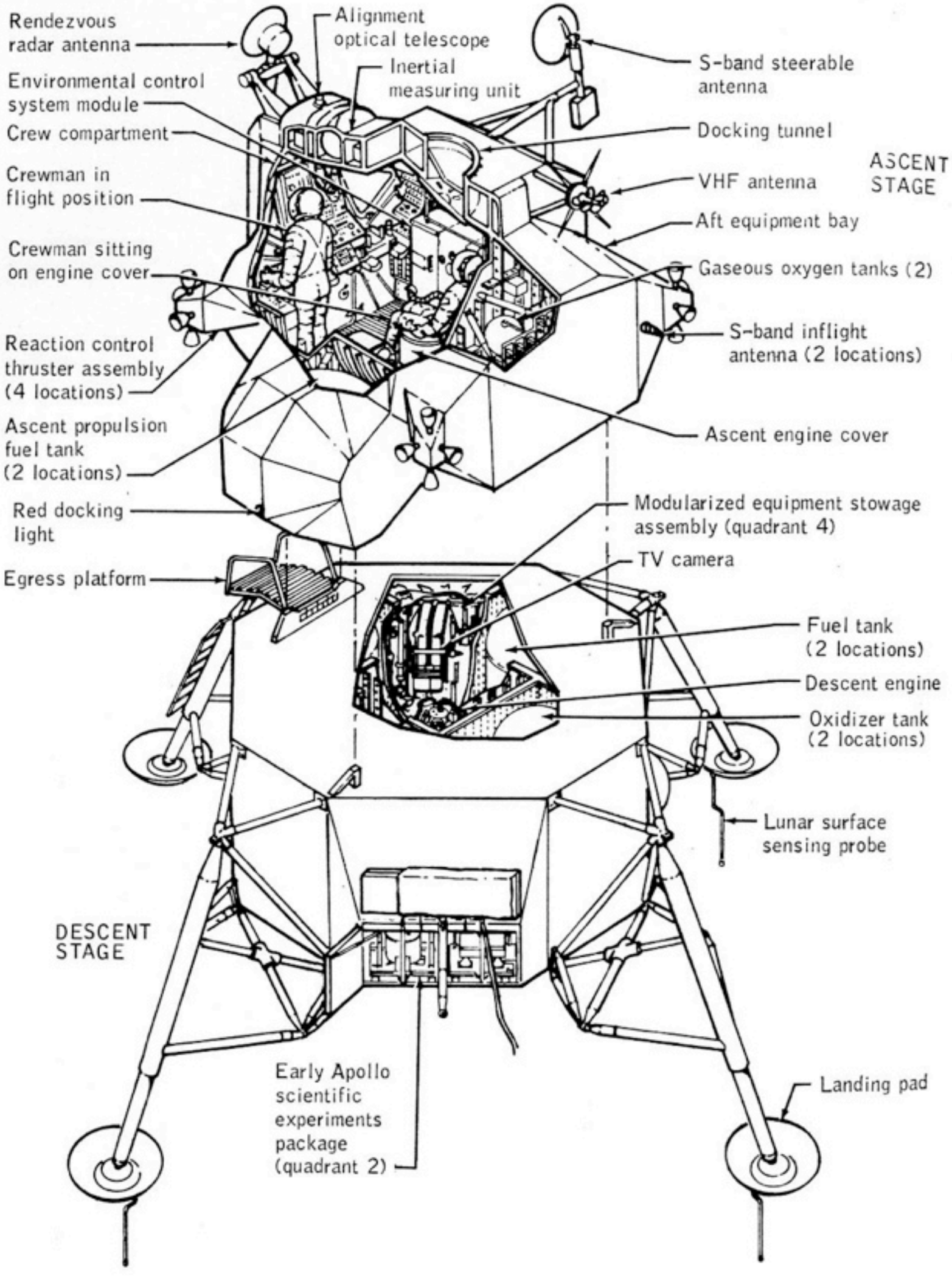


L = min
less time up close

L = max

for n=3 3S,3P,3D
L = 0,$\sqrt{2}\hbar$,$\sqrt{6}\hbar$


Albireo
Sh2-101 (Tulip)
NGC 6888 (Crescent)
Sadr
IC 1318
(Butterfly)
Deneb
IC 5070 (Pelican)
NGC 7000
(Northamerica)
NGC 6960 (Veil west)
NGC 6992 (Veil east)



LUNAR MODULE CONFIGURATION FOR INITIAL LUNAR LANDING

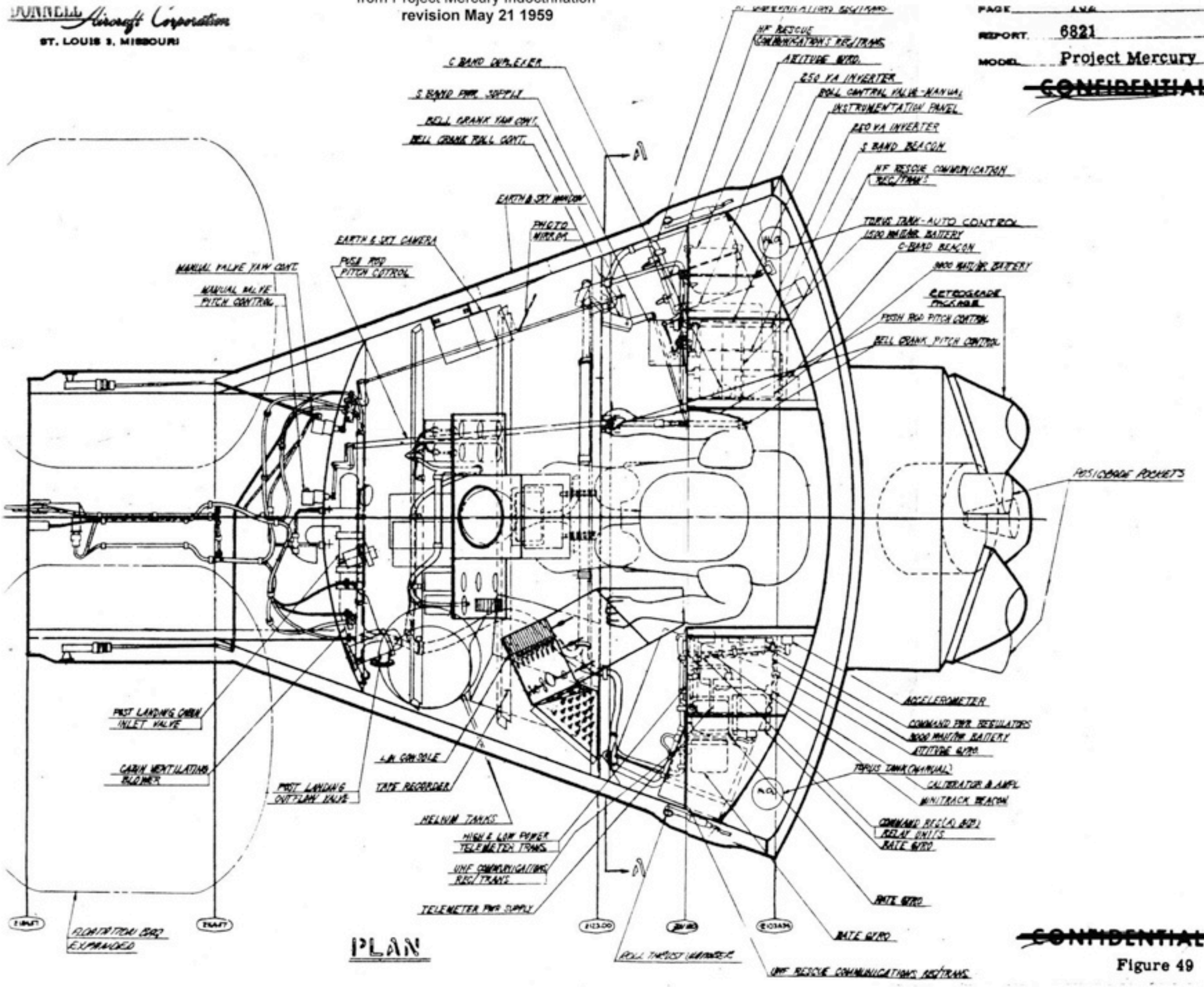
MERCURY SPACECRAFT INTERIOR ARRANGEMENT

from Project Mercury Indoctrination
revision May 21 1959

McDonnell Aircraft Corporation
ST. LOUIS 3, MISSOURI

PAGE N/A
REPORT 6821
MODEL Project Mercury

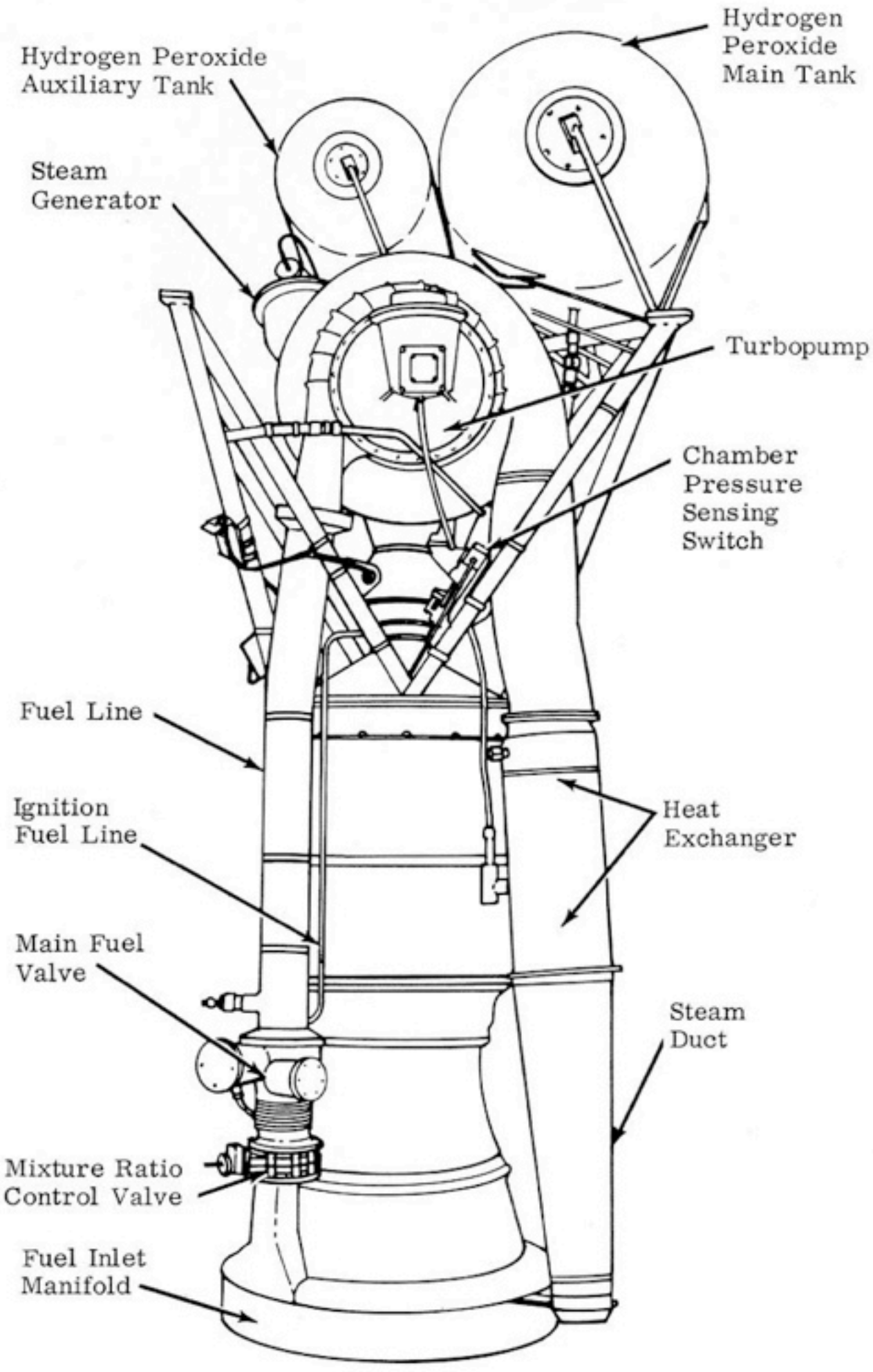
~~CONFIDENTIAL~~



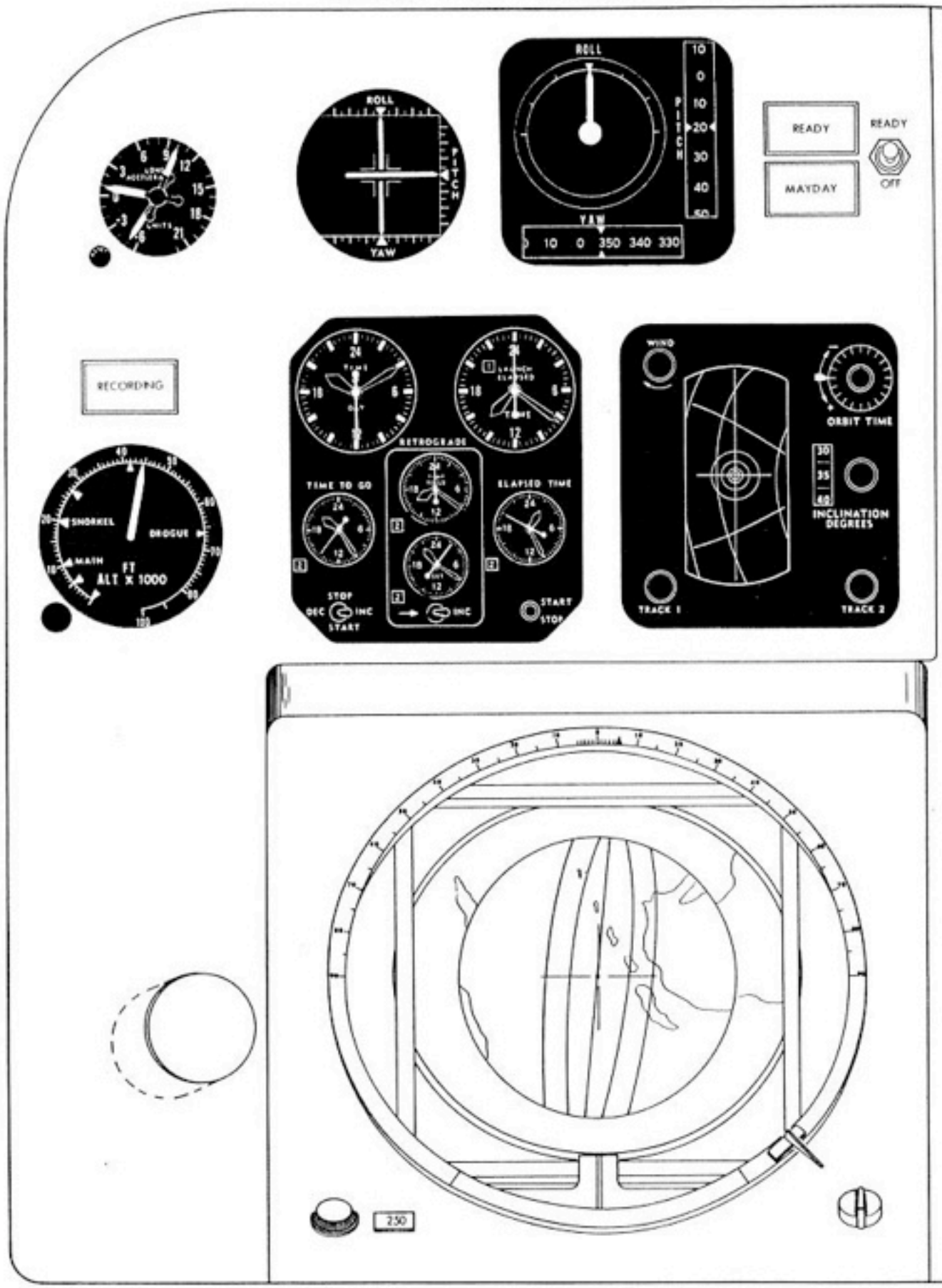
~~CONFIDENTIAL~~

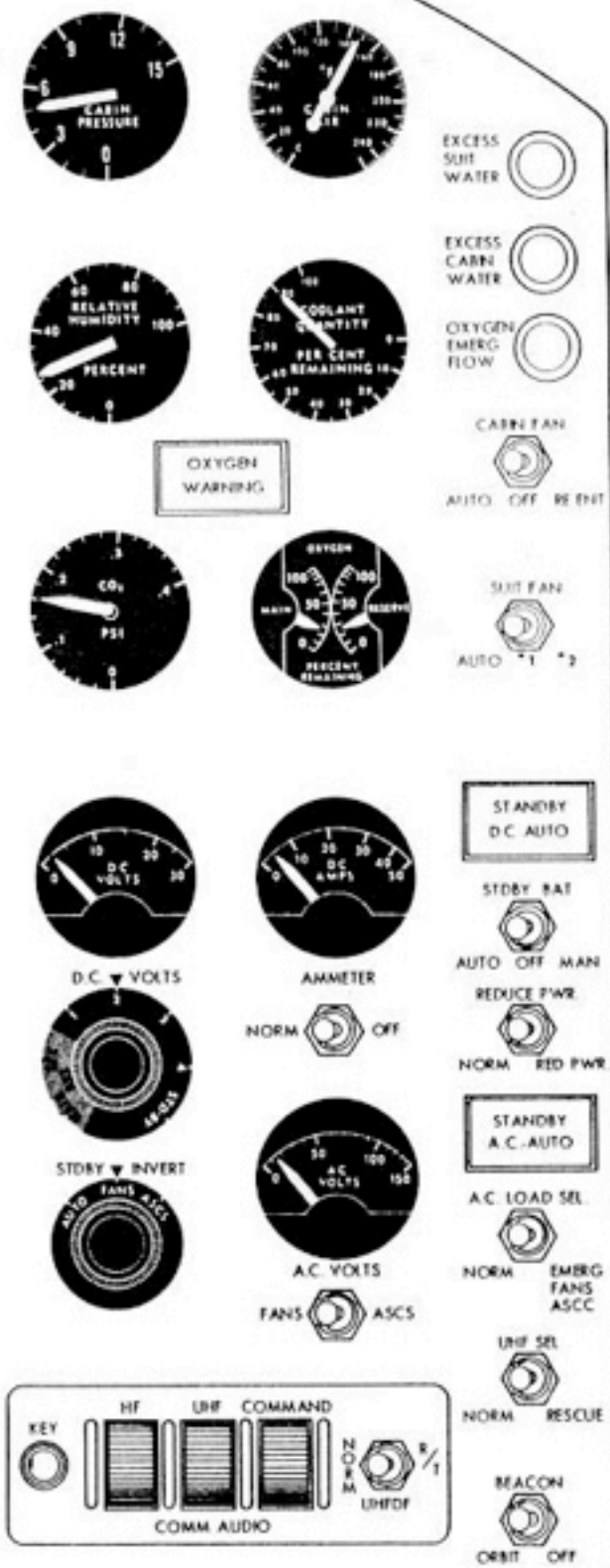
Figure 49

MERCURY-REDSTONE ROCKET ENGINE

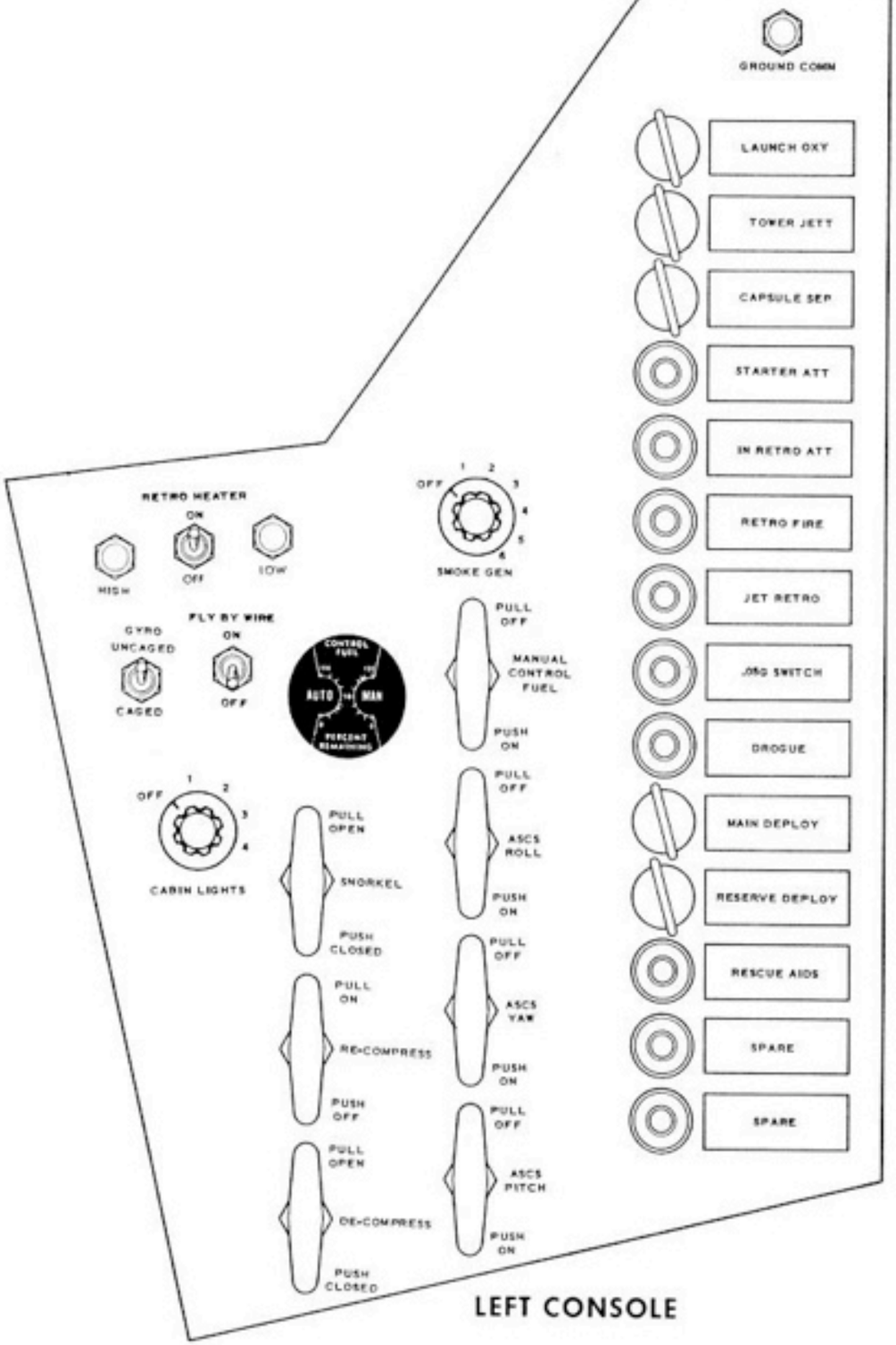


MAIN INSTRUMENT PANEL

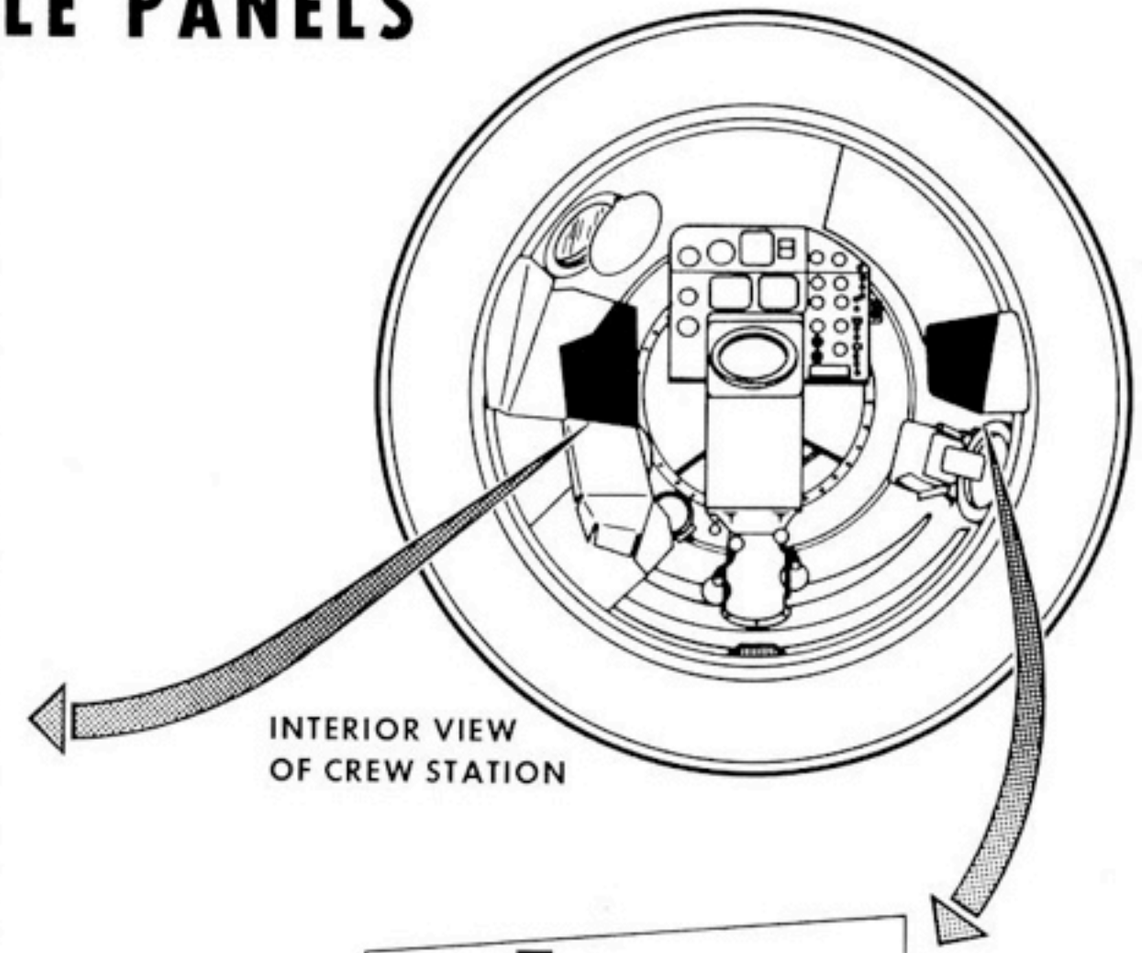




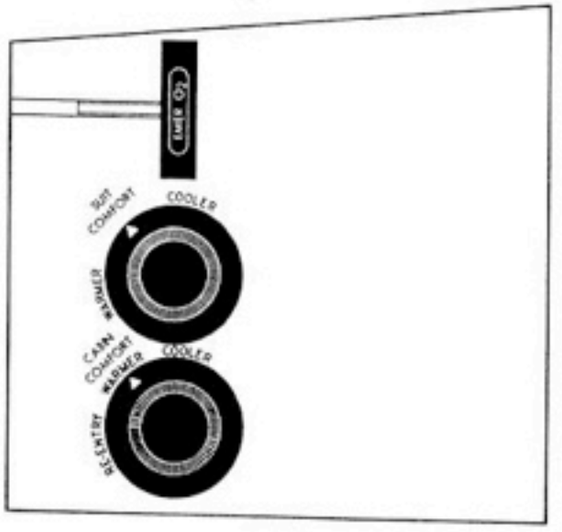
CONSOLE PANELS



LEFT CONSOLE

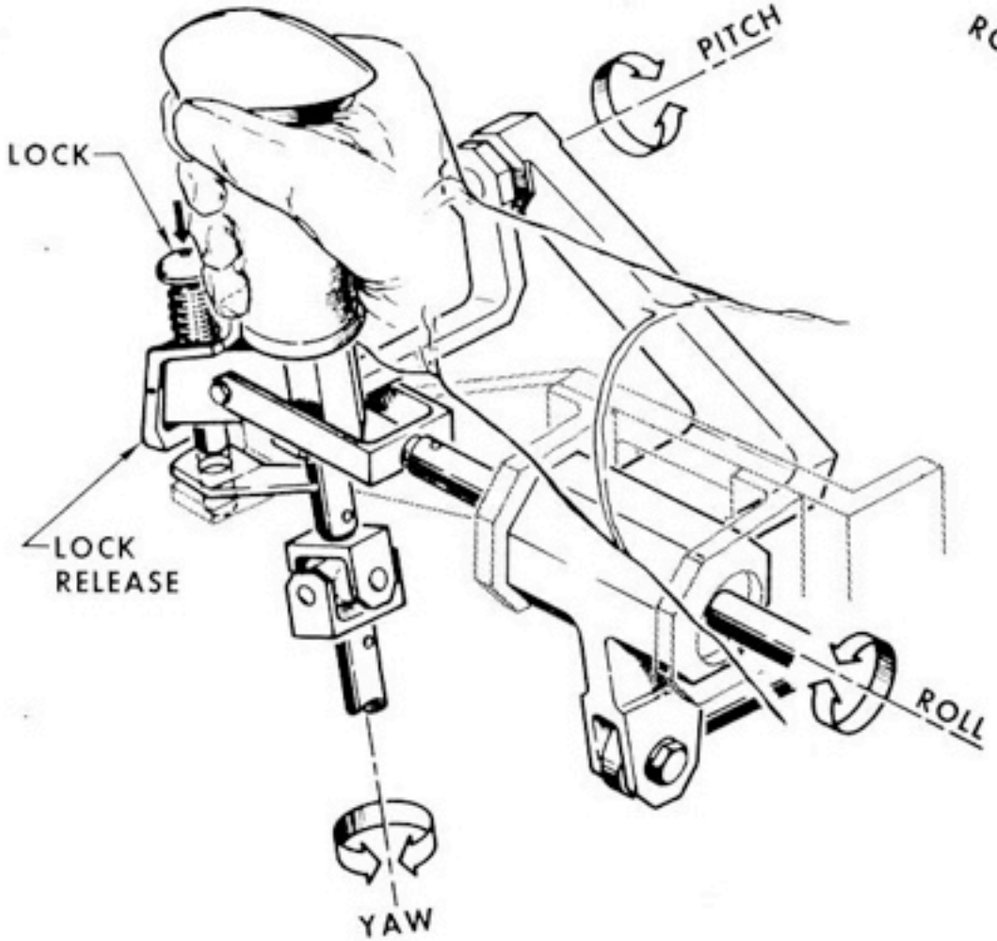


INTERIOR VIEW
OF CREW STATION

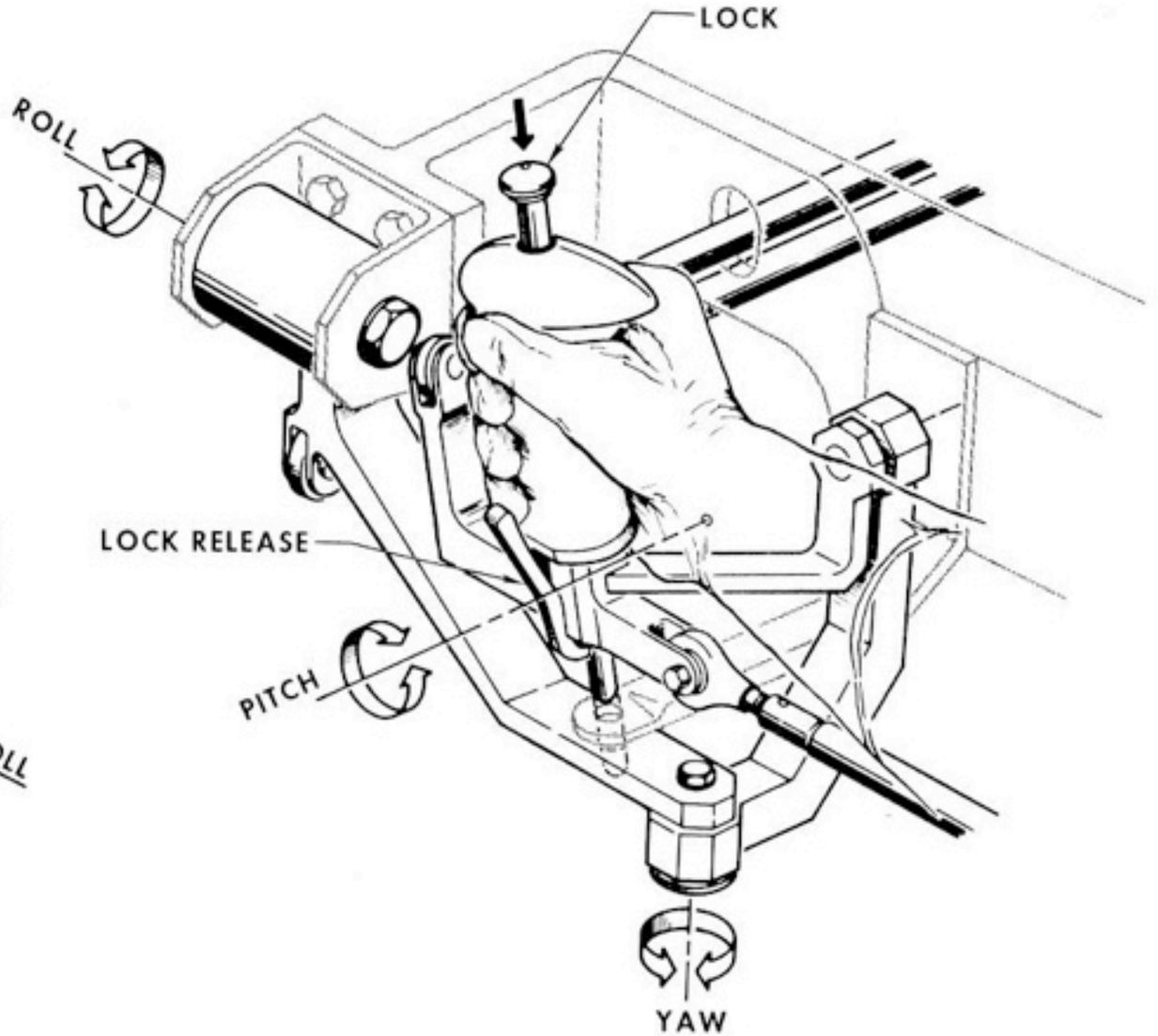


RIGHT CONSOLE

THREE AXIS HAND CONTROL



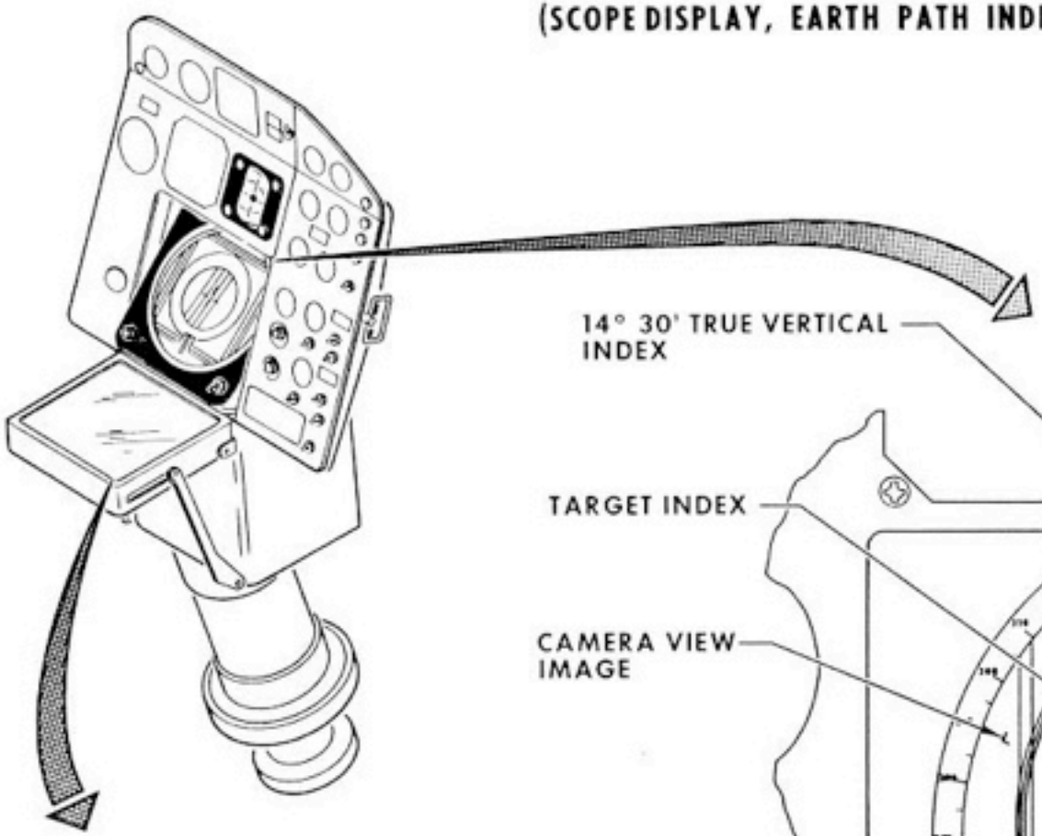
PALM PIVOT

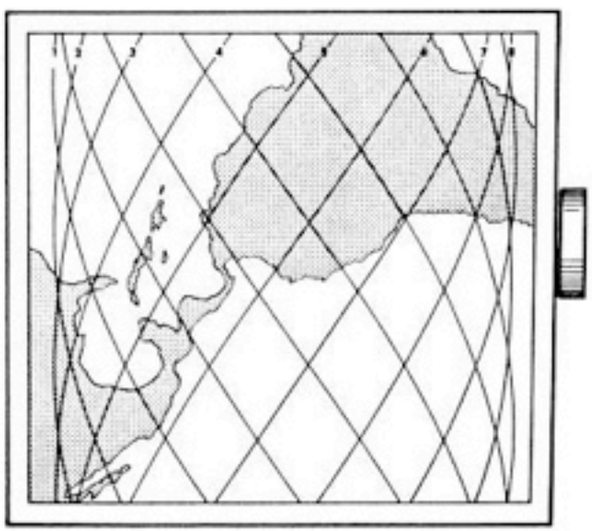


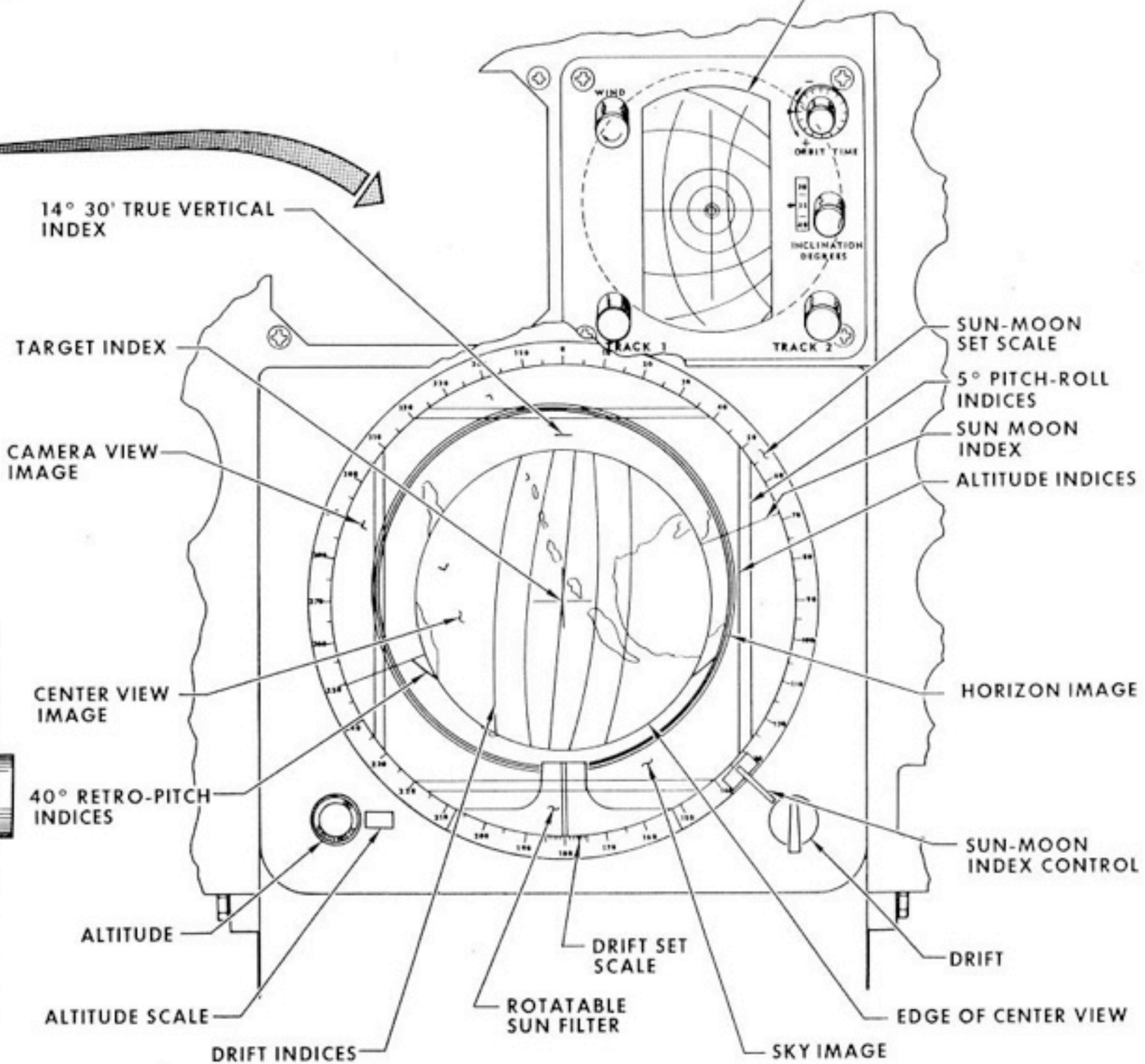
WRIST PIVOT

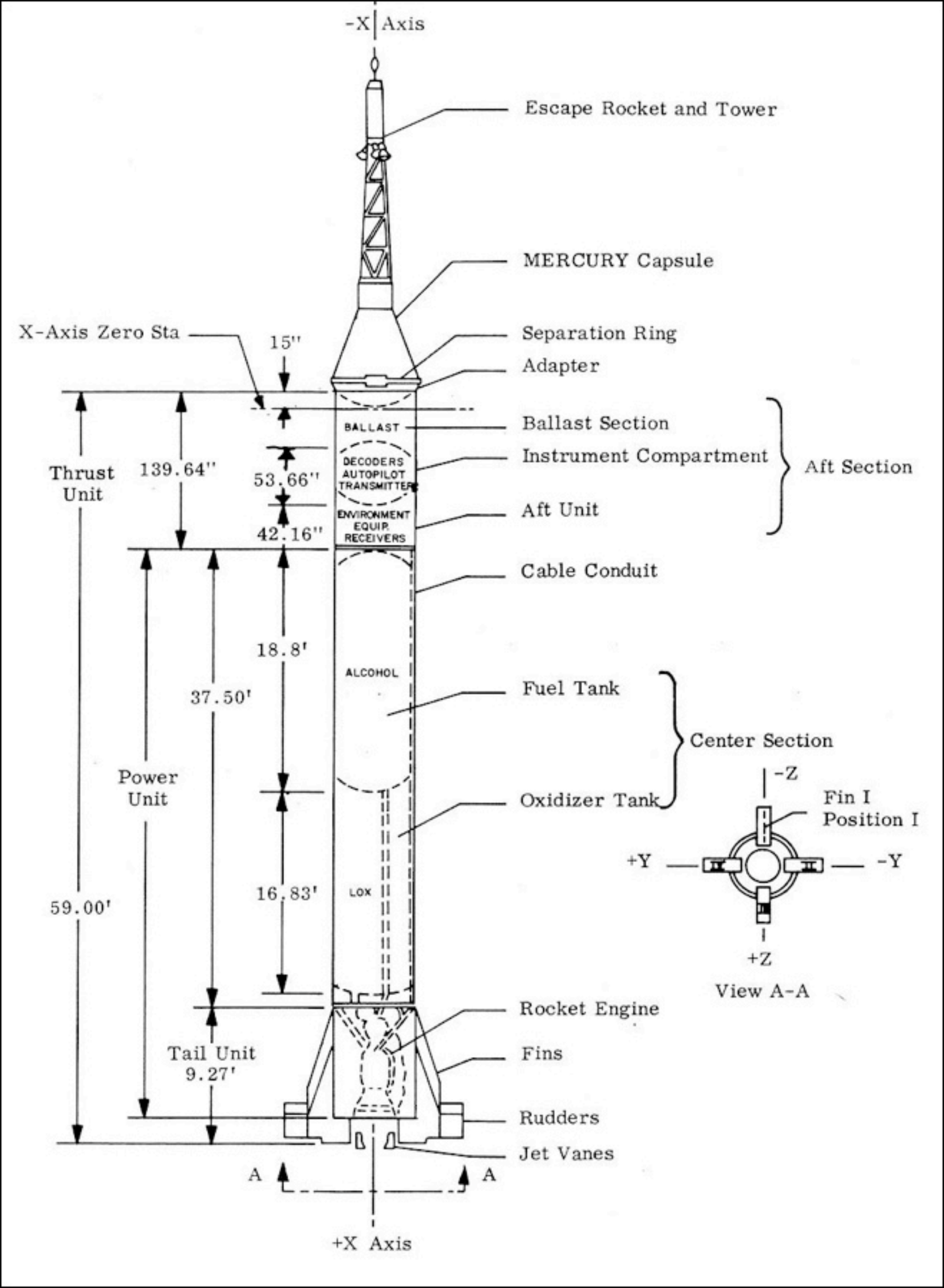
NAVIGATIONAL AIDS

(SCOPE DISPLAY, EARTH PATH INDICATOR AND CHART BOARD)



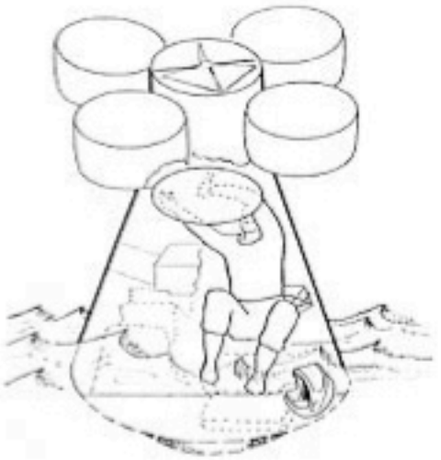





-X Axis
Escape Rocket and Tower
MERCURY Capsule
X-Axis Zero Sta
15"
Separation Ring
Adapter
BALLAST
Ballast Section
DECODERS
AUTOPILOT
TRANSMITTER
Instrument Compartment
Aft Section
ENVIRONMENT
EQUIP.
RECEIVERS
Aft Unit
Thrust
Unit
139.64"
53.66"
42.16"
Cable Conduit
18.8'
ALCOHOL
Fuel Tank
37.50'
Center Section
Power
Unit
Oxidizer Tank
16.83'
LOX
59.00'
-Z
Fin I
Position I
+Y
-Y
+Z
View A-A
Rocket Engine
Tail Unit
9.27'
Fins
Rudders
Jet Vanes
A
A
+X Axis

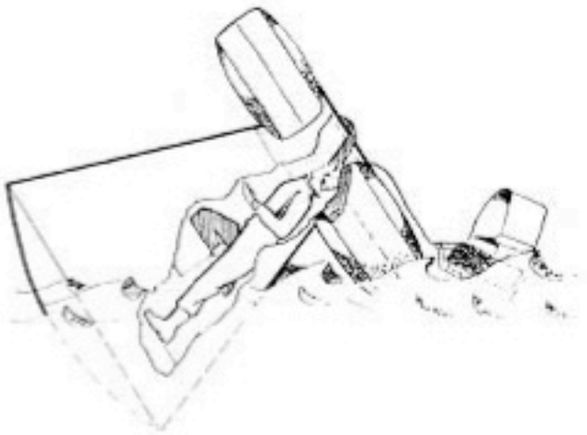
EGRESS PROCEDURES

1. AFTER LANDING, DISCONNECT RESTRAINT AND PERSONAL LEADS, REMOVE HELMET. REMOVE R.H. SIDE OF INSTRUMENT PANEL AND STOW ON TOP OF MAIN PANEL. (FLOTATION BAG INFLATION IS INITIATED BY IMPACT SWITCH.)

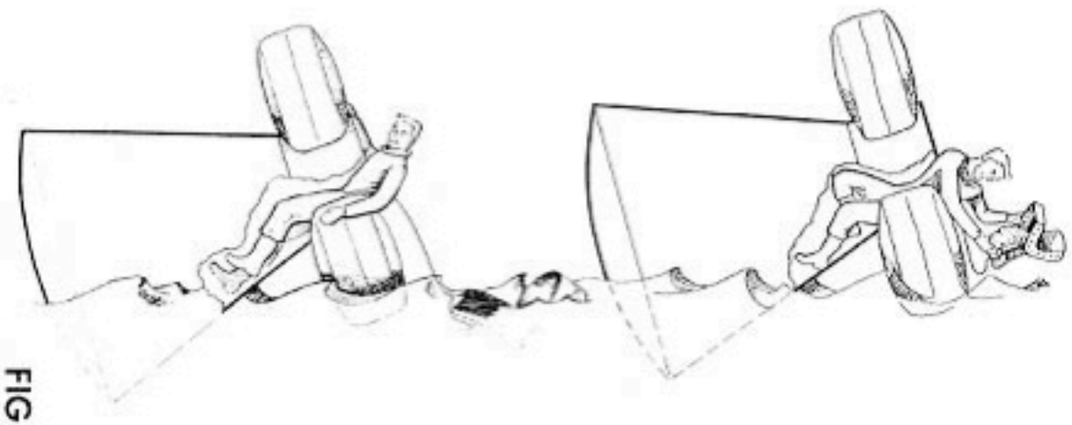


2. SIT ON R.H. SIDE OF CAPSULE AND RELEASE HATCH. CAPSULE WILL BEGIN TIPPING WHEN PILOT SHIFTS WEIGHT.

3. STOW HATCH ON TOP OF LEG COUCH, STEP INTO SEAT AND CLIMB INTO HATCH OPENING.



4. CHECK LANYARD CONNECTIONS OF SURVIVAL KIT. PUSH PARACHUTE CONTAINER AND SURVIVAL KIT OUT OF CAPSULE.



5. MANEUVER THROUGH PARACHUTE HOUSING.

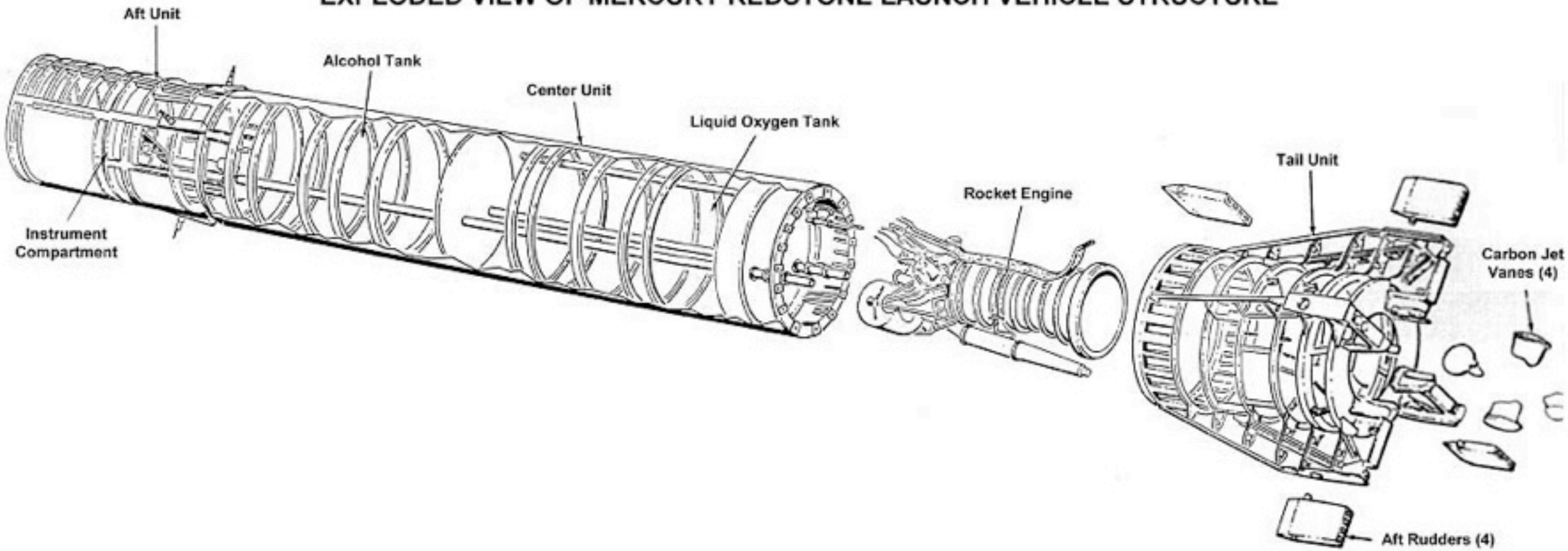
6. RETRIEVE SURVIVAL KIT AND INFLATE RAFT.

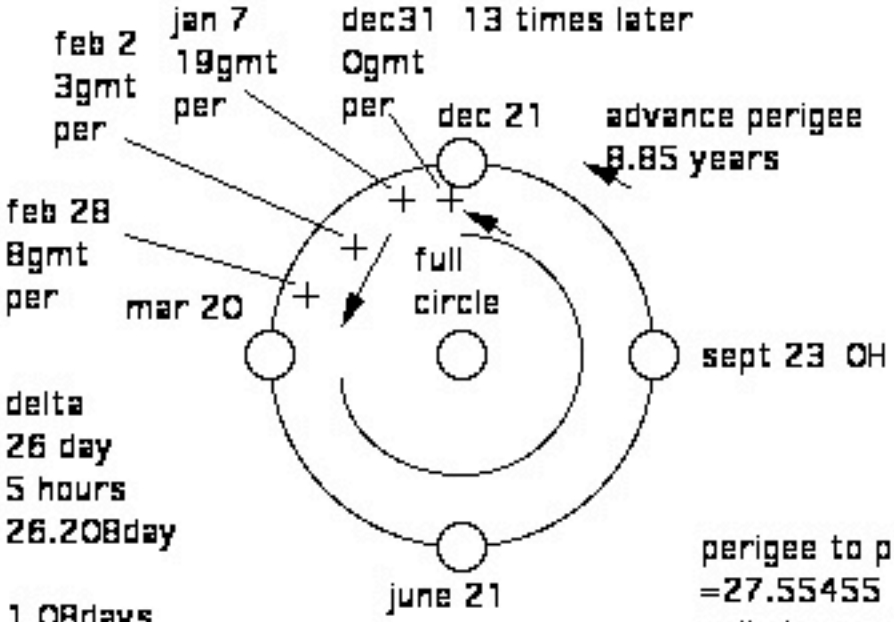
7. STEP INTO RAFT.

8. SECURE RAFT, START EMERGENCY RESCUE PROCEDURES.

FIGURE 57

EXPLODED VIEW OF MERCURY REDSTONE LAUNCH VEHICLE STRUCTURE

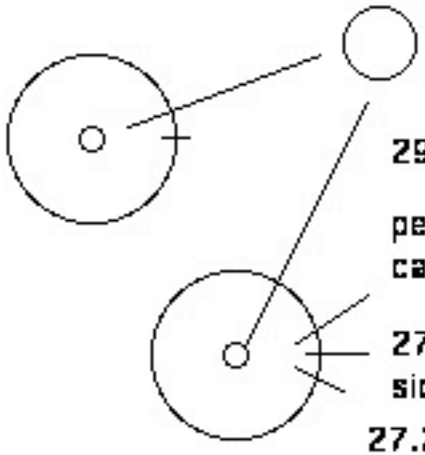




delta
26 day
5 hours
26.208day

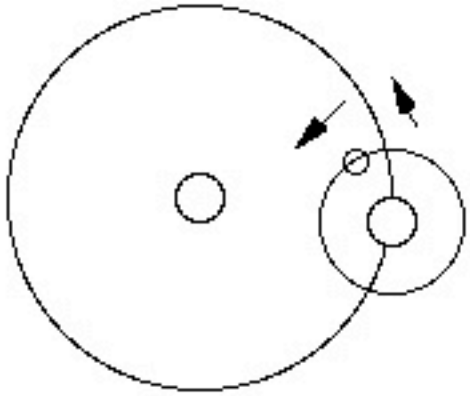
1.08days
less than 27d7h
8.85 year=3232.4days
=123.33 x26.208 days
123x26.28064

perigee to perigee
=27.55455
called anormalistic
month

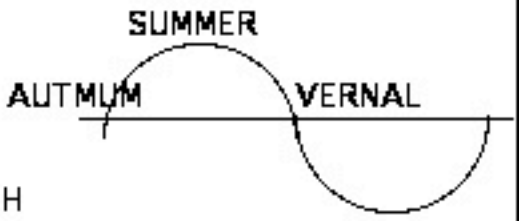


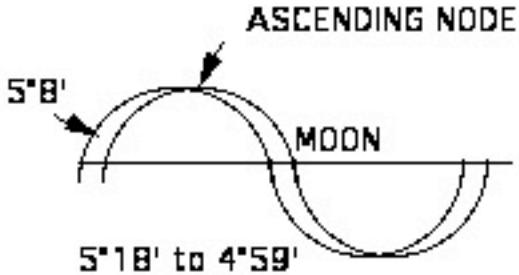
27.21222 days node to node
nodical or draconic month

variation in tilt
±.15° a period of 173 days
5.295 to 4.995

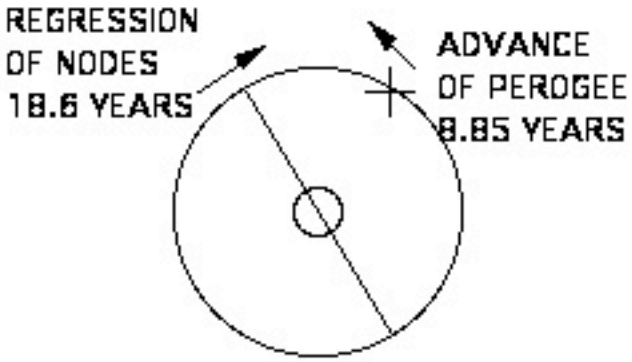


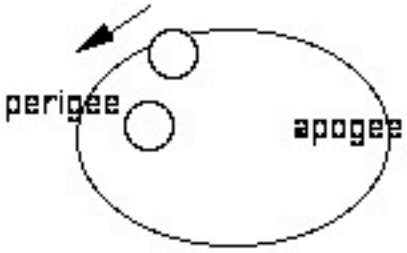
27D 7H 43.2M
SIDEREAL
29D 12H 44.05M
ACCORDING TO EARTH





5°18' to 4°59'





1989
march 20 15:28 GMT vernal equinox
june 21 9:53 GMT summer
jul4 earth at aphelion
Aug 17 total eclipse 2:20 to 3:56
sept 23 1:20 GMT autum
dec 21 21:22 GMT winter

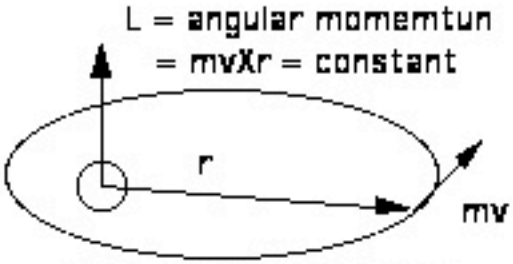
1984 pacific time LESS 8 HOURS
jan 3 earth perihelion 14:00 PMT
march 20 2:25 PMT vernal equinox
june 21 23:02 PMT summer
jul2 23:00 PMT earth at aphelion
sept 23 1:20 GMT autum
dec 21 8:23 PMT winter

1979
jan 15 moon apogee
jan 28 moon perigee
jan 4 earth perihelion
feb 11 moon apogee
feb 25 moon perigee
feb 26 total solar eclipse
march 21 5:22 GMT vernal equinox
june 21 23:56 GMT summer
jul3 earth at aphelion
Aug 17 total eclipse 2:20 to 3:56
sept 23 15:17 GMT autum
sept 19 moon apogee
dec 22 11:10 GMT winter

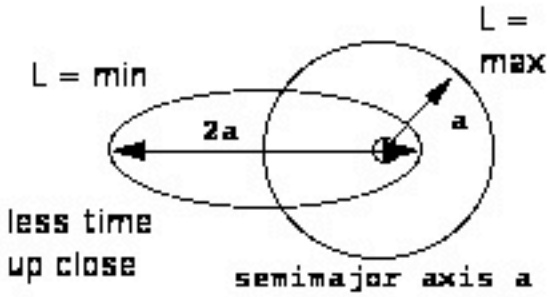
inverse photoelectric effect
(Xrays)
electrons shot at metal lose enegry as

hf = (1/2)mv^2

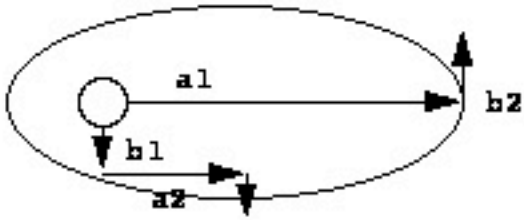
energy of electron transformed into photon.
Bremsstrahlung collision



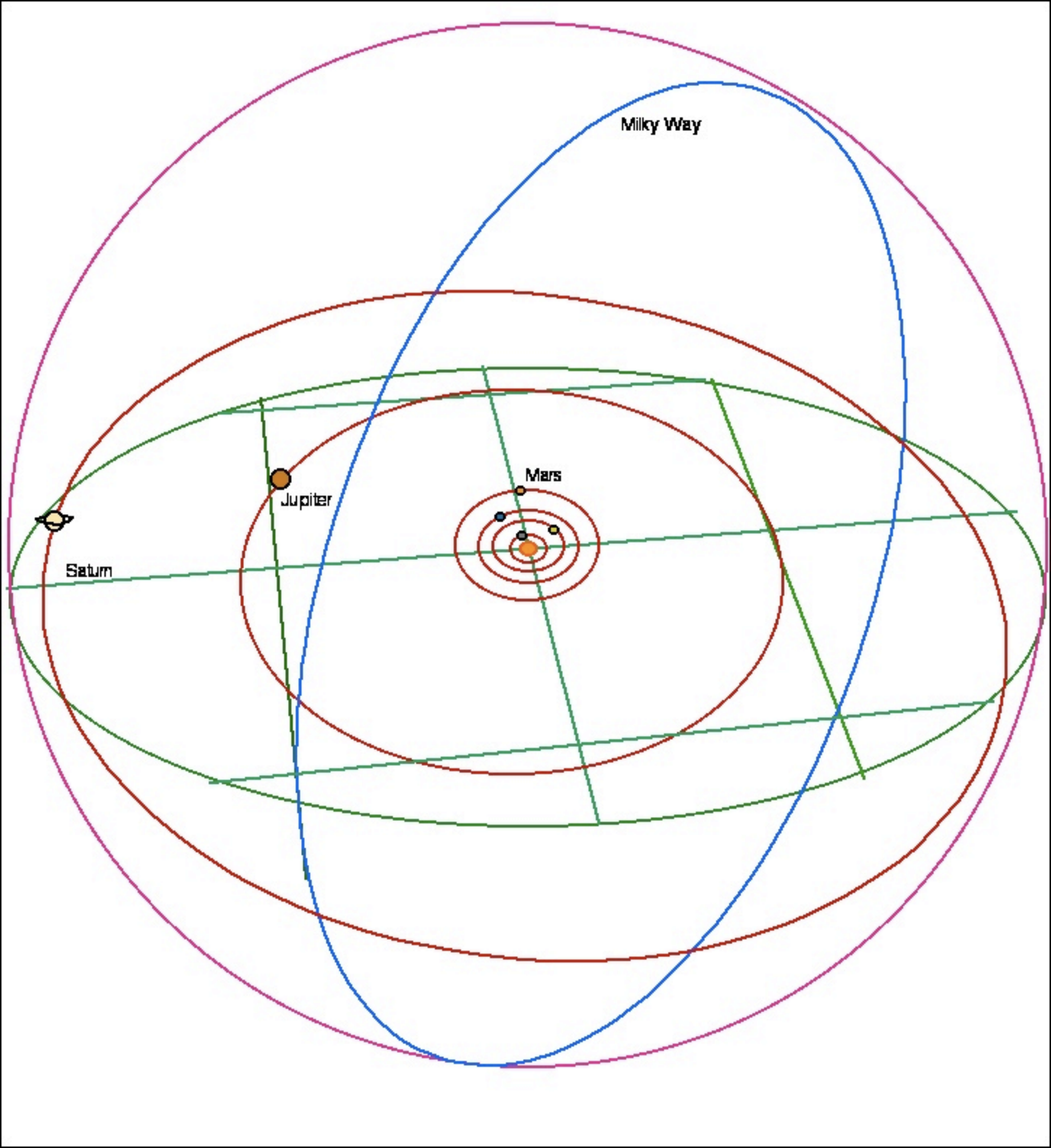
energy only a function of
magnitude of major axis
not eccencity or obital
angular momentum



$$\mathbf{V1 \times V2} = \begin{vmatrix} i & j & k \\ a1 & b1 & c1 \\ a2 & b2 & c2 \end{vmatrix} = (b1c2 - b2c1)i + (c1a1 - c2a1)j + (a1b2 - a2b1)k$$



$$\mathbf{V1 \cdot V2} = a1a2 + b1b2 + c1c2$$


Milky Way
Mars
Jupiter
Saturn